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Acronyms

AES – auger electron spectroscopy
ANS – Advanced Neutron Source
APS – Advanced Photon Source
APECS – Auger-photoelectron coincidence spectroscopy
BCA – binary collision approximation
CCD – charge-coupled device
CDW – charge density wave
CHESS – Cornell High-Energy Synchrotron Source
CPA – constant-phase angle
CVD – chemical vapor deposition
DSC – differential scanning calorimetry
ECR – electron cyclotron resonance
EDX – energy dispersive x-ray
EELS – electron energy loss spectroscopy
EPR – electron paramagnetic resonance
FWHM – full width at half maximum
HFIR– High Flux Isotope Reactor
HPLC – high-performance liquid chromatography
HREM – high-resolution electron microscopy
HREELS – high-resolution electron energy loss spectroscopy
HRLEED – high-resolution low-energy electron diffraction
HRTEM – high-resolution transmission electron microscopy
HTSC – high-temperature superconductors
IBD – ion beam deposition
IPNS – Intense Pulsed Neutron Source
LDA – local density approximation
LEED – low-energy electron diffraction
MBE – molecular beam epitaxy
MOCVD – metallo-organic chemical vapor deposition
NSLS – National Synchrotron Light Source
ORISE – Oak Ridge Institute of Science and Engineering
PIGE – proton-induced gamma emission
PIXE – particle-induced x-ray emission
PLA – pulsed-laser ablation
PLD – pulsed-laser deposition
QMS – quadrupole mass spectrometer
RaBiTS – rolling-assisted biaxially textured substrates
RBS – Rutherford backscattering spectroscopy
RHEED – reflection high-energy electron diffraction
SANS – small-angle neutron scattering
SAXS – small angle x-ray scattering
SEM – scanning electron microscopy
SPEG – solid-phase-epitaxial growth
STEM – scanning transmission electron microscopy
STM – scanning transmission microscopy
TCR – thermochemical reduction
TDS – thermal desorption spectroscopy
TEM – transmission electron microscopy
TRR – time-resolved reflectivity
UHV – ultrahigh vacuum
UIUC – University of Illinois at Urbana-Champaign
WAND – wide-angle neutron diffractometer
WAXD – wide-angle x-ray diffraction
XDCD – x-ray double-crystal diffraction
XPS – x-ray photoemission spectroscopy
XRD – x-ray diffraction
YSZ – yttria-stabilized zirconia

Introduction

This report covers research progress in the Solid State Division from April 1, 1997, through September 30, 1999. During this period, the division conducted a broad, interdisciplinary materials research program in support of Department of Energy science and technology missions. The report includes brief summaries of research activities in condensed matter theory, neutron scattering, synthesis and characterization of materials, ion beam and laser processing, and the structure of solids and surfaces. An addendum includes listings of division publications and professional activities.

Over the past two years, a number of important infrastructure improvements that will provide significant new research opportunities and unique capabilities for the division in neutron scattering and synchrotron x-ray research, electron microscopy, nanostructure fabrication, and theory have been pursued. A major upgrade of neutron scattering capabilities at the High Flux Isotope Reactor (HFIR), including a high-performance cold source, new beam lines and guides, and new and upgraded instrumentation, is under way. These upgrades, together with the proposed Spallation Neutron Source at ORNL, will provide the nation with unsurpassed capabilities worldwide in neutron scattering. The division is also involved in the development of two synchrotron beam lines at the Advanced Photon Source at Argonne National Laboratory, an upgrade of the Z-contrast scanning transmission electron microscope to sub-angstrom resolution, development of a unique laser molecular beam epitaxy laboratory, and acquisition of a 11-Gflop parallel computer.

Theoretical progress has included new insights into thin-film and surface phenomena, highly correlated systems, many body effects, quantum dots, and simulation of laser ablation. Neutron scattering has seen continued growth in the scientific user program along with progress on a broad research front including superconductivity, magnetism, polymers and complex fluids, residual stress mapping, and improved instrumentation.

Advances in materials synthesis and processing are reported for superconductors, thin-film batteries, thermoelectrics, nanocrystals, and optical materials. Ion, laser, and molecular beam processing research has led to new understanding and control of defects, heterostructures, and nanostructure and thin-film growth. Significant progress has been made in the understanding of electrons at surfaces and in the evolution of surface morphology. New insights have been revealed on interfaces using atomic resolution scanning transmission electron microscopy and on microstructural properties in the mesoscale regime using synchrotron x-ray scattering.

Many of these and other research advances over the reporting period have involved collaborations with more than 200 institutions worldwide, over 375 users and guest researchers, and partnerships with The University of Tennessee, Vanderbilt University, and many other universities and laboratories.

Chapter 1

Condensed Matter Theory

Surfaces, Defects, & Nanophysics

ELECTRONIC STRUCTURE OF A LOW-ANGLE TiO_2 TILT GRAIN BOUNDARY[1]

Susan B. Sinnott,[2] R. F. Wood, and S. J. Pennycook

The remarkably large lattice contractions found using high-resolution electron microscopy[3,4] for a $\Sigma 5$ (210) grain boundary in TiO_2 (rutile) are being studied through extensive *ab-initio* total energy calculations. The calculations use density functional and pseudopotential theories in conjunction with plane wave expansions and emphasize the importance of the displacements of the two halves of the bicrystal relative to one another. Experimental work[4] suggests that the stoichiometry and ionic charges at the boundary are preserved at their bulk values, and therefore vacancies and impurities within the grain boundary core have not yet been considered. After extensive experimentation, it was found that a plane-wave cutoff of 1000 eV was required to obtain well-converged results, and this makes the calculations extremely demanding computationally.

Results were obtained for the total energy as a function of contraction and expansion across the grain boundary plane. For the case in which there is no displacement of the two halves of the boundary relative to one another in the c direction, $x_c = 0$. Also, the energy for $x_c = 0.5c$, which is equivalent to interchanging the up-down positions of all ions in the bulk as the grain boundary is crossed, was calculated. In both cases, there were 48 ions per unit cell, and the 27 nearest the grain boundary plane were allowed to relax in addition to the imposed displacements of the two halves of the grain boundary.

The calculations predict no significant rigid body contractions or expansions in either case. Consequently, whatever the origins of the observed contraction, the implication for the computational side is disturbing in that long series of calculations for even more complex structures will have to be considered, requiring greatly increased computational power. However, for the experimental side, the implications may be even more significant. Clearly, the question of the growth of the bicrystals becomes crucial because it is essential that an "intrinsic" grain boundary, devoid of impurities, vacancies, half-rows, etc., be obtained.

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1. Summary of paper to be published.
2. University of Kentucky, Lexington, Ky.
3. U. Dahmen et al., *Inter. Sci.* **2**, 125 (1994).
4. D. J. Wallis et al., *J. Am. Ceram. Soc.* **80**, 499 (1997).

WHAT'S MAGIC ABOUT METAL THIN-FILM GROWTH?[1]

Z. Y. Zhang, J.-H. Cho,[2] Q. Niu,[3] C.-K. Shih,[3] Z. G. Suo,[4] K.-J. Jin,[5] G. D. Mahan,[6] H. Metiu,[7] R. F. Wood, and S. B. Sinnott[8]

For decades, it has been known that certain nuclei are more stable than others and that certain atoms are inert while others are active. In the 1980s, physicists discovered that when atoms form clusters, certain clusters are also more stable than others. These systems are particularly stable when they each contain a "magic number" of elemental building blocks—protons and neutrons for the nuclei, electrons for the atoms, and atoms for the clusters.

A recent line of theoretical studies[1] has shown that when a metal is added to a semiconductor substrate layer by layer, something magic can also take place. Specifically, the confined motion of the conduction electrons within the metal overlayer can mediate a surprisingly long-range repulsive force between the metal-semiconductor interface and the growth front, acting to stabilize the film. Electron transfer from the overlayer to the substrate leads to an attractive force between the two interfaces, acting to destabilize the film. Interface-induced Friedel oscillations in electron density can further impose an oscillatory modulation onto the two previous interactions. These three competing factors, of all electronic nature, can make a flat metal overlayer critically, marginally, or magically stable, or totally unstable against roughening. For many systems, these electronic effects can easily win over the effect of stress. Furthermore, even in the submonolayer growth regime, these competing interactions can lead to the existence of magic length scales for two-dimensional islands. First-principles studies of a few representative systems in the multilayer regime confirm the general features of the "electronic growth" concept, showing the existence of critical/magic thicknesses for smooth growth. These calculations also revealed the possible existence of oscillatory metal-nonmetal transitions for certain tight-binding metals.

Some detailed comparisons between the theoretical predictions made here and experimental results are given elsewhere in this report.[9]

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1. Summary of papers: *Phys. Rev. Lett.* **80**, 5381 (1998); *Phys. Rev. B* **58**, 5116 (1998); *Phys. Rev. Lett.* **80**, 1026 (1998); *Phys. Rev. B* **59**, 13309 (1999); *Phys. Rev. Lett.* **80**, 3582 (1998); to be published.
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8. University of Kentucky, Lexington, Ky.
9. L. Gavioli, "Magic/Critical Thicknesses and Quantum-Size Effects in Ultrathin Metal Overlayer Epitaxy," this report.

MICROSCOPIC MECHANISMS FOR TWO-DIMENSIONAL PATTERN FORMATION AT SURFACES[1]

Z. Y. Zhang, M. G. Lagally,[2] T. J. Zhang,[3] J. X. Zhong,[3] B. G. Liu,[4] J. Wu,[4] E. G. Wang,[4] G. S. Canright,[3] I. M. Sandler,[3] H. J. Gao,[4] Z. Q. Xue,[3] and S. J. Pang[4]

The invention of scanning tunneling microscopy and other modern characterization techniques has made it possible to image with atomic-scale resolution various fascinating patterns of nature formed by the atoms, molecules, or clusters, offering unprecedented opportunities for microscopic understanding of the formation mechanisms involved.

Two-dimensional islands formed at a surface can be classified into two generic classes—compact and noncompact. It was postulated recently that the ultimate rate-limiting process dividing the noncompact and the compact growth regimes is adatom motion across an island corner. This conjecture has been established on firmer ground using various theoretical approaches, and a criterion has been derived to predict the noncompact-compact transition for various systems.

In the diffusion-limited aggregation regime, a fractal-to-compact transition can be induced by raising the growth temperature or decreasing the deposition rate. But, in the presence of a monolayer of surfactant atoms, such a transition can be induced by decreasing the growth temperature or increasing the deposition rate. As a signature of the reaction-limited aggregation regime, this counterintuitive finding has been shown to be rather robust and has been observed experimentally.

When the building blocks consist of two components, charged and neutral, the aggregates formed can have uniquely striking seahorse-like shapes, as observed recently in organic thin-film growth by ionized-cluster-beam deposition. A microscopic mechanism has been proposed, involving a delicate noise-induced chiral symmetry breaking and diffusion-limited aggregation under the influence of a long-range electrostatic force. The model has been further tested experimentally with the application of an external electric bias field.

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1. Summary of papers: *Science* **276**, 377 (1997); to be published; *Phys. Rev. Lett.* **83**, 1195 (1999); *Physical Review B* (in press); *Phys. Lett. A.* **245**, 233 (1998); *Phys. Rev. E* **58**, 6015 (1998); *Fractals* **6**, 337 (1998).

2. University of Wisconsin, Madison, Wis.
3. The University of Tennessee, Knoxville, Tenn.
4. Chinese Academy of Sciences, Beijing, China.

THEORY OF THE NUCLEATION, GROWTH, AND STRUCTURE OF HYDROGEN-INDUCED EXTENDED DEFECTS IN SILICON[1]

R. A. Reboredo,[2] M. Ferconi,[2] and S. T. Pantelides[3]

Large concentrations of H in Si have long been known to induce the formation of extended planar defects known as platelets. In particular, indiffusion of H using a plasma source induces primarily (111) platelets whereas ion implantation induces (111), (100), and (311) platelets. This phenomenon underlies the so-called "smart cut" process for silicon-on-insulator technology.

Earlier theory suggested that hydrogenated vacancies may be the core of the platelets, but the idea was not pursued further because of difficulties in understanding how the defect would nucleate. Subsequent work favored the idea that platelets are a sheet of H pairs, but that could account only for (111) platelets. The new work, based on first-principles calculations, first identified a novel defect that an H_2 molecule can form in the Si crystal. The two H atoms force a Si atom away from its nominal site so that it is bonded only to two of the four neighbors. The two H atoms then bond to the other two Si atoms. This precursor defect costs about 2 eV. When another H_2 molecule arrives, the Si atom is released as an interstitial, leaving behind a fully hydrogenated vacancy.

The next H_2 molecule that arrives can release another Si atom, resulting in a fully hydrogenated divacancy. The third H_2 molecule, however, can do one of two things: (1) release a third Si atom resulting in a fully hydrogenated trivacancy or (2) be absorbed without releasing a Si atom, resulting in a pair of second-neighbor hydrogenated vacancies. Clearly, repetition of step (a) would result in a hydrogenated microvoid whereas an alternation of steps (1) and (2) produces a network of second-neighbor hydrogenated vacancies. The latter can be a random network, but planar structures are preferred energetically. The planar structures are indeed the (111), (100), and (311) platelets, as observed. The theory further explains a number of other observations.

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1. Summary of paper: *Phys. Rev. Lett.* **82**, 4870 (1998).
2. Vanderbilt University, Nashville, Tenn.
3. ORNL Distinguished Visiting Scientist from Vanderbilt University.

NOVEL DEFECT COMPLEXES AND THEIR ROLE IN THE *p*-TYPE DOPING OF GaN[1]

R. A. Reboredo[2] *and S. T.* Pantelides[3]

GaN has emerged as the material of choice for blue/green optoelectronic devices, but problems still remain before viable commercialization on a large scale. One of the serious problems is the low *p*-type conductivity that can be achieved with today's growth methods. The most common dopant is Mg. It has been found that its incorporation is aided by the presence of H, but H must subsequently be removed to activate the dopants. Existing theory accounted for the data in terms of H passivating substitutional Mg by forming a Mg-N-H complex (H is not directly attached to the substitutional Mg but is attached to a neighboring N atom) which then breaks during the final anneal. This picture is incomplete as there is evidence for other defect complexes (e.g., vibrational lines in the 2000-cm^{-1} range which suggest Mg-H bonds, in contrast to the Mg-N-H center that has a vibrational frequency at 3125 cm^{-1}). In addition, the removal of H is a difficult process, which is at odds with the idea that one simply has to break up the Mg-N-H complexes.

New first-principles calculations have uncovered a new family of complexes that play a major role in the *p*-type doping process. It was found that, in the absence of H, Mg enters as both substitutional and interstitial and that a substitutional-interstitial pair is the most stable defect complex. In addition, one gets pairs of substitutional Mg and interstitial Ga. These results provide a clear explanation of why *p*-type conductivity is not achieved if the dopant is incorporated without H. When H is present, the various Mg complexes are hydrogenated and have Mg-H bonds, accounting for the observations of vibrational lines in the 2000-cm^{-1} range. The complex Mg-N-H is, however, the most stable structure. Thus, extended annealing in an H atmosphere should gradually convert the more complex defects to the benign Mg-N-H form from which H can be easily removed. It was concluded that the formation of the novel defects is a limiting factor in *p*-type doping. An annealing sequence was proposed to achieve higher *p*-type doping. After growth in the presence of H, the samples should first be annealed in an H atmosphere at moderate temperatures before the final anneal that removes H.

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1. Summary of paper: *Phys. Rev. Lett.* **82**, 1887 (1999).
2. Vanderbilt University, Nashville, Tenn.
3. ORNL Distinguished Visiting Scientist from Vanderbilt University.

ASPECTS OF NANOPARTICLE FORMATION BY LASER ABLATION[1]

R. F. Wood and J.-N. Lebouef[2]

One of the most effective ways of making single-wall carbon nanotubes is by laser ablation into a background gas. Although successful, the process is poorly understood. But the crucial importance of the formation of nanoparticles to initiate tube growth is evident, and this in itself is controversial. Some groups have concluded that nanoparticles can form without the background gas. It has been argued that nanoparticles are unlikely to form in vacuum because the expansion of the plume is so rapid that the "freezing limit" (collisionless regime) is reached too rapidly for nucleation and growth to the observed nanoparticle size. The presence of the background gas changes the dynamics of the process completely. Figure 1 shows results from our previously developed multiple scattering model. It is seen that in a matter of just a few μs, the ablated Si plume is dramatically slowed by the "snowplowing" of the Ar background gas which is compressed into a peak whose density is an order of magnitude greater than its initial density. The ablated Si is trapped within this peak. The question then arises as to how this peak dissipates by diffusion. A simple calculation shows that it is at this point that the required drastic change in the time scale of the process occurs.

A typical value of the diffusion coefficient, D, is of the order 0.5 cm^2/s. The average distance of diffusion, x, in a given time, t, is given by $x^2 = 2\,Dt$.

The finite difference cell width for the calculations of Fig. 1 was $\Delta x = 0.05$ cm. Therefore, the time for particles to diffuse out of a cell is 2.5 ms), two to three orders of magnitude greater than the peak formation time. There is now ample time for nanoparticles to nucleate and grow, as elementary classical nucleation theory shows. Moreover, this is precisely the time frame in which the nanoparticles are observed to form experimentally.

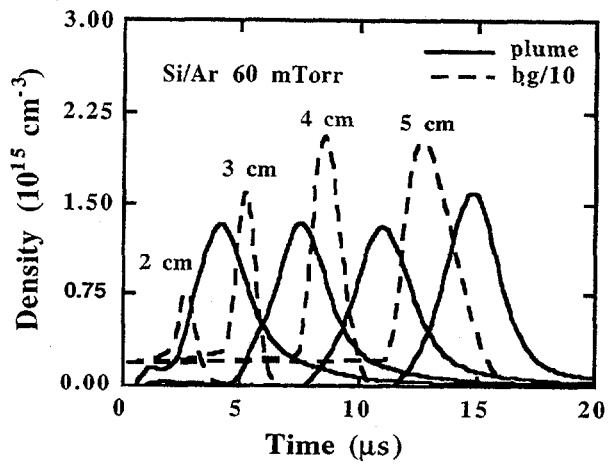

Fig. 1. Densities of the plume and background as a function of time at several different distances from the target for Si ablated into 60 mTorr of Ar.

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1. Summary of paper to be published.
2. University of California, Los Angeles, Calif.

Magnetism, Superconductivity, & Many-Body Effects

SPIN DENSITY WAVE ORDERING IN Fe/Cr MULTILAYERS AND WEDGES[1]

R. S. Fishman and Z.-P. Shi[2]

Several recent experiments have detected a spin-density wave (SDW) within the Cr spacer of Fe/Cr multilayers and wedges. To model the behavior of a SDW within an Fe/Cr/Fe trilayer, assumed boundary conditions at the Fe-Cr interfaces were combined with the free energy of the Cr spacer. Depending on boundary conditions, the SDW may be collinear and commensurate (C) or incommensurate (I) with the bcc Cr lattice or noncollinear and helical (H). By contrast, bulk Cr only supports an I SDW below its Néel temperature of 310 K.

For the case of perfect interfaces, the Fe moments will be oriented either ferromagnetically (F) or antiferromagnetically (AF). The I SDW antinodes (maxima in the SDW envelope) will then lie near the Fe-Cr interfaces. With increasing temperature, the SDW undergoes a series of transitions between I phases with decreasing numbers of nodes until it becomes C above $T_{IC}(N)$. For a fixed temperature, the magnetic coupling alternates between F and AF with increasing N but undergoes a phase slip (with F or AF couplings repeated for N and $N + 1$ ML) whenever the number of SDW nodes changes by one. In the limit $N \rightarrow \infty$, $T_{IC}(N)$ is independent of the Fe-Cr coupling strength and always larger than the bulk Néel transition temperature. These results explain the very high I-to-C transition temperature of about 600 K extrapolated from measurements on Fe/Cr/Fe wedges.

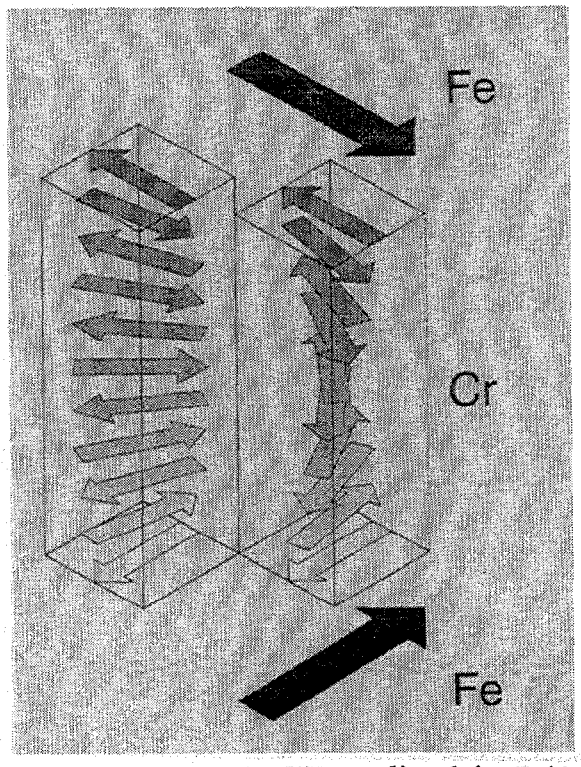

Fig. 1 The H SDW's predicted for Fe/Cr multilayers with interfacial steps.

Although absent in bulk transition metals, a H SDW is stabilized by steps. As shown in Fig. 1, a step may produce two H SDWs rotating in opposite directions with neighboring Fe moments oriented at 90 degree angles. In agreement with neutron-scattering results, the I-to-H transition temperature T_{IH} is always lower than the bulk Néel temperature T_N, and the nodes of the I SDW lie near the Fe-Cr interfaces. While a H SDW with a single $\pm\pi/2$ twist has lower free energy than an I SDW above T_N, H SDWs with larger twists are predicted to be stable between T_{IH} and T_N (Fig. 1).

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1. Summary of papers: *Phys. Rev. Lett.* **78**, 1351 (1997); *Phys. Rev. Lett.* **81**, 4979 (1998); *Phys. Rev. B* **59**, 13849 (1999).
2. ORNL/ORISE postdoctoral research

STRUCTURAL AND PHASE TRANSITIONS IN MnNi ALLOYS[1]

R. S. Fishman W.-T. Lee,[2] S. H. Liu,[3] D. Mandrus, J. L. Robertson, K.-J. Song,[4] and J. R. Thompson[5]

In all likelihood, γ-Mn alloys are the simplest bulk metals to support a non-collinear spin-density wave (SDW). Because the fcc phase of pure Mn is only stable at high temperatures, γ-Mn is produced by doping with a few percent of Ni, Cu, or Fe. Phenomenological models suggest that the experimental phase diagram of MnNi alloys contains two non-collinear SDWs below the Néel temperature T_N. When the Ni concentration exceeds about 18%, a triple-Q SDW with moments along the crystal diagonals was predicted in the cubic phase between T_N and T_t. In the tetragonal phase with $c/a > 1$, below T_t, the SDW was predicted to have a double-Q structure with the spins lying in the ab plane and pointing at 45 degree angles to the crystal axis. Along with the collinear, single-Q SDW expected in the tetragonal phase of lightly doped alloys with $c/a < 1$, these SDW configurations are sketched in Fig. 1(a).

Studies of a MnNi polycrystal with a Ni concentration of 20% and a Néel temperature of about 450 K have provided the first experimental evidence that this picture is wrong. While the cubic-to-tetragonal transition at $T_t \approx 250$ K is observed using neutron scattering, a SDW transition at $T_m \approx 125$ K is marked by a small jump in the magnetic susceptibility.

To explain the distinct structural and magnetic transitions, a phenomenological model which includes both elastic and magnetoelastic contributions has been constructed. Assuming that the softening of the combination of elastic constants $c_{11} - c_{12}$ breaks the cubic symmetry below T_t, the magnetic structure below T_t responds to the tetragonal distortion by tilting toward the ab plane, as shown in Fig. 1(b). When the tetragonality becomes sufficiently large, the SDW transforms from the "tilted" T SDW (or T′ SDW) state to a D SDW state. It has been demonstrated that the gap in spin-wave spectrum should change discontinuously at T_m. By using neutron scattering measurements, it is possible to use this prediction to test our phenomenological model.

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1. Summary of papers: *Phys. Rev. B* **59**, 8672 (1999); in press.
2. ORNL/ORISE postdoctoral research associate.
3. University of California, San Diego, Calif.
4. Graduate student from The University of Tennessee, Knoxville, Tenn.
5. Adjunct R&D participant from The University of Tennessee.

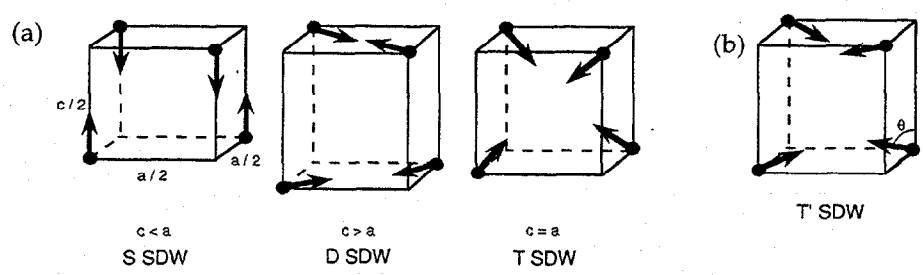

Fig. 1. (a) The three SDW configurations believed to occur in γ-Mn alloys and (b) a newly predicted SDW phase.

SPIN-POLARON THEORY OF HIGH-T_C SUPERCONDUCTIVITY

R. F. Wood and J. F. Cooke

Work has continued on a spin-polaron model[1] of high-T_c superconductivity with particular emphasis on the calculation of the q- and ω-dependent magnetic susceptibility, $\chi(q,\omega)$, for comparison with inelastic neutron scattering results.

A previously developed 3D tetrahedral method for Brillouin zone integration has been modified for 2D integration and applied to the calculation of $\chi(q,\omega)$. It has been tested on an anisotropic effective mass model that mimics the antiferromagnetic (AF) band structure of the copper oxide planes published several years ago.[1] The AF band structure calculations are based on an explanation of the approach originally introduced by Slater to describe chromium.[2] The effective mass model can be solved analytically for $\chi(q,\omega)$, and the agreement between the numerical and analytical integration results is excellent. A large central peak at the (π,π) point (commensurate position) appears to persist even when the numerical bands with matrix element effects are included in the calculation of $\chi(q,\omega)$. However, its intensity is quite sensitive to the details of the band structure calculations and to the values of the various parameters chosen, particularly in the Hubbard U term. It comes predominantly from the oxygen orbitals of the CuO_2 planes, with virtually no contributions from the Cu $d(x^2-y^2)$ orbitals whose contribution is strongly dependent on the value of U.

The incommensurate splitting of side peaks at twice the Fermi wave vector can be made to scale remarkably well with the value of x in $La_{1-x}Sr_xCuO_4$ and to fit the experimental results in the "underdoped" regime. This again suggests that the well-known, but still not understood, neutron results have their origin in band structure effects, provided matrix element effects are included in the calculation of $\chi(q,\omega)$. The possible formation of spin polarons has not yet been taken into account, and it is not clear what impact, if any, this will have on the central peak at the (π,π) point. Modifications of the band structure and introduction of spin-polaron effects are being pursued in an effort to understand the behavior of this peak. Also, the possible role of dynamic stripe formation in splitting the central peak into incommensurate components is being studied.

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1. R. F. Wood, M. Mostoller, and J. F. Cooke, *Physica C* **165**, 97 (1990); R. F. Wood and J. F. Cooke, *Phys. Rev. B* **45**, 5585 (1992).

2. J. C. Slater, *Phys. Rev. B* **82**, 538 (1951); J. C. Slater and G. F. Koster, *Phys. Rev.* **94**, 1498 (1954).

IMPORTANCE OF MANY-BODY EFFECTS IN DOPANT-DOPANT INTERACTIONS IN III–V SEMICONDUCTORS?[1]

Ph. Ebert,[2] T. J. Zhang,[3] F. Kluge,[2] M. Simon,[2] Z. Y. Zhang, and K. Urban[2]

The ability to incorporate reproducibly dopant atoms with precisely controlled concentrations and spatial distributions is essential in various technological applications of semiconductor materials. As the effort for device miniaturization continues to intensify, the means to achieve this goal are becoming increasingly difficult. Dopant incorporation in submicrometer- and nanometer-scale systems is ultimately governed by the intrinsic interactions between the dopant atoms. The generally accepted view is that the charge of a dopant atom is screened by the charge carriers in a given semiconductor, resulting in a repulsive screened Coulomb interaction between the dopants. Such a repulsion, in turn, will lead to a rather homogeneous distribution of the dopant atoms in the semiconductor.

Recent cross-sectional scanning tunneling microscopy (XSTM) studies of Zn dopant atoms in GaAs and several other III–V semiconductors have revealed that the negatively charged Zn dopants are often inhomogeneously distributed and form clusters. At the first sight, the clustering behavior seems to suggest the existence of an effective attractive interaction in addition to the screened Coulomb repulsion between two dopants. However, our quantitative analysis of the dopant distributions by Monte Carlo simulations leads to the conclusion that the effective attraction actually results from strong many-body effects in the otherwise repulsive dopant-dopant interactions. Furthermore, a methodology to determine quantitatively the intrinsic screening length of point charges in semiconductors based on a statistical analysis of the positions of dopant atoms in XSTM images was illustrated. It was shown that the many-body effects are also important and need to be corrected when extracting the intrinsic screening length of the Yukawa potential as a function of the carrier concentration in such systems. This study reveals a basic physical origin limiting the homogeneity of dopant atoms achievable in semiconductors.

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1. Summary of paper: *Phys. Rev. Lett.* **83**, 757 (1999).

2. Forschungszentrum Jülich, Jülich, Germany

3. The University of Tennessee, Knoxville, Tenn.

CONSERVING CALCULATIONS OF QUASIPARTICLE STATES FOR REALISTIC BAND STRUCTURES[1]

Adolfo G. Eguiluz[2] and Wolf-Dieter Schöne[3]

The absolute band gap of Si is a quantity of great significance in materials science. As a consequence, benchmarks for this observable have played a key role in the development of *ab initio* quasiparticle (QP) theory. The GW approximation (GWA) for the electron self-energy yields results in apparent quantitative agreement with experiment for the gap and for the valence and conduction bands of semiconductors. Thus, the GW one-electron band structure is the standard against which the quality of other approximate schemes is routinely judged.

The first conserving evaluation of the absolute band gap of Si within the GWA was reported. (The hallmark "conserving" calculation is that microscopic conservation laws are obeyed exactly by an approximate choice for the self-energy functional.) It was shown that the self-consistent implementation of the GWA yields a band gap which, in fact, disagrees with experiment.

This is illustrated in Fig. 1, which shows the QP peaks corresponding to the states at both edges of the gap. First, note the gap obtained from Kohn-Sham eigenvalues, which were obtained in the local density approximation (LDA); this gap (0.57 eV) disagrees from experiment (1.17 eV) by a factor of 2. Next, note the result obtained from $\Sigma_{GW}[G_{LDA}]$ (i.e., from the GW self-energy evaluated with LDA Green's functions) ("1st" in Fig. 1). This calculation, which is not conserving, corresponds to the usual implementation of the GWA. The gap thus obtained (1.34 eV) is in good agreement with experiment—which is the usual success story. Finally, there is the conserving calculation ("sc" in Fig. 1)—the Dyson equation is actually solved, and

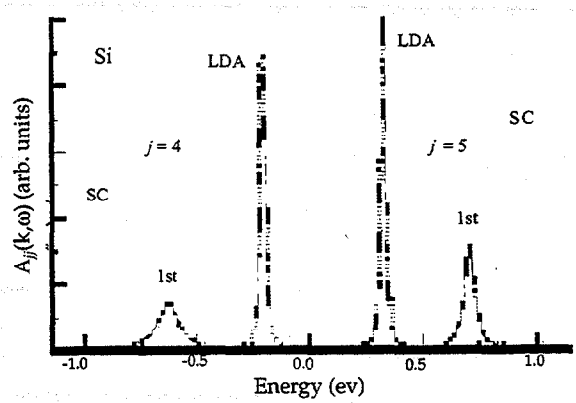

Fig. 1. Impact of self-consistency on the absolute band gap of Si. Shown is the spectral function $Ajj(k,\omega)$ for the states at the bottom ($j = 4$) and the top ($j = 5$) of the gap.

the new Green's function is used to recompute the self-energy iteratively. The gap obtained from $\Sigma_{GW}[G_{LDA}]$ turns out to be too large (~1.9 eV), overestimating the experimental value by as much as the LDA underestimates it.

Thus, there is a band gap problem, once again. It is argued in [4] that the feedback of the electron-hole correlations onto the QP states (this process is beyond the GWA) must be included in a definitive evaluation of the gap.

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1. Summary of papers: *Phys. Rev. Lett.* **81**, 1662 (1998); *Phys. Rev. Lett.* **83**, 242 (1999).
2. UT/ORNL Collaborating Scientist.
3. Postdoctoral research associate from The University of Tennessee.
4. A. G. Eguiluz and W. Ku, cond-mat/9903032.

PLASMON LIFETIME IN POTASSIUM: A CASE STUDY OF CORRELATED ELECTRONS IN SOLIDS AMENABLE TO *AB INITIO* THEORY[1]

Adolfo G. Eguiluz[2] and Wei Ku[3]

The lifetimes of the electronic excitations provide valuable insight into the physics of correlated electrons in solids. Interestingly, the plasmon linewidth in K was found to be anomalous in landmark electron energy-loss spectroscopy (EELS) measurements by Sprösser-Prou, vom Felde, and Fink [4]. These authors proposed that the measured positive dispersion of the full width at half maximum of the plasmon loss, $\Delta Ei_{1/2}(q)$, must be due to strong short-range correlations. Because these correlations only vanish in the high-density limit, $r_s \rightarrow 0$, which is far from being realized in K, this conclusion seems reasonable, *a priori*.

The circles in Fig. 1 correspond to a well-converged calculation of $\Delta Ei_{1/2}(q)$ for bcc K. Our *ab initio* results agree extremely well with the EELS data. By contrast, the $\Delta Ei_{1/2}(q)$ predicted by an intuitive model, based on evaluation of the dielectric function to second order in the electron-ion interaction, is in complete disagreement with experiment—which is precisely what led to the proposal of the importance of dynamical correlations

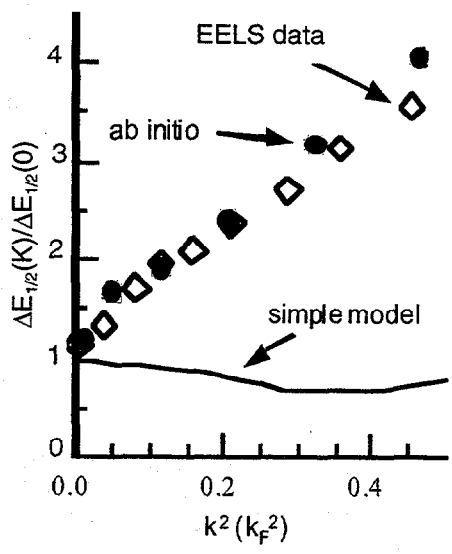

Fig. 1. Plasmon linewidth dispersion in K. Comparison of our results (circles) with the experimental data in Ref. [3] and with the simple model results alluded to in the text.

As for the physics behind the measured $\Delta Ei_{1/2}(q)$, it has been shown that the dominant channels for the decay of the collective mode in K are single particle-hole pairs involving empty states of *d*-symmetry (these states are nearly degenerate with the plasmon energy, ~4 eV). The phase space complexity which these flat bands introduce into the plasmon damping process is poorly approximated using nearly-free-electron states, explaining why the simple model breaks down.

Thus, the positive dispersion of $\Delta Ei_{1/2}(q)$ is not a signature of dynamical-correlation effects. Rather, the "anomalous" linewidth dispersion is due to a subtle interplay between unoccupied *d*-bands and the collective mode. On the other hand, the exchange-correlation effects built into the LDA band structure were found to play a role in the agreement with the experimental data for $\Delta Ei_{1/2}(q)$ shown in Fig. 1. Our work provides strong motivation for the use of *ab initio* paradigms in the study of electronic excitations in solids.

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1. Summary of papers: *Phys. Rev. Lett.* **82**, 2350 (1999); cond-mat/9903032.
2. UT/ORNL Collaborating Scientist.
3. Graduate student from The University of Tennessee.
4. J. Sprösser-Prou, A. vom Felde, and J. Fink, *Phys. Rev. B* **40**, 5799 (1989).

Transport Properties & Applications

TRANSPORT PROPERTIES OF CARBON NANOTUBES[1]

T. Kostyrko,[2] M. Bartkowiak,[3] and G. D. Mahan[4]

The discovery of carbon nanotubes (NTs) opened a new chapter in mesoscopic physics, because of their many expected technological applications, ranging from hydrogen storage to molecular electronics. This relatively new group of one-dimensional carbon systems, related to fullerenes, can be thought of as wound-up graphene sheets of varying lengths and diameters. The main emphasis of our study is with transport properties of the NTs The aim is to understand the importance of disorder effects, electron-phonon interactions, and electron correlations in their electronic structure, conductance, and thermopower.

The reflection R (related to conductance Γ by $\Gamma = e^2 n_c(1 - R)/h$, where n_c denotes a number of conducting channels) was studied from a barrier created by defects of various types. It was found that for large enough diameters of the tube, localized defects reflect electrons according to a scaling law: $R_1 = \alpha(E/N_c t)^2$ where N_a is a NT index (proportional to the diameter), E is the effective strength of the defect, t is the band energy parameter (hopping), and α depends on the NT helicity.

The reflection was calculated from a sequence of defects, and its energy dependence was related to the appearance of a quasibound state. This state is also seen in the density of states and in the energy dependence of the quasiparticle lifetime. The localization length $\xi(\omega)$ of electronic states was computed as a function of Fermi energy. Comparison of $\xi(0)$ with the mean free path λ_{mfp} in the limit of small defect concentration c and small defect strength E led to a simple approximate relation $\xi(0) \approx 3\,\lambda_{mfp} = 3 \times 3aN_a t^2/2cE^2$ (ta - lattice constant).

A tight binding model was proposed to describe a rope made of individual NTs. Analysis of the model showed that intertube interaction leads to opening of the pseudogap near or at the Fermi surface and breaks electron hole symmetry there. The finding allows an explanation of the doping dependence of the conductivity in ropes.

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1. Summary of papers: *Phys. Rev. B* **59**, 3241 (1999); *Phys. Rev. B* **60**, 10735 (1999).
2. ORNL/ORISE postdoctoral research associate.
3. Guest scientist from The University of Tennessee, Knoxville, Tenn.
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WIEDEMANN-FRANZ LAW AT BOUNDARIES[1]

G. D. Mahan[2] and M. Bartkowiak[3]

An electrical conductor can be characterized by macroscopic transport coefficients such as the electrical conductivity σ and the thermal conductivity K. The latter has contributions from the flow of phonons (K_p) and electrons (K_e). The Wiedemann-Franz law is a relation between σ and K_e of the form

$$K_e = L_0(k_B/e)^2$$

where (k_B/e) is Boltzmann's constant in units of $\mu V/K$. The constant L_0 is 2–3 depending upon whether the conductor obeys Maxwell-Boltzmann or Fermi-Dirac statistics at the relevant temperature. The Wiedemann-Franz Law is found to be obeyed in most materials and is a relationship for estimating the thermal conductivity from a knowledge of the electrical conductivity.

When currents flow through interfaces, there are boundary resistances to the flow of heat and electricity. The inverse of these resistances are boundary conductances. The boundary conductance σ_B for electrical current has the units of Siemens/m2. Similarly, the boundary conductance K_{eB} for heat current has the units of $W/(K/m^2)$.

During our modeling of currents through boundaries, these thermal resistances were calculated for a variety of simple physical models such as tunneling through barriers, thermal emissions over barriers, etc. In each case, it was found that K_{eB} was proportional to σ_B, and the proportionality was identical to that of equation (1). The interface conductances seem to obey the same relationship as the bulk conductances. This effect is called "the boundary form of the Wiedemann-Franz law." The result is surprising. Proofs of the Wiedemann-Franz law for bulk conductivity always use solutions of the Boltzmann equation for transport. The law requires that the mean-free-path for scattering is the same for heat transport as for electrical transport. However, in the derivation of the Wiedemann-Franz law for interfaces, the Boltzmann equation is not solved, and the derivation does not have a relaxation time. In spite of these fundamental differences in the derivation, the interface law has the same form as the one for volume transport.

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1. Summary of paper: *Appl. Phys. Lett.* **74**, 953 (1999).
2. UT/ORNL Distinguished Scientist.
3. The University of Tennessee, Knoxville, Tenn.

MULTILAYER THERMIONIC REFRIGERATION[1]

G. D. Mahan,[2] L. M. Woods,[3] J. O. Sofo,[4] and M. Bartkowiak[5]

A new concept was proposed for solid state refrigeration. "Thermionic emission" of electrons over periodic barriers in a multilayer geometry is shown to be a relatively efficient method of cooling. Most solid state refrigeration is done using thermoelectric units. They are relatively inefficient, but are highly reliable and have no adverse environmental effects because of Freon or other gases. The new refrigerator, using multilayer thermionic emission, is similar to a thermoelectric unit in that it has high reliability and no adverse environmental aspects. The theoretical modeling predicts that the new device could have a higher efficiency than a thermoelectric unit. If that projection is correct, then the new refrigerator would have a large number of applications in consumer and military devices.

A potential barrier is an efficient energy filter, in that only energetic electrons can transport current over the barrier. Thermionic emission is the flow of heat from a metal electrode into the vacuum. The same phrase is used for the flow of electrons over any internal barrier in a solid state device. Such electron flow has a high Seebeck coefficient, because energetic electrons are favored over colder ones. If mostly hot electrons can surmount the barrier, and leave, then the electron gas in the system becomes colder, on the average. The process is identical in concept to other forms of evaporative cooling.

Computer modeling showed that the refrigerator was relatively efficient for a single barrier only for small temperature differences, say 1 K. This result led to the idea of a multibarrier device, because macroscopic cooling is achieved by having a series of barriers. The barriers in a solid could be due to band offsets between different semiconductor layers, or else the Schottky barrier at the interface between a metal and a semiconductor. In either case, multiple barriers are achieved by having a multilayer device—either of different kinds of semiconductors or else alternate layers of a metal and a semiconductor. The multilayer geometry has the additional benefit of a low thermal conductivity, because the phonons scatter effectively from the multiple interfaces.

The predicted efficiency depends upon the materials in the device. Barrier layers must have a low thermal conductivity and energy barriers which are 50–100 meV. With such a material, the refrigerator would have an efficiency on the order of present Freon compressors, which is about twice what can be achieved with thermoelectric devices.

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1. Summary of papers: *Phys. Rev. Lett.* **80**, 4016 (1998); *J. Appl. Phys.* **83**, 4683 (1998).
2. UT-ORNL Distinguished Scientist.
3. Graduate student from The University of Tennessee, Knoxville, Tenn.
4. Centro Atomico Bariloche, Argentina.
5. Guest scientist from The University of Tennessee.

MULTILAYER THIN-FILM THERMOELECTRIC DEVICES[1]

M. Bartkowiak[2] *and G. D.* Mahan[3]

There has been a resurgence of interest in improving the performance of thermoelectric devices. One approach is to find new materials. Another approach is to improve the performance by taking advantage of various boundary effects in thin films and superlattices made of known thermoelectric materials. Thermoelectric coolers are very important elements of many electronic and optoelectronic systems. Thin-film and superlattice-based thermoelectric devices could be integrated into such systems, provided that they are efficient enough.

The general equations for transport of heat and electricity in the direction perpendicular to the boundaries of a thermoelectric thin film or a superlattice have been derived, and they show that the boundary effects can cause a multiple increase of the thermoelectric figure of merit.

Boundary thermal resistances both for phonons (Kapitza resistance) and for electrons, the contact electrical resistance at the junctions, and the boundary thermoelectric effects have been considered. It is shown that the Kapitza resistance causes reduction of the effective thermal conductivity of the system only if the electron and phonon subsystems are out of equilibrium. In this case, the thermoelectric figure of merit Z can be increased by reducing the thickness of the film. The electrical contact resistance at the junctions is shown to degrade the performance of the device. However, according to the boundary Wiedemann-Franz law, electrical contact resistance is accompanied by a thermal boundary resistance for the electron subsystem, which can cause an additional enhancement of Z. In some cases, this can lead to a device with ZT as high as 3 at room temperature. Our results are in good agreement with recent experimental data.

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1. Summary of paper: *Appl. Phys. Lett.* **74**, 953 (1999).
2. Guest scientist from The University of Tennessee, Knoxville, Tenn.
3. UT/ORNL Distinguished Scientist.

Chapter 2

Neutron Scattering

Crystal Structure & Dynamics

HIGH-TEMPERATURE STRUCTURAL BEHAVIOR OF $SrRuO_3$[1]

B. C. Chakoumakos, S. E. Nagler, S. T. Misture,[2] and H. M. Christen[3]

Metallic but nonsuperconducting perovskite oxides, such as $SrRuO_3$, are of interest for thin-film device applications incorporating the cuprate superconductors. In addition, the nature of the magnetism and its relationships to the band structure and Fermi-surface properties are of fundamental interest in the context of the widely varied ground states exhibited by oxide perovskite materials. $SrRuO_3$ is an itinerant ferromagnet with T_c = 162 K and a moment of 1.2 μ_B/Ru atom. To complement low-temperature measurements of the magnetization density in $SrRuO_3$ using polarized neutron diffraction, the high-temperature crystal structural behavior has been studied. Our results only agree qualitatively with a recent high-temperature x-ray diffraction study; important differences are attributed to the greater contribution to the scattering by oxygen as observed with neutrons and the inclusion of more reflections.

The unusual metal $SrRuO_3$ is perhaps the only known 4*d* transition-metal-based ferromagnet (T_c = 162 K) with a sizable moment. To complement low-*T* polarized neutron diffraction measurements of the magnetization density, high-*T* neutron diffraction measurements have been made. Two structural phase transitions were observed. Between 10 and 800 K, $SrRuO_3$ is orthorhombic; and at 800 K, it appears to be tetragonal until 975 K, where it becomes cubic. The temperature variation of the lattice parameters (Fig. 1) are given along with structural descriptions of the different phases (Table 1).

Table 1. Crystal Structure Data for $SrRuO_3$

Atom	*x*	*y*	*z*	U_{iso} (Å^2)
300 K, *Pnma*, *a* = 5.5368(2) Å, *b* = 7.8523(3) Å, *c* = 5.5731(2) Å				
Sr	0.0162(6)	1/4	-0.0016(7)	0.0100(4)
Ru	1/2	0	0	0.0072(3)
O1	-0.0034(7)	1/4	0.4492(7)	0.0102(7)
O2	0.2232(4)	-0.0270(3)	0.2235(4)	0.0114(6)
894 K, *I4/mcm*, *a* = 5.5887(1) Å, *c* = 7.9168(4) Å				
Sr	0	1/2	1/4	0.0237(5)
Ru	00	0	0.0097(4)	
O1	00	1/4	0.026(2)	
O2	0.2275(4)	0.7275	0	0.032(1)
1082 K, *Pm'3m*, *a* = 3.9735(1) Å				
Sr	1/2	1/2	1/2	0.0309(4)
Ru	0	0	0	0.0138(3)
O	1/2	0	0	0.0424(4)

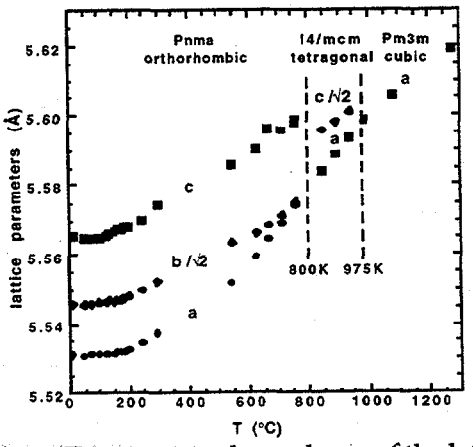

Fig. 1. Temperature dependence of the lattice parameters for $SrRuO_3$.

1. Summary of paper: *Physica B* **241–243**, 358 (1998).
2. Alfred University, Alfred, N.Y.
3. ORNL/ORISE postdoctoral research associate. Present address: Neocera, Inc., Beltsville, Md.

STRUCTURAL DISORDER AND THERMAL CONDUCTIVITY OF THE SEMICONDUCTING CLATHRATE $Sr_8Ga_{16}Ge_{30}$[1]

B. C. Chakoumakos, B. C. Sales, D. G. Mandrus, and G. S. Nolas[2]

New directions in the research of thermoelectric materials include the clathrate-type compounds of the group IV elements, with the structural formula X_8E_{46} with E = Si, Ge, Sn, Al, Ga, In and X = Na, K, Rb, Cs, Sr, Ba. These compounds are cubic, space group *Pm3n*, and are isotypic with the type I ice clathrate (Fig. 1). The properties that make these materials promising thermoelectric candidates include *N*-type semiconducting behavior, relatively high Seebeck coefficients and electrical conductivity, and glass-like thermal conductivity. The well-known and anomalously large "rattling" of the guest atom in the oversized XE_{24} cage has been explored by means of neutron crystallography, illustrating the use of atomic displacement parameters to estimate thermodynamically related properties for evaluating thermoelectric behavior.

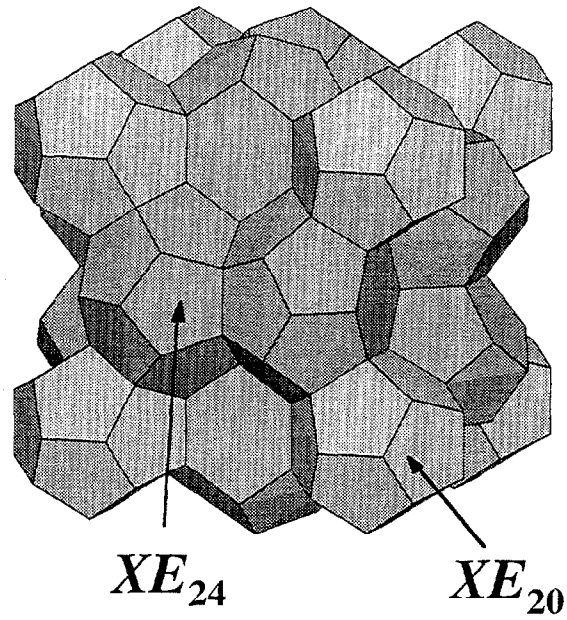

Fig. 1. Polyhedral structure of the X_8E_{46} clathrate.

The temperature dependence of the atomic displacement parameters for $Sr_8Ga_{16}Ge_{30}$ determined from refinements of neutron powder and single-crystal diffraction data shows that anomalously large values for one of the two unique Sr atoms persist from 295 to 11 K. Its position is better described by a fractionally occupied fourfold split site, but the rms displacement remains the largest of all the atoms in the structure. Difference Fourier maps of this Sr site show a residual nuclear density with lobes in the directions of the split-atom positions. The Ga and Ge atoms appear to be fully disordered on the three distinct framework sites. The measured atomic displacement parameters are used to derive estimates of the following thermodynamic-related quantities: Debye temperature = 271 K, mean velocity of sound = 2600 m/s, temperature of the Einstein "rattler" = 85 K, mean-free path of heat-carrying phonons = 5.36 Å, and lattice thermal conductivity = 0.008 W/cm-K.

Studies such as this provide insight into what roles the various forms of structural disorder play in determining the thermodynamic quantities of interest, in particular, the lattice thermal conductivity.

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1. Summary of paper: *Journal of Alloys and Compounds* (in press).
2. Marlow Industries, Inc., Dallas, Tex.

X-RAY AND NEUTRON SCATTERING STUDY OF Si-RICH Si-Ge SINGLE CRYSTALS

D. Le Bolloc'h,[1] J. L. Robertson, H. Reichert,[2] S. C. Moss,[3] and M. L. Crow[4]

In the past, the performance of devices based on silicon technology has been advanced primarily through component miniaturization. However, the limit where further reduction in size is no longer feasible for many applications is fast approaching. For this reason, future gains in performance depend upon either moving to other technologies such as GaAs or developing silicon technology in new directions. One approach, that has already produced a considerable gain in performance, extends existing silicon technology by alloying silicon with germanium. Increased carrier mobility, along with other properties of SiGe alloys, is driving the development of new electronic devices with significantly improved operating frequency, power consumption, current density, and noise characteristics.

Current applications of SiGe alloys generally rely upon thin-film technology, and substantial literature exists on the physical properties of such films. For a more fundamental understanding of the SiGe alloy system, however, studies on equilibrium phase bulk specimens are needed because the properties of thin films are often observed to differ from those of bulk materials.

X-ray synchrotron and elastic neutron diffuse scattering measurements indicate that there is no chemical short-range order. However, moderately intense scattering associated with the static displacements was clearly present and is consistent with an expansion of the lattice in the vicinity of the Ge atoms. This indicates that the Ge experiences a confined local atomic environment on the Si host lattice relative to that found in pure Ge.

The phonon dispersion was also measured using inelastic neutron scattering, and the

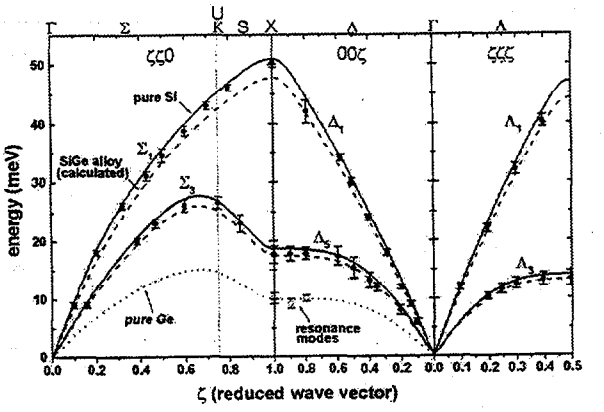

Fig. 1. Acoustic phonon dispersion in the (110) plane. The data are indicated by the solid circles. The dispersion of pure Si is given by the solid line; and pure Ge is given by the dotted line. The dashed line shows the calculated dispersion.

dispersion is shown in Fig. 1. The phonon dispersion of pure Si and pure Ge have been shown to be nearly homologous, and the acoustic phonons in the alloy are found to be nearly homologous to the pure Si. The observed reduction in the phonon energies of the SiGe alloy relative to pure Si is only half that expected. This behavior is probably a result of the confined environment of the Ge atoms on the Si host lattice which will stiffen the force constants between the Ge-Si and Ge-Ge pairs and thereby increase the phonon energies

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OBSERVATION OF TRANSIENT ORDERING IN $FE_{0.3}V_{0.7}$

W. T. Kasch,[1] W.-T. Lee,[2] and J. L. Robertson

Theoretical calculations have shown that some binary solid solutions exhibit a competition between chemical ordering and phase separation.[3] Because the kinetics of ordering are typically much faster than that associated with phase separation, transient ordering may arise upon quenching although the alloy system ultimately phase separates.

In this experiment, elastic neutron scattering measurements were made to study the ordering kinetics of a body-centered-cubic $Fe_{0.3}V_{0.7}$ alloy. The sample was annealed at 1200°C for 36 h to form a random solid solution and subsequently quenched to a temperature of 800°C which is 50°C below the miscibility gap.

The time evolution of the diffuse scattering was recorded immediately following the quench. Time-dependent Warren-Cowley short-range order (SRO) parameters α_i were extracted from the diffuse scattering. Negative values for α_i indicate a preference for Fe-V atomic pairs, while positive values for α_i indicate a preference for Fe-Fe or V-V pairs. The time evolution of the α_i's for the first four neighbor shells are shown in Fig. 1. The rapid increase in the magnitude of the α_i's during the first few hours after the quench and the subsequent decrease clearly demonstrate the presence of transient short-range chemical ordering. Such an arrangement is consistent with the emergence and dissipation of transient B2 ordering.

Using reverse Monte Carlo computer simulations, atomic configurations were generated from the parameters obtained from the data at the end of the measurement (3000 m after the quench). The results indicate the coexistence of clustering and ordering. Evidently, the system phase-separated into V-rich regions and regions of SRO Fe-V. No evidence of the σ-phase was observed. However, it is expected that the alloy will eventually phase-separate in accordance with the phase diagram of Fe-V alloys.

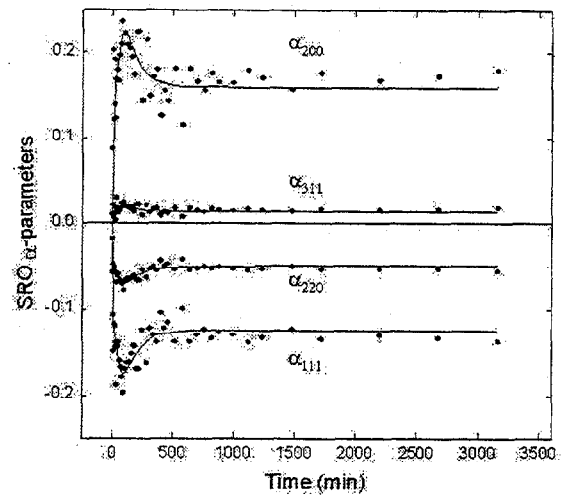

Fig. 1. Plot of the time evolution of the short-range order parameters α_i for the first four nearest neighbor shells. Time is measured in minutes after the sample was quenched.

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1. ORNL Energy Research Undergraduate Laboratory Fellow from Florida Institute of Technology, Melbourne, Fla.
2. ORNL/ORISE postdoctoral research associate.
3. L. Reinhard and P. E. A. Turchi, *Phys. Rev. Lett.* **72**, 120 (1994).

RESIDUAL STRESSES AROUND COLD-WORKED HOLES PRODUCED BY THE STRESSWAVE™ PROCESS[1]

S. Spooner, C. A. Meyer,[2] B. D. Flinn,[2] E. T. Easterbrook,[3] and C. R. Hubbard[4]

The introduction of compressive hoop stresses around holes by cold expansion has been shown to substantially increase resistance to fatigue failure. However, the current split sleeve and split mandrel cold expansion method is costly and time-consuming. An easily automated method of producing cold-worked holes is currently being developed. This approach to treating holes reduces the tight tooling and starting hole tolerances required with mandrel methods and reduces time-consuming process steps. Tooling is simplified by eliminating the number of different mandrel and sleeve sizes because the induced residual stress is less dependent on hole diameter. Computer modeling using finite element analysis (FEA) of the cold-working technique has shown that favorable residual stresses introduced by this novel process are equivalent or superior to the existing process. Neutron residual stress measurements validate FEA calculations and show that the compressive hoop stresses are radially symmetric around the hole. A maximum hoop stress of –440 Mpa at 1 mm from the hole edge was measured in a 0.19-in.-thick plate of 7075-T6 aircraft alloy.

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1. Summary of paper to be published.
2. University of Washington, Seattle, Wash.
3. Aviamet, Inc., Kent, Wash.
4. Metals and Ceramics Division, ORNL.

COMPARISON OF THE EXPERIMENTALLY MEASURED STRAIN TENSOR IN A WELD OVERLAY WITH THE RESULTS OF A FINITE ELEMENT CALCULATION

S. Spooner, X-L. Wang,[1] C. R. Hubbard,[1] and Z. Feng[2]

In the analysis of residual stresses in welds, it can be assumed that the principal stresses are simply related to the direction of the weld line and the geometry of the welded joint. However, in the case of a short single overlay weld pass on a flat plate, the principal axes are no longer simply related to the weld geometry. Finite element analysis (FEA) modeling of a single-pass overlay weld obtains a variation of the principal axis directions. A set of measurements of the in-plane principal strain axes are determined and compared with the FEA calculations. Test points located at 4-mm depth in the base metal (including the heat-affected zone) were centered on a 5-mm grid that included one half of the end of the weld. At each test point, residual strains were measured in the plane of the plate in eight equally spaced directions covering 180°. Measurements were fit to a sinusoidal function to determine the angular location and values of the minimum and maximum strains. The principal axes varied up to 90° from the direction of the weld line. Beyond the end of the weld pass, the maximum tensile strain was perpendicular to the weld line. The maximum tensile strain gradually became parallel to the weld line near the midpoint of the weld. The measured principal strain directions were compared with the FEA calculations and were found to be in very good agreement. However, the magnitude of measured strains was always smaller than calculated values. These measurements confirmed that there are large shear stresses at the ends of the weld pass—a result that would be missed in neutron diffraction measurements if the directions of the principal axes were mistakenly assumed. The difference between measured and calculated strains may arise from unaccounted recovery processes during cooldown. This study makes it clear that measurements of the principal axes are essential for accurate interpretation of residual stress measurements.

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THE RUNG DIMER STRUCTURE FACTOR IN $Sr_{14-x}Ca_xCu_{24}O_{41}$

G. E. Granroth,[1] S. E. Nagler, R. S. Eccleston,[2] Y. Nagata,[3] H. Fujino,[3] J. Akimitsu,[3] and S. Katano[4]

Many proposed spin ladder materials, for example $(VO)_2P_2O_7$,[5] have been shown to be more appropriately described by other models. For this reason, proposed ladder systems have come under close scrutiny. $Sr_{14-x}Ca_xCu_{24}O_{41}$ for $x = 0$ and $x = 11.5$ has been studied. This material contains both chain and ladder structures. Scattering from a two-leg spin ladder is modulated by a dimer structure factor along the rung direction. The modulation should be observed in a constant energy scan. Figure 1 shows such a scan in $Sr_{14-x}Ca_xCu_{24}O_{41}$. The solid line is a fit to the dimer structure factor convoluted with the instrumental resolution using Monte Carlo integration. Aside from an overall scale factor, the only parameter in the fit is the dimer spacing of ~3.81. This value is in agreement with the Cu-Cu distance along the rung of the ladder. This confirms that the two-spin ladder appropriately models the ladder structures in $Sr_{14-x}Ca_xCu_{24}O_{41}$. It is the first ladder material to exhibit the appropriate structure factor.

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1. ORNL/ORISE postdoctoral research associate.
2. Rutherford Appleton Laboratory, U.K.
3. Aoyama-Gakuin University, Tokyo, Japan.
4. Japan Atomic Energy Research Institute, Tokai-mura, Japan.
5. A. W. Garrett et al., *Phys. Rev. Lett.* 79, 745 (1997).

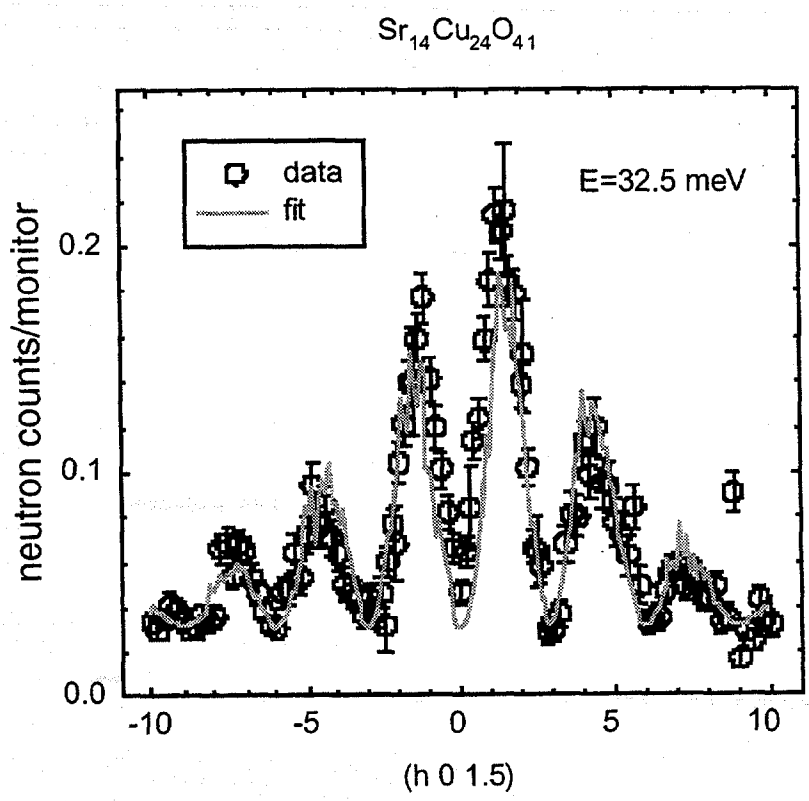

Fig. 1. Constant energy scan along the ladder rung direction. The solid line is a fit to the dimer structure factor convoluted with the instrumental resolution.

EVOLUTION OF SPIN DYNAMICS IN THE CMR MANGANITES[1]

J. A. Fernandez-Baca, P. Dai, J. Zhang,[2] H. Y. Hwang,[3] C. Kloc,[3] S.-W. Cheong,[3,4] Y. Tomioka,[5] and Y. Tokura[5]

Recent neutron scattering experiments performed at ORNL provide strong evidence that the role of the lattice distortions has to be taken into account in the description of the spin dynamics of the colossal magnetoresistance (CMR) materials $A_{1-x}B_xMnO_3$ ($x \sim 1/3$). The materials for these experiments were selected from the well-characterized region where the lattice distortions can be tuned (by different A-site substitutions) to vary linearly with T_c $Nd_{0.7}Sr_{0.3}MnO_3$ (NSMO, T_c = 198 K), $La_{0.7}Ca_{0.3}MnO_3$ (LCMO, T_c = 250 K) and $Pr_{0.63}Sr_{0.37}MnO_3$ (PSMO, T_c = 300 K). The main finding is that the spin dynamical behavior of these compounds is similar in the low-temperature metallic state but drastically different at temperatures around T_c. In fact, the stiffness constant for the long-wavelength spin waves at $T = 0$ for the three systems are remarkably similar ($D \sim 165$ meV-Å^2) despite the fact that their transition temperatures are significantly different. The differences in the spin dynamics close to T_c are evident in Fig. 1 which shows the inelastic scattering spectra for the three systems at various temperatures. The origin of the central peak which dominates the spin dynamics of NSMO and LCMO near T_c is related to the spontaneous formation of spin clusters of size ~20 Å. The spin-wave spectrum of PSMO, on the other hand, is rather conventional. These results indicate that magnetism alone cannot explain the exotic spin dynamic properties of these systems and that their increased electron-coupling must play a dominant role.

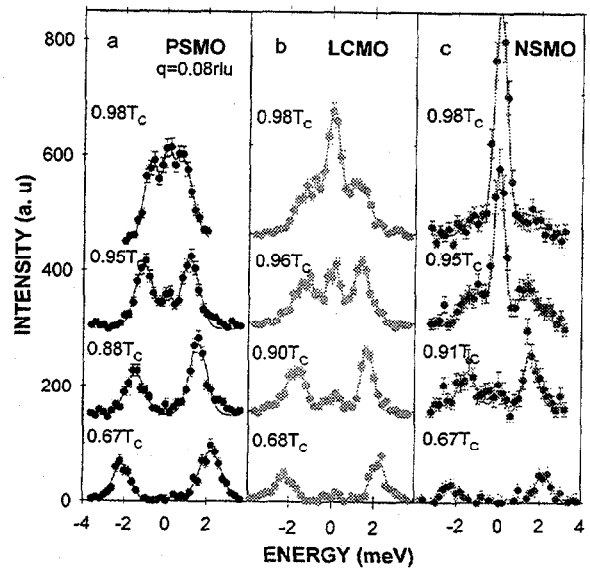

Fig. 1. Spin waves in the CMR manganites.

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1. Summary of paper: *Phys. Rev. Lett.* **80**, 4012 (1998).
2. Present address: Florida International University, Miami, Fla.
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4. Rutgers University, Piscataway, N.J.
5. Joint Research Center for Atom Technology, Tsukuba, Japan.

THE MAGNETIC EXCITATION SPECTRUM AND THERMODYNAMICS OF HIGH-T_c SUPERCONDUCTORS[1]

P. Dai, H. A. Mook, S. M. Hayden,[2] G. Aeppli,[3] T. G. Perring,[4] R. D. Hunt,[5] and F. Dogan[6]

Inelastic neutron scattering was used to study the wave-vector and frequency-dependent magnetic fluctuations in single crystals of superconducting $YBa_2Cu_3O_{6+x}$. The spectra contain several important features, including a gap in the superconducting state, a pseudogap in the normal state, and the much-discussed resonance peak. The appearance of the pseudogap determined from transport and nuclear resonance coincides with formation of the resonance in the magnetic excitations. The exchange energy associated with the resonance has both temperature and doping dependence, as well as the magnitude to describe approximately the electronic specific heat near the superconducting transition temperature (T_c).

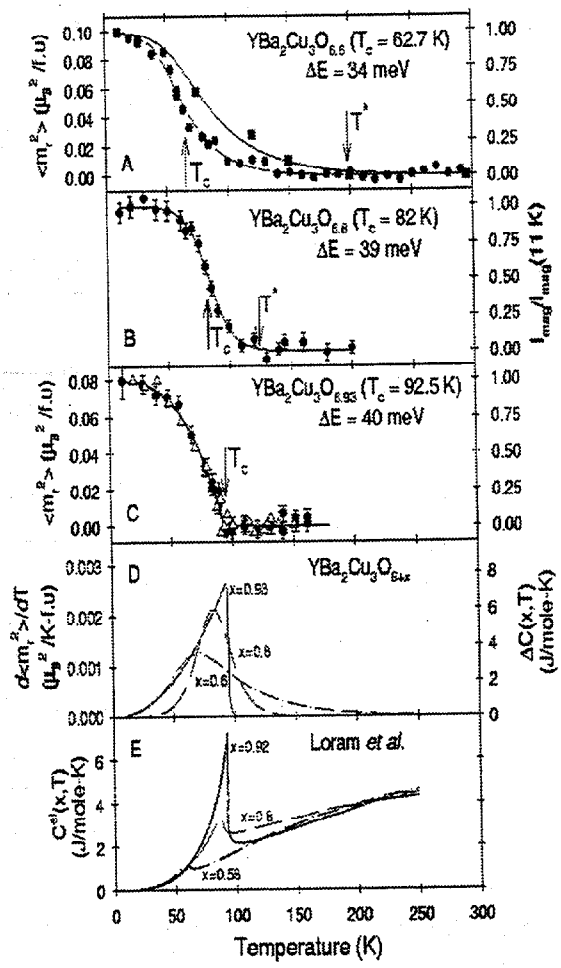

Fig. 1. Temperature dependence of the spin fluctuations in $YBa_2Cu_3O_{6+x}$.

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1. Summary of paper: *Science* **284**, 1344 (1999).
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CHARGE FLUCTUATIONS IN $YBa_2Cu_3O_{7-x}$ HIGH-TEMPERATURE SUPERCONDUCTORS

H. A. Mook and F. Dogan[1]

Understanding the behavior of electrons in the high-transition-temperature (T_c) cuprate superconductors remains a highly challenging problem. One important possibility for these materials is that electronic charge and spin, rather than forming a uniform state, separate into a dynamic arrangement in which the Cu-spins form antiferromagnetic stripes that separate domain walls containing the charge. The dynamical behavior of the spins has been extensively studied by neutron scattering with recent results[2] showing that the low-frequency fluctuations display a universal spatial behavior for different classes of materials that is consistent with the stripe picture. However, arguments for the stripe phases are difficult to sustain without a demonstration that charge is distributed in domain walls with the proper spacing to fit with the spin distribution. Recent neutron scattering work[3] at HFIR on phonons for the $YBa_2Cu_3O_{7-x}$ high-T_c superconductors image charge fluctuations with the correct periodicity for charge to be located in domain walls separated by the spin stripes. The results provide strong support for the existence of a dynamic stripe phase in the high-T_c superconductors.

Figures 1(a)–1(d) display contour maps of the phonon intensity as a function of wave vector for an optical phonon branch for different oxygen compositions. Results for the $O_{6.2}$ insulating composition show no phonon anomaly while those for the superconducting compositions $O_{6.35}$ and $O_{6.6}$ show anomalies that occur at a reciprocal lattice position twice that of magnetic incommensurate scattering. The anomaly for the

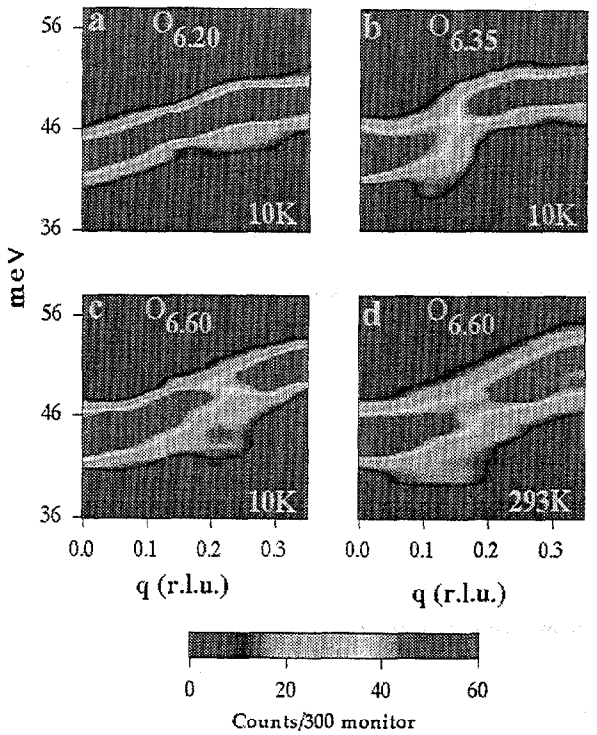

Fig. 1. Phonon dispersion for planar oxygens showing anomalies at the wave vector of the charge fluctuations

$O_{6.6}$ composition is still visible at 293 K. These results are exactly what is expected if a dynamic striped phase is present in the $YBa_2Cu_3O_{7-x}$ superconductors. The existence of such a phase would have a significant effect on our understanding of the superconducting process.

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1. University of Washington, Seattle, Wash.
2. H. A. Mook et al., *Nature* **395**, 580 (1998).
3. H. A. Mook and F. Dogan, *Nature* **401**, 145 (1999).

ANOMALOUS DISPERSION OF LONGITUDINAL OPTIC (LO) PHONONS IN $La_{1.85}Sr_{0.15}CuO_4$ AT LOW TEMPERATURES[1]

M. Yethiraj, R. J. McQueeney,[2] Y. Petrov,[3] T. Egami,[3] G. Shirane,[4] and Y. Endoh[5]

Inelastic neutron scattering measurements of $La_{1.85}Sr_{0.15}CuO_4$ show that a discontinuity in dispersion develops in the middle of the highest energy LO phonon branch at low temperatures. This result suggests dynamic short-range unit cell doubling in the CuO_2 plane along the direction of the Cu-O bond, such as charge ordering on every other row of oxygen. Such charge ordering is related to, but is different from, the stripe charge ordering observed for nonsuperconducting cuprates.

The dispersion of the oxygen LO mode is strongly temperature-dependent, as can be seen in Fig. 1. In particular, no peak is seen at 10 K at (3.25, 0, 0), while a peak develops at 76 meV at 300 K. The results for this LO mode are characterized by two remarkable features. One is the apparent discontinuity of dispersion at (0.25, 0, 0), and the other is the flatness of the same from (0.25, 0, 0) to (0.5, 0, 0).

The magnetic periodicity of the lattice in this sample is approximately 8 times the in-plane lattice spacing, *a*, giving rise to a 4*a* periodicity in the charge ordering. However, in this study, a distinct discontinuity in the dispersion curve at $Q = (0.25, 0, 0)$ which implies a charge ordering corresponding to 2*a* was measured.

Regardless of the exact origin, the observed phonon dispersion strongly suggests that the possibility of a new local dynamic charge ordering that is strongly interacting with the lattice, distinct from the spin/charge stripes which have been seen previously, must be considered.

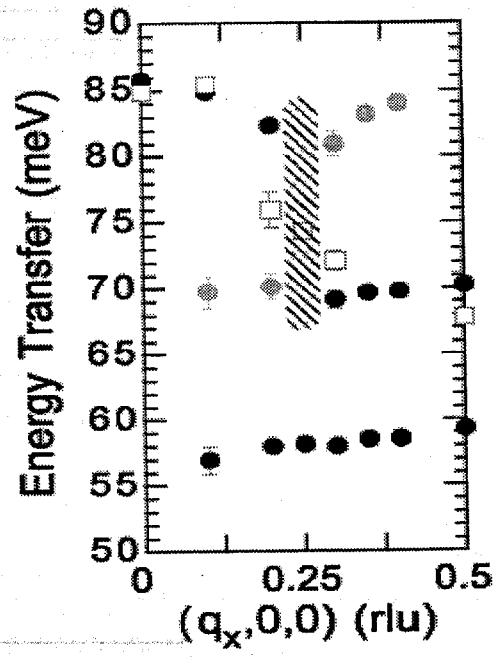

Fig. 1. The dispersion relation of the upper two LO branches along $(q_x, 0, 0)$ as obtained from fits to Gaussians. The 10-K results are filled circles, and room-temperature results are empty squares. The gray shaded circles indicate the frequency of the weak extra branches seen at 10 K. The hatched area at (3.25, 0, 0) indicates a broad ill-defined phonon peak.

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1. Summary of paper: *Phys. Rev. Lett.* **82**, 628, (1999).
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FLUX-LATTICE SYMMETRY IN V_3Si: NONLOCAL EFFECTS IN A HIGH-K CUBIC SUPERCONDUCTOR[1]

M. Yethiraj, D. K. Christen, D. McK. Paul,[2] and J. R. Thompson[3]

Magnetic fields penetrate a type-II superconductor as quantized flux lines. Each flux line contains one quantum (h/2e) of flux, and an array of them creates a modulation of the magnetic field. Flux lines are generally expected to be arranged in a regular hexagonal lattice because their interaction is repulsive and a hexagonal lattice that maximizes the distance between them can reasonably be expected to be the lowest energy configuration. However, square lattices of flux lines have been seen experimentally.

In the high-K cubic superconductor V_3Si, phase transitions of the flux-lattice structure occur as a function of applied field and temperature. With the field parallel to the fourfold [100] axis, the flux lattice transforms from triangular to square symmetry at approximately 1 T. With the field parallel to the twofold [110] axis, the lattice, which is a nearly perfect hexagonal array at the lowest fields, distorts as the field is increased; the rate of increase in this distortion changes abruptly at 1.3 T. As T_c is approached, the system tends toward a more isotropic hexagonal array of the flux lines. These transitions are largely but not completely in agreement with a recent theory of the effects on the flux-line arrangements of nonlocal electrodynamics in the London limit.

In a material in which there is no (in-plane) mass anisotropy, previous studies indicated a fourfold symmetry for the cross section of a single flux line. This variation of the London penetration depth within the basal plane is inconsistent with local London theory and points directly to the importance of nonlocal interactions.

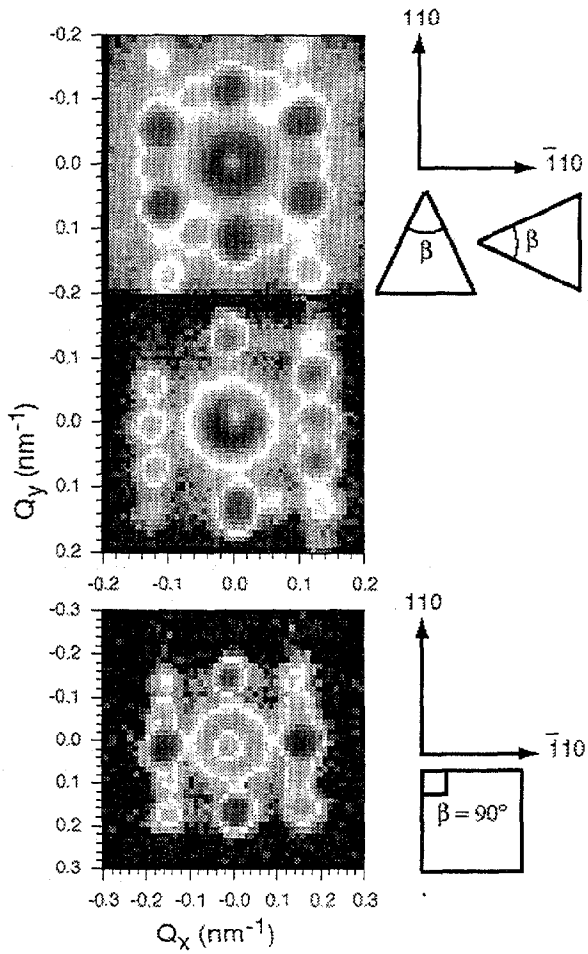

Fig. 1. Small-angle neutron scattering patterns at 0.75, 1, and 1.5 T are shown, respectively. The structure is indicated alongside.

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1. Summary of paper: *Phys. Rev. Lett.* **82**, 5112 (1999).
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DISCOVERY OF A NOVEL LONGITUDINAL MODE IN $KCuF_3$

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Recent field theories have predicted that a novel, gapped longitudinal mode should exist in ordered magnets consisting of coupled $S = 1/2$ Heisenberg antiferromagnetic chains. The mode is a signature of zero-point fluctuations that suppress the size of the ordered moment in quasi-1D quantum antiferromagnets. A series of inelastic neutron scattering experiments on the quasi-1D antiferromagnetic material $KCuF_3$ has resulted in the detection of this new mode of excitation. Figure 1 shows the magnetic scattering above background near a 1D antiferromagnetic zone center in the ordered phase of $KCuF_3$. The dashed line is an extrapolation of the transverse scattering expected from the gapless overlap of the spin wave modes with the instrumental resolution. The broad peak near 16 meV is the longitudinal mode. The intrinsic width of roughly 4 meV is larger than predicted by theory and may arise because the mode decays into spin waves.

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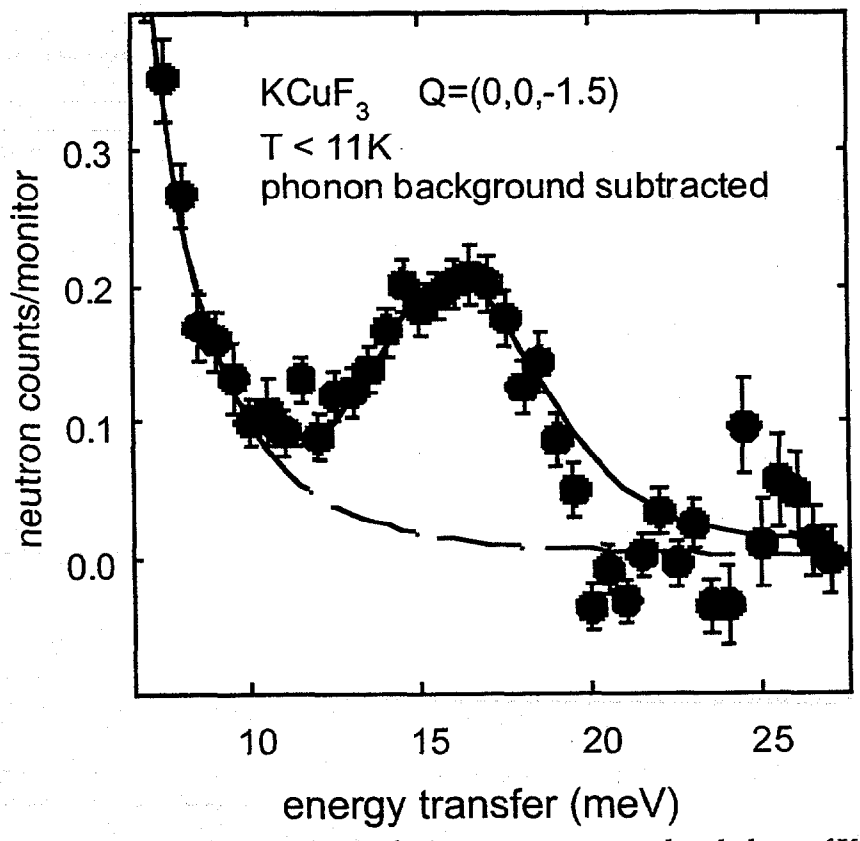

Fig. 1. Magnetic scattering in the low-temperature ordered phase of $KCuF_3$.

Large-Scale Structures

DEMONSTRATION OF A NEW SHARP CROSSOVER MODE NEAR THE CRITICAL POINT OF SYSTEMS WITH AN ADDITIONAL LENGTH SCALE[1]

Y. B. Melnichenko,[2] G. D. Wignall, M. A. Anisimov,[3] J. V. Sengers,[3] and W. A. Van Hook[4]

One of the most impressive results of the theory of phase transitions is the prediction of the universal behavior of condensed matter in the vicinity of the critical temperature T_c. This universality arises from the divergence of the size of the fluctuations (e.g., the correlation length, ξ), which conceals all specific details of the molecular structure and intermolecular interactions as $T \Rightarrow T_c$. In the case of systems described by the Ising model (e.g., simple liquids, small molecule mixtures, etc.), the susceptibility χ (e.g., the forward cross section at zero angle in a neutron scattering experiment) varies as $\tau\gamma$, where $\tau = (T-T_c)/T_c$ is the reduced temperature and $\gamma = 1.24$ in the vicinity of T_c. In a wider region around the critical point, the correlation length is reduced, and the impact of the critical fluctuations becomes less pronounced. Thus, χ may be described by a mean-field approach with $\gamma = 1.0$. The susceptibility of systems investigated thus far crosses over from the mean-field to the Ising limit in a regular manner [i.e., the effective exponent (slope) of the susceptibility $\gamma_{eff} = -\tau d(\ln\chi)/d\tau$ increases monotonically from $\gamma = 1.0$ to 1.24]. However, it has recently been suggested that the crossover may become sharp and nonmonotonic in complex systems with an additional characteristic length scale substantially larger than the range of interactions which occurs in small-molecule liquids and mixtures.

Solutions of polymers in organic solvents are appropriate for verifying this theoretical prediction, as the macromolecules introduce an additional length scale (e.g., the size of the polymer coils or radius of gyration, R_g) of the order of hundreds of Å. Moreover, small-angle neutron scattering, in combination with deuterium labeling, provides a unique opportunity of determining χ in both $\xi << R_g$ and $\xi >> R_g$ regimes. The results are illustrated in Fig. 1, which compares the sharp crossover observed for polystyrene in cyclohexane with the regular crossover behavior observed in small-molecule systems (e.g., xenon). It may be seen that the susceptibility of the polymer solution crosses over from the mean-field to the asymptotic Ising behavior in a novel and nonmonotonic manner, in accordance with theoretical predictions.

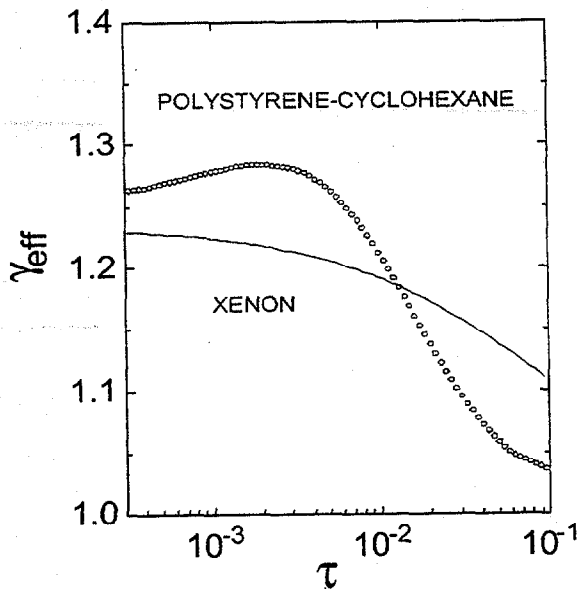

Fig. 1. The γ_{eff} vs. τ for xenon near the liquid-gas critical point and a polymer solution near the polymer–solvent critical demixing point.

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1. Summary of paper: *Phys. Rev. Lett.* 79, 5266 (1997).
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MOLECULAR WEIGHT SCALING IN CRITICAL POLYMER SOLUTIONS[1]

Y. B. Melnichenko,[2] G. D. Wignall, and W. A. Van Hook[3]

The temperature variation of the thermodynamic properties of polymer solutions can be described by scaling laws with the universal values of the appropriate critical indices. However, the amplitudes (prefactors) in the scaling laws are not universal and depend on the molecular weight (M_W) of the polymer. For example, the amplitude (ξ_O) of the correlation length (ξ) of the concentration fluctuations scales as $\xi_0 \sim (M_W)^n$. The M_W-dependence of ξ_0 was first investigated by Debye and co-workers[4] using light scattering, and the results of these experiments for solutions of polystyrene in cyclohexane are shown in Fig. 1. The fitted (solid) line corresponds to the power law $\xi_0 \sim (M_W)^{0.285}$, and the disagreement between this result and theoretical estimates by de Gennes ($n = 0.185$) has remained an enigma for almost 40 years.

Examination of the experimental procedures and the data treatment[4] revealed that the average concentration (ϕ) of the polymer in Debye's experiment was much lower than the actual critical concentration ($\phi/\phi_C \sim 0.5$). Corrections for this effect should lead to a lower value of the scaling exponent (n), and attempts have been made to clarify the reasons for the long-standing discrepancy by studying the variation of ξ_0 with M_W in solutions of polystyrene in *d*-methylcyclohexane at the critical concentration ($\phi = \phi_C$). The results of the small-angle neutron scattering (SANS) experiments performed are illustrated in Fig. 1. It may be seen that the SANS data are described by the power law $\xi_0 \sim (M_W)^{0.195\pm0.010}$, and the measured exponent is therefore in agreement with the value ($n = 0.185$), calculated by de Gennes. Complementary SANS experiments have shown that a mismatch between the critical and actual

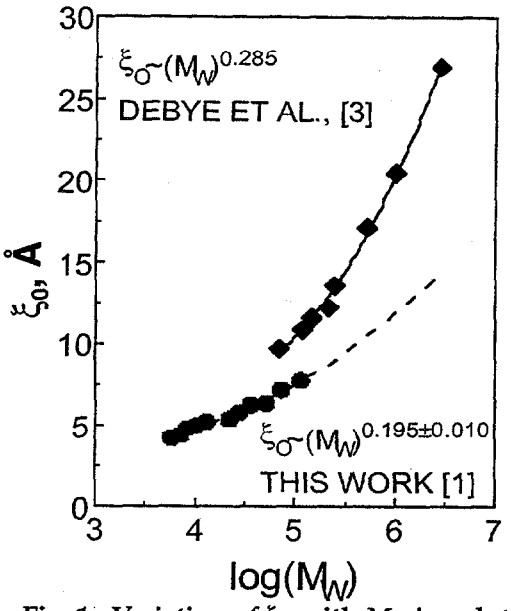

Fig. 1. Variation of ξ_O with M_W in solutions of polystyrene in cyclohexane (Debye et al. [4]) and polystyrene in *d*-methylcyclohexane.[1]

concentrations may lead to an absolute value of ξ_0 up to ~400% higher than that at ϕ_C. If the mismatch is M_W-dependent, as is believed is the case in Debye's experiment, this could lead to an overestimate of the exponent n by ~0.7. This is the first experimental observation of the critical exponent (n) describing the amplitude (ξ_0), which is consistent with the predictions of modern scaling theory.

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1. Summary of paper: *Europhysics Letters* (in press).
2. ORNL/ORISE postdoctoral research associate.
3. The University of Tennessee, Knoxville, Tenn.
4. P. Debye, H. Cole, and D. Woermann, *J. Chem. Phys.* 33, 1746 (1960).

FIRST OBSERVATION OF A "THETA PRESSURE" FOR POLYMERS IN SUPERCRITICAL FLUIDS[1]

Y. B. Melnichenko,[2] G. D. Wignall, E. Kiran,[3] K. D. Heath,[4] S. Salaniwal,[4] H. D. Cochran,[4] and M. Stamm[5]

A supercritical fluid (SCF) is a substance at a pressure and temperature above the liquid-vapor critical point where the coexisting liquid and vapor phases become indistinguishable. SCFs, in general, and supercritical carbon dioxide (CO_2), in particular, have emerged as an attractive alternative to the organic solvents used for polymer manufacturing and processing. One key advantage of SCFs is the possibility of continuously tuning the solvent quality by varying the pressure (P) in addition to the temperature (T), which offers an unparalleled means for controlling polymer solubility. Despite recent progress in many specific areas of SCF science and technology, significant challenges remain for developing the same level of understanding of the behavior of polymers in SCFs as has been reached for polymers in traditional organic solvents.

Small-angle neutron scattering has recently been used to study the dimensions of strongly interacting polymer molecules in SCFs to test the prediction that they will adopt "ideal" configurations, unperturbed by excluded volume effects at a "theta pressure" ($P\Theta$) as they do in liquid organic solvents at the theta temperature ($T\Theta$). Experiments on poly(dimethyl siloxane) in supercritical CO_2 confirm that the supercritical polymer solutions exhibit both of these phenomena, and for $P > P\Theta$ and $T > T\Theta$, the system exhibits a "good solvent" domain, where the polymer molecules expand beyond the unperturbed R_g because of excluded volume effects. However, for $T < T\Theta$ and $P < P\Theta$, the interacting chains do not collapse and maintain their unperturbed dimensions (Fig. 1) as observed in organic solvents. Thus, supercritical polymer solutions represent all salient features of the phase diagram for polymers in organic solvents. Moreover, SCFs exhibit novel effects such as pressure-induced transition to the Θ point which represents a new concept in the physics of polymer-solvent systems.

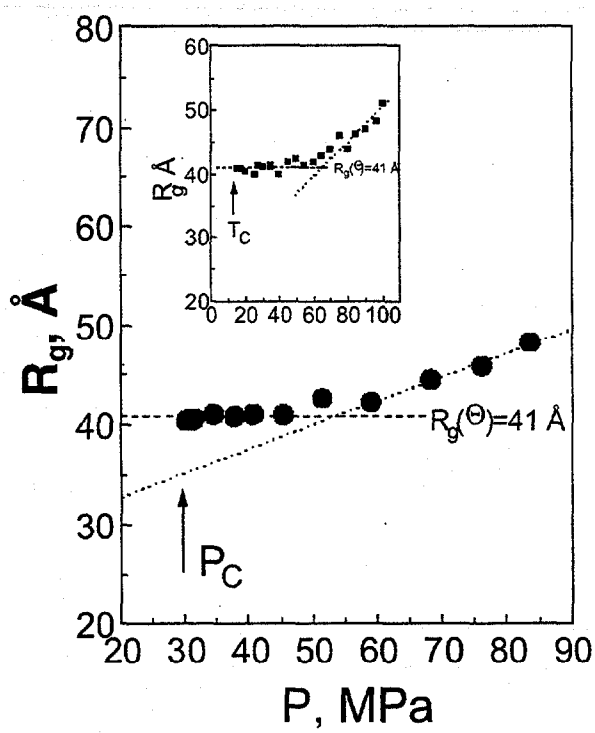

Fig. 1. The variation of R_g with pressure and temperature (inset) in solutions of poly(dimethyl siloxane) in supercritical CO_2.

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1. Summary of paper: *Macromol.* **32**, 5344 (1999).
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PHASE BEHAVIOR OF BLENDS OF LINEAR AND BRANCHED POLYETHYLENES ON MICRON LENGTH SCALES VIA ULTRA SMALL-ANGLE NEUTRON SCATTERING (USANS)[1]

M. M. Agamalian,[2] R. G. Alamo,[3] M. H. Kim,[3] J. D. Londono,[4] L. Mandelkern,[3] and G. D. Wignall

Polyethylene (PE) is produced in many forms, and high-density PE (HDPE) chains contain very little branching. Low-density PE (LDPE) contains both short- and long-chain branches, and linear LDPE (LLDPE) contains only short-chain branches. The properties of the species can be altered by mixing, and blends of HDPE, LDPE, and LLDPE are widely used commercially. However, understanding their properties is handicapped by the absence of a consensus concerning the melt miscibility of the components. For example, pinhole small-angle neutron scattering (SANS) experiments indicate that HDPE/LDPE blends are homogenous.[5] Similarly, SANS indicates that mixtures of HDPE and short-chain-branched PE, such as LLDPE, are homogenous when the branch content is low, but phase separate when the branch content is higher.

However, it has been claimed[6] that these experiments do not provide unambiguous evidence for a one-phase melt for HDPE/LDPE blends and that the data might also be interpreted as arising from a bi-phasic melt with very large (μm-sized) particles. This hypothesis has been addressed via a new ultrahigh resolution instrument,[7] which increases the spatial resolution to ~30 μm. The results (Fig. 1) confirm that HDPE/LDPE blends are homogenous in the melt. Studies of a blend of linear (HDPE) and short-chain-branched PE [e.g., hydrogenated polybutadiene (HPB)] which phase separates when the branch content is high have been conducted. It may be seen that ultra SANS (USANS) can directly resolve both the size of dispersed phase (~4 μm) and the forward cross section ($d\Sigma/d\Omega \sim 10^8$ cm^{-1}), which is six orders of magnitude higher than for homogenous blends, thus confirming the conclusions drawn from previous SANS studies.[5]

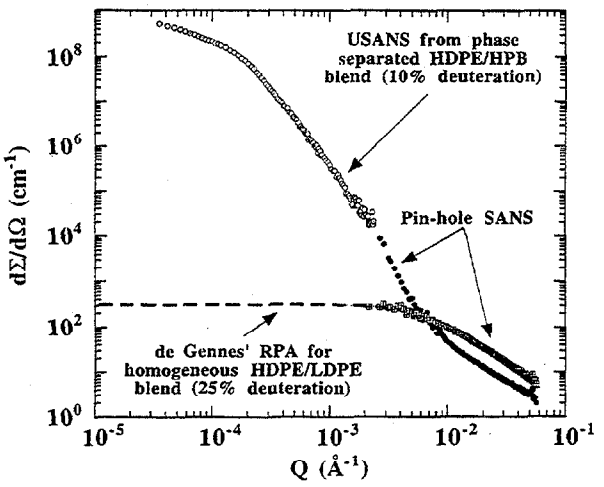

Fig. 1. Combined USANS and pinhole SANS data from phase-separated HDPE/HPB and homoegenous HDPE/LDPE blends.

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1. Summary of paper: *Macromol.* **32**, 3093 (1999).
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4. DuPont Central Research & Development, Wilmington, Del.
5. R. G. Alamo et al., *Macromol.* **27**, 411 (1994).
6. C. Shipp et al., *Polymer* **37**, 2291 (1996).
7. M. Agamalian, R. Triolo, and G. D. Wignall, *J. Appl. Crystallogr.* **30**, 345 (1997).

STRUCTURE AND GROWTH KINETICS OF ZIRCONIUM HYDROUS POLYMERS IN ORGANIC SOLUTIONS BY SMALL-ANGLE X-RAY SCATTERING[1]

A. Singhal,[2,3] G. Beaucage,[4] M. T. Harris,[2] L. M. Toth,[2] K. D. Keefer,[5] J. S. Lin, M. Z.-C. Hu,[3] and J. R. Peterson[2]

The sol-gel process used to produce ceramic powders, coatings, and glasses can modify the molecular precursor structure and thus control the properties of the final products for potential technological applications. The inorganic polymer nature is important in controlling the morphology and thermochemical properties of ceramics derived from solution processing. The extent of hydrolysis and the condensation reaction affects structures of inorganic polymers or polymer-like aggregates.

Several previous studies (e.g., ^{17}O nuclear magnetic resonance and turbidity measurements) have been undertaken to understand hydrolysis growth kinetics and the condensation reaction for zirconium and titanium alkoxide at the early stage of hydrolysis. However, severe problems exist in relating turbidity measurements to hydrolysis kinetics as they can only detect particles that are large enough to scatter light; therefore, the turbidity is related to colloidal growth kinetics rather than to the hydrolysis and condensation kinetics. Furthermore, for acid/base-catalyzed systems and formation of transparent gels where precipitates do not form, turbidity measurements fail.

Small-angle x-ray scattering (SAXS) measurements were utilized in studying the zirconium butoxide/ethanol solutions, hydrolyzed by water/HCl/ethanol solution, for an aging period ranging from 109 ms to a few days. By using an Ismatech peristaltic pump and a mixing tee, a rapid-mixing, continuous-flow technique was used to control the flow-rate and the reaction time by varying the Teflon and silicone connection tubings length and then to monitor hydrolysis and condensation reactions in situ at a very early stage by the SAXS technique. Typically, solutions of [Zr] = 0.1 M, [HCl] = 0.01 M, and $[H_2O]$ = 1.1 M were used with varying degree of dilution by adding ethanol.

Results prove that the condensation reaction starts before completion of hydrolysis, and as a result, polymers formed at the earlier stages (t ~ 100 ms) are weakly cross-linked. On further aging, because of the internal condensation process, these weakly cross-linked polymers convert to highly branched polymers with a structure similar to an ideal Gaussian randomly branched polymer with a persistence length of 8.3 ± 0.5 Å.

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1. Summary of paper: *J. Non-Cryst. Solids* **246**, 197 (1999).
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SURFACE ADSORPTION OF SURFACTANT AGGREGATES[1]

W. A. Hamilton, P. D. Butler,[2] J. C. Schulz,[3] H. N. Patrick,[3] and G. G. Warr[3]

Adsorbed surfactant layers are important in many classical colloidal applications, including mineral flotation and detergency. However, while a plethora of more complicated structures (spherical, cylindrical, and ellipsoidal micellar aggregates, as well as other more complicated morphologies) are observed in bulk-surfactant self-assembly, the traditional view of adsorbed surfactant on mineral oxides has been of an essentially structureless bilayer.

Neutron reflectivity (NR) measurements on the MIRROR reflectometer at ORNL have often indicated that some surfactant "films" adsorbed from solution onto solid surfaces are apparently thinner than would be expected from this generally current "textbook" assumption of bilayer adsorption. Figure 1 shows a number of neutron scattering length density profile fits to NR measurements taken for an aqueous micellar solution of tetradecyl trimethylammonium bromide (TTAB) in a sapphire cell. These measurements indicated that either the adsorbed layer was an unrealistically thin bilayer or that ellipsoidal micellar aggregates in the bulk solution persisted on the surface.

Subsequent in-solution atomic force microscopy (AFM) measurements have verified our "micelles on the surface" conjecture. The orange-peel appearance in the AFM image (Fig. 2) is due to spheroidal TTAB micelles about 6 nm in diameter adhering to a quartz surface.

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1. Summary of paper to be published.
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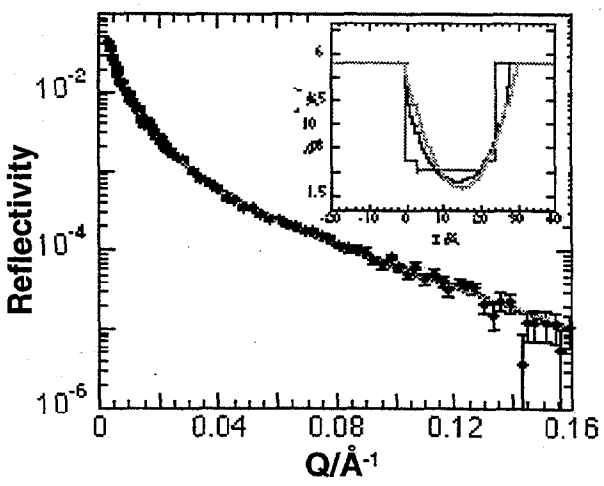

Fig. 1. Rectangular bilayer scattering length density profile fit (inset) to NR data has the same (root mean square) width as that of cylinder and ellipsoidal profile fits of greater overall width.

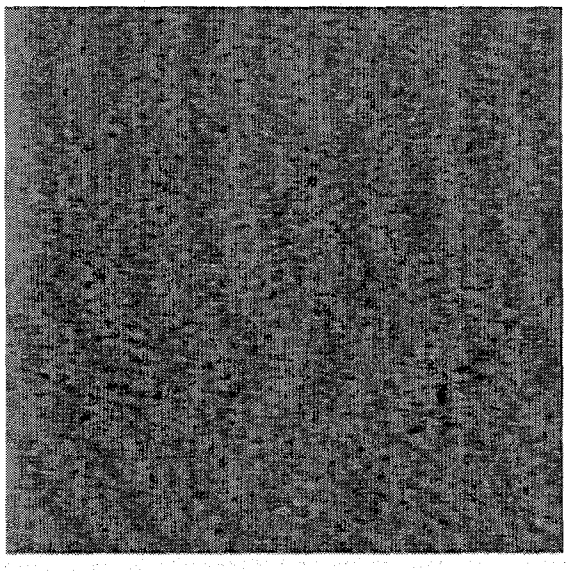

Fig. 2. In-solution AFM image of TTAB micelles adsorbed onto quartz (250 × 250 nm).

THE FRACTAL GEOMETRY OF ROCKS[1]

A. P. Radlinski,[2] E. Z. Radlinska,[3] M. Agamalian,[4] G. D. Wignall, P. Lindner,[5] and O. G. Randl[5]

Sedimentary rocks are formed from a mixture of organic and inorganic debris buried and compacted over geological periods of time. Recent progress in small-angle neutron scattering (SANS) instrumentation enables the microstructures of rocks to be studied well beyond the SANS limit ($Q \sim 10^{-3}$ Å^{-1}), where Q is the scattering vector. In particular, the ORNL ultra SANS (USANS) facility can measure down to $Q \sim 2 \times 10^{-5}$ Å, and this technique has been applied to a hydrocarbon source rock U116, originating from the MacArthur Basin in Australia.

Figure 1 shows a combination of SANS data taken on the ORNL and Institut Laue-Langevin SANS instruments, along with USANS data. All three data sets overlap smoothly, and the cross section varies as

$$d\Sigma/d\Omega(Q) \sim Q^{-1}\, G(5 - D_s)\xi^{5-d},$$

$$\times\, [1 + (Q\xi)^2]^{(D_s-5)/2} \sin[D_s - 1)\arctan(Q\xi)],$$

where D_s is the surface fractal dimension and ξ is the upper limit for the range of scale invariance. Analysis of the data shows that the pore-rock fabric interface is a surface fractal ($D_s = 2.82$) over 3 orders of magnitude of the length scale and 10 orders of magnitude in cross section. To our knowledge, these data represent the largest range over which fractal behavior has been observed. Such an extent of fractal microstructure in a rock is remarkable when compared with the limited size range over which the fractal properties are usually studied (typically 1.3 orders of magnitude). This study extends the widest length range previously observed (2 decades in length scale and 7.5 decades in intensity)[6] and shows that

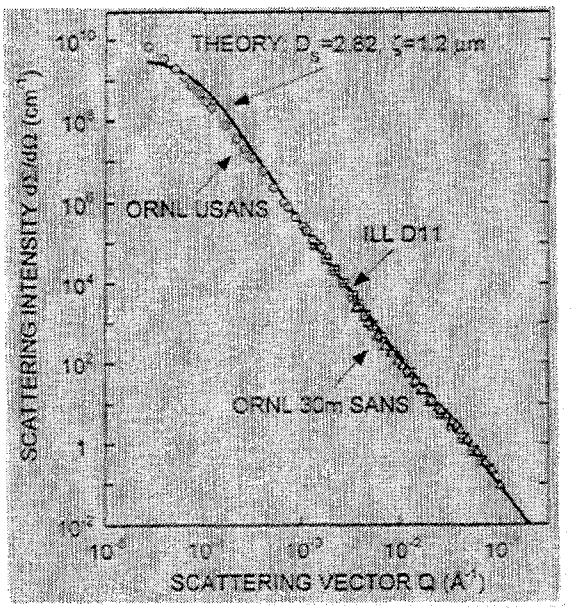

Fig. 1 SANS and USANS data from sedimentary rock showing fractal behavior over 10 orders of magnitude in intensity.

sedimentary rocks are one of the most extensive fractal systems found in nature. As observed in *Physical Review Focus* (4/20/99), "the constancy of the fractal dimension over so many scales ... this study will enhance the idea that you can describe rock with simple concepts."

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1. Summary of paper: *Phys. Rev. Lett.* **82**, 3078 (1999).
2. Australian Geological Survey Organization, Canberra, Australia.
3. The Australian National University, Canberra, Australia.
4. ORNL/ORISE postdoctoral research associate. Present address: Spallation Neutron Source Project, ORNL.
5. Institut Laue-Langevin, Grenoble, France.
6. H. D. Bale and P. W. Schmidt, *Phys. Rev. Lett.* **53**, 596 (1984).

Chapter 3

Synthesis, Processing, and Characterization of Materials

Materials Development & Properties

ION IMPLANTATION/ANNEALING-INDUCED PRECIPITATION OF NANOPHASE FERROMAGNETIC PARTICLES IN YTTRIUM-STABILIZED ZrO_2[1]

S. Honda,[2] F. A. Modine, A. Meldrum,[3] J. D. Budai, T. E. Haynes, L. A. Boatner, and L. A. Gea[4]

Recent investigations have established the concept of creating "smart" surfaces through the use of ion implantation/annealing techniques to form embedded nanophase precipitates whose properties change at a phase transition.[5] In our previous work, "smart" surfaces were created on single crystals of Al_2O_3 by the co-implantation of V and O to form embedded nanophase VO_2 precipitates.

In the present work, ion implantation and annealing techniques were used to form embedded ferromagnetic nanophase precipitates and thereby create magneto-optically active near-surface regions on otherwise inactive materials. Magnetic precipitates were formed by first implanting Fe^+ or Ni^+ into $Y_{0.15}Zr_{0.85}O_{1.93}$ (YSZ) with an implant energy of 140 keV, a fluence of 8.0×10^{16} ions/cm^2, and at a temperature of –189°C. After implantation, the specimens were annealed at temperatures ranging from 500° to 1100°C in several types of reducing atmospheres. X-ray diffraction and TEM analyses of the Fe- or Ni-implanted/annealed specimens revealed that crystallographically aligned precipitates of metallic α-Fe, Fe_3O_4, or Ni could be formed in YSZ depending on the annealing conditions. Magneto-optical effects due to ferromagnetic precipitates of Fe, Fe_3O_4, and Ni in the near-surface region of YSZ were observed using magnetic circular dichroism (MCD). The MCD effects observed at room temperature for α-Fe and Fe_3O_4 are shown in Fig. 1. The magneto-optical response of the α-Fe, Fe_3O_4, and Ni precipitates was markedly different as determined from the MCD-detected hysteresis curves. The precipitation mechanism, the chemical nature of the precipitates, and the particle-size distributions due to different annealing conditions have been correlated with the magneto-optical properties. This work extends the active precipitate/surface-composite concept to encompass the creation of magneto-optically active surfaces on otherwise benign materials.

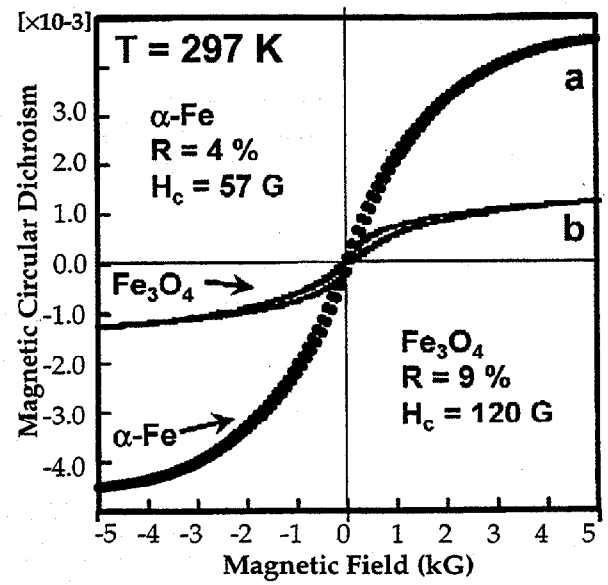

Fig. 1. MCD results showing the hysteretic response of ferromagnetic α-Fe and Fe_3O_4 precipitates in YSZ. The coercivity, *C*, and the ratio, *R*, of the remanent response at *H* = 0 to the saturation value are shown.

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1. Summary of paper: *Mat Res. Soc. Symp. Proc.* **540**, 225 (1999).
2. ORNL/ORISE postdoctoral research associate.
3. ORNL/ORISE postdoctoral research associate. Present address: University of Alberta, Edmonton, Canada.
4. ORNL/ORISE postdoctoral research associate. Present address: Joint Research Center, Ispra, Italy.
5. L. A. Gea and L. A. Boatner, *Appl. Phys. Lett.* **68**, 3081 (1996).

FORMATION OF ORIENTED PARTICLES IN AN AMORPHOUS HOST: ZnS NANOCRYSTALS IN SILICON[1]

A. Meldrum,[2] R. A. Zuhr, E. Sonder,[3] J. D. Budai, C. W. White, L. A. Boatner, R. C. Ewing,[4] and D. O. Henderson[5]

Ion implantation combined with thermal processing has previously been used to form semiconducting compound crystalline precipitates that are both faceted and crystallographically aligned coherently with a host single-crystal lattice. In the present work, it has been shown that crystalline precipitates that are coherently aligned crystallographically can also be made to occur in an amorphous matrix. This is achieved by using ion implantation and thermal processing to produce ZnS nanocrystals that are coherently oriented with respect to an initially single-crystal Si host. The ZnS particles are significantly more resistant to ion irradiation-induced amorphization than is the host Si matrix, and accordingly, ion bombardment with Si^+ ions at an appropriate fluence can subsequently be used to amorphize the Si host leaving the remaining crystalline ZnS particles in a coherently aligned state.

Nanophase precipitates of ZnS were formed in the near-surface region of a (100)-oriented single-crystal Si wafer by the sequential stoichiometric implantation of zinc and sulfur plus a subsequent anneal for 1 h at 1000°C in flowing Ar + 4%H_2. X-ray diffraction measurements confirmed the formation of zincblende-structure ZnS precipitates in crystalline Si, and TEM results revealed the presence of a band of faceted crystallographically coherent (with respect to the Si host) ZnS precipitates at a depth consistent with that determined by RBS analysis.

Si wafers containing the oriented ZnS precipitates were then irradiated at room temperature with $^{30}Si^+$ ions to a total fluence of 4.75×10^{15} cm^{-2}. These Si^+ irradiation conditions were selected in order to leave the ZnS particles in a fully crystalline state.

Cross-sectional TEM analysis of the samples following the Si irradiation clearly showed that the ZnS nanoparticles remained crystalline and crystallographically oriented with respect to each other even though the Si host had been rendered amorphous. Accordingly, a new type of near-surface nanocomposite has been formed that consists of crystallographically oriented, dispersed precipitates in an amorphous host matrix. By exploiting the flexibility of ion implantation and the intrinsic differences in the recrystallization behavior between potential host materials and various nanophase precipitates, it should be possible to achieve a wide range of surface nanocomposite systems consisting of oriented crystalline particles embedded in a variety of amorphous matrices.

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1. Summary of paper: *Appl. Phys. Lett.* **74**, 697 (1999).
2. ORNL/ORISE postdoctoral research associate. Present address: University of Alberta, Edmonton, Canada.
3. ORNL retiree.
4. University of Michigan, Ann Arbor, Mich.
5. Fisk University, Nashville, Tenn.

LONG-RANGE FERROELECTRIC INTERACTIONS IN $KTaO_3/KNbO_3$ SUPERLATTICE STRUCTURES[1]

H.-M. Christen,[2] E. D. Specht,[3] D. P. Norton, M. F. Chisholm, and L. A. Boatner

Prior attempts have been made to quantify size effects in ferroelectrics, but unequivocal observations of these phenomena have been elusive because of a variety of experimental difficulties. Recent investigations have focused on the decrease of the ferroelectric phase transition temperature, T_c, in fine-grained ceramics; the decrease of the ferroelectric domain size with decreasing thickness in free-standing wedge-shaped TEM samples; and the increase of T_c in epitaxial thin films. Unfortunately, in all these studies, either defects, surface charges, nonuniform strains, or other effects have complicated interpretations of the experimental results.

Here, the difficulties noted above are circumvented by exploiting the properties of epitaxial superlattices [i.e., alternating atomic-scale layers of paraelectric $KTaO_3$ and ferroelectric $KNbO_3$ grown on (001)-oriented $KTaO_3$ substrates by pulsed-laser deposition]. The in-plane structure of $KNbO_3$ closely matches that of the $KTaO_3$ substrate, resulting in $KTaO_3/KNbO_3$ heterostructures that are uniformly strained in-plane without misfit dislocations. This strain imposes an in-plane $KNbO_3$ lattice spacing identical to that of the $KTaO_3$ substrate for the temperature range $30° < T < 700°C$, and a tetragonal-to-tetragonal transition is observed whose transition temperature T_c depends on the $KNbO_3$ layer thickness, as shown in Fig. 1. The in-plane strain results in a significant increase in T_c for superlattices with relatively thick $KNbO_3$ layers.

The following three conclusions summarize our findings: (1) uniform compressive strain results in an increase of T_c in $KNbO_3$, (2) decreasing the superlattice period in symmetric $KTaO_3/KNbO_3$ superlattices results in a decrease of T_c, and (3) a critical length scale of ~50 Å is observed, below which superlattices behave as a random alloy film of the same composition, illustrating the long-range nature of ferroelectric interactions in the $KTaO_3/KNbO_3$ system.

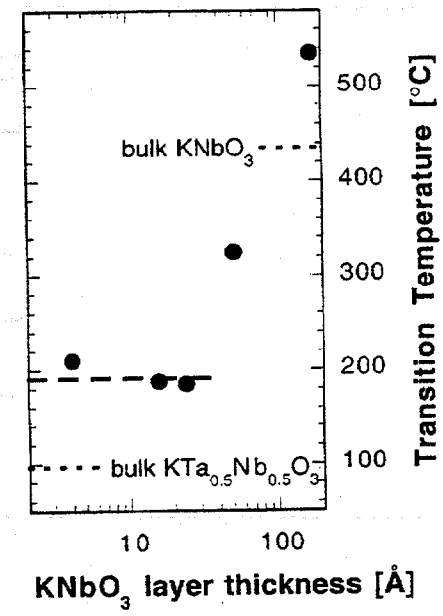

Fig. 1. Phase transition temperature vs. $KNbO_3$ layer thickness. The broken line indicates the T_c of the solid-solution film. Also shown are the T_c's of bulk $KNbO_3$ and $KTa_{0.5}Nb_{0.5}O_3$.

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1. Summary of paper: *Appl. Phys. Lett.* **72**, 2535 (1998).
2. ORNL/ORISE postdoctoral research associate. Present address: Neocera, Inc., Beltsville, Md.
3. Metals and Ceramics Division, ORNL.

OPTICAL SPECTROSCOPY AND LASING PROPERTIES OF NEODYMIUM-DOPED LUTETIUM ORTHOPHOSPHATE[1]

Alexandra Rapaport,[2] Olivier Moteau,[2] Michael Bass,[2] L. A. Boatner, and Chiranjit Deka[3]

Diode-pumped microchip lasers are of interest because of their potential applications as small, sturdy, high-efficiency devices.[4] A key element in an improved Nd^{3+}-doped microchip laser would be a host material that would permit the incorporation of laser-active ions at a higher concentration than is possible in yttrium aluminum garnet (~1%).

The spectroscopic properties of a new, highly doped material, Nd^{3+}:$LuPO_4$, have been investigated. This crystal allows 10 times the doping concentration found in the traditional Nd:YAG laser crystal without "stressing" the crystalline structure. The stimulated-emission cross section of the Nd^{3+} $^4F_{3/2}$ level was measured to be about twice that found in YAG; therefore, 10%-doped Nd:$LuPO_4$ should present a gain per unit length almost 20 times higher than for Nd:YAG.

Initial lasing experiments with a 1-mm-thick unpolished, uncoated crystal gave a slope efficiency of 54% with 88% of the pump power absorbed. This actually created a heat-removal problem, as the sample size did not allow for a large surface for thermal contact with the holder/heat sink. The availability of larger but thinner crystals should reduce this difficulty. In any case, the thermal properties of this material need to be further investigated to enable microchip laser design. It is worth noting that the crystal was not damaged with high-intensity (more than 40-kW/cm^2) cw pump light from the diode laser.

Visible light was emitted inside the crystal when it was lasing because of an up-conversion process in which a Nd^{3+} ion in the $^4F_{3/2}$ state absorbs a photon at the lasing wavelength to populate higher lying excited states, which then emit in the visible. Such a process reduces the population inversion as well as the photon density at the lasing wavelength. It is, therefore, detrimental to the lasing characteristics of the material and contributes to the moderate slope efficiency obtained thus far.

From the moderate slope efficiency and the green emission visible during lasing, it is inferred that excited-state absorption and/or cross relaxations may represent potential problems in this new host. However, an optimization of the crystal characteristics might enable the use of a lower Nd^{3+} concentration in order to limit cross relaxation. Although the optimized concentration might be lower than 10%, this high-gain material should make possible the fabrication of a micro-laser with reduced-gain medium length. As the matrix is very stable and resistant, Nd:$LuPO_4$ deserves attention as a promising new laser material.

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1. Summary of paper: *J. Opt. Soc. Am. B* **16**, 911 (1999).
2. University of Central Florida, Orlando, Fla.
3. Beckman Coulter, Inc., Miami, Fla.
4. J. J. Zayhowski and A. Mooradian, *Opt. Lett.* **14**, 24 (1989).

DYNAMIC COUPLING OF CRYSTAL-FIELD AND PHONON STATES IN $YbPO_4$ [1]

C.-K. Loong,[2] M. Loewenhaupt,[3] J. C. Nipko,[2] M. Braden,[4] W. Reichardt,[4] and L. A. Boatner

The crystal-field splitting of *f*-electron energy levels belonging to rare-earth ions situated on specific crystallographic sites of a crystalline solid is a well-known phenomenon. When the energy separations between the states within the Hund's-rule ground multiplet are comparable with the energies of thermal and zero-point motion of the lattice, however, a coupling of the two subsystems may give rise to complex thermodynamic phenomena. Specifically, a treatment of the ion lattice interaction within the framework of cooperative Jahn-Teller (JT) effects points to either an onset of a static lattice distortion that occurs at low temperature or to continual dynamic fluctuations that take place between energetically equivalent configurations of the crystal-field (CF) and phonon states. Evidence for dynamic JT effects in these materials, on the other hand, is expected to be less conspicuous as compared with the static JT phase transition or to long-range magnetic ordering, and in order to detect these effects, the dynamic properties of these systems have to be examined over a relatively wide range of wave vectors and temperatures.

Ytterbium orthophosphate, $YbPO_4$, is a promising candidate for investigating the dynamic nature of the JT effect, and Becker and coworkers[5] have reported the mixing of two Yb^{3+} CF states at 32 and 43 meV with an E_g phonon mode at 37 meV from 4.2 to 295 K by using Raman scattering techniques. In the present work, the dynamic response of 4*f*-electron-lattice interactions in $YbPO_4$ has been characterized by neutron spectroscopy using single-crystal specimens. The Yb^{3+}:$^2F_{7/2}$ ground multiplet shows broadened and overdamped energy levels. A coupling of the upper Γ_6 and Γ_7 states with optic phonons was observed throughout the Brillouin zone, resulting in a strong renormalization of the bare crystal-field and phonon excitation spectra over the 15–475 K temperature range.

The results of our single-crystal measurements of $YbPO_4$ provide evidence for dynamic JT effects that may involve monopolar fluctuations of the Yb ions over a wide range of temperatures. The nature of this ion-lattice interaction appears to be unique to the class of RMO_4 materials.

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1. Summary of paper: *Phys. Rev. B* **60**, R12 549 (1999).
2. Argonne National Laboratory, Argonne, Ill.
3. Technische Universitat Dresden, Dresden, Germany.
4. Institut für Nuklear Festköperphysik, Karlsruhe, Germany.
5. P. C. Becker et al., *Phys. Rev. B* **45**, 5027 (1992).

STRUCTURE OF ZINC POLYPHOSPHATE GLASSES[1]

B. C. Sales, J. U. Otaigbe,[2] G. H. Beall,[3] L. A. Boatner, and J. O. Ramey

The technique of high-performance liquid chromatography (HPLC) has been used to determine the distributions of phosphate-anion chains and rings in a variety of zinc-phosphate-based glasses. The phosphate-anion distributions in simple binary zinc phosphate glasses are compared with those found in multi-cation alkali-zinc phosphate glasses. Multi-cation zinc phosphate glasses are chemically durable and can be tailored to exhibit transition temperatures sufficiently low for co-processing with a variety of plastics to form novel organic-inorganic composite materials. The intermediate range order in the multi-cation glasses is found to be similar to that measured in the binary zinc phosphate glasses. Scanning calorimetry measurements indicate, however, that the multi-cation glasses are more resistant to crystallization than the binary glasses. The fraction of phosphorus sites with 2 (Q^2), 1 (Q^1), and 0 (Q^0) bridging oxygen, as well as the ratio of bridging to nonbridging oxygen (BO/NBO), is obtained from the chromatograms. Structural data for the zinc phosphate glasses obtained using HPLC are compared with results reported in the literature (Table 1) that were deduced using more traditional solid state techniques such as nuclear magnetic resonance, x-ray photoemission spectroscopy, and Raman spectroscopy.

Table 1. Structural characteristics of Zn phosphate glasses as determined using HPLC, NMR, and XPS. The fraction of phosphorus with 2 (Q^2), 1 (Q^1), or 0 (Q^0) bridging oxygen is given, as is the ratio of bridging to nonbridging oxygen (BO/NBO).

Composition	Q^0	Q^1	Q^2	BO/NBO	Techniques
54.5 ZnO	0.0	0.18	0.82	0.4	NMR & XPS
45.5 P_2O_5	0.01	0.15	0.84	0.38	HPLC
60 ZnO	0.0	0.50	0.50	0.30	NMR & XPS
40 P_2O_5	0.02	0.48	0.50	0.28	HPLC
66.7 ZnO	0.13	0.70	0.17	0.10	NMR & XPS
33.3 P_2O_5	0.17	0.65	0.18	0.11	HPLC
Corning (A)	0.23	0.72	0.05	0.13	HPLC
Corning (B)	0.06	0.66	0.28	0.22	HPLC

1. Summary of paper: *J. Non-Cryst. Solids* **226**, 287 (1998).
2. Iowa State University, Ames, Iowa.
3. Corning, Inc., Corning, N.Y.

THE STRUCTURE OF LEAD-INDIUM PHOSPHATE AND LEAD-SCANDIUM PHOSPHATE GLASSES[1]

K. Suzuya,[2] C.-K. Loong,[3] D. L. Price,[3] B. C. Sales, and L. A. Boatner

The poor chemical durability of phosphate glasses has traditionally hampered many large-scale industrial applications of this class of materials. The addition of some modifying cations into the parent network former of P_2O_5, however, has been shown to produce phosphate glasses with drastically different physical and chemical properties—and in particular to form chemically durable phosphate glasses.[4] Both indium and scandium have been shown to increase the chemical durability of lead phosphate glasses while leaving these materials transparent to light in the visible wavelength region.[5] Additionally, lead-indium phosphate and lead-scandium phosphate glasses exhibit other useful properties including a high index of refraction, low preparation temperature, and low melt viscosity.

Because information regarding the local environment of the In and Sc ions is valuable to theoretical modeling of the optical and other characteristics as well as to the future development of phosphate-based novel materials and devices for technological applications, in the present work, the short-range and intermediate-range order structures of a $(PbO)_{56.3}(In_3O_2)_{4.2}(P_2O_5)_{39.5}$ and a $(PbO)_{54.2}(Sc_3O_2)_{3.6}(P_2O_5)_{42.2}$ glass were studied by time-of-flight neutron diffraction.

From analyses of the measured structure factors of these glasses and those of a pure P_2O_5 glass and a $(PbO)_{58.8}(P_2O_5)_{41.2}$ glass, the breakdown of the P_2O_5 network structure to short PO_4-chain-like units by the addition of PbO was characterized. The local environment of the dopant In and Sc ions was also investigated. The In-O and Sc-O distance (2.1 Å) is shorter than that of Pb-O (2.52 Å), and the coordination number for Sc-O (6.1) and In-O (5.5) is slighter higher than that of Pb-O (5.2). The results of the present study suggest that octahedrally coordinated InO_6 and ScO_6 structures are important to the increase of durability observed for Pb-In-P-O and Pb-Sc-P-O optical glasses.

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1. Summary of paper: *J. Non-Cryst. Solids* **258**, 48 (1999).
2. Japan Atomic Energy Research Institute, Tokai-mura, Japan.
3. Argonne National Laboratory, Argonne, Ill.
4. B. C. Sales and L. A. Boatner, *Science* **226**, 45 (1984); *J. Non-Cryst. Solids* **79**, 83 (1986); *Mater. Lett.* **2**, 301 (1984).
5. B. C. Sales and L. A. Boatner, *J. Am. Ceram. Soc.* **70**, 615 (1987).

FINDING NEW THERMOELECTRIC COMPOUNDS USING CRYSTALLOGRAPHIC DATA: ATOMIC DISPLACEMENT PARAMETERS[1]

B. C. Sales, B. C. Chakoumakos, D. Mandrus, and J. W. Sharp[2]

New bulk thermoelectric compounds are normally discovered with the aid of simple qualitative structure-property relationships. Most good thermoelectric materials are narrow-gap semiconductors composed of heavy elements with similar electronegativities. The crystal structures are usually of high symmetry (cubic, hexagonal, possibly tetragonal) and often contain a large number of atoms per unit cell. In the present work, a new structure-property relationship which links atomic-displacement parameters (ADPs) and the lattice thermal conductivity of clathrate-like compounds is discussed. For many clathrate-like compounds, in which one of the atom-types is weakly bound and "rattles" within its atomic cage, room-temperature ADP information can be used to estimate the room-temperature lattice thermal conductivity, the vibration frequency of the "rattler," and the temperature dependence of the heat capacity. ADPs are reported as part of the crystal structure description, and hence, ADPs represent some of the first information that is known about a new compound. For most ternary and quaternary compounds, all that is known is its crystal structure. ADP information thus provides a useful screening tool for the large and growing crystallographic data bases. Examples of this analysis are presented in Table 1.

Table 1. Comparison between thermodynamic quantities estimated using room-temperature x-ray crystallography data (ADP columns) and the same quantities measured either directly or inferred from another technique.

	$LaFe_4Sb_{12}$		Tl_2SnTe_5		$Ba_8Ga_{16}Ge_{30}$	
	ADP	Other	ADP	Other	ADP	Other
Θ_D(K)	299	305	159	160	275	300
Θ_E(K)	79	80	38	30	51	50
v_s(m/s)	2886	3007	1488	—	2123	—
d(Å)	7.9	9	6.45	—	6.3	—
K_L(w/cm-K)	0.014	0.017	0.004	0.004	0.008	0.020

1. Summary of paper: *J. Solid State Chem.* **146**, 528 (1999).
2. Marlow Industries, Dallas, Tex.

THERMOELECTRIC PROPERTIES OF THALLIUM-FILLED SKUTTERUDITES[1]

B. C. Sales, B. C. Chakoumakos, and D. Mandrus

Crystallographic data, electrical and thermal transport measurements, and heat capacity data are reported for several compounds with the filled skutterudite structure: $Tl_xCo_{4-y}Fe_ySb_{12}$ and $Tl_xCo_4Sb_{12-y}Sn_y$, where $0 < (x,y) < 1$ and $x \approx y$. These materials have potential use for thermoelectric power generation. The Tl atomic displacement parameters (ADPs) are large relative to the other elements in the compounds indicating substantial "rattling" of the Tl about its equilibrium position. A simple analysis of the ADPs and low-temperature heat capacity data indicates an Einstein temperature for the Tl of 53 ± 2 K. The resonant scattering of acoustic phonons by the Tl "rattlers" is believed to be the major cause of a rapid decrease in the lattice thermal conductivity as small amounts of Tl are inserted into the voids of the skutterudite structure. Thermal and electrical transports are investigated as a function of void filling with monovalent Tl and are compared with previous data reported for partial filling with trivalent rare-earth ions. For comparable filling fractions, the Tl compounds had higher electron mobilities and a similar depression of the thermal conductivity. Unlike the rare-earth skutterudites however, within experimental error, there was no evidence of mass-fluctuation scattering, and the minimum thermal conductivity occurred near complete void filling. At elevated temperatures (800 K), the maximum thermoelectric figure of merit, *ZT*, for *n*-type samples is estimated from room-temperature data to be about 0.8 for both Tl- and rare-earth-filled Co_4Sn_{12}.

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1. Summary of paper: *Physical Review B* (in press).

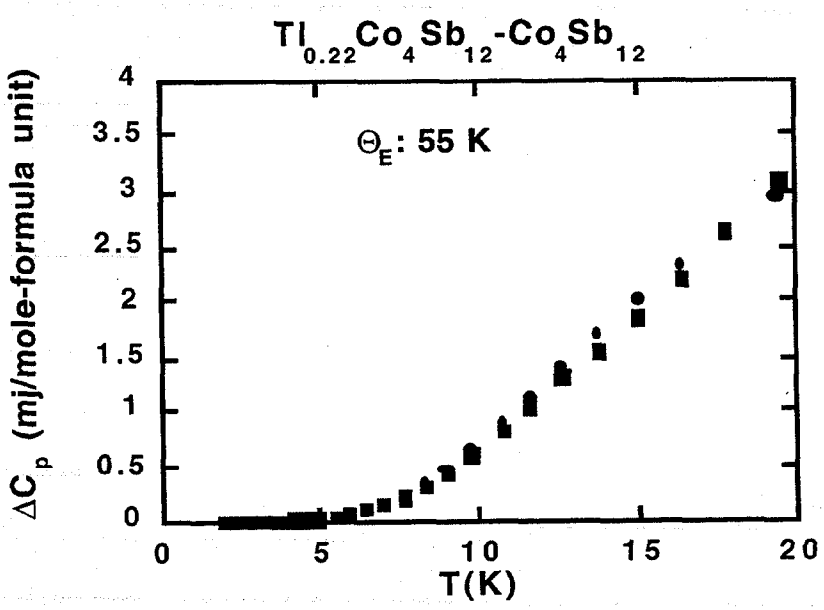

Fig. 1. Difference in heat capacity between a Tl-doped alloy ($Tl_{0.22}Co_4Sb_{12}$) and Co_4Sb_{12}. The Tl contribution to the heat capacity is accurately described by an Einstein contribution with an Einstein temperature of 55 K. Squares are measured data, circles are calculated.

THERMOELECTRIC PROPERTIES OF Tl_2SnTe_5 AND Tl_2GeTe_5[1]

J. W. Sharp,[2] B. C. Sales, D. G. Mandrus, and B. C. Chakoumakos

The thermoelectric effect is used for a wide variety of small-scale cooling applications. In the important temperature range 250–350 K, the best known materials are solid solutions found in the Bi_2Te_3–Sb_2Te_3–Bi_2Se_3 system. Ternary tellurides and antimonides aimed at discovering a material with advanced thermoelectric performance in this temperature range are being explored. The properties of two tellurides selected for study as novel thermoelectric materials are discussed. One of these compounds seems to have a thermoelectric figure of merit comparable to that of *p*-type Bi_2Te_3.

With a few exceptions, most binary compounds that are plausible thermoelectric candidates have been considered. Many ternary compounds have been investigated also, but most of these have been adaptations of binary compounds—with or without a preservation of the overall stoichiometry. For instance, Cu_2GeSe_3 and $CuIn_2Se_4$ are derived from the binary zincblende structure. By contrast, our approach is to investigate the thermoelectric properties of ternary tellurides and antimonides that adopt advantageous and largely unexplored crystal structures. These ternary systems are an opportune field in which to search for crystalline semiconductors that approach the ideal "phonon glass." For Tl_2SnTe_5 the dimensionless thermoelectric figure of merit, $ZT = S^2T/\rho\kappa$, reaches a value of 0.6 at 300 K and peaks at 0.85 at 400 K.

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1. Summary of paper: *Appl. Phys. Lett.* **74**, 3794 (1999).
2. Marlow Industries, Dallas, Tex.

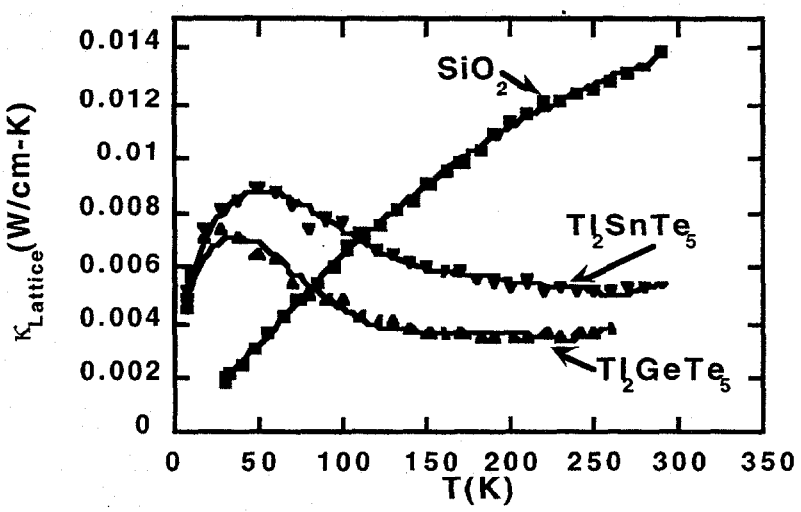

Fig. 1. Lattice thermal conductivity vs. temperature for vitreous silica, Tl_2SnTe_5 and Tl_2GeTe_5. The Wiedemann-Franz law has been used to estimate and subtract the electronic portion of the thermal conductivity. The lines through the data are guides to the eye.

UNUSUAL TRANSPORT AND LARGE DIAMAGNETISM IN THE INTERMETALLIC SEMICONDUCTOR $RuAl_2$[1]

D. Mandrus, V. Keppens,[2] B. C. Sales, and J. L. Sarrao[3]

Unconventional semiconductors such as FeSi, $Ce_3Bi_4Pt_3$, and $LaFe_3CoSb_{12}$[4,5] have attracted attention recently because of both their unusual transport and thermodynamic properties and their potential for thermoelectric applications. Theoretically, many of these materials have also attracted attention—both as hybridization-gap semiconductors and as Kondo insulators. Gap formation in these materials is thought to arise from the hybridization of a narrow band of *f* or *d* electrons with a broad *sp* band. This hybridization gives the valence and conduction bands a strong *f* or *d* character and leads to a sharp structure in the density of states close to the band edges. As pointed out by Mahan and Sofo,[6] narrow peaks in the density of states a few k_BT from the Fermi energy can be beneficial for thermoelectric performance.

Resistivity, thermopower, thermal conductivity, Hall coefficient, and magnetic susceptibility of $RuAl_2$ have been measured over a wide temperature range. Room-temperature sound velocity measurements were also made. It was found that at low temperature, $RuAl_2$ behaves as a low-carrier-density semimetal. As the temperature is raised, excitations across a 0.6-eV pseudogap dominate the transport, and $RuAl_2$ behaves effectively as a semiconductor. The diamagnetic susceptibility of $RuAl_2$ is anomalously large and has an unusual temperature dependence that can be attributed to a Pauli term that reflects underlying structure in the density of states. It is also suggested that the large diamagnetic response is a universal feature of hybridization gap semiconductors. The potential of $RuAl_2$ for thermoelectric applications was evaluated. It was found that even if the lattice component of the thermal conductivity could be reduced to its minimum value, the electrical properties of $RuAl_2$ are not good enough to make it an attractive thermoelectric material.

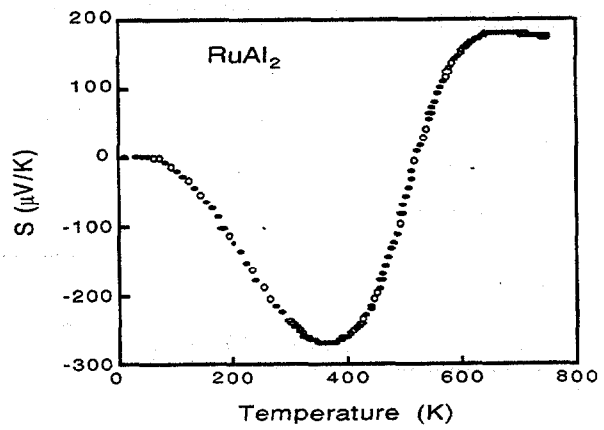

Fig. 1. Seebeck coefficient of $RuAl_2$. The rapid change from a large negative to a large positive thermopower is quite unusual.

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1. Summary of paper: *Phys. Rev. B* **58**, 3712 (1998).
2. ORNL/ORISE postdoctoral research associate. Present address: University of Mississippi, Oxford, Miss.
3. National High Magnetic Field Laboratory, Tallahassee, Fla.
4. B. C. Sales, D. Mandrus, and R. K. Williams, *Science* **272**, 1325 (1996).
5. D. Mandrus et al., *Mat. Res. Soc. Symp. Proc.* **478**, 199 (1997).
6. G. D. Mahan and J. O. Sofo, *Proc. Natl. Acad. Sci. USA* **93**, 7436 (1996).

SPIN GLASS FORMATION IN Co_2RuO_4[1]

D. Mandrus, V. Keppens,[2] and B. C. Chakoumakos

Aside from perovskites and perovskite-related materials, spinels are probably the most heavily studied class of transition-metal oxides. Interest in spinels grew rapidly just after World War II, when Néel explained the magnetism of ferrites[3] and Verwey was studying the metal-insulator transition in Fe_3O_4 that today bears his name.[4] Spinels are at once technologically important and scientifically interesting. In particular, spinel ferrites—good magnetic insulators—are of enormous importance in the electronics industry, and other spinels are important for their catalytic and electrochemical properties.

The magnetic and electronic transport properties of spinels continue to attract interest. As part of a broad-based effort to study electron correlations in oxides containing second- and third-row transition metals, the magnetic properties of the spinel Co_2RuO_4 have been investigated. Neutron diffraction and ac (Fig. 1) and dc magnetic susceptibility measurements on Co_2RuO_4 were made. These measurements show that Co_2RuO_4 undergoes a spin-glass transition at about 16 K. Magnetic susceptibility measurements on $ZnCoRuO_4$, in which Ru^{3+} is the only magnetic ion present, were also made. These measurements indicate that Ru-Ru interactions are weak and that the likely source of frustration in Co_2RuO_4 is the competition between A-A and A-B interactions.

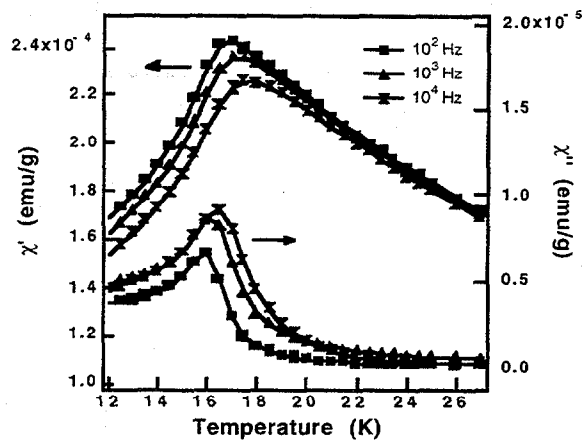

Fig. 1. Real (χ′) and imaginary (χ″) part of the ac susceptibility of Co_2RuO_4 showing archetypal spin-glass behavior.

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1. Summary of paper: *Mater. Res. Bull.* **34**, 1013 (1999).
2. ORNL/ORISE postdoctoral research associate. Present address: University of Mississippi, Oxford, Miss.
3. L. Néel, *Ann. Phys., Paris* **3**, 137 (1948).
4. E. J. W. Verwey, P. W. Haayman, and F. C. Romeijn, *J. Chem. Phys.* **15**, 174 (1947).

LOCALIZED VIBRATIONAL MODES IN METALLIC SOLIDS[1]

V. Keppens,[2] D. Mandrus, B. C. Sales, B. C. Chakoumakos, P. Dai, R. Coldea,[3] M. B. Maple,[4] D. A. Gajewski,[4] E. J. Freeman,[4] and S. Bennington[5]

Filled skutterudite antimonides are cubic compounds with the formula RM_4Sb_{12}, where R is a rare-earth element (such as La or Ce) and M is a transition metal (such as Fe or Co). The rare-earth ion is weakly bound in an oversized atomic cage formed by the other atoms. Its presence has been shown to cause a dramatic reduction in the lattice component of the thermal conductivity, while having little effect on the electronic properties of the compound. This combination of properties makes filled skutterudites of interest as thermoelectric materials. It has been suggested that localized, incoherent vibrations of the rare-earth ion are responsible for the reduction in thermal conductivity, but no direct evidence for these local vibrational modes exists. An observation of local modes in La-filled skutterudites, using heat capacity, elastic constant, and inelastic neutron scattering measurements (Fig. 1) has been made. The La atoms show unusual thermodynamic behavior, characterized by the presence of two low-energy localized modes. Our results suggest that consideration of local modes will play an important role in the design of the next generation of thermoelectric materials.

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1. Summary of paper: *Nature* **395**, 876 (1998).
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5. Rutherford Appleton Laboratory, Chilton, United Kingdom.

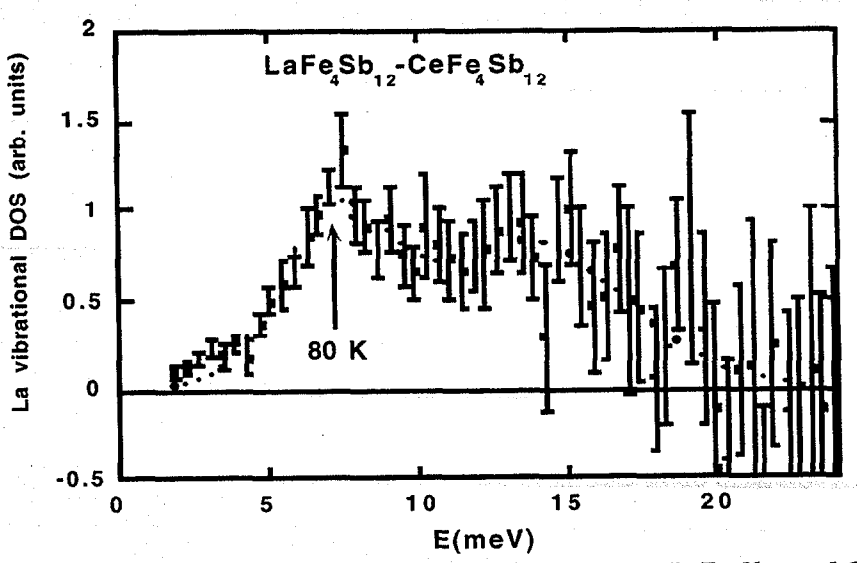

Fig. 1. Difference in the inelastic neutron scattering between $LaFe_4Sb_{12}$ and $CeFe_4Sb_{12}$ vs. energy loss. The incident neutron energy was 30 meV, and the energy resolution was ~2 meV. $CeFe_4Sb_{12}$ was used as a reference because the neutron scattering cross-section of Ce is much smaller than that of La. The difference spectra therefore reflect the vibrational density of states (DOS) associated with the La atoms. The peaks at 7 and 15 meV correspond to temperatures of 80 and 175 K, respectively.

DIELECTRIC FUNCTIONS OF UNIAXIAL CRYSTALS DETERMINED USING TWO-MODULATOR GENERALIZED ELLIPSOMETRY[1]

G. E. Jellison, Jr., F. A. Modine, J. O. Ramey, and L. A. Boatner

The dielectric functions [$\varepsilon(E) = \varepsilon_1(E) + i\varepsilon_2(E)$] of crystalline materials are very important characteristics of the material. From a fundamental point of view, the values of $\varepsilon(E)$ give the positions of critical points in the band structure. Practically, accurate values of $\varepsilon(E)$ are necessary for the interpretation of many experiments such as spectroscopic ellipsometry. Isotropic materials require only a single complex function $\varepsilon(E)$ to describe its optical response, but uniaxial materials require two functions, $\varepsilon_o(E)$ and $\varepsilon_e(E)$, and two angles, θ and ϕ, to specify their optical response. Until recently, the measurement of $\varepsilon_o(E)$ and $\varepsilon_e(E)$ has been very difficult, particularly for energies above the optical band gap.

Recently, a two-modulator generalized ellipsometer[2] (2-MGE), which is capable of measuring all the traditional ellipsometry parameters, as well as the cross-polarization ellipsometry parameters, has been developed. These additional measured parameters can be used to determine directly both $\varepsilon_o(E)$ and $\varepsilon_e(E)$ from a single measurement—once the effects of surface roughness are taken into account.

A 2-MGE has been used to determine the uniaxial optical functions of three materials: rutile (TiO_2), zinc oxide (ZnO), and bismuth tri-iodide (BiI_3), shown in Fig. 1. The measured values of $\varepsilon_o(E)$ and $\varepsilon_e(E)$ compare very well with other published data below the band gap. Above the band gap, the values of $\varepsilon_o(\lambda)$ and $\varepsilon_e(\lambda)$ determined from 2-MGE have error limits of 0.5–1.0% and, therefore, are the most accurate available.

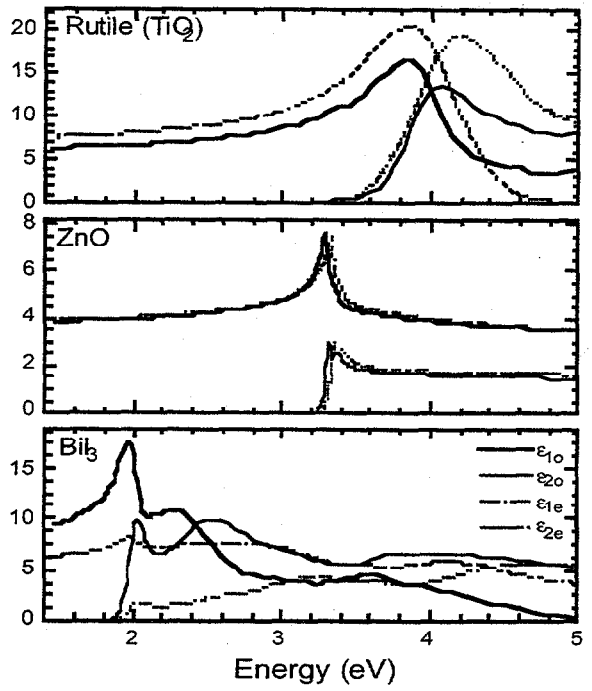

Fig. 1. The complex dielectric functions for three uniaxial materials: TiO_2, ZnO, and BiI_3.

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1. Summary of papers: *Opt. Lett.* **22**, 1808 (1997); *Phys. Rev. B* **58**, 3586 (1998); *Phys. Rev. B* **59**, 9718 (1999).
2. G. E. Jellison, Jr., and F. A. Modine, *Appl. Opt.* **36**, 8184 (1997); *ibid.* **36**, 8190 (1997).

RADIATION EFFECTS IN ZIRCON, HAFNON, AND THORITE[1]

A. Meldrum,[2] S. J. Zinkle,[3] L. A. Boatner, and R. C. Ewing[4]

The effects of heavy-ion irradiation on the isostructural orthosilicates zircon ($ZrSiO_4$), hafnon ($HfSiO_4$), and thorite ($ThSiO_4$) are important because these minerals are under active investigation for use as a waste form for plutonium-239. Accordingly, irradiation-induced alterations of zircon, hafnon, and thorite have been investigated.

Pure synthetic zircon, hafnon, and thorite crystals were irradiated with 800-keV Kr^+ ions in situ in a transmission electron microscope. All the materials were amorphized at temperatures up to 900 K. At low doses, disordered regions ~3 nm in diameter, corresponding to individual damage cascades, were observed by high-resolution microscopy. At higher doses, the materials gradually became amorphous, as determined by electron-diffraction. The amorphization dose was observed to increase in two stages as a function of temperature (Fig. 1), consistent with previous experiments on zircon and α-alumina.

When increasing the temperature to 950 K (zircon) and ~1000 K (hafnon), a new effect was observed. Above these temperatures, the material decomposed under irradiation into the component oxides: tetragonal ZrO_2 or HfO_2 + amorphous SiO_2. At 300 K, zircon was amorphized at 0.3 d.p.a., but at 1050 K, zircon and hafnon decomposed directly into their component oxides. In contrast, ThO_2 did not precipitate in the displacement cascades of crystalline thorite at these temperatures.

These experiments show that the phase decomposition of zircon and hafnon into their component oxides is nucleated through the effects of the ion irradiation. This has important ramifications in situations where these materials may be exposed to irradiation, particularly at elevated temperatures. For example, the present results imply that a Pu-loaded zircon waste form should be maintained at temperatures well below the phase decomposition temperature in order to avoid the redistribution of Pu and its daughter products between the component oxides. On the basis of the results shown in Fig. 1, there is a temperature "window" between approximately 700 and 900 K in which a Pu-doped zircon waste form will neither amorphize nor undergo phase decomposition.

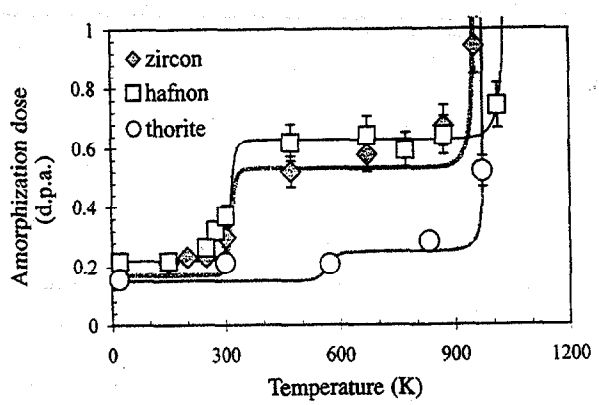

Fig. 1. Critical amorphization dose as a function of temperature for zircon, hafnon, and thorite. The lines were obtained by solving an amorphization/recrystallization model.[1]

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1. Summary of papers: *Nature* **395**, 56 (1998); *Phys. Rev. B* **59**, 3981 (1999).
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Superconductivity

HIGH-PERFORMANCE $YBa_2Cu_3O_7$ COATINGS FOR NEXT-GENERATION SUPERCONDUCTING WIRES[1]

R. Feenstra, D. T. Verebelyi,[2] M. Paranthaman,[3] A. Goyal,[4] D. F. Lee,[4] and D. K. Christen

Recent promising developments of coated conductors for high-temperature superconducting (HTSc) wire applications have created a need for robust and simplified processes for the deposition of $YBa_2Cu_3O_7$ (YBCO) superconducting layers. YBCO is the HTSc material of choice for coated conductors because of its intrinsically superior flux-pinning properties in magnetic fields at liquid nitrogen temperatures. A method for the fabrication of YBCO thick coatings that is based upon findings of earlier basic research studies of YBCO thin films has been developed.[5]

In this approach, the film deposition step is separate from the YBCO-formation step. For the scale-up of coated conductors, this two-step process offers several advantages over single-step in situ techniques. In the two-step process, deposition of the precursor coating, composed of yttrium, copper, and BaF_2, can occur at arbitrarily high rates, at ambient temperature, and without the need of a controlled oxygen source. Because of the chemical stability of BaF_2, the precursor-coated tapes are robust against handling prior to the subsequent reaction heat treatment where YBCO is formed in the controlled oxygen/water-vapor environment of a processing furnace.

The transfer of this technique to metal tape substrates first required the development of a compatible oxide buffer-layer architecture. Such layers were obtained using a combination of vapor deposition techniques and are illustrated schematically in Fig 1.

While only short segments of coated conductors have been demonstrated so far, the conversion processing is potentially scalable to a large-volume, batch mode. Results of superconducting electrical transport properties are shown in Fig. 1. Compared with established benchmark systems, these coatings exhibit excellent critical current densities in large magnetic fields at 77 K, providing performance proof-of-principle for further development.

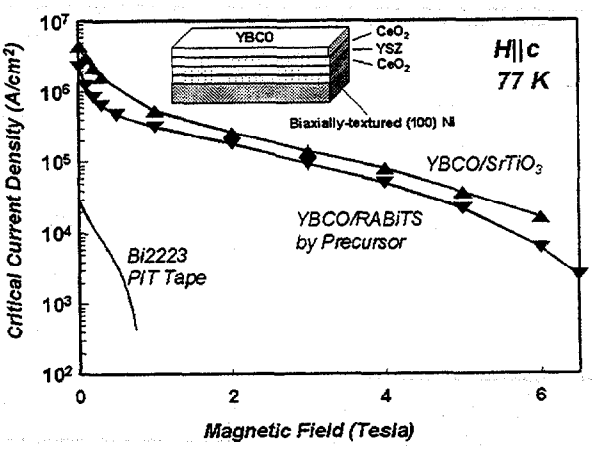

Fig. 1. Critical current density (J_c) in magnetic fields at 77 K. Data are compared for a coated conductor segment, a high-J_c YBCO film on single crystal $SrTiO_3$, and for a first-generation-HTSc Bi-based, powder-in-tube processed tape.

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1. Summary of paper to be published.
2. ORNL/ORISE postdoctoral research associate.
3. Chemical and Analytical Sciences Division, ORNL.
4. Metals and Ceramics Division, ORNL.
5. R. Feenstra et al., *J. Appl. Phys.* **69**, 6569 (1991).

GROWTH AND SUPERCONDUCTING PROPERTIES OF $YBa_2Cu_3O_7$ FILMS ON CONDUCTIVE $SrRuO_3$ AND $LaNiO_3$ MULTILAYERS FOR COATED CONDUCTOR APPLICATIONS[1]

T. Aytug,[2] J. Z. Wu,[3] C. Cantoni,[4] D. T. Verebelyi,[4] E. D. Specht,[5] M. Paranthaman,[6] A. Goyal,[5] D. P. Norton, and D. K. Christen

In recent years, thin films of conductive $SrRuO_3$ (SRO) and $LaNiO_3$ (LNO) oxides have attracted considerable interest because of their potential for many technological applications. Recently, the development of rolling-assisted biaxially textured substrates (RABiTS) emerged as a promising method for the fabrication of $YBa_2Cu_3O_7$ (YBCO)-based coated conductors. The key issue in the RABiTS approach is the necessity to use buffer-layer structures that prevent the diffusion of Ni into the superconductor and provide an epitaxial template for the HTSc layer. To date, various insulating-oxide buffer layers have been investigated. However, conductive-oxide buffer layers are particularly important for electric power applications of HTSc materials, because they provide a metallic contact between the HTSc layer and the metal substrate, thereby improving electrical stability.

Because SRO is known to be compatible with YBCO and LNO is compatible with RABiTS, a comparative study of the structural and superconducting properties of YBCO films grown on multilayers of SRO-LNO-buffered $LaAlO_3$ (LAO) and $SrTiO_3$ (STO) substrates has been made. All YBCO films grown on SRO and LNO buffers showed excellent structural and superconducting properties. The results of measurements of the magnetic field dependence of the critical current density (J_c) of these samples, as shown in Fig. 1, indicate consistently high J_c performance for samples on SRO layers. The results also suggest possible Ni contamination of YBCO through the LNO layers, while indicating the prevention of this contamination by an additional, highly stable SRO layer. This work points to the use of an SRO/LNO structure as an alternative buffer layer architecture for the development of RABiTS-based, fully conductive YBCO coated conductors.

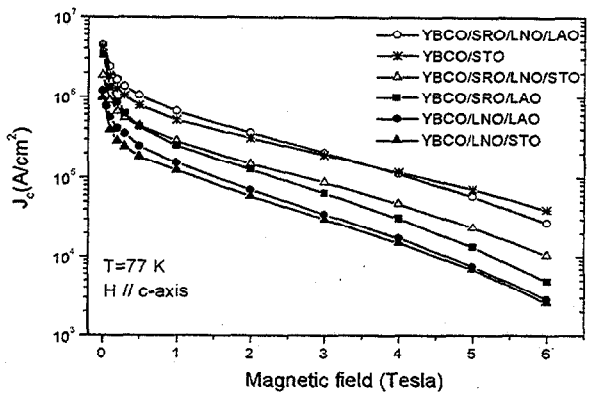

Fig. 1. Magnetic field dependence of J_c for YBCO films grown on multilayers of SRO/LNO-buffered single-crystal substrates at 77 K. Data are compared with a high-J_c YBCO film on single-crystal $SrTiO_3$.

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1. Summary of paper to be published.
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DEVELOPMENT OF EPITAXIAL $Nd_{1+x}Ba_{2-x}Cu_3O_y$ THIN FILMS GROWN ON $LaAlO_3$ AND Ni METAL SUBSTRATES BY PULSED-LASER DEPOSITION[1]

C. Cantoni,[2] D. P. Norton, D. K. Christen, A. Goyal,[3] D. M. Kroeger,[3] D. T. Verebelyi,[2] and M. Paranthaman[4]

Among the *RE*-Ba-Cu-O (*RE* = light rare-earth element) compounds, bulk samples of $NdBa_2Cu_3O_{7-\delta}$ (NdBCO) have shown high transition temperatures, $T_c \sim 96$ K and enhanced flux pinning in high magnetic fields.[5] As an alternative to YBCO, these properties make NdBCO a candidate for applications in coated conductor technology. The Nd-Ba-Cu-O phase is characterized by the existence of the solid solution $Nd_{1+x}Ba_{2-x}Cu_3O_y$, in which very small amounts of Nd substitutions on the Ba site ($x < 0.1$) considerably suppress T_c.[6] It was found that the stability line that gives the values of temperature and oxygen partial pressure for optimal NdBCO film deposition is shifted to a lower oxygen pressure region of the 1/T-log [$P(O_2)$] phase diagram compared with the YBCO stability line. Optimal NdBCO films having $T_{c0} = 93$ K and J_c(0 T, 77 K) = 3 MA/cm^2 are grown when the oxygen partial pressure is about two orders of magnitude lower (i.e., $P(O_2) = 0.8 - 1$ mTorr) than the values typically used for YBCO. The structural, morphological, and transport properties of NdBCO films deposited on $LaAlO_3$ substrates and rolling-assisted biaxially textured substrates (RABiTS) were studied. Figure 1 shows a comparison between J_c vs. applied magnetic field data obtained for NdBCO films on YSZ/CeO_2/Ni, NdBCO films on $LaAlO_3$, and YBCO films on $LaAlO_3$, measured at 77 K. Optimal YBCO and NdBCO films on $LaAlO_3$ show very similar J_c(H) curves. However, NdBCO films appear to carry a slightly higher current than YBCO films at high magnetic fields and show a higher irreversibility field. For the NdBCO films grown on YSZ/CeO_2/Ni, J_c(H = 0) is reduced to the value 270 kA/cm^2. However, J_c is less sensitive to field than for the films on single crystals, and the irreversibility field is higher ($H_{irr} \approx 8$ T). Electron diffraction analysis of NdBCO films on RABiTS revealed dense morphology and macroscopic percolation paths formed by grain boundaries of less than 3°.

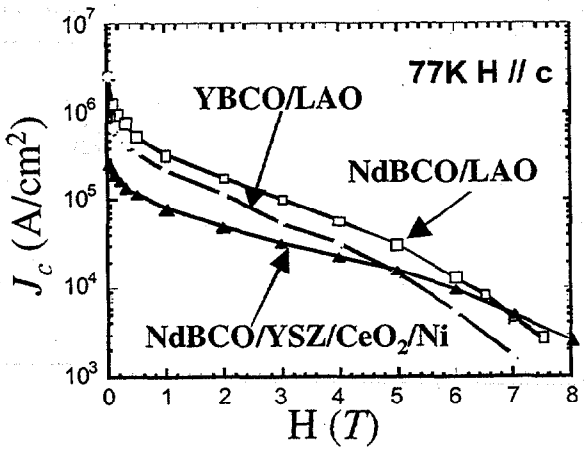

Fig. 1. J_c vs. H (77 K) for NdBCO films on LAO and RABiTS and YBCO on LAO.

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1. Summary of paper: *Physica C* (in press).
2. ORNL/ORISE postdoctoral research associate.
3. Metals and Ceramic Division, ORNL.
4. Chemical and Analytical Sciences Division, ORNL.
5. M. R. Koblischka et al., *Phys. Rev. B* **58**, 2863 (1998).
6. K. Takita et al., *Jpn. J. Appl. Phys.* **27**, L67 (1988).

$YBa_2Cu_3O_7$ GRAIN BOUNDARIES IN LARGE MAGNETIC FIELDS

D. T. Verebelyi,[1] R. Feenstra, C. Cantoni,[1] and D. K. Christen

Second-generation superconducting wires consist of an epitaxial film deposited on a textured, buffered metallic tape. These "coated conductors" are based on a substrate that is polycrystalline but contains grains that are very well-aligned. In fact, grain boundary (GB) misorientations of only a few degrees are typical.[2] At high angles, previous results[3] indicate an exponential dependence on the critical current density (J_c). However, limited data in the literature have allowed large discrepancies to exist for the low-angle grain boundary (LAGB) regime.

Our approach uses $SrTiO_3$ bicrystals as a template for producing single YBCO [001]-tilt boundaries. The GB system has been investigated through analyses of the V-J relationship in a magnetic field where characteristic tunneling behavior is easily observed. This method, when combined with a current larger than J_c^{GRAIN}, allows for simultaneous measurement of dissipation of the GB and surrounding grains.

Figure 1 shows the 77-K field dependence of J_c for several single GBs up to their irreversibility field.[4] Three regimes are defined by characteristic transport behavior: the first ($\theta < 3°$) exhibits nonlinear, grain-like V-J behavior, with decreasing J_c as θ increases because of excessive GB disorder; tunneling occurs in the second regime ($3° < \theta < 24°$) across a near-metallic barrier which produces V-J curves characterized by non-ohmic, linear differential behavior (excess current); in the third regime ($\theta > 24°$), the GB is sufficiently disordered to produce classic Josephson tunneling which can be described by the resistively shunted junction model.

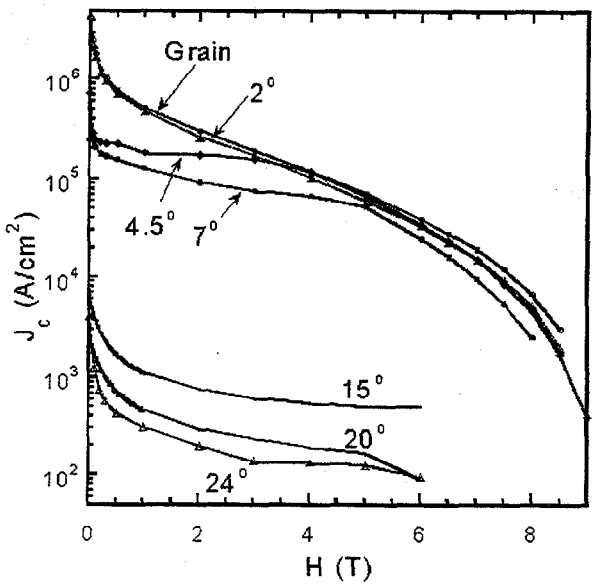

Fig. 1. J_c vs. H (77 K) for several YBCO single (001)-tilt boundaries.

To summarize, for LAGBs, a 2° GB contributes no observable dissipation as compared with a grain, while the effects of tunneling are illustrated by 4.5° and 7° GBs. Note that the GBs in the tunneling regime have lower J_c's than their adjacent grains because of a reduction in strongly coupled material available for transport, but the GB field dependence leads to grain-limited J_c's at high field.

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1. ORNL/ORISE postdoctoral research associate.
2. A. Goyal et al., *J. Met.* **51**, 19 (1999).
3. Z. Ivanov et al., *Appl. Phys. Lett.* **59**, 3030 (1991).
4. D. Verebelyi et al., *IEEE Trans. Appl. Supercond.* **9**, 2655 (1999).

ALTERNATING TRANSPORT CURRENT FLOW IN SUPERCONDUCTIVE FILMS—THE ROLE OF A GEOMETRICAL BARRIER TO VORTEX MOTION[1]

H. R. Kerchner, D. P. Norton, A. Goyal,[2] J. D. Budai, D. K. Christen, D. M. Kroeger,[2] M. Paranthaman,[3] D. F. Lee,[2] F. A. List,[2] R Feenstra, and E. H. Brandt[4]

$YBa_2Cu_3O_{7-\delta}$ films grown on both $SrTiO_3$ single crystal and rolling-assisted biaxially textured (Ni) substrates (RABiTS) carry high critical current densities, J_c. A geometrical barrier to vortex motion raises the apparent J_c but also increases the power loss associated with ac transport current through such tapes above that expected from W. T. Norris' 1970 theory of hysteretic energy loss. Present theoretical estimates of the geometrical barrier have insufficient magnitude to account for our observations at low ac current levels. Evidence is reported that the ferromagnetic Ni substrate makes no significant contribution to the tape self-field loss. Loss is enhanced, and J_c is modestly reduced by the presence of low-angle grain boundaries. Application of a dc magnetic field further lowers J_c and raises loss in the films.

Figure 1 shows the power loss in the superconducting RABiTS tape as a function of the spatially root-mean-square current density $\langle J_{rms}\rangle = I_0/2^{3/2}ad$ due to transport I_0 through $YBa_2Cu_3O_{7-\delta}$ films of thickness d and width $2a$ on $SrTiO_3$ and RABiTS with no magnetic field applied. The solid lines are based on Norris' theory; the dotted lines include edge currents that peak at $J_e = 2H_{c1}/d$; and the dashed lines include larger edge currents $I_e = 0.8$ A. The larger edge currents better fit the loss data but it has been impossible to justify them theoretically.

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1. Summary of paper: *Phys. Rev. B* **60**, 6878 (1999).
2. Metals and Ceramics Division, ORNL.
3. Chemical and Analytical Sciences Division, ORNL.
4. Max Planck Institut für Metalforschung, Stuttgart, Germany.

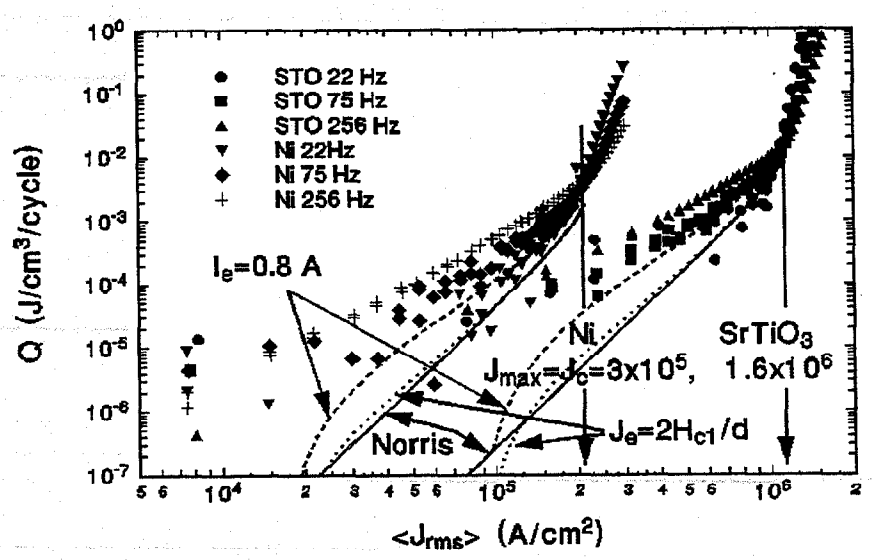

Fig. 1. Electrical energy loss Q per cycle per unit volume from the average ac current densities $\langle J_{rms}\rangle$.

NONLOCAL ELECTRODYNAMICS IN A YNi_2B_2C SUPERCONDUCTOR[1]

J. R. Thompson,[2] K. J. Song,[3] M. Yethiraj, D. Mandrus, D. K. Christen, C. V. Tomy,[4] and D. McK. Paul[4]

A nonlocal relation between the microscopic super-current density j and the field (vector potential A) is an old idea. Only recently, however, have theory, materials, and experimental methods converged in a clear demonstration of the importance of nonlocality in high-κ superconductors. Nonlocality becomes significant when the electronic mean-free path is long relative to the coherence length ξ. Nonlocality qualitatively changes the magnetization of borocarbide superconductors and profoundly changes the symmetry of the flux lattice.

Conventional London theory has been very useful because it is valid at all temperatures. The standard theory provides a logarithmic dependence of the equilibrium magnetization M and the magnetic field H, with $M(H) \sim (1/\lambda^2) \times \ln(H_{c2}/H)$ having two length scales, ξ and the London penetration depth λ. Recently, London theory was extended to incorporate nonlocal effects, introducing a third length scale, ρ. Their differing temperature dependencies mean that for clean materials, the nonlocal form reduces to the local expression as T approaches T_c; it contains the standard form as a special case. Thus, the nonlocal theory predicts that the "clean" equilibrium magnetization should vary logarithmically near T_c, but it progressively deviates from this dependence at low temperatures.

Experimental results for M versus $\log(H)$ are shown in Fig. 1 for a single crystal of YNi_2B_2C. Near T_c (14.6 K), the linear response corresponds to local London behavior, as expected. Well below

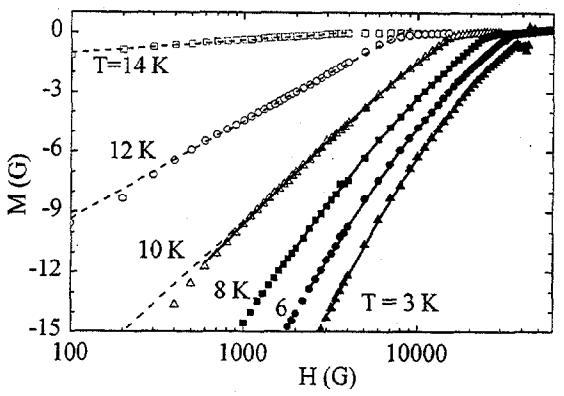

Fig. 1. The equilibrium magnetization M versus magnetic field H, with H || c-axis for single-crystal YNi_2B_2C. Solid lines are fitted to non-local London theory; dotted lines show the standard theory.

T_c, the significant curvature reflects strong effects of nonlocality with the solid lines fitted to the nonlocal theory. Not only does the theory give an excellent description of the experiment, but also the resulting parameters (λ, ρ, and ξ) are well behaved. This and complementary studies of both the heat capacity and the angular response of M show that nonlocality can strongly influence these high-κ materials.

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1. Summary of paper: *Phys. Rev. B* **59**, R6620 (1999).
2. Adjunct research and development participant from The University of Tennessee, Knoxville, Tenn.
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Thin-Film Batteries & Solid Electrolytes

NANOCRYSTALLINE $Li_xMn_{2-y}O_4$ THIN FILMS[1]

N. J. Dudney, J. B. Bates,[2] R. A. Zuhr, J. D. Robertson,[3] and S. A. Hackney[4]

Thin films of lithium manganese oxides are extremely sensitive to processing conditions because of the large number of possible spinel and related compounds. Films deposited by rf magnetron sputtering onto unheated substrates are dense and at least partially nanocrystalline (*n*), having a spinel structure. A dense, fine-grained microstructure with good transport properties was achieved at low gas pressures and low deposition temperatures where both gas scattering and surface diffusion effects are reduced. The film composition, though always Mn-deficient relative to the composition of the sputter target, varied with the rate of deposition and the process gas mixture and pressure.

Despite varying compositions, when the films are incorporated as the cathode in an all solid state thin-film battery with a Li anode, the lithium insertion reactions of $nLi_xMn_{2-y}O_4$ were found to be reversible over a wide composition range and reproducible from film to film. These batteries can be fabricated onto low-temperature substrates, such as polymers, and they have important low-power applications such as backup power sources for complementary metal oxide semiconductor (CMOS) devices.

Upon prolonged cycling of batteries with the $nLi_xMn_{2-y}O_4$ cathode, electrochemical and x-ray diffraction results indicate an increase in the crystallinity. As illustrated in Fig. 1, this is observed as a gradual increase in the battery capacity near 4 V. The recrystallization is promoted by repeated insertion and extraction of Li^+ ions and does not appear to occur to the same extent upon passive storage of the cell.

Measurements of the potential of Li-$nLi_xMn_{2-y}O_4$ cells reveal a true hysteresis in the charge-discharge reactions. This was verified by observing the relaxation of the cathode potentials as a function of the lithium composition at several different temperatures. Such a hysteresis is the general behavior for a number of thin-film amorphous (*a*) or nanocrystalline Li insertion electrode materials, including aV_2O_5 and *a*Siton.[5] Models based on free-energy composition diagrams demonstrate that the hysteresis may be attributed to a nonequilibrium transition between two nonstoichiometric phases. Although the structural basis for the transition is not known, it may be related to the change in the volume or crystalline order of the ~50-Å nanocrystals within a more disordered matrix.

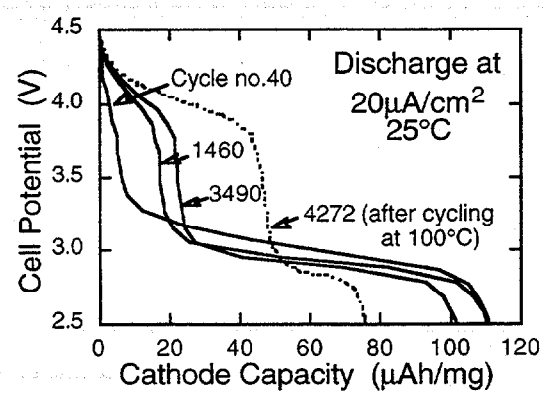

Fig. 1. Cell potential for a lithium-$nLi_xMn_{2-y}O_4$ thin-film battery vs. the lithium capacity of the cathode for selected discharge cycles.

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1. Summary of papers: *J. Electrochem. Soc.* **146**, 2455 (1999); *Ceramic Transactions* (in press); to be published.
2. Present address: Excellatron Corporation, Smyrna, Ga.
3. University of Kentucky, Lexington, Ky.
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5. B. J. Neudecker, R. A. Zuhr, and J. B. Bates, "Li-Ion Thin-Film Batteries with Nitrided Anodes," this report.

"Li-FREE" THIN-FILM BATTERY WITH IN SITU PLATED Li ANODE[1]

B. J. Neudecker, N. J. Dudney, and J. B. Bates[2]

Attempts to manufacture Li batteries free of a metallic Li anode have generally failed. Such an initially "Li-free" battery configuration relies on successful electrochemical plating and stripping of Li at the surface of the anode current collector, as illustrated in Fig. 1. In batteries with a liquid or polymer electrolyte, the electrodeposited Li generally develops an unacceptable dendritic or "mossy" morphology. With an inorganic solid electrolyte such as Lipon, a dense Li layer forms. However, to achieve a battery which maintains a high capacity for many cycles, the addition of an overlayer, as shown in Fig. 1, is imperative.

Scanning electron microscopy studies in the absence of the overlayer revealed that Li first diffused into and through the Cu anode current collector and then reacted with gas impurities in the Ar glove box at the backside of the Cu anode current collector. These two thermodynamically favored processes resulted in a severe, proportional capacity loss of the battery (Fig. 2).

By adding an overlayer to the standard thin-film cell configuration (Fig. 1), the chemical diffusion of Li on top of the Cu anode current collector was blocked. Thus, the electroplated Li is completely encapsulated in a protective micro-chamber formed by the gas-tight overlayer and the gas-tight, glassy Lipon electrolyte. As a result, the so-called Li-free thin-film battery showed a small capacity fade over 1000 cycles of about 20–26%, whereas batteries without such an overlayer suffered from an unacceptable capacity loss after 5 cycles (Fig. 2). Thin-film batteries have been fabricated in which up to 1 mm of Li has reversibly been plated and stripped, thus also demonstrating the high mechanical flexibility of a ceramic Lipon overlayer. Among other advantages over thin-film batteries with as-fabricated metallic Li anodes, Li-free thin-film batteries survive solder reflow conditions (250°C in air) used to assemble electronic circuit boards or could directly be deposited onto Si wafers, avoiding possible contamination during the vapor deposition of metallic Li.

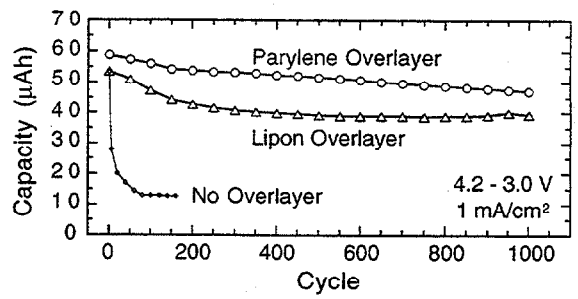

Fig. 2. Cycle stability of Li-free thin-film batteries with 1-mm × 1-cm² $LiCoO_2$ cathodes.

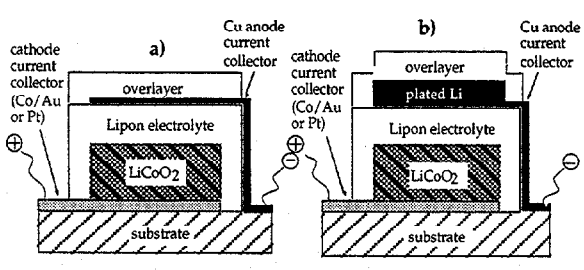

Fig. 1. Li-free thin-film battery (a) prior to operation or at the end of discharge and (b) during operation.

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1. Summary of paper: *Journal of the Electrochemical Society* (in press).
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Li-ION THIN-FILM BATTERIES WITH NITRIDED ANODES[1]

B. J. Neudecker, R. A. Zuhr, and J. B. Bates[2]

In Li-ion batteries, the metallic Li anode is replaced by insertion materials that, upon electrochemical lithiation by the positive cathode during the initial charge, form anodes with potentials close to metallic Li. At ORNL, new nitrided insertion anodes, such as silicon tin oxynitride ("SiTON"),[1] SnN_x ($x \leq 1.33$), InN_x ($x \leq 1$), and $ZnN_{0.67}$ have been developed. Because thin-film batteries configured with one of these anodes, a Lipon electrolyte, and a $LiCoO_2$ cathode can survive 250°C in air for a few minutes, they can be attached to electronic circuit boards using the solder reflow process or surface mount technique.

As lithium is inserted into these anodes during the initial charge of the Li-ion battery, the valence state of M (M = Si, Sn, In, or Zn) is gradually reduced under the concurrent formation of the nanocrystalline Li_3N and/or Li_2O matrix. At the end of charge, the anode consists technically of an electroactive, nanocrystalline Li_yM phase, a nanocrystalline Li_3N and/or Li_2O matrix, and a precipitated electroactive Li if the Li_yM has become supersaturated. In lithiated SiTON however, some of the Si and/or Sn are part of the matrix whose exact stoichiometry has not been determined.

Formation of the matrix irreversibly consumes lithium that is exclusively supplied by the heaviest and most voluminous component of the Li-ion cell, the $LiCoO_2$ cathode. Thus, the matrix formation results in a severe, irreversible capacity loss of the Li-ion battery (Table 1). To combat this capacity loss, two strategies have successfully been applied. First, using subnitride anodes, in which M is initially not in its maximum valence state, requires less matrix formation per M, thereby significantly decreasing the capacity loss (Table 1). Unfortunately, anodes merely consisting of M are not practical because they typically show very poor cycle stabilities. Second, supersaturating nitrided anodes with Li in "cathode-heavy" cells dramatically reduces the inherent capacity loss and, in addition, proves to be highly reversible over thousands of electrochemical cycles. Taking this idea of supersaturating the anode with Li to an extreme, the insertion anode material was omitted altogether. This led to the development of our "Li-free" thin-film batteries which have an inherent anode capacity loss near zero.

Table 1. Inherent Capacity Loss of Anodes

Anode Material	*Capacity Loss*
SiTON	46%
$ZnN_{0.67}$	43%
InN	42%
$InN_{0.44}$	23%
$SnN_{1.33}$	49%
$SnN_{0.48}$	19%

1. Summary of papers: *J. Power Sources* **81–82**, 27 (1999); to be published.
2. Present address: Excellatron Corporation, Smyrna, Ga.

CRYSTALLINE PHASES IN LITHIUM MANGANESE OXIDE THIN FILMS[1]

N. J. Dudney, A. Ueda,[2] J. B. Bates,[3] R. A. Zuhr, and M. Croft[4]

Crystalline $LiMn_2O_4$ is an attractive material for use in rechargeable lithium batteries. When deposited as a thin film, the stoichiometry, microstructure, and phase composition following crystallization at high temperatures depend on the processing conditions used for sputter deposition. When corroborated by x-ray diffraction and chemical analysis, measurements of the chemical potential of lithium in the films as a function of the lithium concentration provide the most sensitive probe of the phase composition. This is accomplished by fabricating and cycling a thin-film Li/Lipon/$Li_xMn_{2-y}O_4$ cell. Figure 1 shows the cell potential measured for several lithium manganese oxide cathode films between 3 and 5.3 V (1 μAh = 37 nmoles Li).

The upper section of Fig. 1 shows the cell potential of an undoped $Li_xMn_{2-y}O_4$ film. A cell potential near 4 V is attributed to insertion or removal of Li from the tetrahedral 8a sites of the spinel lattice, accompanied by a change in the Mn III/IV oxidation states. Films deposited at lower deposition rates and higher oxygen pressures (dashed line) are increasingly Mn-deficient (higher *y*) and have a significant capacity at 4.6 V which is attributed to the presence of an additional phase, Li_2MnO_3.

The lower section of Fig. 1 shows the cell potential for a Mn-"doped" film for which the capacity near 5 V is almost eliminated. This proves that the Li removal associated with the 5-V potential requires either oxidation of Mn beyond the IV state or oxidation of other species in the cathode or current collector. Recent observations of the chemical shift of the Mn-K edge by x-ray absorption spectroscopy[3] support the continued donation of the Li electron to the Mn-d orbitals at potentials >4.5 V.

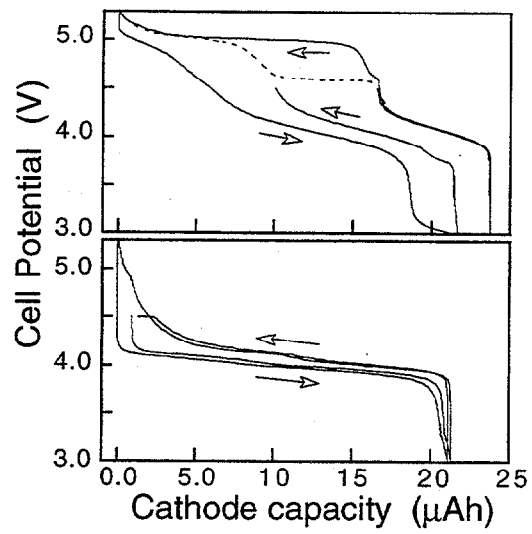

Fig. 1. Electrochemical potential of Li/ $Li_xMn_{2-y}O_4$ thin-film cells upon slow (2-μA/cm²) insertion and removal of Li.

Continued cycling of Li in the films to 5.3 V leads to an overall decreased capacity, particularly above 4.5 V. This is attributed to a gradual decrease in the crystallinity of the film. In an attempt to stabilize the capacity above 4.5 V, films were doped with a variety of transition metals at nominally 10% of the Mn concentration. Only Ni was found to be effective.

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1. Summary of papers: in *Lithium Batteries*, Vol. 98-16, ed. by S. Surampudi and R. A. Marsh, The Electrochemical Society, Pennington, N.J. (in press); *Physical Review B* (in press); to be published.
2. ORNL/ORISE postdoctoral research associate. Present address: Hitachi Maxell Corporation, Osaka, Japan.
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PREFERRED ORIENTATION OF POLYCRYSTALLINE $LiCoO_2$ FILMS[1]

J. B. Bates,[2] F. X. Hart,[3] N. J. Dudney, and S. A. Hackney[4]

Crystalline $LiCoO_2$, widely used as the cathode in rechargeable lithium batteries, has a hexagonal layered structure with alternating layers containing Co and Li separated by close-packed oxygen layers. Polycrystalline films deposited by rf magnetron sputtering exhibit a strong preferred orientation or texturing after annealing at 700°C. For films 1- to 4-μm thick, few if any grains are oriented with their (003) planes parallel to the substrate. As shown recently by lattice model calculations of the elastic constants and strain energy densities for $LiCoO_2$, extremes in texturing were caused by a tendency to minimize the volume strain energy. Results show that the energy to stretch or compress the lattice along the c direction is smaller than in directions perpendicular to c (i.e., $C_{33} < C_{11} = C_{22}$). From the results shown in Table 1, it can be seen that the order of the percentage of grain orientations determined from x-ray diffraction analysis follows roughly the order of the calculated volume strain energies.

For thinner films, the surface energy usually is more important than the volume strain energy in determining the preferred orientation of the films, and, in fact, films 0.05-μm thick were strongly oriented with the (003) planes of all grains parallel to the surface.

In addition to the film thickness, the substrate temperature during film growth was the only process condition found to alter the film texture. Films deposited at temperatures of 200 to 300°C had a higher percentage of (003)-oriented grains compared with those deposited at lower temperatures.

Although, as illustrated in Fig. 1, lithium ion diffusion should be much faster through cathodes with a high percentage of (101)- and (104)-oriented grains than through cathodes with predominantly (003)-oriented grains, it was not possible to verify this expectation in actual thin-film battery performance because the resistance of most cells was dominated by that of the electrolyte film and the electrolyte-cathode interface.

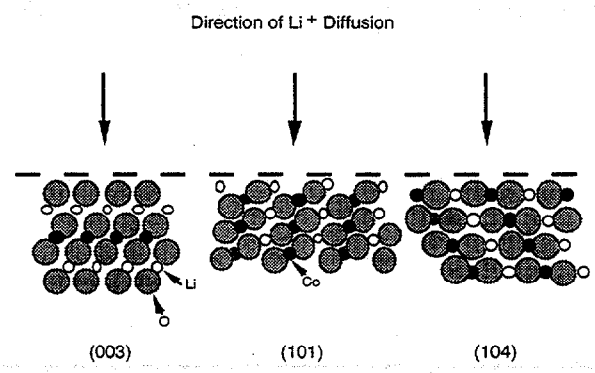

Fig. 1. Illustration of the preferred orientation of $LiCoO_2$ grains with respect to the direction of current flow in a thin-film battery.

Table 1. Calculated volume strain energies and percentage of grain orientations observed from x-ray diffraction for a 4-μm-thick $LiCoO_2$ film.

Plane (hkl)	Vol. Strain Energy (J/cm^3)	%Grains
101	7.5	47
110	7.6	14
104	7.8	16
012	7.9	13
107	8.7	10
003	12.6	0

1. Summary of papers: *Appl. Phys.* 83, 7560 (1998); *Journal of the Electrochemical Society* (in press).
2. Present address: Excellatron Corporation, Smyrna, Ga.
3. University of the South, Sewanee, Tenn.
4. Michigan Technological University, Houghton, Mich.

Chapter 4

Ion Beam and Laser Processing

Ion Beam Processing

FORMATION OF CdS NANOCRYSTALS BY SEQUENTIAL IMPLANTATION[1]

C. W. White, A. Meldrum, J. D. Budai, S. P. Withrow, E. Sonder,[2] R. A. Zuhr, D. M. Hembree, Jr.,[3] M. Wu,[4] and D. O. Henderson[3]

Nanocrystals have attracted considerable interest recently because these materials can have properties that are substantially different from bulk materials. In many cases, these properties can be tuned as a result of quantum confinement by changing the particle size. It has been demonstrated that ion implantation can be used to create a wide range of elemental and compound semiconductor nanocrystals in a range of host materials. This includes forming CdS nanoparticles in matrices of SiO_2, Al_2O_3, and (100) Si.

To form CdS nanoparticles in SiO_2, multiple energy implants of Cd and S were used to form uniform concentrations of Cd and S down to a depth of ~0.15 μm. Different concentrations of Cd and S were implanted into a series of samples in order to change the nanoparticle size. Thermal annealing (at 1000°C for 1 h in Ar + 4%H_2) was used after implantation to cause the nucleation and growth of CdS nanoparticles.

Figure 1 shows size distributions (measured by transmission electron microscopy) for CdS nanocrystals formed in SiO_2 samples containing different concentrations of Cd and S. As the impurity concentration is reduced from $5.3 \times 10^{21}/cm^3$ (of Cd and S) to $0.8 \times 10^{21}/cm^3$, the average size decreases from ~95 to ~45 Å. In addition, there is a significant reduction in the size distribution as the concentration decreases. Optical measurements of the absorption edge in these nanocomposites shows that the nanoparticle band gap blue shifts by almost 0.2 eV for the sample with the smallest nanoparticles. Band gap shifts measured in these samples are in good agreement with band gap changes predicted as a result of quantum confinement as the particle size is reduced.

Size distributions narrower than those in Fig. 1 are desirable for many applications. Experiments are under way to attempt to reduce these size distributions by using electron (or ion) stimulated nucleation and growth[5] or localized implantation of individual nanoparticles using a focused ion beam.[6]

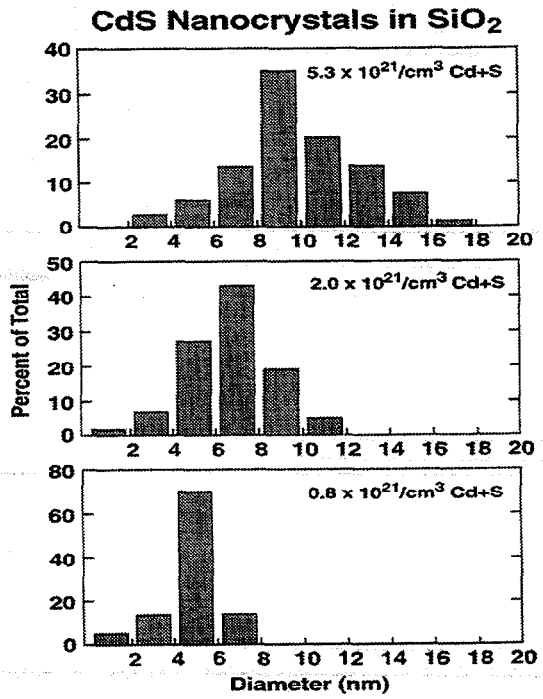

Fig. 1. Size distribution of CdS nanocrystals produced in SiO_2 samples with different concentrations of Cd- and S-implanted impurities.

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1. Summary of paper: *Nucl. Instrum. Methods Phys. Res. B* **148**, 991 (1999).
2. ORNL retiree.
3. Y-12 Plant, Oak Ridge, Tenn.
4. Fisk University, Nashville, Tenn.
5. A. Meldrum et al., *Mat. Res. Soc. Sym. Proc.* **536**, 317 (1999).
6. R. A. Zuhr et al., *Mat. Res. Soc. Sym. Proc.* **536**, 251 (1999).

NANOSTRUCTURED ARRAYS FORMED BY FOCUSED ION BEAMS

R. A. Zuhr, J. D. Budai, P. G. Datskos,[1] A. Meldrum,[2] K. A. Thomas,[1] R. J. Warmack,[3] C. W. White, L. C. Feldman,[4] M. Strobel,[5] and K.-H. Heinig[5]

Amorphous, polycrystalline, and single-crystal nanoparticles ranging in size from a few to several hundred nanometers in diameter can be formed in a variety of substrates by ion implantation and subsequent annealing. They may be metals or semiconductors and can be made of either single or multiple elements by using sequential implantation techniques. These composite materials frequently exhibit unique optical properties that may lead to applications in optical devices. One problem of composite materials formed in this way is that the particle size is generally not uniform, leading to degradation of the desired optical properties. The purpose of this work is to make equally spaced lattices of colloidal particles of uniform size by using a finely focused ion beam (FIB) to implant ions only into a microscopic region at each point of a two-dimensional array. Simulations using a kinetic lattice Monte Carlo code indicate that such localized implants should form an array of colloids that, under proper conditions, may Ostwald ripen into a single large colloid at each lattice site. Such a composite would exhibit greatly enhanced optical properties.

A 30-keV Ga FIB (FIB-2000) has been used to form 1.1-mm-square lattices of Ga spots on Si substrates. In spite of careful iterative focusing of the ion beam, the observed implant spots are larger (×200) in area than the nominal beam size. The presence of Ga in the implanted dots has been confirmed by several techniques, including ion scattering, synchrotron x-ray microanalysis, and atomic force and electron microscopy. Figure 1 shows a transmission electron microscopy (TEM) image of a particle of Ga formed near the edge of an implanted spot. This crystalline particle is about

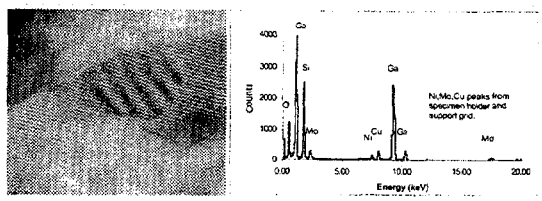

Fig. 1. TEM and EDS of 18-nm Ga crystallite formed by 30-keV FIB in Si.

18 nm in diameter and can be positively identified as Ga from the corresponding electron diffraction spectroscopy (EDS) spectrum.

It has been demonstrated that a two-dimensional lattice of Ga dots can be formed with a FIB at 30 keV. Aggregation of the implanted profile into a single particle at each of the lattice sites has not yet been shown, but it is clear that Ga is retained in the substrate and does form small crystalline colloids. The dose and energy, and thus the depth, of the implanted ions are critical in the formation of uniform single particles because the Ga ions must be implanted in a symmetric three-dimensional distribution in order to form a single colloid. Several techniques to produce such single uniform quantum dots at each point by the FIB process are currently being investigated.

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EFFECTS OF H ON PHOTOLUMINESCENCE FROM Si NANOPARTICLES IN SiO_2[1]

S. P. Withrow, C. W. White, A. Meldrum,[2] J. D. Budai, D. M. Hembree, Jr.,[3] and J. C. Barbour[4]

Si nanocrystals formed in SiO_2 by ion implantation followed by thermal annealing exhibit strong photoluminescence (PL) peaked in the near infrared. An understanding of the mechanism responsible for this phenomenon is required in order to control the properties of the PL and to tailor potential optoelectronic and other applications.

Hydrogen plays a significant role in enhancing the PL. Annealing Si-implanted SiO_2 in a forming gas ambient of Ar + 4%H_2 increases the luminescence a factor of 4 over that observed following annealing in only Ar (Fig. 1). The change is reversible. Quantitative H profiles, measured using elastic recoil detection, indicate that H is present only at the depths of the Si implant following an 1100°C, 1-h forming gas anneal and is not present in the sample after annealing in Ar for the same temperature and time. This selective trapping in the vicinity of the nanoparticles suggests the role of the H is to passivate surface states at the Si nanoparticle/SiO_2 interface, leading to enhanced PL. Calculations based on the size and concentration of the nanoparticles (as measured using transmission electron microscopy) indicate that the H density is $2 \times 10^{13}/cm^2$, which is somewhat higher than the total interface state density expected at a Si/SiO_2 interface. The presence of H has almost no effect on the spectral distribution of the luminescence.

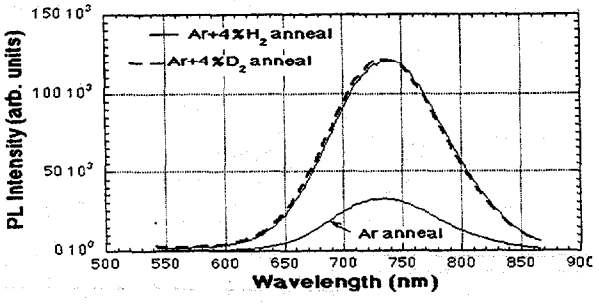

Fig 1. PL yield for different annealing ambients.

Annealing samples at temperatures up to 400°C results in no changes in either the measured H or in the PL. Above this temperature, the H becomes mobile. Comparisons between H profiles and PL spectra for anneals greater than 600°C show a correlation between the PL yield decrease and a decrease in the amount of trapped H. A small amount of residual H that is not involved in the PL mechanism can be present. This observation indicates that radiative recombination and the mechanism for H enhancing the PL, presumably passivation, are independent.

No isotopic effect is observed. Annealing in either hydrogen- or deuterium-forming gas results in the same PL yield and spectral distribution. This result indicates that the mechanism responsible for the PL does not involve transition-energy levels that are isotope dependent.

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1. Summary of paper: *J. Appl. Phys.* **86**, 396 (1999).
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BORON-ENHANCED DIFFUSION OF BORON IN SILICON FROM ULTRALOW ENERGY ION IMPLANTATION[1,2]

A. Agarwal,[3] H.-J. Gossmann,[4] D. J. Eaglesham,[4] S. B. Herner,[4] A. T. Fiory,[4] and T. E. Haynes

Demands for continuing performance improvement of Si-based integrated circuits are driving the scaling of circuit features to ever smaller dimensions. Ion implantation is the method of choice for introducing dopants into Si. Therefore, the implantation energies are being reduced to the sub-keV range for light dopant atoms such as B, and more severe limits are being placed on the amount of diffusion that can be tolerated during postimplant annealing. This project has improved our understanding and control of enhanced diffusion of B at sub-keV energies in silicon processing.

As shown in Fig. 1, when the implanted species is Si^+, transient-enhanced diffusion (TED) observed in B-doped marker layers is suppressed as the implant depth is reduced, vanishing for implant depths below ~3 nm. This effect is due to the more rapid annihilation of the excess implant-induced interstitials that are responsible for TED of B. However, when B^+ is implanted at comparable depths, the diffusion remains enhanced in the buried B markers, implying that B^+ implantation introduces an additional source of interstitials related to the chemical nature of the implanted ions. A similar enhancement was also found when supersaturated B-doped caps were grown on Si by molecular beam epitaxy and annealed. The onset of this effect is associated with a threshold B concentration of 5% to 10% in both implanted and grown layers and is attributed to injection of interstitials during formation of a nanocrystalline silicon boride phase in supersaturated Si:B mixtures.

While this work has shown that TED is eliminated by surface annihilation of interstitials as the implant depth becomes shallower, a new diffusion-enhancement mechanism was discovered. This latter mechanism becomes dominant for B implants at low energies because the B concentration becomes proportionately larger. Understanding and controlling such diffusion effects are critical to the continued viability of Si-integrated circuit manufacturing.

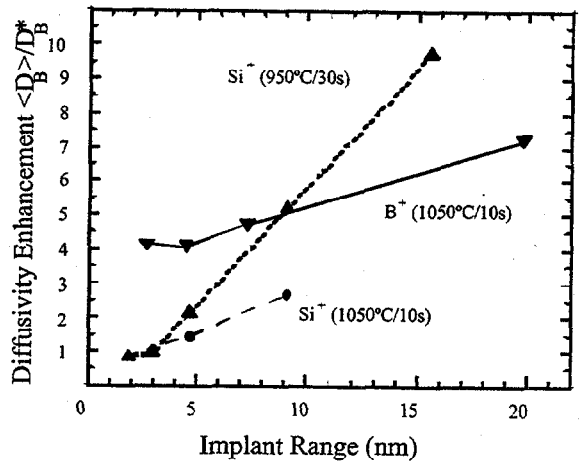

Fig. 1. Comparisons of diffusion enhancements caused by low-energy implantation of B^+ and Si^+ into B-doped marker layers as a function of the depth of implant, with postimplant annealing parameters in parentheses. Enhanced diffusion from Si^+ implants vanishes when the ion range is <3 nm from the surface, while B^+ implants retain an enhancement factor of ~4×.

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1. Summary of paper: *Appl. Phys. Lett.* **74**, 2435 (1999).

2. Research supported by the Laboratory Technology Research Program.

3. ORNL/ORISE postdoctoral research associate. Present address: Eaton Semiconductor Equipment Operations, Beverly, Mass.

4. Bell Laboratories, Lucent Technologies, Murray Hill, N.J.

DEPTH PROFILING EXCESS VACANCIES IN MeV-IMPLANTED SILICON USING Au LABELING[1,2]

V. C. Venezia,[3] D. J. Eaglesham,[4] T. E. Haynes, A. Agarwal,[5]
D. C. Jacobson,[4] H.-J. Gossmann,[4] and F. H. Baumann[4]

Large concentrations of Frenkel pairs are produced during ion implantation of crystalline solids as collisions along the ions' trajectories displace atoms from lattice sites leaving vacancies and the corresponding recoil interstitials. Answers to many fundamental questions about radiation effects in crystals depend upon knowledge of the subsequent evolution of these defect populations. In particular, silicon semiconductor technology is dependent upon ion implantation for controlling doping profiles, but the resulting point defects greatly affect the diffusion and activation of the implanted dopants.

Great strides have been made recently toward detailed understanding of the evolution of implant-induced interstitials because of the ability to quantitatively monitor interstitial clusters using transmission electron microscopy. However, comparable knowledge of vacancies has been stymied by the absence of a quantitative method to count them. A new method that relies on the trapping of in-diffused Au atoms near interstitial sinks, such as vacancy clusters, has been developed to measure the concentration profiles of clustered vacancies. The spatial locations of Au profiles have been correlated with those for open-volume defects obtained by variable-energy e^+ annihilation to confirm that the Au profiles do correspond to vacancy-type defects. Titration experiments are in progress to calibrate the ratio of Au to vacancies, and preliminary results indicate the calibration factor is of the order of magnitude of 1.

This new capability to measure changes in retained vacancy concentration in silicon as a function of various implant and annealing parameters opens the opportunity to greatly improve our quantitative understanding of vacancy interactions in ion-implanted silicon.

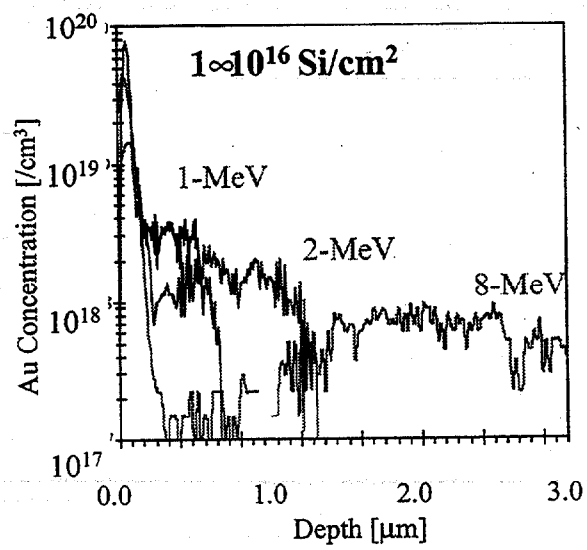

Fig. 1. Au profiles measured by Rutherford backscattering spectrometry after implantation and annealing of Si^+ into silicon at various energies and in-diffusion of Au. Au profiles correspond to the concentration profiles of excess vacancies produced by the Si^+ implants and move deeper into the silicon substrate with increasing Si^+ energy.

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1. Summary of paper: *Appl. Phys. Lett.* **73**, 2980 (1998).

2. Research supported by the Laboratory Technology Research Program.

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4. Bell Laboratories, Lucent Technologies, Murray Hill, N.J.

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OPTIMIZED ION-INDUCED, THIN-FILM TRANSFER PROCESSES FOR SEMICONDUCTORS

O. W. Holland, T. E. Haynes, D. K. Thomas, A. Agarwal,[1] V. C. Venezia,[2] D. J. Eaglesham,[3] R. B.Gregory,[4] T. A. Wetteroth,[4] and S. R. Wilson[4]

H^+ implantation is the basis for a thin-film transfer process which, when combined with oxidation and hydrophilic wafer bonding, can be exploited to produce material such as silicon-on-insulator. Its principal advantage over other bonding techniques is one of economy because the wafer remaining after separation is usable for additional processing. The process is still costly, however, because of the high dose required to affect the transfer ($\sim 4 \times 10^{16}$ cm^{-2}). Studies performed to understand this process better and to make it more efficient include, among others, co-implantation of He^+ with H^+. This variation was motivated in part by the need to distinguish the hydrogen chemistry (passivation and the formation of platelet-like microvoids) from the physical components (fracture due to gas pressure). This yielded a remarkable result; namely, the discovery of a synergistic effect because of co-implantation of He with the H that reduces the total dose required for separation (and thus improves the economy of the process) by a factor of 4.[5]

In similar studies with SiC, application of the co-implantation process to produce a more efficient process was unsuccessful. Instead, the effect (i.e., exfoliation) was completely suppressed in SiC by increasing the gas concentration even in samples implanted with only H^+ ions. This behavior was attributed to a competition between the positive effects of hydrogen on exfoliation and the negative effects of ion-induced damage. This can account for the negative co-implantation result because the heavier He^+ ions produce substantially more damage in SiC than H^+. Experiments were done in SiC to isolate the effects of the hydrogen-silicon chemistry from that of the implant damage. This led to the successful use of a combination of techniques such as "hot" and channeled ion implantation which lowered the H^+ fluence required to affect thin-film separation in SiC by almost a factor of 2, making the process more efficient and producing material with fewer defects.[6]

Studies such as these have led both to a better understanding of the processes of implantation-induced layer transfer in various semiconductors and to improvements in the process efficiency and material quality that promise to enable thin-film transfer for more diverse applications.

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1. ORNL/ORISE postdoctoral research associate. Present address: Eaton Semiconductor Equipment Operations, Beverly, Mass.

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4. Motorola Inc., Tempe, Ariz.

5. *Appl. Phys. Lett.* 72, 1086 (1998); patent pending.

6. *Appl. Phys. Lett.* 75, 2623 (1999); patent pending.

Laser & Molecular Beam Processsing of Thin Films

TIME-RESOLVED MEASUREMENTS OF CARBON NANOTUBE SYNTHESIS BY LASER ABLATION[1]

D. B. Geohegan, A. A. Puretzky,[2] X. Fan,[3] and S. J. Pennycook

Single-walled carbon nanotubes (SWNT) appear well-suited to revolutionize electronics as ultrasmall active components or molecular wires. Their electronic properties range from semiconducting to near-perfect metallic behavior, and these properties are determined entirely by their precise atomic structure. However, neither the size nor structure of SWNT can currently be controlled during synthesis, principally because of the lack of in situ diagnostic investigations.

Pulsed-laser ablation is one of the best methods to grow high-purity SWNT, and it is amenable to time-resolved characterization. High-quality SWNT were synthesized by pulsed-laser ablation of a graphite target inside a quartz tube furnace containing Ar gas at 1000°C. A small amount of metals (Ni, Co) vaporized with the graphite-formed nanoparticles (< 20-nm diam) which catalyzed the growth of SWNT, permitting approximately 70%–90% of the carbon to "self-assemble" exclusively into SWNT.

In situ laser-induced fluorescence combined with gated, intensified CCD-array imaging and spectroscopy were used for the first time to understand when and where SWNT grow and what the feedstock for growth is and provide the first estimates of SWNT growth rates. The measurements revealed that nanotube growth occurs over several seconds at an average growth rate of ~0.2 μm/s. The principal ejecta are atoms and molecules that quickly convert (within 200 μs for C, 2 ms for Co) to nanoparticles. SWNT grow from this mixture of nanoparticles that are hydrodynamically trapped within a spinning vortex ring. These results provide new insights and opportunities for controlled growth and scaled-up production methods.

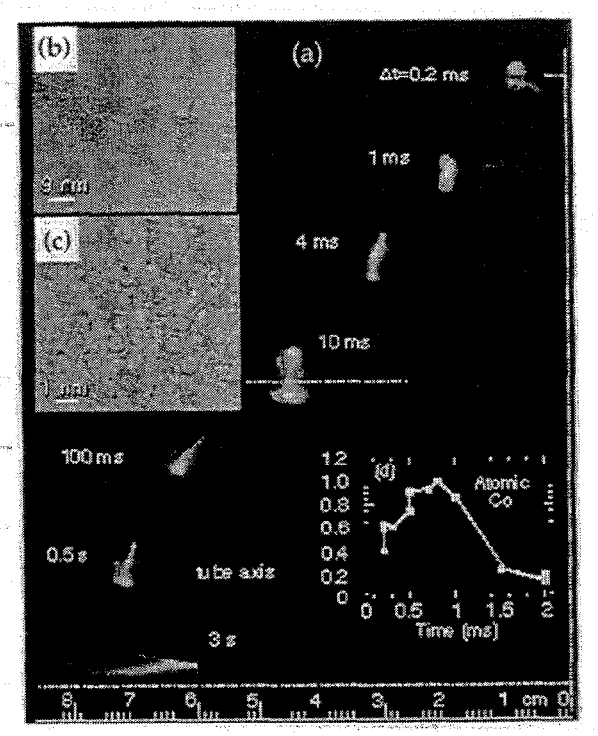

Fig. 1. (a) LIF-images of the plume under SWNT growth conditions. (b, c) High-resolution TEM of SWNT bundles. (d) Population of atomic Co in the plume vs. time.

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1. Summary of papers: *Applied Physics Letters* (in press); *Applied Physics A* (in press).
2. ORNL/ORISE postdoctoral research associate.
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GAS-PHASE NANOPARTICLE FORMATION DURING PULSED-LASER DEPOSITION[1]

C. M. Rouleau, D. H. Lowndes D. B. Geohegan, A. A. Puretzky,[2] D. J. Rader,[3] G. Duscher,[4] S. J. Pennycook, T. G. Thundat,[5] and E. A. Kenik[6]

Thin films formed from nanoparticles having diameters in the range 1–10 nm can have highly desirable properties that differ considerably from the bulk because of quantum confinement effects and the dominance of surface and interface electronic states. Low-dimensionality Si, for example, either in porous or nanocrystalline form, exhibits *bright* room-temperature photo- and electroluminescence in the *visible* regime, an inaccessible region of the optical spectrum for bulk Si.

The formation of Si and ZnTe nanoparticles by pulsed-laser ablation into a background gas were studied as a function of processing conditions using spatially resolved collection on transmission electron microscope (TEM) grids, followed by high-resolution Z-contrast TEM and electron energy loss spectroscopy (EELS) *of individual nanoparticles*. To understand the dynamics of nanoparticle formation and transport, a time-delayed laser was used to induce photoluminescence (PL) from gas-suspended nanoparticles. This PL was photographed with a gated, intensified CCD-array (ICCD) camera system for the first time in order to determine the time scales for nanoparticle formation and obtain in situ PL spectra of gas-suspended nanoparticles. Optimally PL thin films were then deposited using these new diagnostics.

Similar techniques were applied to determine the range of gas pressures and temperatures over which nanoparticles are produced in the gas-phase during the deposition of YBCO superconductor thin films by pulsed-laser deposition. Nanoparticles were found to form during millisecond time scales, but thermophoresis swept them away from a hot substrate as they formed, a previously unknown self-cleaning effect.

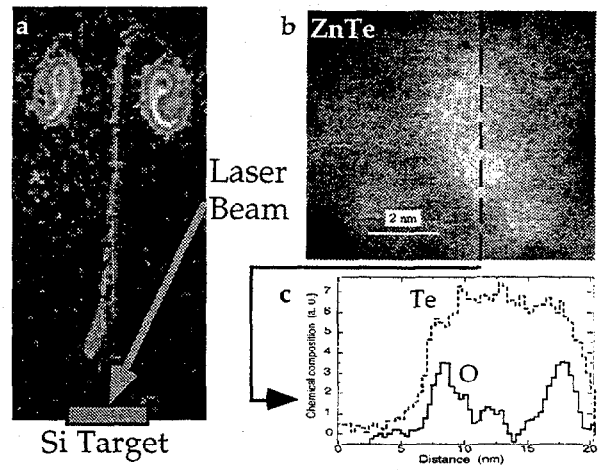

Fig. 1. (a) ICCD image of Si ablation into 10-Torr He showing formation of turbulent "smoke ring." (b) High-resolution Z,contrast TEM image of large ZnTe nanocrystal (center) with small nanocrystal attached (lower right). c) Composition profile derived from spatially resolved EELS across larger ZnTe nanoparticle.

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1. Summary of papers: *J. Mater. Res.* **14**, 359 (1999), *Appl. Phys. Lett.* **74**, 3788 (1999), and *Appl. Phys. Lett.* **72**, 2987 (1998).
2. ORNL/ORISE postdoctoral research associate.
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COLD ELECTRON FIELD EMISSION FROM SMOOTH AND NANOSTRUCTURED CARBON FILMS[1]

V. I. Merkulov,[2] D. H. Lowndes, and L. R. Baylor[3]

It was recently found that ArF (193-nm) pulsed-laser irradiation of a graphite target can be used to deposit extremely smooth (1–2-Å rms roughness) amorphous carbon films with systematically variable bonding, ranging from amorphous diamond (~75% sp^3) to predominantly sp^2-bonded amorphous C. On the other hand, hot-filament chemical vapor deposition (HF-CVD) produces graphitic (sp^2-bonded) films that are highly structured on the nanoscale. These films were used to evaluate the relative importance of the electronic bonding state and of nanostructure for cold field emission (FE) of electrons from carbon.

Very smooth, undoped amorphous carbon films were poor field emitters, regardless of their sp^3 content. "Conditioning" that resulted in striking an arc between the scanned WC probe tip and the carbon film was required to obtain emission from all such samples. From a Fowler-Nordheim analysis of the emitted currents, a high geometrical enhancement factor (GEF) ~100–150 and a low emitting area ~10^{-2} μm^2 were inferred for initially smooth films with both the highest and the lowest sp^3 contents. Scanning electron microscopy (SEM) measurements revealed a crater at the location of the arcing. Consequently, the FE from these films (~1 nA at ~50 V/μm) was attributed to sharp protrusions around the crater and a large GEF associated with them.

In contrast, HF-CVD C films exhibited very promising FE characteristics. (1) No conditioning or arcing was required to initiate FE, suggesting a nondestructive FE mechanism. (2) Turn-on fields were quite low, ranging from 9 to 30 V/μm. (3) By laterally scanning the 25-μm-diam probe tip, the films were found to be continuously emitting (though with some variation of threshold voltage), corresponding to an emission site density of at least 3 x $10^5/cm^2$. (4) The maximum FE current before damage was 5–50 μA, corresponding to a macroscopic current density ~1–10 A/cm^2. (5) Emission was stable for 30–50 hours, the maximum time for which measurements were made.

High-resolution SEM showed that the HF-CVD films having good FE characteristics were highly nanostructured, with many features in the 100-nm range and smaller. It was concluded that the excellent FE from HF-CVD C films, despite their high work function (essentially graphite, ~4.6 eV), is associated with their nanostructure and the corresponding large GEF. These films are very promising for FE displays and other vacuum microelectronic device applications.

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1. Summary of papers: *Appl. Phys. Lett.* **75**, 1228 (1999); *Appl. Phys. Lett.* **73**, 2591 (1998).
2. ORNL/ORISE postdoctoral research associate.
3. Fusion Energy Division, ORNL.

IMAGING OF VAPOR PLUMES PRODUCED BY MATRIX-ASSISTED LASER DESORPTION: A NEW PLUME SHARPENING EFFECT[1]

A. A. Puretzky,[2] D. B. Geohegan, G. B. Hurst,[3] M. V. Buchanan,[4] and B. S. Luk'yanchuk[5]

Matrix-assisted laser desorption ionization (MALDI) is rapidly becoming an established commercial technique for the fast mass analysis of very heavy biomolecules (up to several hundred thousand Daltons). It is a promising approach in rapid genome sequencing and practical applications in gene-related disease diagnostics. In MALDI, a UV or IR laser deposits energy into an organic crystal matrix which rapidly vaporizes and nondestructively launches embedded biomolecules into vacuum. During vaporization, a small fraction of biomolecules becomes ionized and can be detected by high-resolution time-of-flight mass spectrometry. However, a lack of knowledge of the matrix and analyte molecules vapor plume transport and of analyte ionization processes currently limits applications of the MALDI technique.

For the first time, gated imaging of both light matrix-molecule and heavy biomolecule vapor expansion during MALDI have been employed to characterize plumes of desorbed species. Laser-induced fluorescence (LIF) imaging of dye-tagged DNase I proteins shows that these heavy molecules (30,000 Da) propagate within a very narrow angular distribution compared with the 3-HPA matrix (139-Da) molecules during MALDI (Fig. 1). This narrow distribution continues to sharpen over extended distances and times following laser desorption. A special solution of the gas dynamic equations was employed to develop a generalized theory for the 3D-expansion of heavy/light two-component plumes and the observed plume sharpening effect.[1]

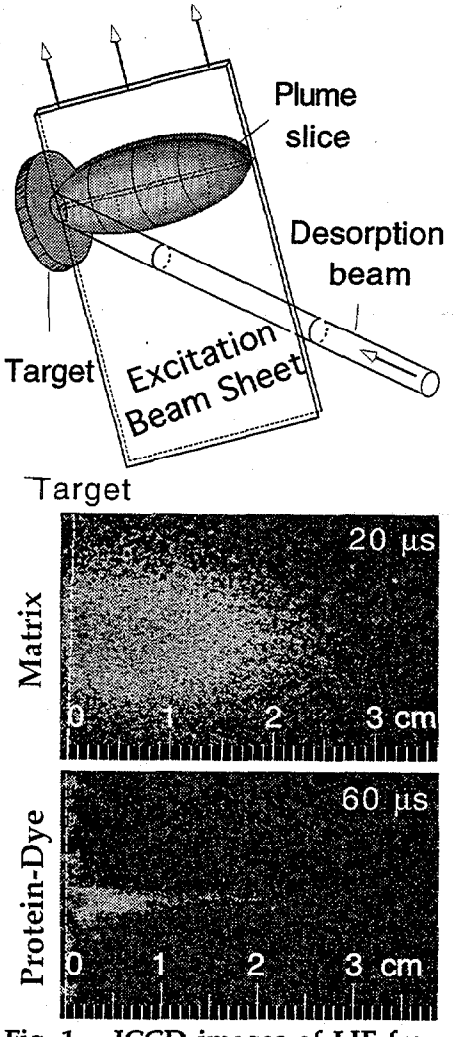

Fig. 1. ICCD images of LIF from matrix (upper image) and dye-tagged protein molecules (lower image) showing that the heavy biomolecules propagate within a very narrow angular distribution compared with that of the matrix.

1. Summary of paper: *Phys. Rev. Lett.* **83**, 444 (1999).

2. ORNL/ORISE postdoctoral research associate.

3. Chemical and Analytical Sciences Division, ORNL.

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EPITAXY OF OXIDES ON DISSIMILAR MATERIALS[1]

D. P. Norton, C. Park,[2] D. T. Verebelyi,[2] D. K. Christen, M. F. Chisholm, and J. D. Budai

Oxides are important for many electronic and optical applications. Often, these demand integration for crystalline oxides on non-oxide substrates. The epitaxial growth of oxide thin films on dissimilar materials, such as metals or semiconductors, represents a significant materials challenge. Many factors influence this process, including lattice mismatch, chemical interactions, and thermodynamic stability of native oxides.

Recently, the formation of epitaxial yttria-stabilized zirconia (YSZ) as a buffer layer on (001) biaxially textured Ni for deposited high-temperature superconducting tapes was investigated. The growth of (001)-oriented (YSZ) directly on the (001) Ni surface is realized via nucleation on an oxygen-terminated nickel surface using pulsed-laser deposition. Under conditions where the nickel surface is either oxygen-free or substantially covered with NiO, a mixed orientation of YSZ occurs. However, the epitaxial YSZ layer nucleated on the oxygen-terminated surface can serve as a single buffer layer for a superconducting coated conductor, yielding $YBa_2Cu_3O_7$ films with high critical current densities.

The growth of crystalline oxides on semiconductors was also investigated. These structures are important in integrating electronic and optical oxides with semiconductor devices. Figure 1 shows a Z-contrast scanning transmission electron microscopy (STEM) image of an epitaxial (001) CeO_2 film on a (001) Ge surface obtained using a new hydrogen-assisted pulsed-laser deposition method. The hydrogen partial pressure and substrate temperature are selected to be sufficiently high that the germanium native oxides are thermodynamically unstable. The Gibbs free energy of CeO_2 is larger in magnitude than that of the Ge native oxides, making it more favorable for the metal oxide to reside at the interface in comparison to the native Ge oxides. By satisfying these criteria, the CeO_2/Ge interface is atomically abrupt with no native oxide present.

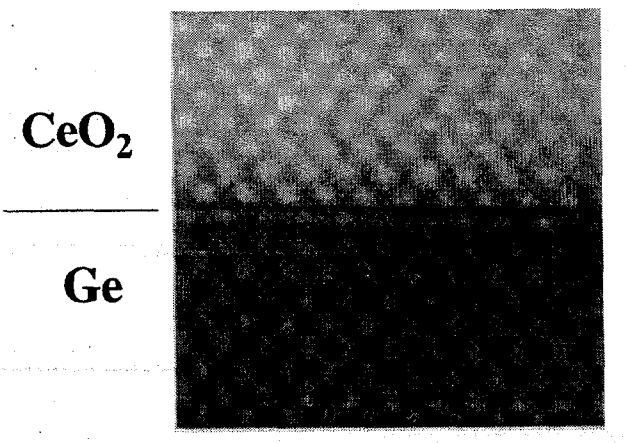

Fig. 1. *Z*-contrast STEM image of epitaxial CeO_2 on (001) Ge.

1. Summary of papers to be published.
2. ORNL/ORISE postdoctoral research associate.

ENHANCED LUMINESCENCE IN EPITAXIAL OXIDE PHOSPHORS[1]

D. P. Norton, Y. E. Lee,[2] and J. D. Budai

Oxide thin-film phosphors have received considerable attention for use in flat-panel displays because of their good luminescent characteristics, stability in high vacuum, and absence of corrosive gas emission under electron bombardment when compared with sulfide-based phosphors. Although numerous studies have been performed to improve the luminescent intensity of polycrystalline phosphor materials, there have been few studies involving epitaxial luminescent films. As a result, the fundamental relationship between structural properties and luminescent characteristics in thin-film phosphors is not fully understood.

Investigations of the growth and properties of epitaxial $ZnGa_2O_4$:Mn thin films grown on single-crystal substrates, comparing their properties to polycrystalline films deposited on glass substrates, have been made in an attempt to delineate the effects of microstructure on luminescent properties. For green emission, $ZnGa_2O_4$:Mn is one of the more promising luminescent oxide materials. Figure 1 shows the relative photoluminescent emission intensity of an epitaxial film grown on single-crystal (100) MgO and a polycrystalline film on glass. The films exhibit a broad-band emission extending from 470 to 580 nm, peaking at 506–512 nm. Enhanced luminescent intensity is observed in the epitaxial films as compared with randomly oriented polycrystalline films, suggesting that growth on low-energy surfaces strongly influences the luminescent properties. This apparent enhancement of luminescence with improved crystallinity is somewhat contrary to conventional models for phosphor materials in which it is assumed that *maximizing* granularity enhances luminescence through scattering. For thin-film phosphors, light confinement through internal reflectance at the film surface and substrate/film interfaces has been assumed to be the most relevant mechanism for photoluminescent reduction when compared with powder phosphors. However, this result clearly indicates that crystallinity can more than overcome light confinement and, thus, be a major contributor in enhancing photoluminescence in thin films.

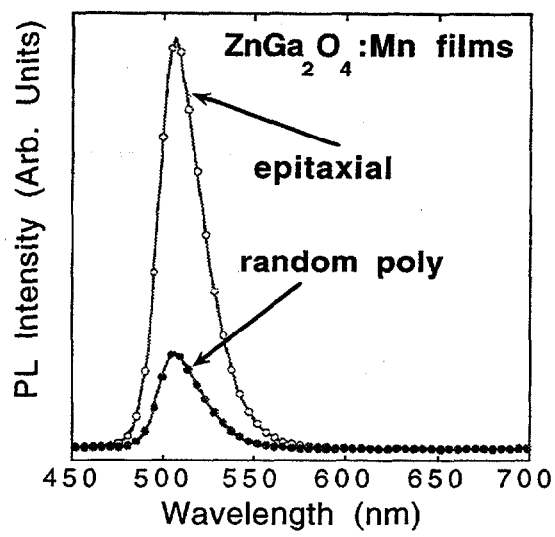

Fig. 1. Comparison of photoluminescence in epitaxial and polycrystalline phosphor films.

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1. Summary of paper: *Appl. Phys. Lett.* **74**, 3155 (1999).
2. ORNL/ORISE postdoctoral research associate.

DIELECTRIC FUNCTIONS OF THIN-FILM AMORPHOUS MATERIALS DETERMINED BY SPECTROSCOPIC ELLIPSOMETRY[1]

G. E. Jellison Jr., F. A. Modine, G. Eres, V. I. Merkulov,[2] D. H. Lowndes, and J. B. Caughman[3]

The complex dielectric function [$\varepsilon(E) = \varepsilon_1(E) + i\varepsilon_2(E)$] of compound materials such as SiO_x and Si_xN_y obviously will depend on stoichiometry, but $\varepsilon(E)$ of single-element thin-film amorphous materials, such as amorphous silicon and diamond, can also vary significantly with deposition conditions. Any structural differences, contaminant atoms (such as hydrogen), or differences in atomic bonding (such as the sp^2 to sp^3 ratio for amorphous diamond) can give rise to large differences in $\varepsilon(E)$. As a result, $\varepsilon(E)$ can be an excellent diagnostic for film quality.

A new diagnostic technique for the analysis of thin-film amorphous semiconductors using spectroscopic ellipsometry (SE) in combination with the Tauc-Lorentz model[4] for $\varepsilon(E)$ has recently been developed. This technique is nondestructive and can be used to determine film thickness, surface roughness, interfacial roughness, and the optical band gap from the Tauc-Lorentz expression for $\varepsilon(E)$.

Figure 1 shows the spectroscopic ellipsometry data taken from a tetrahedrally coordinated amorphous carbon (ta-C) film grown on silicon by pulsed-laser ablation. The data are expressed in terms of the complex reflection ratio $\rho = r_p/r_s$, where r_p and r_s are the complex reflection ratios for light polarized parallel and perpendicular to the plane of incidence. The solid line through the data points represents the fit to the data using the model shown in Fig. 1. The fitting results are shown in Table 1, where the χ^2 value of 0.58 states that the model fits the data.

Several of the fitted parameters shown in Table 1 indicate film quality. For example, the optical band gap scales directly with the fraction of carbon atoms that are incorporated in sp^3 (diamond-like) bonds. As a result, films that have higher band gaps are also harder and have larger Young's moduli.

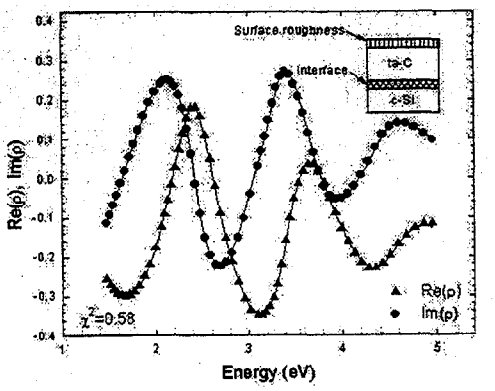

Fig. 1. The real and imaginary parts of the complex reflection ratio ρ determined by spectroscopic ellipsometry for thin-film ta-C grown on silicon by pulsed-laser ablation.

Table 1. Results of the Fit Shown in Fig. 1

Parameter	Value
Surface roughness thickness	1.9 ± 0.1 nm
Film thickness	151.6 ± 0.7 nm
Interface thickness	6.9 ± 1.0 nm
ta-C band gap	1.88 ± 0.04 eV
Refractive index at 600 nm	2.586

1. Summary of papers: *Thin Solid Films* **313**, 193 (1998); *Mat. Res. Soc. Symp.* **526**, 349 (1998); *Appl. Phys. Lett.* **73**, 2591 (1998).
2. ORNL/ORISE postdoctoral research associate.
3. Fusion Energy Division.
4. G. E. Jellison, Jr., and F. A. Modine, *Appl. Phys. Lett.* **69**, 371 (1996); *ibid.* **69**, 2137 (1996).

Chapter 5

Structure of Solids and Surfaces

Surfaces

LOOKING AT ELECTRONIC WAVES IN 2-D: FOURIER-TRANSFORM STM

Ph. Hofmann,[1] B. G. Briner,[2] L. Petersen,[3] P. Sprunger,[4] M. Doering,[2] H.-P. Rust,[2] E. Laegsgaard,[5] A. M. Bradshaw,[2] F. Besenbacher,[5] and E. W. Plummer[6]

The scanning tunneling microscope (STM) measures the local density of states near the surface as a consequence of the fact that imaging is a result of tunneling of electrons from the tip to the sample or visa versa. This simple fact allows the STM to be used as a tool for direct visualization of the electronic wave character of electrons, especially those confined in two-dimensional (2-D) surface states. The most beautiful examples are the quantum corrals constructed by Crommie, Lutz, and Eigler (*Nature* **363**, 524 (1993)). The waves seen in the STM image result from the coherent scattering of the 2-D surface states from any defect on or near the surface, creating a standing wave field with a wavelength given by $1/2\ k_F$, where k_F is the Fermi wave vector. The factor of 2 appears because the STM looks at the charge density not the wave function.

Our investigations have taken this one step farther by demonstrating that the Fourier transform (FT) of these waves produces a direct picture of the Fermi surface [7–11]. The STM images and the FT produce beautiful visualization of quantum mechanics which has been featured by the American Physical Society (APS) in *Physics in the 20th Century*, coffee table book, in a *Europhysics News* article [9], and in invited talks at the March 1998 APS meeting and the Spring Europhysics meeting. It is also a beautiful example of international cooperation, between scientists at ORNL/UTK, in Denmark, and in Germany.

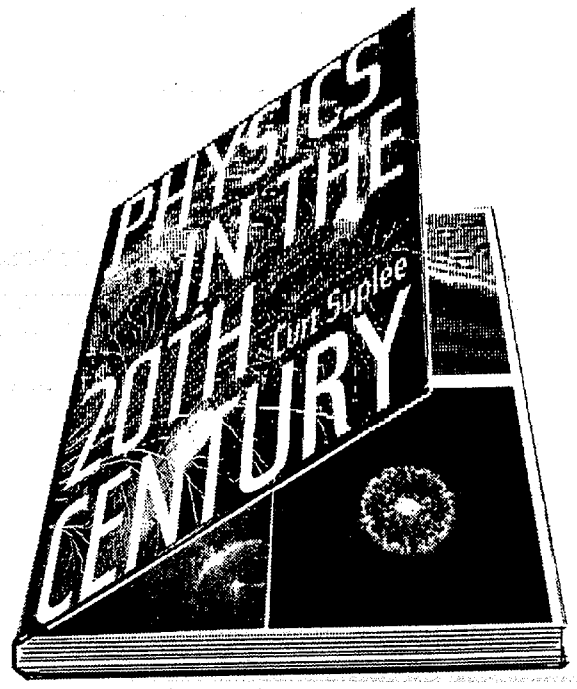

Fig. 1. Picture of the cover of the special volume *Physics in the 20th Century*, showing our STM and FT images.

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3. University of Aarhus, Aarhus, Denmark.
4. Graduate student from the University of Pennsylvania, Philadelphia, Pa. Present address: Louisiana State University, Baton Rouge, La.
5. CAMP, Aarhus, Denmark.
6. UT/ORNL Distinguished Scientist.

7. P. T. Sprunger et al., *Science* **275**, 1764 (1997).
8. Ph. Hofmann et al., *Phys. Rev. Lett.* **79**, 265 (1997).
9. B. G. Briner et al., *Europhysics News* **28**, 148 (1997).
10. L. Petersen et al., *Phys. Rev. B* **57**, R6858 (1998).
11. B. G. Briner et al., *Phys. Rev. B* **58**, 13931 (1998).

THE SURFACE PHASES OF THE *p*-WAVE SUPERCONDUCTOR Sr_2RuO_4

R. Matzdorf,[1] Ismail,[1] E. W. Plummer,[2] T. Kimura,[3] Y. Tokura,[3,4] Z. Fang,[3] and K. Terakura[3]

The strong mutual coupling between charge and spin of the electrons and the lattice degrees of freedom in transition-metal oxides results in effects like charge-, orbital- and spin ordering, colossal magnetoresistance, and unconventional superconductivity. Conceptually, creating a surface by cleaving a single crystal is a controlled way to disturb the coupled system by breaking the symmetry without changing the stoichiometry. It provides an opportunity to study how structural, electronic, and magnetic properties react to the broken symmetry. Sr_2RuO_4 has attracted much attention recently, because it shows spin-triplet superconductivity with a *p*-wave order parameter. It has been shown that the surface layer of vacuum-cleaved Sr_2RuO_4 single crystals exhibits a strongly distorted crystal structure with RuO_6 octahedra rotated around the surface normal direction. Even though the initial reconstruction is driven by stress in the RuO_2, first-principles calculations show that the final surface structure is stabilized by ferromagnetic (FM) order.

The surface of Sr_2RuO_4 single crystals cleaved in ultrahigh vacuum shows extremely large terraces with an extension of up to 10×10 μm^2 [Fig. 1 (top)]. LEED patterns unambiguously show that the surface layer is reconstructed. At all temperatures studied, $80 < T < 300$ K, fractional spots corresponding to a $(\sqrt{2} \times \sqrt{2})R45°$ unit cell are observed [Fig. 1 (middle)]. Both LEED-IV and theory show that the surface structure is caused by a octahedra rotated by $9 \pm 3°$ around the c-axis [Fig. 1 (bottom right)]. The calculation predicts that the reconstruction induces a FM surface phase. The FM order, in turn, stabilizes the distortion, leading to a ferromagnetic surface.

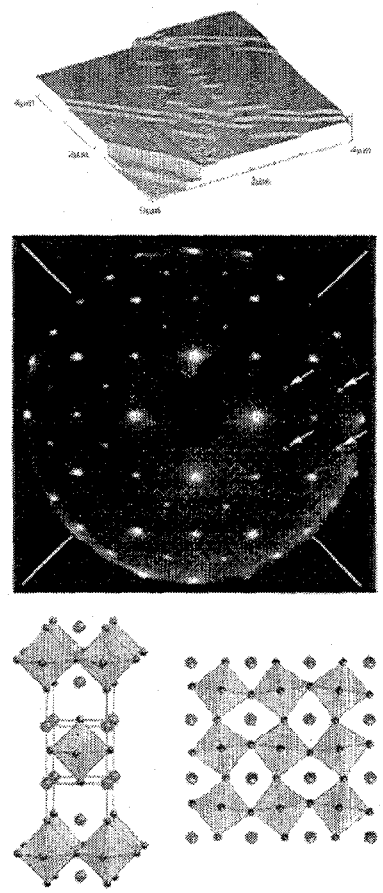

Fig. 1. Top: STM image of a 4×4-μm^2 surface area showing extremely large terraces. Center: Electron diffraction pattern (LEED) showing fractional spots (marked by arrows) created by the surface reconstruction. Bottom left: Ball model of the bulk unit cell of Sr_2RuO_4 (ruthenium in the center of the octahedon). Bottom right: Ball model of the surface structure with rotated octahedra (top view).

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4. University of Tokyo, Tokyo, Japan

DEFECT-MEDIATED CONDENSATION OF A CHARGE DENSITY WAVE

A. V. Melechko,[1] H. H. Weitering,[2] J. Braun,[1] Jiandi Zhang,[3]
J. M. Carpinelli,[1] M. Bartkowiak,[2] and E. W. Plummer[4]

Symmetry, dimensionality, and disorder play a pivotal role in critical phenomena. The atomic imaging capabilities of the scanning tunneling microscope have been used to directly visualize interactions between charge-density oscillation and lattice defects in a two-dimensional charge-density wave (CDW) system. Point defects act as nucleation centers of the CDW, which, as the temperature is lowered, results in the formation of pinned CDW domains that are separated by atomically abrupt charge boundaries. Incomplete freezing of the substitutional disorder at low temperatures indicates a novel CDW-mediated hopping of pinning centers.[5,6]

A CDW is a broken symmetry state of a metal. It incorporates a periodic modulation of the crystal's valence charge and is usually accompanied by a small periodic lattice distortion. Charged impurities can alter the phase and amplitude of the CDW condensate near the impurity site and may even prohibit long-range ordering. In this study, details of the CDW transition in the $(\sqrt{3} \times \sqrt{3})R30^0$ room-temperature phase of the Sn/Ge(111)-α interfaces were investigated with a variable-temperature STM.

Defects, both vacancies and substitutional Ge atoms, created exponentially damped CDW-like perturbations. The hexagonal distortion from a vacancy is shown in Fig. 1 (top). As the temperature decreased, the characteristic length of the wave increased. Figure 1 (bottom) shows the measured $1/l(T)$ for this system. The length parameter diverges at 70 K, allowing the prediction that the CDW phase transition from a single defect would occur at this temperature T_1. In fact the transition occurs at a temperature T_2 = 120 K, when the defects interact via the density wave and move to align themselves with the CDW domain. The dashed horizontal line is the average defect-defect spacing.

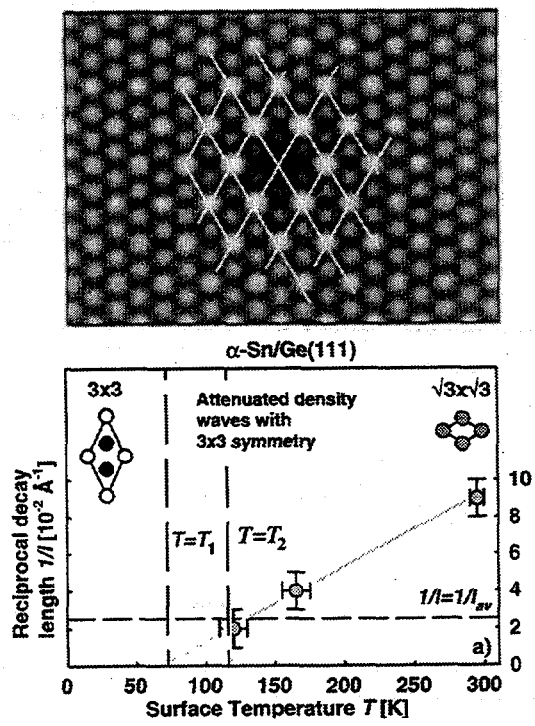

Fig. 1. Top is a simulation of the room-temperature STM image showing damped density wave emanating from a vacancy. Bottom is a plot of the measured inverse extent of the density waves ($1/l(T)$) vs. temperature. The horizontal dashed line is the inverse defect-defect spacing.

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1. ORNL/UT Distinguished Scientist Program graduate student.
2. ORNL/UT Distinguished Scientist Program guest scientist.
3. Florida International University, Miami, Fla.
4. ORNL/UT Distinguished Scientist.
5, A. V. Melechko et al., *Phys. Rev. Lett.* **83**, 999 (1999).
6, H. H. Weitering et al., *Science* **285**, 2107 (1999).

OSCILLATORY LATTICE RELAXATION AND OSCILLATORY THERMAL EXPANSION AT METAL SURFACES[1]

J.-H. Cho,[2] Ismail,[3] Z. Y. Zhang, and E. W. Plummer[4]

The creation of a surface significantly alters the environment, affecting electrons and ions near the surface, leading to a possible spatial rearrangement of both entities. For electrons at simple metal surfaces, it was shown decades ago within the jellium model that the redistribution results in damped density oscillations propagating into the bulk (Friedel oscillations). The ions in such systems have also been frequently observed to experience oscillatory interlayer relaxation, though the driving force has remained controversial.

Using self-consistent density-functional theory calculations, it has been shown that pronounced Friedel oscillations still exist at simple metal surfaces (Fig. 1) even when the effects of the ionic cores are included explicitly. These findings not only confirm a long-standing and widespread speculation, but further provide a simple physical picture for the other common phenomenon. The Freidel oscillations in electron density contribute to drive the ions to relax in an oscillatory fashion, as evidenced by a corroborative comparison between theory and experiment for Mg(10$\bar{1}$0).

Temperature-dependent low-energy electron diffraction *I-V* measurements of the Mg(10$\bar{1}$0) surface also reveal that the interlayer spacings exhibit remarkable oscillatory thermal relaxation propagating deep into the bulk. First-principles density-functional calculations indicate that the unusual thermal expansion is driven by the tendency of the first bilayer to collapse into a single layer.

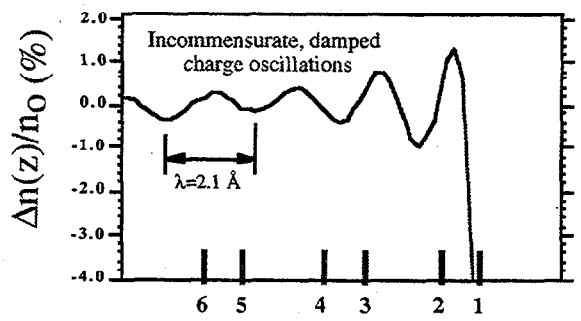

Fig. 1. Charge density at the bulk truncated Mg(10$\bar{1}$0) surface relative to the bulk charge density of Mg. The numbers on the *x*-axis (1, 2, 3, ...) indicate the locations of the corresponding atomic layers.

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1. Summary of papers: *Phys. Rev. B* **59**, 1677 (1999); *Physical Review B* (to be published).
2. ORNL/ORISE postdoctoral research associate.
3 Postdoctoral research associate from The University of Tennessee.
4. ORNL/UT Distinguished Scientist.

GROWTH AND DYNAMICS OF STRAINED Cu FILMS ON Ru(0001) USING X-RAY DIFFRACTION[1]

A. P. Baddorf, D. M. Zehner, H. Zajonz,[2] and D. Gibbs[2]

Strain relief in heteroepitaxial growth of metals on close-packed surfaces commonly occurs through formation of a stripe-phase reconstruction of the overlayer. This reconstruction involves partial dislocations, which separate striped regions of fcc and hcp stacking.[3] The growth and dynamics of reconstruction in strained (lattice mismatch 5.8%) Cu films on Ru(0001) between 460 and 925 K, using x-ray diffraction, have been studied.

The first layer of Cu is pseudomorphic. Intensities can be modeled to show that Cu sits in a hcp site. The second layer forms a stripe phase, observed as satellites around the Ru diffraction (Fig. 1). Upon completion of the second layer, Fig. 2 shows the stripe phase abruptly contracts and locks into a commensurate registry (Cu:Ru = 17:16 below 750 K and 19:18 above 750 K). This is the first such observation.

A second stripe-phase peak grows with deposition of a third Cu layer (Fig. 2). This peak is metastable, with the second stripe-phase atoms diffusing to form 3-D islands. Islands prefer to grow with (111) normal to the surface and rotated slightly in-plane to minimize interface strain. These experiments reveal one of the best documented examples of the Stanski-Krastanov growth mode (surface wetting followed by 3-D growth) and reveal the dynamics of the transition from 2- to 3-D morphology.

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1. Summary of paper to be published.
2. Brookhaven National Laboratory, Upton, N.Y.
3. C. Günther et al., *Phys. Rev. Lett.* **74**, 754 (1995).

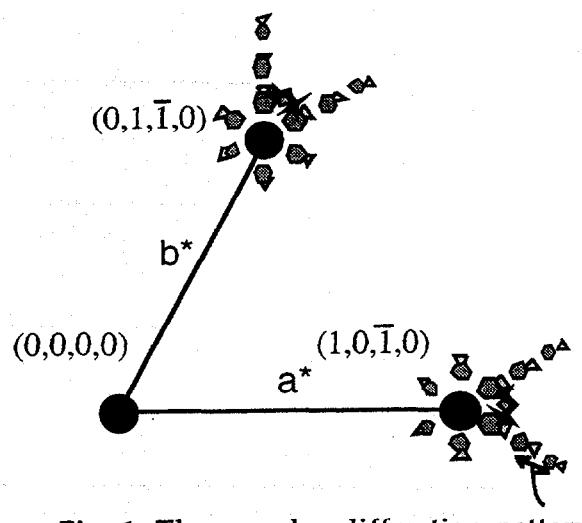

Fig. 1. The complex diffraction pattern induced by growth of three layers of Cu on Ru(0001). Satellites indicate two stripe phases coexisting with columns of Cu.

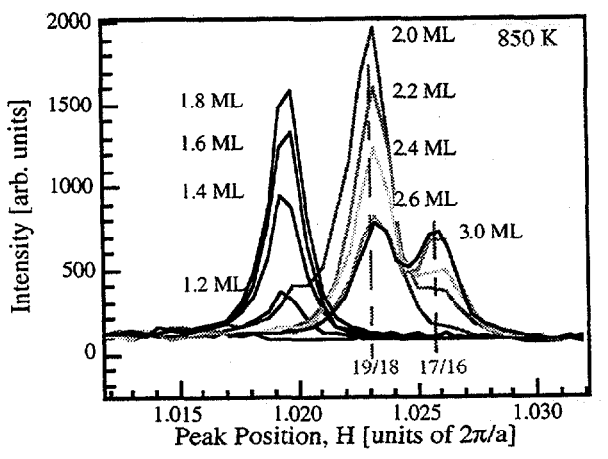

Fig. 2. X-ray scans through one satellite during growth at 850 K. An abrupt peak shift at 2 ML and a second stripe phase above 2 ML are observed.

MAGIC/CRITICAL THICKNESSES AND QUANTUM-SIZE EFFECTS IN ULTRATHIN METAL OVERLAYER EPITAXY[1]

L. Gavioli,[2] K. R. Kimberlin,[3] M. C. Tringides,[3] J. F. Wendelken, K. J. Chao,[4] Ph. Ebert,[4,5] C.-K. Shih,[6] and *Z. Y. Zhang*

It has been widely accepted that the stability of an epitaxial film on a substratre of a different material is determined primarily by the competition between surface tension and stress. However, for ultrathin metal films on semiconductor substrates, recent theoretical studies have shown that the energetics associated with the degrees of freedom of the conduction electrons within the films can play a decisive role, leading to the existence of critical/magic thicknesses for smooth growth.

As an experimental test of the theoreical predictions, the growth and transport properties of thin Ag films on Si(111) have been investigated by scanning tunneling microscopy and in situ resistivity measurements.[1] At low coverage, the Ag adatoms form isolated islands with a magic height and flat tops, rather than commonly observed pyramids. Such plateaus increase their lateral extent with coverage without changing height, forming a percolated network with sharply reduced resistivity above a critical coverage (Fig. 1). This behavior suggests how the quantized electrons confined in the Ag islands could influence the growth.

Separately, Ag films grown on six different III–V compound semiconductors have been investigated by scanning tunneling microscopy and low-energy electron diffraction.[1] It was found that the Ag films on Ga-V semiconductors are well-ordered, atomically flat, and exhibit a substrate-specific critical thickness, while those on In-V semiconductors are still rather flat but significantly more disordered. The morphology of the Ag films can again be qualitatively explained on the basis of the electronic growth mechanism, corresponding to different degrees of charge spilling from the metal side to the substrate side.[1]

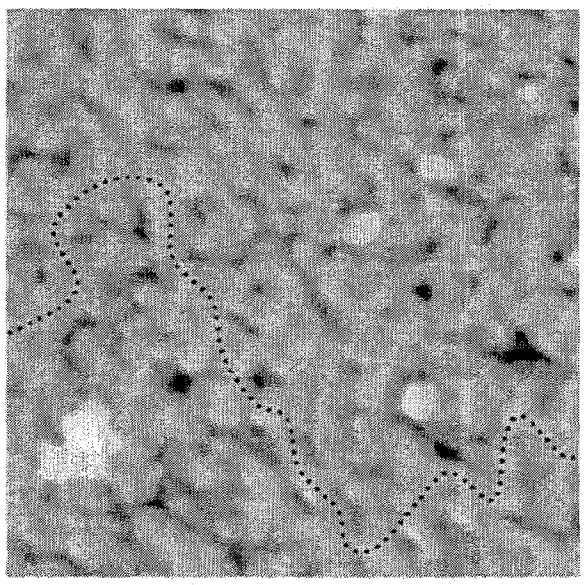

Fig. 1. STM image for an Ag film deposited on Si(111) at 150K and annealed to room temperature. Dotted line illustrates percolation with 3-atomic-layer critical thickness.

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1. Summary of papers: *Phys. Rev. Lett.* **82**, 129 (1999); *Phys. Rev. B* **60**, 4988 (1999).
2. ORNL/ORISE postdoctoral research associate.
3. Iowa State University/Ames Laboratory, Ames, Iowa.
4. University of Texas, Austin, Tex.
5. Forschungszentrum Jülich, Germany.

DETERMINATION OF CRITICAL THICKNESS OF SPIN REORIENTATION IN METASTABLE MAGNETIC ULTRATHIN FILMS[1]

J. Shen,[2] A. K. Swan,[3] and J. F. Wendelken

Spin reorientation of magnetic thin films refers to change of sign of the effective anisotropy constant driven by either thickness or temperature. Critical thickness or critical temperature (i.e., where the spin reorientation occurs) provides important information on magnetic anisotropy constants that play a crucial role in supporting long-range order in magnetic ultrathin films. However, for some films, the situation can be further complicated by the fact that a structural transformation occurs before the spin reorientation, which makes it difficult to study the spin reorientation.

A typical example is the widely studied Fe/Cu(100) ultrathin film system. Both room-temperature (RT) and low-temperature (LT) grown Fe films have a face centered tetragonal (fct) structure up to 4 ML, above which the structure of the films transforms into face-centered cubic (fcc) and body-centered cubic, respectively.

A new approach for studying the "true" critical thickness of the spin reorientation of Fe/Cu(100) films by capping the perpendicularly magnetized fct films (<4 ML) with in-plane magnetized fcc Co(100) films is provided. Spin reorientation would occur when the Co capping layers exceed a certain critical thickness $d_{c,Co}$, as shown in Fig. 1. Figure 2 shows the values of $d_{c,Co}$ as a function of thickness for Fe films grown at RT (solid circles) and LT (open circles). The x-axis interceptions, 4.8 and 3.5 ML, are the values of the critical thickness for spin reorientation of the Fe/Cu(100) films without Co capping for RT and LT films, respectively. The magnetic anisotropy constants of Fe/Cu(100) films can be estimated from Fig. 2. The surface anisotropy constant is about 0.16 ergs/cm^2 (RT) and 0.08 ergs/cm^2 (LT), and the magnetoelastic anisotropy constant is about 1.5×10^7 ergs/cm^3 for both films.

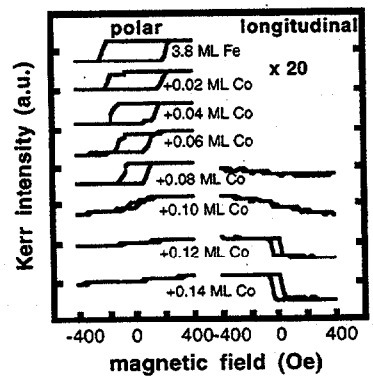

Fig. 1. Kerr hysteresis loops of RT-grown 3.8-ML Fe/Cu(100) film with Co-capped layers. When capped by 0.1 ML of Co, the easy magnetization axis starts to reorient from perpendicular to in-plane direction.

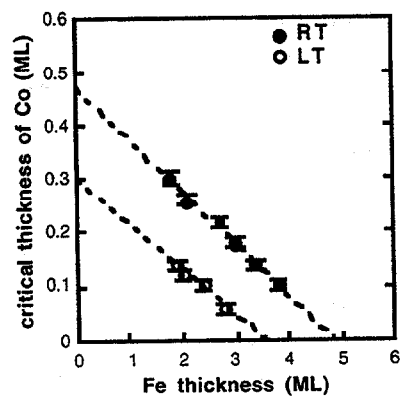

Fig. 2. Critical thickness of Co capping layers as a function of the thickness of the underneath Fe layers. The dashed lines serve to guide the eye.

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1. Summary of paper: *Applied Physics Letters* (in press).
2. ORNL Wigner Fellow.
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TRANSPORT PROPERTIES OF SILICON SURFACES[1]

K. J. Yoo[2], M. Noh[3], A. P. Baddorf, and H. H. Weitering[4]

Transport properties of surfaces and thin films are extremely important in today's device technology, but they are difficult to measure accurately. One major obstacle in the measurement is the difficulty in electrically isolating a surface or thin film from the bulk substrate. The objective of this project was to fabricate electrically isolated surfaces and thin-film materials by ion implantation of an insulating layer beneath the surface and to measure the transport properties of the surface as a function of temperature. This project objective is naturally divided into two goals: (1) to show that surfaces prepared by this method have the same properties as those without the nonconducting subsurface layer and (2) to measure its transport properties.

The first step was to verify that the (100) and (111) surfaces of ultrathin (<500-Å) silicon-on-insulator (SOI) material can be prepared with a structural perfection comparable to the surfaces of bulk Si. Verification has been performed using a variety of surface analysis techniques, including atomic-resolution scanning tunneling microscopy (STM) and ion scattering and ellipsometry. A near-perfect Si(111)7 × 7 reconstruction on a 220-Å thick Si film on SiO_2 is shown in Fig. 1. The ultrathin (100) and (111) Si films are fully depleted of mobile charge carriers, leaving the surface states as the only conduction channel. Indeed, the Si(111)7 × 7 reconstruction appears to be conducting, in contrast to Si(100)2 × 1 which has no electron state density near the Fermi level. Temperature-dependent conductivity measurements on Si(100)2 × 1 conducted under ultrahigh vacuum conditions show an anomaly near $T = 200$ K which likely relates to the $2 \times 1 \rightarrow c(4 \times 2)$ surface charge-density wave phase transition.

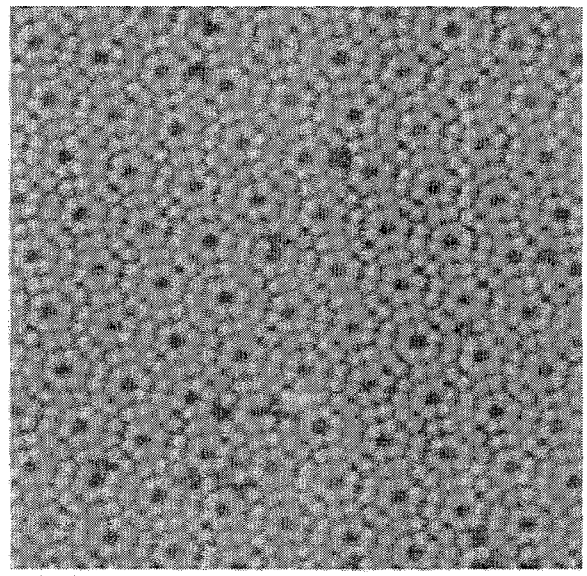

Fig. 1. Atomically resolved STM image from a Si(111)7 × 7 reconstruction on 220-Å thick Si.

This research addresses a very fundamental issue in condensed matter physics; namely, electron transport in reduced dimensional systems. The ultimate goal of these experiments is to correlate the measured conductivities with the band effective masses, density of states at the Fermi level, and the atomic-scale nature and density of the structural defects.

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1. Summary of papers: *Appl. Phys. Lett.* **72**, 2313 (1998); *Applied Physics Letters* (to be published).
2. Graduate student from The University of Tennessee, Knoxville, Tenn.
3. Postdoctoral research associate from The University of Tennessee, Knoxville, Tenn.
4. Guest scientist from The University of Tennessee, Knoxville, Tenn.

Electron Microscopy

ROLE OF SEGREGANTS IN GRAIN BOUNDARIES[1]

M. F. Chisholm, G. Duscher,[2] A. Maiti,[3] Y. Yan,[4] S. J. Pennycook, and S. T. Pantelides[5]

Grain boundaries are the principal microstructural defect in polycrystalline materials. These structures are not only a major disruption of the periodic arrangement of the crystalline lattice but also a prime sink for the segregation of impurities. Thus, it is not surprising that grain boundaries play an extremely important role in the properties of materials. Using the combined techniques of Z-contrast imaging, electron energy loss spectroscopy (EELS), and first-principles density functional theory calculations, the atomic and electronic structures of grain boundaries in semiconductors, ceramics, and metals have been probed. This synergistic application of experiment and theory highlights how the precise atomic configurations of host atoms and impurities determine important segregation phenomena. Below are two recently published examples of this combined theoretical and experimental approach to atomic-scale characterization.

In Si, dopants such as arsenic tend to segregate in grain boundaries and become electrically inactive. The causes and nature of this process are important both for fundamental understanding and technological control. Z-contrast imaging has been used to determine, for the first time, the atomic structure of the boundary and to establish that As segregates to selected sites in this Si boundary. Theoretical calculations show that these are the sites where As atoms can segregate in the form of electrically inactive paired dimers.

In most cases, impurities segregate at substitutional or interstitial sites without significantly affecting the atomic configurations at the boundary. There have also been suggestions and theoretical predictions, however, that segregated impurities may induce a structural transformation of a grain boundary. In Fig. 1, direct atomic-resolution Z-contrast imaging reveals that the experimetal atomic structure of a MgO grain boundary is different from the theoretical (and widely accepted) structure. Additionally, the images show that certain columns in the boundary are brighter than their neighbors. The extra brightness is an indication that impurities with atomic numbers greater than that of Mg are present in the boundary. EELS clearly reveals the impurity is Ca. Theoretical calculations of the total energy of the two structures with and without segregated Ca conclusively demonstrate that the segregant induces a structural transformation of the boundary. This appears to be a mechanical effect; the preferred segregation structure contains sites that can more easily accommodate the larger Ca atom.

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1. Summary of papers: *Phys. Rev. Lett.* **81**, 132 (1998); *Phys. Rev. Lett.* **81**, 3675 (1998).
2. Vanderbilt University, Nashville, Tenn.
3. ORNL/ORISE postdoctoral research associate. Present address: Molecular Simulations, Burlington, Mass.
4. ORNL/ORISE postdoctoral research associate. Present address: National Renewable Energy Laboratory, Golden, Colo.
5. Vanderbilt University/ORNL Distinguished Visiting Scientist.

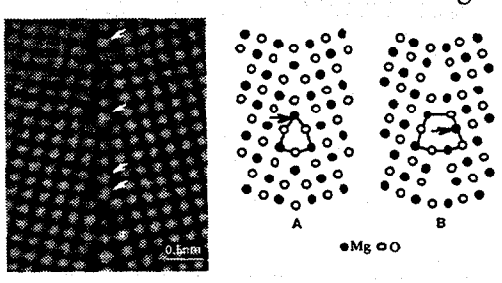

Fig. 1. Z-contrast image of 24° [001] tilt boundary in MgO. White arrows highlight columns with extra intensity. Boundary structure schematic (A) is the model directly determined from the image. Model (B) is the calculated equilibrium structure of pure MgO [001] tilt boundaries. The site with the largest Ca segregation energy for both structures is indicated with a black arrow.

DIRECT EXPERIMENTAL OBSERVATION OF THE ATOMIC STRUCTURE AND LOCAL ELECTRONIC STRUCTURE OF THREADING DISLOCATIONS IN GaN THIN FILMS[1]

Y. Xin,[2] E. M. James,[3] N. D. Browning,[3] and S. J. Pennycook

The benign effect of a high density of threading dislocations[4] on GaN high-efficiency light-emitting diodes has led to considerable interest in determining their fundamental properties. Although early work[4] suggested that threading dislocations are not nonradiative recombination centers, abundant evidence recently indicates dislocations are optically and electrically active and might be negatively charged.[5]

These experiments used both a 200-kV JEOL 2010F and a 300-kV VG HB603U field emission microscope, which have point resolutions of ~0.14 nm. The experimental setup allows atomic-resolution Z-contrast imaging and electron energy loss spectroscopy (EELS) to be obtained at the same time. Figure 1(a) shows a Z-contrast image of a threading dislocation with pure edge component, showing the core to consist of an eightfold ring. The core column clearly contains significant Ga concentration, contrary to theoretical predictions.[1]

EELS [Fig. 1(b)] showed dramatic changes in the nitrogen K-edge fine structure on and off the dislocation core, reflecting broken C6v symmetry in the core region. No states were observed in the band gap. This experimental determination of atomic and electronic structure, in combination with theory, is a powerful means for elucidating the effects of extended defects on device performance.

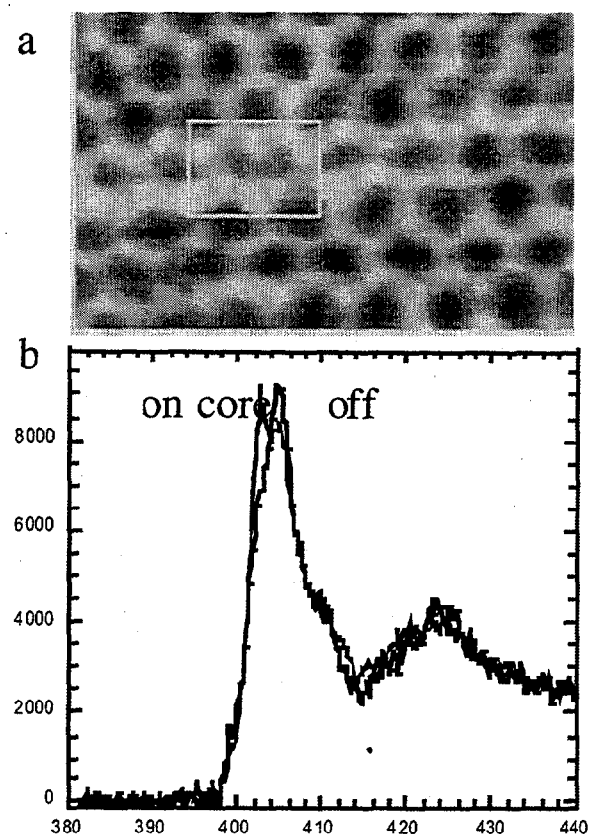

Fig. 1. (a) Atomic-resolution Z-contrast image of an end-on pure edge dislocation showing an eightfold ring core and (b) atomic-resolution EELS of N-K edge on and off dislocation core showing the fine structure changes.

1. Summary of Paper: *Appl. Phys. Lett.* **72**, 2680, 1999.
2. ORNL/ORISE postdoctoral research associate.
3. University of Illinois at Chicago, Chicago, Ill.
4. S. D. Lester et al., *Appl. Phys. Lett.* **66**, 1249 (1995).
5. A. F. Wright and U. Grossner, *Appl. Phys. Lett.* **73**, 2751 (1998); K. Leung et al., *Appl. Phys. Lett.* **74**, 2495 (1999).

CRYSTALLINE OXIDES ON SILICON[1]

M. F. Chisholm, F. J. Walker,[2] and R. A. McKee[3]

Since the introduction of metal-oxide-semiconductor capacitors in the early 1960s, the electronic industry has relied on silica (SiO_2) as the gate dielectric in field effect transistors. Continuing miniaturization of these devices, however, will soon reduce the gate-oxide thickness to the point where the resulting tunneling currents will become so large that they will make transistor design untenable. In addition to excessive tunneling currents, the interface between the amorphous SiO_2 film and silicon contains a high density of defects that must be passivated. An alternative gate dielectric composed of a crystalline oxide could, in principle, address both of these shortcomings. For example, the titanate perovskites have dielectric constants that are one to three orders of magnitude larger than that of SiO_2 and a lattice constant that can be exactly matched with that of silicon.

A number of attempts to grow crystalline oxides on silicon have been made, but until the recent ORNL achievement, these have all been unsuccessful. The problem has been that silicon oxides have invariably formed at the interface between silicon and the deposited film. The ORNL process not only protects the silicon surface from reaction with oxygen, but also promotes the epitaxial growth of crystalline oxides that are completely lattice matched with silicon (no interfacial defects).

The perfection of the physical structure has been found to couple directly to its electronic structure. A metal-oxide-semiconductor capacitor using $SrTiO_3$ as an alternative to SiO_2 yields an equivalent oxide thickness of 8 Å. It has also been demonstrated that a transistor with a crystalline oxide gate exhibits electron mobility that rivals state-of-the-art SiO_2 field effect transistor behavior. These results suggest that crystalline oxides on semiconductors may be the long-awaited alternative to the SiO_2 gate.

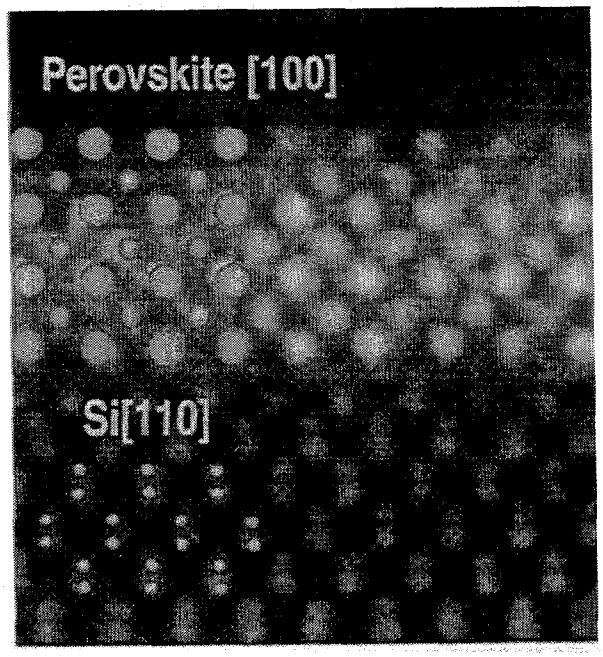

Fig. 1. Z-contrast image of a commensurate $SrTiO_3$ film on (001) Si with no interfacial reaction layer.

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1. Summary of paper: *Phys. Rev. Lett.* **81**, 3014 (1998).
2. The University of Tennessee, Knoxville, Tenn.
3. Metals and Ceramics Division, ORNL.

HYDROGEN IN γ-ALUMINA[1]

K. Sohlberg,[2] S. J.Pennycook, and S. T. Pantelides[3]

Two seemingly unrelated debates concerning the composition and structure of γ-alumina have long resisted resolution, despite the fact that it is technologically one of the most important catalytic materials.

First, it is widely held that γ-alumina has a defect spinel structure, with a fraction of the spinel cation sites vacant. The distribution of the vacancies over the two cation sublattices has never been satisfactorily decided, however. Second, numerous chemical analyses of γ-alumina have found non-negligible hydrogen content, but because none of these techniques gives structural information, the hydrogen was typically dismissed as an impurity.

Computational studies on γ-alumina have been carried out, and it was found that both controversies have a single resolution.[1] The calculations reveal that γ-alumina is a series of compounds of the form $H_{3m}Al_{2-m}O_3$ and that H is mobile at elevated temperatures. As shown in Fig. 1, the $n = 0.2$ form [where $m = 2n/(n + 3)$] is energetically stable with respect to H-gain or loss. The calculations demonstrate that this hydrogen mobility is dominated by classical site-to-site hopping with negligible quantum-mechanical tunneling. Figure 2 shows the diffusion pathway.

Results for H diffusion, density as a function of H content, and OH vibrational modes are in excellent agreement with experimental data. It has also been found that the variability in hydrogen content gives rise to a very unusual surface chemistry with profound implications for the role of γ-alumina in catalysis.

Understanding this surface chemistry also allows us to understand some perplexing results obtained with the latest experimental techniques: (1) The filling of surface vacancies with Pt atoms results in Pt_3 clusters *precisely matching* those observed by atomic-resolution electron microscopy of ultradispersed Pt on a γ-alumina surface.[4] (2) A massive spontaneous reconstruction[5] of the γ-alumina surface depletes all three-coordinated Al from the surface, as observed by cross-polarized ^{27}Al surface NMR.

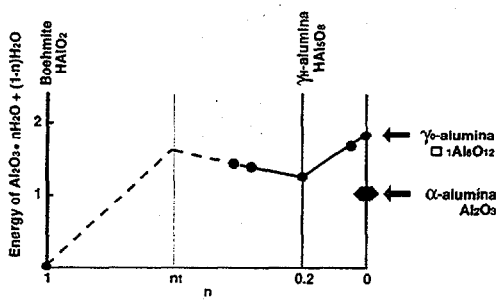

Fig. 1. Total energy vs. hydrogen content.

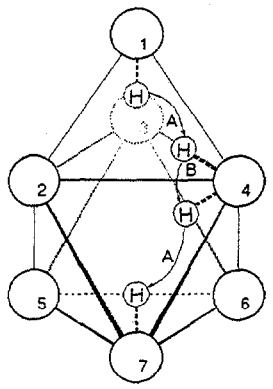

Fig. 2. Pathway for hydrogen diffusion.

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1. Summary of paper: *J. Am. Chem. Soc.* **121**, 7493 (1999).
2. ORNL/ORISE postdoctoral research associate.
3. Vanderbilt University/ORNL Distinguished Visiting Scientist.
4. P. D. Nellist and S. J. Pennycook, *Science* **274**, 413 (1996).
5. K. Sohlberg, S. J. Pennycook, and S. T. Pantelides, *Journal of the American Chemical Society* (in press).

SUB-ÅNGSTROM RESOLUTION THROUGH INCOHERENT TRANSMISSION ELECTRON MICROSCOPY[1]

P. D. Nellist[2] and S. J. Pennycook

It is over 100 years since Lord Rayleigh first pointed out the advantages of incoherent imaging[3]—freedom from interference artifacts and a potential factor of 2 gain in image resolution. For many years, it has been possible to see the advantages of the direct interpretability of the incoherent Z-contrast image in the scanning transmission electron microscope (STEM). The factor of 2 improvement in resolution has now been demonstrated using the VG Microscopes HB603U 300-kV STEM at ORNL. Although the conventional coherent phase contrast point resolution of this microscope is 1.9 Å, under incoherent imaging conditions, information transfer is observed to 0.78 Å. This is the highest image resolution ever achieved in any microscope and well demonstrates the benefit of incoherent imaging with electrons.

Figure 1 shows Si[110] imaged under optimum conditions, allowing the {004} dumbbell spacing of 1.36 Å to be resolved. The Fourier transform of the image intensity confirms the presence of the {004} spatial frequency to the image. The lower panels of Fig. 1 show the image of Si[112] in which the dumbbell spacing is only 0.78 Å. Using a larger than optimum objective aperture size and underfocused objective lens, sub-Ångstrom information transfer is confirmed by the presence of the {444} spot in the Fourier transform.

In coherent phase contrast imaging, chromatic aberration effects cause strong damping of the image contrast at high spatial frequencies because of the rapid oscillation of the transfer function. Under incoherent imaging conditions, such effects are greatly reduced because of the predominance of symmetric interference paths through the objective lens. With the recent demonstration of spherical aberration correction in the STEM,[4] incoherent imaging thus appears to be a practical route to sub-Ångstrom electron microscopy.

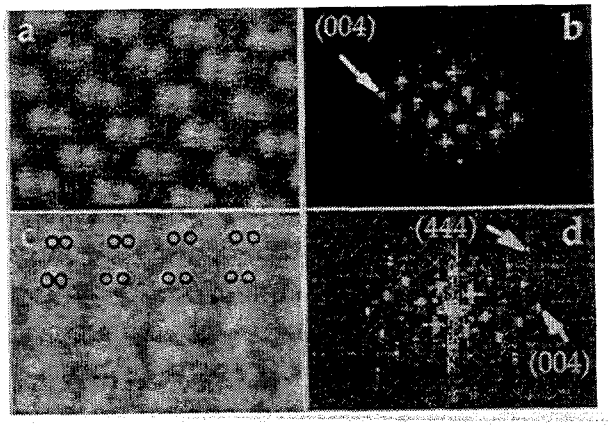

Fig. 1. Incoherent images of (a) Si [110] resolving the 1.36-Å {004} dumbbell spacing as shown in the power spectrum (b). Sub-Ångstrom resolution is demonstrated in the image of Si[112] (c) by the presence of the 0.78-Å {444} spot in (d). Circles in (c) denote atom positions.

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1. Summary of paper: *Phys. Rev. Lett.* **81**, 4156 (1999).
2. University of Birmingham, United Kingdom..
3. Lord Rayleigh, *Philos. Mag.* **42**, 167 (1896).
4. O. L. Krivanek, N. Delby, and A. R. Lupini, *Ultramicroscopy* 78, 1 (1999).

TOWARD ATOMIC COLUMN-BY-COLUMN SPECTROSCOPY[1]

B. Rafferty[2] and S. J. Pennycook

The ultimate goal of analysis in the electron microscope is core-level and valence-band spectroscopy of individual atomic columns. It has been accepted that object functions for inelastic scattering will always have a larger physical extent than their elastic counterparts. The actual difference in sizes, however, has not been quantified accurately, and the manipulation of experimental configurations has not been considered in detail. Previous authors have carried out some calculations of inelastic object functions, but the theory and the level of approximation have differed greatly. Maslen and Rossouw[3] developed a fully quantum mechanical (*e*, 2*e*) scattering theory to describe the inelastic scattering of a fast electron by an isolated hydrogenic atom. Others[4] did not separate the electron probe from the object function, and while claiming to carry out fully quantum mechanical calculations, close scrutiny showed that matrix elements had been ignored, leaving a purely classical, geometrical result, as in Ref. 5. They concluded that resolutions of at best ~5–7 Å could be achieved in an inelastic image.

Full quantum mechanical calculations based upon the theory of Maslen and Rossouw[3] were performed. The main assumption was that the object functions would be significantly smaller than the probe size so that incoherent scattering conditions could be established and the probe removed from the scattering process (this turns out to be an accurate assumption). Once incoherent imaging conditions were established for the inelastically scattered electrons, the next logical step was to dispense with the conventional circular collector aperture and replace it with an annular aperture. Results of the calculations showed that even for circular apertures, imaging resolutions of less then 2 Å could be achieved readily, and with annular apertures, the imaging resolution would be close to that dictated by the size of the electron probe alone (1.3 Å) (Fig. 1). The calculations further indicate the possibility of significant resolution improvement with acceptable signal through the use of an annular aperture of inner radius of 20 mrads.

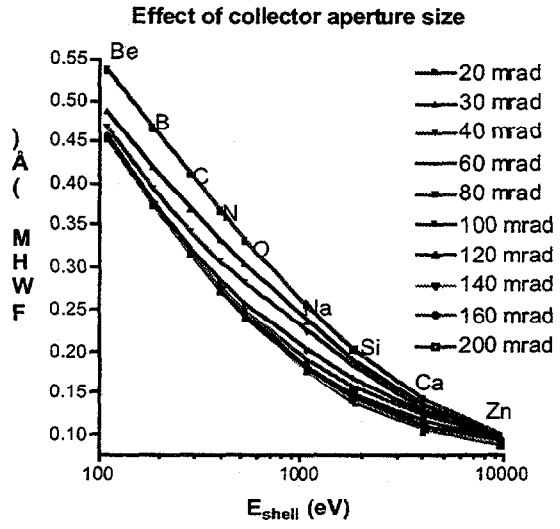

Fig. 1. Widths of inelastic object functions for several K-shell excitations.

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1. Summary of paper: *Ultramicroscopy* **78**, 111 (1999).
2. ORNL/ORISE postdoctoral research associate.
3. V. W. Maslen and C. J. Rossouw, *Philos. Mag.* **49**, 735 (1984); C. J. Rossouw and V. M. Maslen, *Philos. Mag.* **49**, 743 (1984).
4. H. Kohl and H. Rose, *Adv. Elect.* **65**, 173 (1985); D. Muller and J. Silcox, *Ultramicroscopy* **59**, 195 (1995).
5. J. D. Jackson, *Classical Electrodynamics*, Wiley, New York, 1975.

THREE-DIMENSIONAL STRUCTURE INFORMATION FROM Z-CONTRAST STEM IMAGING[1]

A. V. Kadavanich,[2] S. J. Rosenthal,[3] and S. J. Pennycook

Knowledge of the exact three-dimensional shape of individual nanocrystalline particles such as quantum dots or catalyst particles is critical to understanding their electronic, optical, or catalytic properties. In Z-contrast scanning transmission electron microscopy (STEM), image intensity depends not only on atomic number, but when the atoms are arranged in columns, it also depends on the number of atoms present (i.e., the column thickness).[4]

To this end, colloidal CdSe nanocrystals embedded inside polymer films have been studied. The shape of such nanocrystals is sufficiently established[5] to serve as a first-order testing standard. The Z-contrast STEM image of such a nanocrystal is shown in Fig. 1, together with the maximum entropy (MaxEnt) reconstruction of its object function. The dumbbell shape of the CdSe atoms pairs is resolved, and from the intensity difference between Cd columns and Se columns, the polarity of the crystal lattice can be assigned. Also shown are plots of the intensity versus position for each axis of the nanocrystal. The thickness envelope of the latter neatly follows the expected shape profile.[5]

In principle, absolute thicknesses can be extracted from the intensity differences of different columns but requires intensity measurements with better than 7% precision. Currently limited by signal-to-noise ratio, this will improve dramatically as sub-Ångstrom probes become available, making possible an accurate three-dimensional reconstruction of nanocrystal atomic structure.

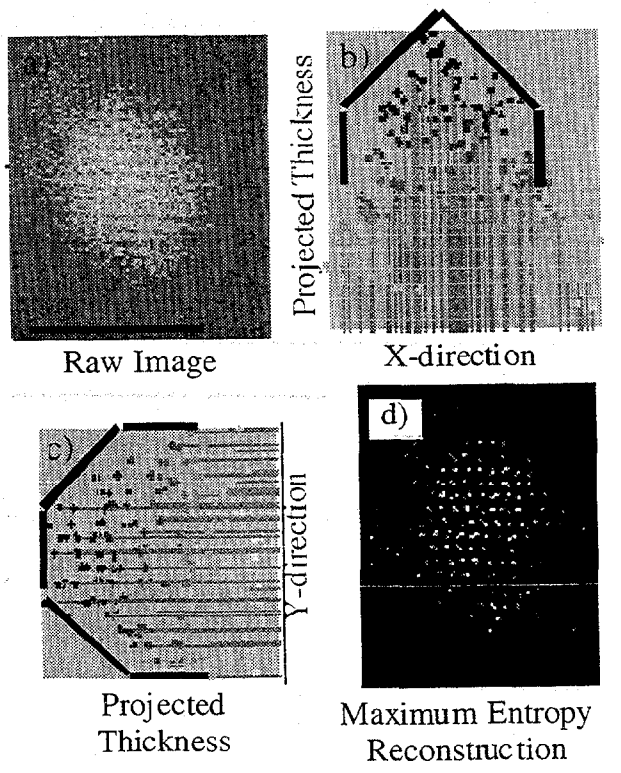

Fig. 1. (a) Z-STEM image of CdSe nanocrystal, (d) MaxEnt reconstruction of image (b), (c) integrated intensity of each dumbbell column projected along the image axes. Thick lines indicate the expected thickness envelope.

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1. Summary of paper to be published.
2. ORNL/ORISE postdoctoral research associate.
3. Vanderbilt University, Nashville, Tenn.
4. S. J Pennycook and D. E. Jesson, *Phys. Rev. Lett.* **64**, 938 (1990).
5. J. J. Shiang et al., *J. Phys. Chem.* **99**, 17417 (1995).

OBSERVATION OF IODINE ATOMIC CHAINS IN I-DOPED CARBON NANOTUBES[1]

X. Fan,[2] E. C. Dickey,[3] S. J. Pennycook, L. Grigorian,[3] P. C. Eklund,[3] R. Buczko,[4] and S. T. Pantelides[5]

Single-wall carbon nanotubes (SWNT) were doped with iodine, resulting in charge transfer and modified electronic properties. This behavior is in contrast to graphite and fullerenes, which do not form charge transfer compounds with iodine. Here, a combination of Z-contrast imaging and first-principles density-functional calculations were used to explain the doping mechanism.

Conventional phase contrast electron microscopy is primarily sensitive to the carbon structure, whereas Z-contrast microscopy provides a direct image of the iodine distribution. In comparing the two images recorded simultaneously, it is seen that the iodine is incorporated within particular nanotubes, but not in others. In the high-resolution Z-contrast image of Fig. 1, two chains of iodine atoms are visible. The maximum separation of the two strands is ~6 Å, much less than the diameter of the SWNT. It is clear that the iodine atomic chains are inside the nanotube, and the changing spacing of the two strands suggests that the chains spiral along the walls in the form of a double helix. Single iodine atoms are quite sensitive to the electron irradiation, causing atom displacement. Therefore, further studies with density-functional calculations were performed to confirm the preferred iodine-carbon configuration. Using a simple iodine chain $(I_5)^-$ and a curved graphene sheet, it was found that it is stable if the iodine is on the inner side of graphene, but not stable outside or above a flat graphene sheet. This is consistent with the fact that iodine does not intercalate graphite because of a mismatch in bond lengths. Inside the tube, however, the chain can easily adjust its configuration so that each iodine atom correlates with the center of a carbon-carbon bond, the site of intercalation in graphite, while keeping the preferred iodine bond length. This atomic configuration naturally explains the spiral nature of the iodine chain within the nanotube.

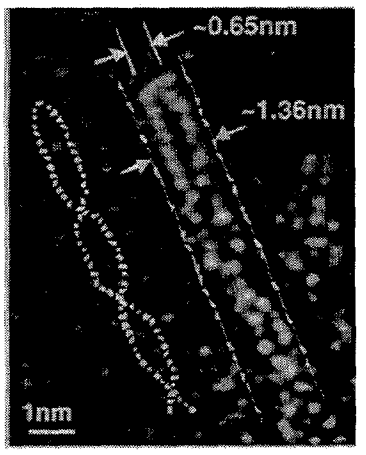

Fig. 1. Z-contrast image of iodine-doped SWNT showing a double helix atomic chain of iodine inside a nanotube. The schematic of the double helix is shown on the left. The nanotube wall positions are indicated by two dashed line with 1.36-nm distance apart. The actual nanotube wall is not visible in the Z-contrast dark field image.

This combined experimental and theoretical approach has succeeded in revealing the stable iodine configurations and the doping mechanism, information that is essential for understanding and controlling the electronic properties of carbon nanotubes.

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1. Summary of paper to be published.
2. ORNL/ORISE postdoctoral research associate and University of Kentucky, Lexington, Ky.
3. University of Kentucky, Lexington, Ky.
4. Postdoctoral research associate from Vanderbilt University, Nashville, Tenn.
5. Vanderbilt University/ORNL Distinguished Visiting Scientist.

DIRECT OBSERVATION OF SUBCRITICAL FLUCTUATIONS AND NANOSCALE STRAIN MAPPING DURING QUANTUM DOT FORMATION[1]

D. E. Jesson, M. Kästner,[2] B. Voigtländer,[2] V. A. Shchukin,[3] M. F. Chisholm, and S. J. Pennycook

The strain-induced roughening of lattice mismatched films during heteroepitaxy is receiving considerable attention as a potential means of fabricating quantum dot arrays for novel device applications. Subcritical fluctuations which occur during the important nucleation phase of 3D islands have been directly imaged using scanning tunneling microscopy (STM) (Fig. 1). Surprisingly, the fluctuations consist of several hundred atoms, even at relatively low growth temperatures and are consistent with classical nucleation concepts. The islands, once nucleated, elastically interact. A new method using scanning transmission electron microscopy to directly image columnar bending and, hence, the elastic relaxation of quantum dots, has been developed.

Based on these observations, a new theoretical treatment has been developed to describe the subsequent growth and coarsening of quantum dots in the presence of elastic interactions. This has important implications for creating dots of uniform size and spacing.

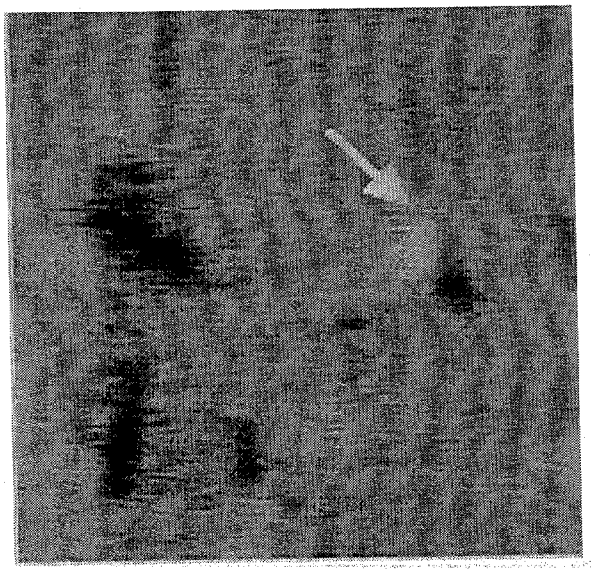

Fig. 1. STM image of Ge deposited on Si(001) at 300°C. A subcritical fluctuation (arrowed) consisting of 270 atoms occurs adjacent to a two-monolayer-deep pit.

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1. Summary of papers to be published.
2. Forschungszentrum Jülich, Germany.
3. A. F. Ioffe Physical Technical Institute, St. Petersburg, Russia.

X-Ray Diffraction

X-RAY MICROBEAM STUDY OF THE GROWTH OF EPITAXIAL OXIDE FILMS ON TEXTURED METAL SUBSTRATES[1]

J. D. Budai, N. Tamura,[2] D. P. Norton, B. C. Larson, G. E. Ice,[3]
J.-S. Chung,[2,3] C. Park,[2] J. Z. Tischler, and W. P. Lowe[3]

The availability of intense, focused x-ray microbeams at synchrotron facilities has enabled new techniques for materials studies. The ORNL x-ray microbeam facility, constructed in collaboration with the MHATT-CAT beam line at the high-brightness Advanced Photon Source (APS) uses elliptically shaped mirrors to focus either white or monochromatic x-ray beams to diameters as small as ~0.7 μm. In a white-beam mode, a CCD detector records Laue patterns from each illuminated grain, and automated pattern analysis yields a 3-D grain orientation (resolution $\Delta\theta \sim 0.01°$) and complete 3-D deviatoric strain tensor.

X-ray microdiffraction has been used to study epitaxial growth of multilayer films consisting of oxide buffer layers and superconductors (YBCO) on rolling-assisted biaxially textured substrates (RABiTS).[5] Nickel substrates were rolled and recrystallized to produce cube texture, and epitaxial oxide films (CeO_2/YSZ/YBCO) were sequentially deposited by pulsed-laser ablation. Microbeam Laue patterns, such as those shown in Fig. 1, were collected from individual grains and analyzed to obtain the crystallographic orientation and strain within each epitaxial layer. X-ray microbeams enable local measurements from a large number of different vicinal grains grown under identical growth conditions on a single sample; i.e., a combinatorial approach. Such measurements were previously unavailable.

Results reveal that successive film layers are not strictly epitaxial; rather, each heteroepitaxial layer exhibits a crystallographic tilt. Typically, it was found that the tilt angle depends linearly on the vicinal angle for a particular grain in the substrate. The slope of the tilt dependence on substrate vicinal angle can be explained for many of our samples by a geometrical lattice-mismatch deformation model. Growth kinetics, surface energy, and growth modes, however, are all found to play important roles during epitaxial growth.

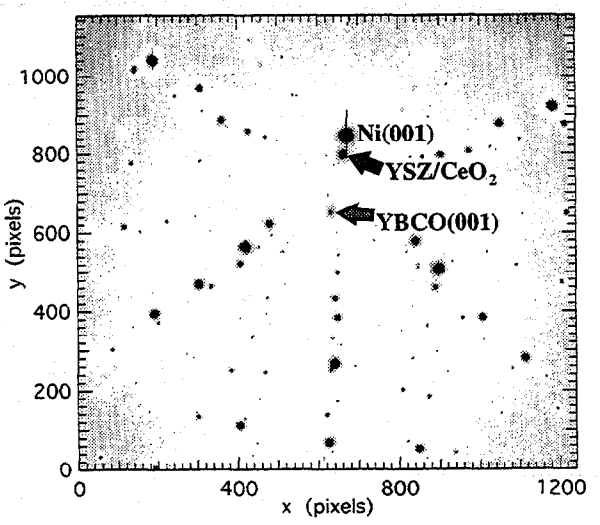

Fig. 1 CCD image showing separate (001) x-ray Laue patterns from each layer of the epitaxial multilayer.

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1. Summary of paper to be published.
2. ORNL/ORISE postdoctoral research associate
3. Metals and Ceramics Division, ORNL.
4. Howard University, Washington, D.C.
5. D. P. Norton et al., *Science* **274**, 755 (1996).

X-RAY MICROBEAM INVESTIGATION OF THE DEPTH DEPENDENCE OF ION-IMPLANTATION-INDUCED DEFECTS[1]

M. Yoon,[2] B. C. Larson, J. Z. Tischler, T. E. Haynes, and P. Zschack[3]

The lattice defects produced during ion-implantation doping of semiconductors is a long-standing problem for semiconductor process design, as well as for fundamental understanding of damage production and defect evolution. In particular, the spatial separation of vacancies and the displaced interstitials leads to a vacancy-rich region below the projected range of the implanted ions.[4]

Submicron x-ray beams have been used on the UNI-CAT beam line at the Advanced Photon Source to make the first cross-section x-ray scattering measurements of the depth dependence of concentration, size distribution, and vacancy/interstitial nature of clustered defects in MeV ion-implanted Si. Si wafers with <001> orientation were implanted at 300°C with 9×10^{16} cm^{-2} Si ions, and Fresnel zone plate focusing optics were used to perform x-ray Bragg diffuse scattering measurements with ~0.65-μm resolution.

The inset in Fig. 1 shows a cross-section depth profile of the x-ray diffuse scattering near the (220) reflection. The abrupt rise denotes the crystal surface, and a large peak arises at the projected range of the implanted Si ions. Figure 1 shows the measured diffuse scattering (at the arrow positions) scaled by q^4 to emphasize the large-q "local-Bragg" scattering region. The scattering from interstitial and vacancy-type clusters is distributed to opposite sides of the ($q = 0$) Bragg position and is peaked at q-values inversely proportional to the size of loop-type defects.[5] The solid lines are fits of the data by scattering calculations for vacancy and interstitial dislocation loops, with loop concentrations for radii of 5 to 50 Å as parameters.

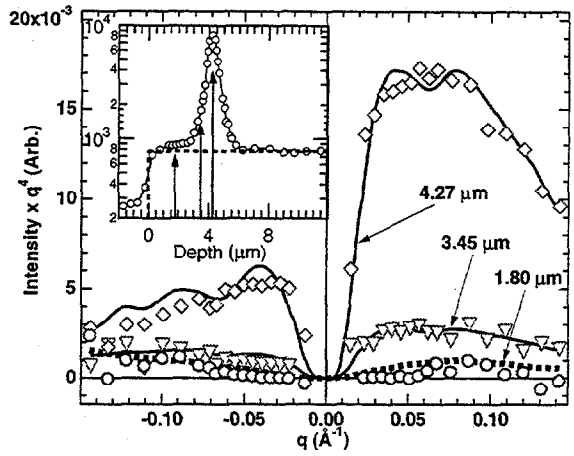

Fig. 1. Depth–resolved diffuse scattering (scaled by q^4) for self-ion-irradiated Si near the (220) reflection. The arrow positions denote measurement positions in the inset.

The strong intensity for positive-q at 4.25 μm indicates interstitial type clusters corresponding to the large number of implanted ion interstitials at the projected range, while the small increase in scattering for negative-q at 1.8 μm indicates an excess of vacancy-type clusters in this region. Measurements with improved spatial resolution and varying implant conditions are in progress.

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1. Summary of paper: *Appl. Phys. Lett.* **75**, 2791 (1999).
2. ORNL/ORISE postdoctoral research associate.
3. UNI-CAT and MRL–University of Illinois, Urbana, Ill.
4. O. W. Holland, B. Nielsen, and D. S. Zhou, *J. Electron. Mater.* **25**, 99 (1996).
5. B. C. Larson and F. W. Young, Jr., *Phys. Status Solidi (a)* **104**, 273 (1987).

MICROSTRUCTURE OF GaN NANOCRYSTALS IN SAPPHIRE SYNTHESIZED BY ION IMPLANTATION

J. D. Budai, C. W. White, A. Meldrum,[1] L. E. McNeil,[2] S. P. Withrow, and R. A. Zuhr

High-dose ion implantation, followed by precipitation during thermal annealing, has been shown to provide a versatile technique for creating a wide variety of semiconductor nanocrystals embedded in transparent substrates such as sapphire.[3] Processing conditions control the microstructure and, hence, physical properties of GaN nanocrystals formed in sapphire by Ga and N ion implantation and annealing.

In general, the GaN nanocrystals possess a hexagonal wurtzite structure and are three-dimensionally aligned with respect to the sapphire substrate in the orientation commonly observed for epitaxial films. The final microstructure, however, depends strongly on the implantation and annealing conditions. In particular, the precipitate size is found to be greatly affected by the implantation order. Under otherwise identical conditions, implanting Ga followed by N produces much smaller precipitates than implanting N followed by Ga. In Fig. 1, the GaN x-ray correlation length changed from 35 to 100 Å simply by reversing the implantation order. This large size effect has been explained by the formation of gas bubbles (i.e., large nucleation sites) when N is implanted first.

Damage accumulation during implantation also plays a dominant microstructural role. Low-temperature (LN_2), high-dose implantation leads to substrate amorphization in a surface region. Implanted ions subsequently move with the recrystallization interface during annealing, resulting in an almost complete ion loss at the surface. In contrast, recrystallization of a buried amorphous zone results in movement of the implanted ions to form a continuous GaN layer.

Although photoluminescence measurements from samples containing GaN nanocrystals reveal peaks at 3.31 and 3.37 eV, similar peaks from samples implanted with only Ga ions have been found. This suggests that photoluminescence peaks previously attributed to GaN films are actually defect-related spectral features.

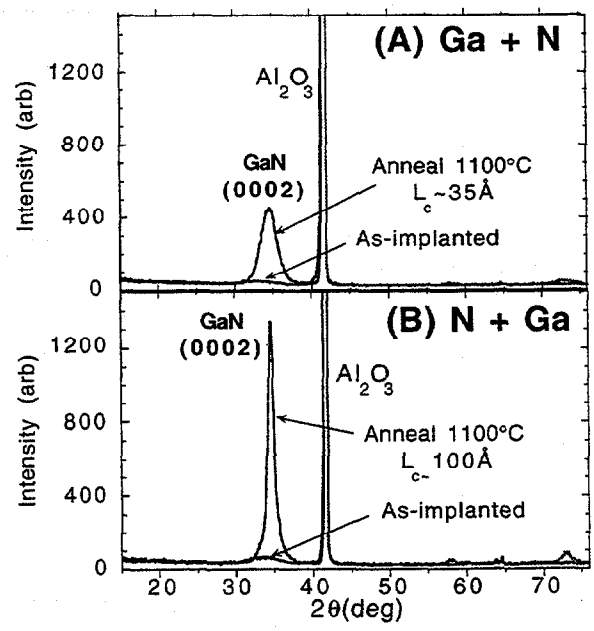

Fig. 1 X-ray θ–2θ scans from sapphire substrates implanted with (a) Ga then N or (b) N then Ga ions at 550°C, followed by annealing at 1100°C.

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1. ORNL/ORISE postdoctoral research associate. Present address: University of Edmonton, Alberta, Canada.
2. University of North Carolina, Chapel Hill, N.C.
3. J. D. Budai et al., *Nature* **390**, 384 (1997).

TIME-RESOLVED STUDIES OF $SrTiO_3$ HOMOEPITAXY BY SYNCHROTRON X-RAY SURFACE DIFFRACTION

G. Eres, J. Z. Tischler, M. Yoon,[1] B. C. Larson, D. H. Lowndes, C. M. Rouleau,[2] and P. Zschack[3]

The ability to monitor the evolution of atomic-scale surface structures in *real time* facilitates fundamental studies of the mechanisms governing thin-film growth. Interference between the substrate and the overlayer scattering along crystal truncation rods (CTR) provides surface structure information, and the abrupt nature of pulsed-laser ablation (PLA) allows measurements of surface structural changes both during and after arrival of the ablation plume. Measurements of off-specular CTRs provide information on the incorporation of atoms parallel to the surface, while specular reflections provide information on atomic structure perpendicular to the surface.

The high brilliance of the Advanced Photon Source has been used to make time-resolved surface diffraction measurements of PLA $SrTiO_3$ homoepitaxial growth. On the UNI-CAT beam line, intensities in the range 10^4–10^5 cts/s are typical for $SrTiO_3$ at CTR anti-Bragg positions, making possible time-slice measurements of surface diffraction rods with 5-ms resolution. Figure 1 shows time-resolved x-ray diffraction measurements made at the (0 0 1/2) specular anti-Bragg position during homoepitaxial growth of $SrTiO_3$. As for reflection high-energy electron diffraction (RHEED), the oscillations correspond to the growth of monolayers of $SrTiO_3$. Superimposed on the RHEED-like oscillations are a beating pattern with a period of two oscillations and a fine structure corresponding to the arrival of single-laser pulses at 10-s intervals.

The beating in the oscillations provides information on the stoichiometry of the deposited layer, and the short transients following individual laser pulses provide time-resolved information on the deposition and surface aggregation/crystallization aspects of film growth governed by the balance between diffusion and ordering kinetics. Detailed modeling of the deposited film stoichiometry, deposition transients, and multiple-layer growth effects are in progress for measurements under varying temperature and growth conditions.

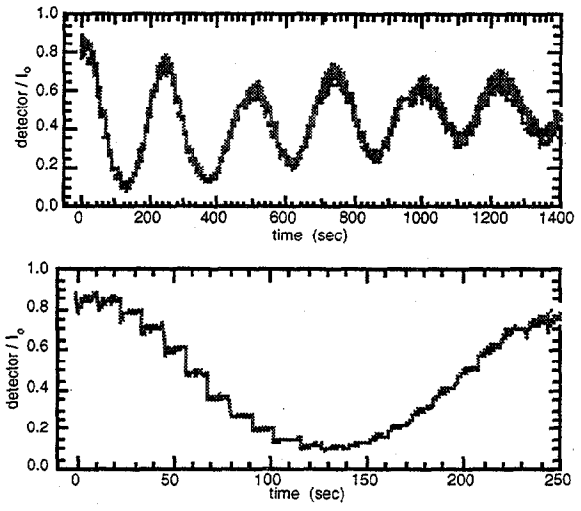

Fig. 1. Time-resolved diffraction for $SrTiO_3$ homoepitaxy at (0 0 1/2) anti-Bragg position. (a) oscillations from layer-by-layer growth and (b) expanded view of single-pulse reflectivity transients in the first oscillation.

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1. ORNL/ORISE postdoctoral research associate.
2. ORNL Wigner Fellow.
3. UNI-CAT and MRL–University of Illinois, Urbana, Ill..

IN SITU X-RAY DIFFRACTION STUDY OF PLD GROWTH OF ZnO-Al_2O_3[1]

J. Z. Tischler, G. Eres, M. Yoon,[2] B. C. Larson, D. H. Lowndes, J. D. Budai, and P. Zschack[3]

Pulsed-laser deposition (PLD) provides epitaxial film and heterostructure growth conditions that result in materials properties not available by near-equilibrium growth methods. A PLD film-growth chamber for in situ time-resolved x-ray diffraction investigations of the deposition and crystallization processes on the UNI-CAT undulator beam line at the Advanced Photon Source has been constructed. The film-growth chamber is mounted on a six-circle x-ray diffractometer where a rotatable mirror reflects excimer laser pulses onto the ablation target as the chamber is rotated for surface diffraction measurements.

Initial film-growth measurements on this system were made to investigate heteroepitaxial PLD growth of ZnO on Al_2O_3. ZnO is of strong interest both as a wide band-gap semiconductor and as a substrate for lattice-matched growth of GaN films. Time-slice x-ray crystal truncation rod (CTR) measurements made after each excimer laser ablation pulse during growth of ZnO on Al_2O_3 at 400° revealed the surface structure transients associated with ZnO aggregation and crystallization to have ~2-s time constants following the abrupt (<1-ms) deposition of laser ablation pulses. Specular CTR anti-Bragg measurements at the sapphire (0 0 5/2) position showed only a single-growth oscillation, indicating a clustering tendency rather than layer-by-layer growth. Off-specular CTR measurements showed thermally activated relaxation of the 17% lattice mismatch between ZnO and Al_2O_3. As shown in Fig. 1, a broad, nearly relaxed ZnO diffraction peak appears after the deposition of 3 monolayers at 400°C (~25 shots/monolayer), while a sharper and more fully relaxed ZnO peak

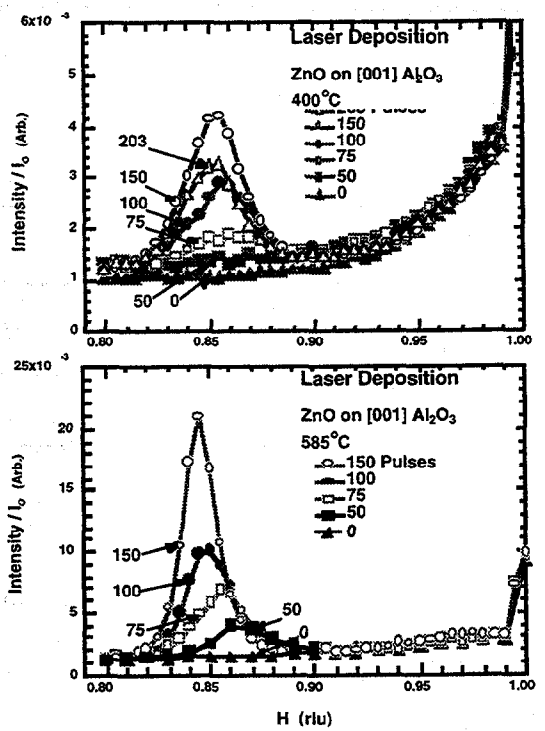

Fig. 1. CTR x-ray diffraction measurements along the (H H 0.3) direction showing highly relaxed ZnO after 2 monolayers.

appears after only 2 monolayers at 585°C. The observation of rapid lattice relaxation of ZnO is consistent with TEM observations of misfit dislocations only at the ZnO-Al_2O_3 boundary, which is of importance for growing ZnO films with good electrical properties and for use as GaN substrates.

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1. Summary of paper to be published.
2. ORNL/ORISE postdoctoral research associate.
3. UNI-CAT and MRL–University of Illinois, Urbana, Ill.

INELASTIC X-RAY STUDY OF CORRELATION AND BAND STRUCTURE EFFECTS IN A SIMPLE METAL[1]

B. C. Larson, J. Z. Tischler, A. Fleszar,[2] and A. G. Eguiluz[3]

Understanding electronic interactions and correlations is central to obtaining a full description of condensed matter physics. Although the jellium model is often used as a starting point for the dynamical response of nearly free electron metals, it has long been appreciated that the ion-core lattice must be taken into account in analyzing energy loss spectra, even for materials with weak pseudopotentials.

High-resolution inelastic x-ray scattering measurements and first-principles dynamical response calculations have been used to determine the impact of the inhomogeneous positive-ion potential on electronic energy-loss spectra of simple metals. The measurements were performed on Al using the X21 beam line at the National Synchrotron Light Source, and the response calculations included the band structure for Al and local-field effects in the time-dependent extended local density approximation (TDLDA). Comparison of the energy-loss measurements with jellium and first-principles response calculations for wave vectors in the range 0.7–2.5 k_F has shown clearly that ion-core lattice effects are responsible for characteristic shifts of the spectral weight to lower energies and the presence of high energy tails in addition to zone-boundary collective state (ZBCS) resonances and gaps. Figure 1 shows inelastic x-ray scattering for a wave vector of 1 k_{F+} and first-principles calculations that account for the characteristic features, whereas only qualitative agreement is found for the jellium homogenous gas response. Similar results were found for large wave vectors.

Because the nonjellium high-energy tails and the spectral shift to lower energies in the measured dynamical response are retained upon melting,[4,5] these results provide direct evidence that metallic liquids retain the essential local electronic structure of the solid lattice. Moreover, these results show that the persistence of the so-called double-peak structure in Al after thermal melting does not rule out ion-lattice effects as the origin of the double-peak.

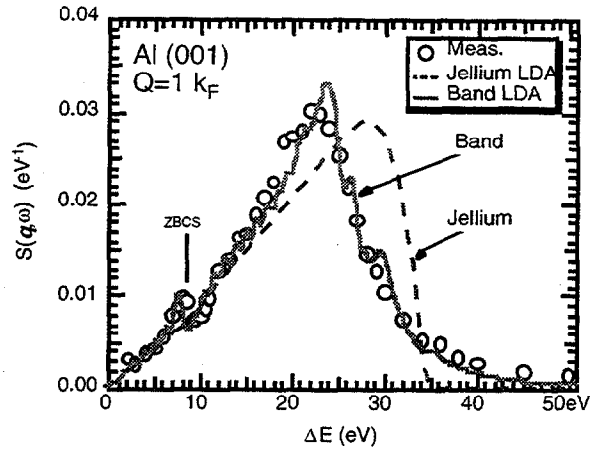

Fig. 1. Inelastic x-ray scattering measurements and calculations of the dynamical response for Al at a wave vector of 1 k_F.

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1. Summary of paper: *Journal of Physics and Chemistry of Solids* (in press).
2. University of Würzburg, Germany.
3. UT/ORNL Collaborative Scientist.
4. J. P. Hill et al., *Phys. Rev. Lett.* **77**, 3665 (1996).
5. C. Sternemann et al., *Phys. Rev. B* **57**, 622 (1998).

Publications and Papers

(April 1, 1997–September 30, 1999)

JOURNAL ARTICLES

G. Aeppli, T. E. Mason, S. M. Hayden, H. A. Mook, and J. Kulda, "Nearly Singular Magnetic Fluctuations in the Normal State of a High-T_c Cuprate Superconductor," *Science* **278**, 1432 (1997).

G. Aeppli, C. Broholm, J. F. Di Tusa, S. M. Hayden, T. Ito, S.-H. Lee, T. E. Mason, H. A. Mook, K. Oka, T. G. Perring, A. Schroder, H. Takagi, and G. Xu, "Magnetic Coherence in the Transition-Metal Oxides," *Physica B* **237**, 30 (1997).

G. Aeppli, T. E. Mason, H. A. Mook, A. Schroeder, and S. M. Hayden, "Magnetic Coherence in the Superconducting and Normal States of $La_{2-x}Sr_xCuO_4$," *Physica C* **282–287**, 231 (1997).

G. Aeppli, D. J. Bishop, C. Broholm, E. Bucher, S.-W. Cheong, P. Dai, Z. Fisk, S. M. Hayden, R. Kleiman, T. E. Mason, H. A. Mook, T. G. Perring, and A. Schroeder, "Neutron Scattering and the Search for Mechanisms of Superconductivity," *Physica C* **317–318**, 9 (1999).

G. Aeppli, S. M. Hayden, P. Dai, H. A. Mook, R. D. Hunt, T. G. Perring, and F. Dogan, "The Weights of Various Features in the Magnetic Spectra of Cuprates," *Phys. Status Solidi B* **215**, 519 (1999).

C. M. Aegerter, S. T. Johnson, W. J. Nuttall, S. H. Lloyd, M. T. Wylie, M. P. Nutley, E. M. Forgan, R. Cubitt, S. L. Lee, D. McK. Paul, M. Yethiraj, and H. A. Mook, "Observation of Vortex Lattice Melting in Twinned $YBa_2Cu_3O_{7-x}$ Using Neutron Small-Angle Scattering," *Phys. Rev. B* **57**, 14511 (1998).

M. Agamalian, G. D. Wignall, and R. Triolo, "Optimization of a Bonse-Hart Ultra Small-Angle Neutron Scattering Facility by Elimination of the Rocking Curve Wings," *J. Appl. Crystallogr.* **30**, 345 (1997).

M. Agamalian, G. D. Wignall, and R. Triolo, "Recent Developments in Ultra Small-Angle Neutron Scattering Techniques," *Neutron News* **9**, 24 (1998).

M. M. Agamalian, D. K. Christen, A. R. Drews, C. J. Glinka, H. Matsuoka, and G. D. Wignall, "Surface-Induced Parasitic Scattering in Bonse-Hart Double-Crystal Diffractometers," *J. Appl. Crystallogr.* **31**, 235 (1998).

M. M. Agamalian, E. Iolin, L. Rusevich, C. J. Glinka, and G. D. Wignall, "Back Face Reflection from a Perfect and Ultra Lightly Deformed Thick Crystal," *Phys. Rev. Lett.* **81**, 602 (1998).

M. Agamalian, R. G. Alamo, M. H. Kim, J. D. Londono, L. Mandelkern, and G. D. Wignall, "Phase Behavior of Blends of Linear and Branched Polyethylenes on Micron-Length Scales via Ultra Small-Angle Neutron Scattering," *Macromol.* **32**, 3093 (1999).

M. Agamalian, E. Iolin, and G. D. Wignall, "A New Dynamical Diffraction Effect 'Neutron Camel,'" *Neutron News* **10**, 24 (1999).

A. Agarwal, T. E. Haynes. D. J. Eaglesham. H.-J. Gossmann, D. C. Jacobson, J. M. Poate, and Y. E. Erokhin, "Interstitial Defects in Silicon from 1 to 5 keV Si^+ Ion Implantation," *Appl. Phys. Lett.* **70**, 3332 (1997).

A. Agarwal, H.-J. Gossmann, D. J. Eaglesham, L. Pelaz, D. C. Jacobson, T. E. Haynes, J. Jackson, and Y. E. Erokhin, "Reduction of Transient Diffusion from 1 to 5 keV Si^+ Ion Implantation Due to Surface Annihilation of Interstitials," *Appl. Phys. Lett.* **71**, 3141 (1997).

A. Agarwal, H.-J. Gossmann, D. J. Eaglesham, L. Pelaz, S. B. Herner, D. C. Jacobson, T. E. Haynes, Y. E. Erokhin, and R. Simonton, "Boron-Enhanced Diffusion of Boron: The Limiting Factor for Ultra-Shallow Junctions," *Int. Electron Devices Meet. Tech. Dig.* **1**, 467 (1997).

A. Agarwal, T. E. Haynes, V. C. Venezia, O. W. Holland, and D. J. Eaglesham, "Efficient Production of Silicon-on-Insulator Films by Co-Implantation of He^+ with H^+," *Appl. Phys. Lett.* **72**, 1086 (1998).

A. Agarwal, H.-J. Gossmann, D. J. Eaglesham, L. Pelaz, D. C. Jacobson, J. M. Poate, and T. E. Haynes, "Critical Issues in Ion Implantation of Silicon Below 5 keV: Defects and Diffusion," *Mater. Sci. Eng. A* **253**, 269 (1998).

A. Agarwal, H.-J. Gossmann, D. C. Jacobson, D. J. Eaglesham, B. Sosnowski, J. M. Poate, I. Yamada, J. Matsuo, and T. E. Haynes, "Enhanced Diffusion from Decaborane Molecular Ion Implantation," *Appl. Phys. Lett.* **73**, 2015 (1998).

A. Agarwal, H.-J. Gossmann, D. J. Eaglesham, L. Pelaz, S. B. Herner, D. C. Jacobson, and T. E. Haynes, "Damage, Defects, and Diffusion from Ultralow Energy (0–5-keV) Ion Implantation of Silicon," *Mater. Sci. Semicond. Proc.* **1**, 14 (1998).

A. Agarwal, D. J. Eaglesham, H.-J. Gossmann, L. Pelaz, S. B. Herner, D. C. Jacobson, and T. E. Haynes, "Boron-Enhanced Diffusion of Boron from Ultralow Energy Ion Implantation," *Appl. Phys. Lett.* **74**, 2435 (1999).

M. Ajgaonkar, Y. Zhang, H. Grebel, and C. W. White, "Nonlinear Optical Properties of a Coherent Array of Submicron SiO_2 Spheres (Opal) Embedded with Si Nanoparticles," *Appl. Phys. Lett.* **75**, 1532 (1999).

T. S. Anderson, R. H. Magruder III, D. L. Kinser, R. A. Zuhr, and D. K. Thomas, "Ag:Sb and Sb:Ag Implantations into High-Purity Silica," *J. Mater. Res.* **12**, 3316 (1997).

T. S. Anderson, R. H. Magruder III, D. L. Kinser, R. A. Zuhr, and D. K. Thomas, "Formation and Optical Properties of Metal Nanoclusters Formed by Sequential Implantation of Cd and Ag in Silica," *Nucl. Instrum. Methods Phys. Res. B* **124**, 40 (1997).

T. S. Anderson, R. H. Magruder III, D. L. Kinser, J. E. Wittig, R. A. Zuhr, and D. K. Thomas, "Ag:Cd and Cd:Ag Implantations into High-Purity Silica," *J. Non-Cryst. Solids* **224**, 229 (1998).

R. Andrews, D. Jacques, A. M. Rao, F. Derbyshire, D. Qian, X. Fan, E. C. Dickey, and J. Chen, "Continuous Production of Aligned Carbon Nanotubes: A Step Closer to Commercial Realization," *Chem. Phys. Lett.* **303**, 467 (1999).

B. K. Annis, G. D. Wignall, A. R. Hopkins, P. G. Rasmussen, R. A. Basheer, and A. Rafil, "Structural Investigation of Polyaniline/Nylon 6 Blends by SAXS and WAXS," *J. Polym. Sci.* **35**, 2765 (1997).

M. J. Antonell, C. R. Abernathy, V. Krishnamoorthy, R. W. Gedridge, Jr., and T. E. Haynes, "Thermal Stability of Heavily Tellurium-Doped InP Grown by Metalorganic Molecular Beam Epitaxy," *J. Electron. Mater.* **26**, 1283 (1997).

A. J. Arko, J. J. Joyce, A. B. Andrews, D. Mandrus, E. Moshopoulou, Z. Fisk, and P. C. Canfield, "The 5*f* Band Structure of Antiferromagnetic Usb_2 from Angle-Resolved Photoemission Spectroscopy: Application to Heavy Fermions," *Philos. Mag. B* **75**, 603 (1997).

G. Arrhenius, B. C. Sales, S. Mojzsis, and T. Lee, "Entropy and Charge in Molecular Evolution—The Case of Phosphate," *J. Theor. Biol.* **187**, 503 (1997).

S. E. Babcock, C. Y. Yang, J. L. Reeves, Y. Wu, A. E. Pashitski, A. Polyanskii, D. C. Larbalestier, A. Goyal, M. Paranthaman, F. A. List, D. P. Norton, D. M. Kroeger, and A. Ichinose, "Electromagnetic Connectivity and Microstructure in $YBa_2Cu_3O_{7-\delta}$ Films on Rolling-Assisted Biaxially Textured Substrates," *Mater. Sci. Forum* **294**, 165 (1999).

A. P. Baddorf, V. Jahns, J. Zhang, J. M. Carpinelli, and E. W. Plummer, "Periodic Lattice Distortion Accompanying the (3×3) Charge-Density-Wave Phase of Sn/Ge(111)," *Phys. Rev. B* **57**, 4579 (1998).

C. Ballesteros, Y. Chen, Y. Chen, R. Gonzalez, M. R. Kokta, and X. F. Zong, "Precipitates in Thermochemically Reduced Ni-Doped Sapphire," *Philos. Mag. A* **76**, 357 (1997).

W. Bao, C. Broholm, G. Aeppli, S. A. Carter, P. Dai, C. D. Frost, J. M. Honig, and P. Metcalf, "Magnetic Correlations in a Classic Mott System," *J. Magn. Magn. Mater.* **177–181**, 283 (1998).

W. Bao, C. Broholm, G. Aeppli, S. A. Carter, P. Dai, T. F. Rosenbaum, J. M. Honig, P. Metcalf, and S. F. Trevino, "Magnetic Correlations and Quantum Criticality in the Insulating Antiferromagnetic, Insulating Spin Liquid, Renormalized Fermi Liquid, and Metallic Antiferromagnetic Phases of the Mott System V_2O_3," *Phys. Rev. B* **58**, 12727 (1998).

T. Barnes, J. Riera, and D. A. Tennant, "A Study of the $S = 1/2$ Alternating Chain Using Multiprecision Methods," *Phys. Rev. B* **59**, 11384 (1999).

M. W. Barsoum, T. El-Raghy, C. J. Rawn, W. D. Porter, H. Wang, E. A. Payzant, and C. R. Hubbard, "Thermal Properties of Ti_3SiC_2," *J. Phys. Chem. Sol.* **60**, 429 (1999).

J. B. Bates, "Thin-Film Rechargeable Lithium Batteries," *Electronic Engineering*, p. 63 (March 1997).

J. B. Bates and N. J. Dudney, "Thin-Film Rechargeable Lithium Batteries for Implantable Devices," *J. ASAIO* **43**, M644 (1997).

J. B. Bates, "High-Power, High-Energy Density Thin-Film Rechargeable Lithium and Lithium-Ion Batteries for Devices Available for Licensing," *Mat. Tech.* **12**, 87 (1997).

R. N. Bhattacharya, R. D. Blaugher, Z. F. Ren, W. Li, J. H. Wang, M. Paranthaman, D. T. Verebelyi, and D. K. Christen, "Superconducting Thallium Oxide Films by the Electrodeposition Method," *Physica C* **304**, 55 (1998).

R. N. Bhattacharya, R. D. Blaugher, Z. F. Ren, W. Li, J. H. Wang, M. Paranthaman, D. T. Verebelyi, and D. K. Christen, "Superconducting Epitaxial $(TlBi)_{0.9}Sr_{1.6}Ba_{0.4}Ca_2Cu_3Ag_{0.2}O_x$ Film from an Electrodeposited Precursor," *Electrochem. Solid State Lett.* **1**, 165 (1998).

R. N. Bhattacharya, P. A. Parilla, R. D. Blaugher, Z. F. Ren, W. Li, J. H. Wang, Y. T. Wang, A. M. Hermann, M. Paranthaman, A. Goyal, D. T. Verebelyi, and D. K. Christen, "Superconducting Thallium Oxide Films from Electrodeposited Precursors," *IEEE Trans. Appl. Supercond.* **9**, 1681 (1999).

H. K. Birnbaum, C. Buckley, F. Zeides, E. Sirois, P. Rozenak, S. Spooner, and J. S. Lin, "Hydrogen in Aluminum," *J. Alloys and Compounds* **253–254**, 260 (1997).

C. R. Blanchard, R. A. Page, and S. Spooner, "The Measurement of Compressive Creep Deformation and Damage Mechanisms in a Single-Phase Alumina: Part II—Correlation of Creep Cavitation and Grain Boundary Sliding," *J. Mater. Sci.* **33**, 5049 (1998).

A. T. Boothroyd, A. Mukherjee, S. Fulton, T. G. Perring, R. S. Eccleston, H. A. Mook, and B. M. Wanklyn, "High-Energy Magnetic Excitations in CuO," *Physica B* **234–236**, 731 (1997).

H. Boukari, J. S. Lin, and M. T. Harris, "Small-Angle X-Ray Scattering Study of the Formation of Colloidal Silica Particles from Alkoxides: Primary Particles or Not?" *J. Colloid Interface Sci.* **194**, 311 (1997).

H. Boukari, J. S. Lin, and M. T. Harris, "Probing the Dynamics of the Silica Nanostructure Formation and Growth by SAXS," *Chem. Mater.* **9**, 2376 (1997).

B. G. Briner, P. Hofmann, M. Doering, H.-P. Rust, A. M. Bradshaw, L. Petersen, P. Sprunger, E. Laegsgaard, F. Besenbacher, and E. W. Plummer, "Looking at Electronic Wave Functions on Metal Surfaces," *Europhys. News* **28**, 148 (1997).

B. G. Briner, P. Hofmann, M. Doering, H.-P. Rust, E. W. Plummer, and A. M. Bradshaw, "Observation of Interfering Bloch Waves," *Europhys. Lett.* **39**, 67 (1997).

B. G. Briner, P. Hofmann, M. Doering, H.-P. Rust, E. W. Plummer, and A. M. Bradshaw, "Charge Density Oscillations on Be(100): Screening in a Non-Free Two-Dimensional Electron Gas," *Phys. Rev. B* **58**, 13931 (1998).

N. D. Browning, D. J. Wallis, P. D. Nellist, and S. J. Pennycook, "EELS in the STEM: Determination of Materials Properties on the Atomic Scale," *Micron* **28**, 333 (1997).

N. D. Browning, P. D. Nellist, D. P. Norton, M. F. Chisholm, and S. J. Pennycook, "The Atomic Origins of Reduced Critical Currents at [001] Tilt Grain Boundaries in $YBa_2Cu_3O_{7-\delta}$ Thin Films," *Physica C* **294**, 183 (1998).

N. D. Browning, J. P. Buban, C. Prouteau, G. Duscher, and S. J. Pennycook, "Investigating the Atomic-Scale Structure and Chemistry of Grain Boundaries in High-T_c Superconductors," *Micron* **30**, 425 (1999).

N. D. Browning, J. P. Buban, H. O. Moltaji, G. Duscher, S. J. Pennycook, R. P. Rodrigues, K. D. Johnson, and V. P. Dravid, "The Atomic Origins of Electrical Barriers at Grain Boundaries in $SrTiO_3$," *Appl. Phys. Lett.* **74**, 2638 (1999).

N. D. Browning, J. P. Buban, H. O. Moltaji, and G. Duscher, "Investigating the Structure-Property Relationship at Grain Boundaries in Oxides Using Bond-Valence Pair Potentials," *J. Am. Ceram. Soc.* **82**, 366 (1999).

J. P. Buban, H. O. Moltaji, G. Duscher, and N. D. Browning, "Correlating Atomic-Scale Experimental Observations to Develop Three-Dimensional Structural Models for Grain Boundaries in Oxides," *Microsc. and Microanal.* **5**, 48 (1999).

J. D. Budai, C. W. White, S. P. Withrow, M. F. Chisholm, J. Zhu, and R. A. Zuhr, "Controlling the Size, Structure, and Orientation of Semiconductor Nanocrystals Using Metastable Phase Recrystallization," *Nature* **390**, 384 (1997).

M. Bullock, C. Stassis, J. Zarestky, A. I. Goldman, P. Canfield, G. Shirane, and S. Shapiro, "Inelastic Neutron Scattering Studies of the Low-Energy Phonon Excitations in the $RENi_2B_2C$ Superconductors," *Physica B* **241–242**, 798 (1998).

M. Bullock, J. Zarestky, C. Stassis, A. Goldman, P. Canfield, Z. Honda, G. Shirane, and S. M. Shapiro, "Low-Energy Phonon Excitations in Superconducting $RENi_2B_2C$ (RE = Lu, Y)," *Phys. Rev. B* **57**, 7916 (1998).

B. Buschinger, C. Geibel, F. Steglich, D. Mandrus, D. Young, J. L. Sarrao, and Z. Fisk, "Transport Properties of FeSi," *Physica B* **230–232**, 784 (1997).

P. D. Butler, W. A. Hamilton, L. J. Magid. T. M. Slawecki, Z. Han, and J. B. Hayter, "Effect of a Solid/Liquid Interface on Bulk Solution Structures Under Flow," *Physica B* **241–243**, 1074 (1998).

I. Campillo, J. M. Pitarke, A. G. Eguiluz, and A. Garcia, "Electronic Stopping Power of Periodic Crystals," *Nucl. Instrum. Methods Phys. Res. B* **135**, 117 (1998).

I. Campillo, J. M. Pitarke, and A. G. Eguiluz, "Electronic Stopping Power of Aluminum Crystal," *Phys. Rev. B* **58**, 10307 (1998).

C. Cantoni, D. P. Norton, D. M. Kroeger, M. Paranthaman, D. K. Christen, D. Verebelyi, R. Feenstra, D. F. Lee, E. D. Specht, V. Boffa, and S. Pace, "Phase Stability for the In Situ Growth of $Nd_{1+x}Ba_{2-x}CuO_y$ Films Using Pulsed-Laser Deposition," *Appl. Phys. Lett.* **74**, 96 (1999).

S. Cao, A. J. Pedraza, D. H. Lowndes, and L. F. Allard, "The Effects of the Atmosphere on the Surface Modification of Alumina by Pulsed-Laser Irradiation," *J. Mater. Res.* **12**, 1747 (1997).

X. A. Cao, J. R. LaRoche, F. Ren. S. J. Pearton, J. R. Lothian, R. K. Singh, R. G. Wilson, H. J. Gao, and S. J. Pennycook, "Implanted *p-n* Junctions in GaN," *Solid State Electron.* **43**, 1235 (1999).

G. Carini, V. Crupi, G. Dangelo, D. Majolino, P. Migliardo, and Y. B. Melnichenko, "Relaxation Dynamics of H-Bonded Liquids Confined in Porous Silica Gels by Rayleigh Wing Spectroscopy," *J. Chem. Phys.* **107**, 2292 (1997).

C. M. Carlson, J. C. Price, P. A. Parilla, D. S. Ginley, D. Niles, R. D. Blaugher, A. Goyal, M. Paranthaman, D. M. Koreger, and D. K. Christen, "Laser-Ablated Epitaxial $LaAlO_3$ Buffer Layers on Biaxially Textured Ni Substrates for Superconducting Tapes," *Physica C* **304**, 82 (1998).

J. M. Carpinelli, H. H. Weitering, M. Bartkowiak, R. Stumpf, and E. W. Plummer, "Surface Charge Ordering Transition: α Phase of Sn/Ge(111)," *Phys. Rev. Lett.* **79**, 2859 (1997).

J. M. Carpinelli, H. H. Weitering, and E. W. Plummer, "Charge Rearrangement in the $Ge_xPb_{(1-x)}$/Ge(111) Interface," *Surf. Sci.* **401**, L457 (1998).

B. C. Chakoumakos, C.-K. Loong, and A. J. Schultz, "Low-Temperature Structure and Dynamics of Brucite," *J. Phys. Chem. B* **101**, 9458 (1997).

B. C. Chakoumakos, "NSNS Workshop Held in Oak Ridge," *Neutron News* **8**, 7 (1997).

B. C. Chakoumakos, S. E. Nagler, S. T. Misture, and H.-M. Christen, "High-Temperature Structural Behavior of $SrRuO_3$," *Physica B* **241–243**, 358 (1998).

B. C. Chakoumakos, "Systematics of Atomic-Displacement Parameters in Perovskite Oxides," *Physica B* **241–243**, 361 (1998).

B. C. Chakoumakos, D. G. Schlom, M. Urbanik, and J. Luine, "Thermal Expansion of $LaAlO_3$ and $(La,Sr)(Al,Ta)O_3$, Substrate Materials for Superconducting Thin-Film Device Applications," *J. Appl. Phys.* **83**, 1979 (1998).

B. C. Chakoumakos and D. Mandrus, "Ru_3Sn_7 with the Ir_3Ge_7 Structure Type," *J. Alloys Compd.* **281**, 157 (1998).

B. C. Chakoumakos, "Spallation Neutron Source Symposium Held in Washington," *Neutron News* **9**, 13 (1998).

B. C. Chakoumakos, "Neutron Scattering Program at the High-Flux Isotope Reactor, Oak Ridge National Laboratory," *Neutron News* **10**, 5 (1999).

B. C. Chakoumakos, B. C. Sales, D. G. Mandrus, and V. Keppens, "Disparate Atomic Displacements in Skutterudite-Type $LaFe_3CoSb_{12}$, A Model for Thermoelectric Behavior," *Acta Crystallogr. B* **55**, 341 (1999).

K.-W. Chang, B. W. Wessels, W. Qian, V. P. Dravid, J. L. Schindler, C. R. Kannewurf, D. B. Studebaker, T. J. Marks, and R. Feenstra, "In Situ Growth and Doping of Oxycarbonate $Sr_2CuO_2(CO_3)$ Epitaxial Thin Films," *Physica C* **303**, 11 (1998).

K.-J. Chao, Z. Zhang, Ph. Ebert, and C. K. Shih, "Substrate Effects on the Formation of Flat Ag Films on (110) Surfaces of III–V Compound Semiconductors," *Phys. Rev. B* **60**, 4988 (1999).

D. Z. Che, S. Spooner, and J. J. Hoyt, "Experimental and Theoretical Investigation of the Scaled-Structure Function in Al-Li Alloys," *Acta Mater.* **45**, 1167 (1997).

J. Chen, R. Mu, A. Ueda, M. H. Wu, Y.-S. Tung, Z. Gu, D. O. Henderson, C. W. White, J. D. Budai, and R. A. Zuhr, "Characterization of Zinc-Implanted Silica: Effects of Thermal Annealing and Picosecond Laser Radiation," *J. Vac. Sci. Technol. A* **16**, 1409 (1998).

K. M. Chen, D. E. Jesson, S. J. Pennycook, T. Thundat, and R. J. Warmack, "Critical Nuclei Shapes in the Stress-Driven 2D-to-3D Transition," *Phys. Rev. B* **56**, R1700 (1997).

Q. Chen, A. J. Rondinone, B. C. Chakoumakos, and Z. J. Zhang, "Synthesis of Superparamagnetic $MgFe_2O_4$ Nanoparticles by Coprecipitation," *J. Magn. Magn. Mater.* **194**, 1 (1999).

M. F. Chisholm and S. J. Pennycook, "Z-Contrast Imaging of Grain-Boundary Core Structures in Semiconductors," *MRS Bulletin* **22**, 53 (1997).

M. F. Chisholm, A. Maiti, S. J. Pennycook, and S. T. Pantelides, "Atomic Configurations and Energetics of Arsenic Impurities in a Silicon Grain Boundary," *Phys. Rev. Lett.* **81**, 132 (1998).

M. F. Chisholm, R. Buczko, M. Mostoller, T. Kaplan, A. Maiti, S. T. Pantelides, and S. J. Pennycook, "Atomic Structure and Properties of Extended Defects in Silicon," *Solid State Phenomena* **67–68**, 3 (1999).

H.-J. Chiu, H.-L. Chen, T.-L. Lin, and J. S. Lin, "Phase Structure of Poly[3-Hydroxybutyrate/ Poly(Vinyl Acetate)] Blends Probed by Small-Angle X-Ray Scattering," *Macromol.* **32**, 4969 (1999).

C. R. Cho, N. Yarykin, R. A. Brown, O. Kononchuk, G. A. Rozgonyi, and R. A. Zuhr, "Evolution of Deep-Level Centers in *p*-Type Silicon Following Ion Implantation at 85 K," *Appl. Phys. Lett.* **74**, 1263 (1999).

J.-H. Cho, Q. Niu, and Z. Zhang, "Oscillatory Nonmetal-Metal Transitions of Ultrathin Sb Overlayers on the GaAs (110) Substrate," *Phys. Rev. Lett.* **80**, 3582 (1998).

J.-H. Cho, J. Zhang, S.-H. Liou, P. A. Dowben and E. W. Plummer, "Surfaces of the Perovskite Manganites $La_{1-x}Ca_xMnO_3$," *Phys. Rev. B* **59**, 13453 (1999).

J.-H. Cho, Z. Zhang, S.-H. Lee, and M.-H. Kang, "Geometry and Core-Level Shifts of an Adsorbed Sb Monolayer on GaAs(110)," *Phys. Rev. B* **59**, 200 (1999).

J.-H. Cho, Ismail, Z. Y. Zhang, and E. W. Plummer, "Oscillatory Lattice Relaxation at Metal Surfaces," *Phys. Rev. B* **59**, 1677 (1999).

J.-H. Cho, Z. Y. Zhang, S.-H. Lee, and M.-H. Kang, "Geometry and Core-Level Shifts of Arsenic on GaAs(110)," *Phys. Rev. B* **59**, 200 (1999).

J. Choi, J. Zhang, S.-H. Liou, P. A. Dowben, and E. W. Plummer, "The Surfaces of the Perovskite Manganites $La_{1-x}Ca_xMnO_3$," *Phys. Rev. B* **59**, 13453 (1999).

D. K. Christen, "Current Limits to Wire Technology," *Nature* **392**, 862 (1998).

H.-M. Christen, D. P. Norton, L. A. Gea, and L. A. Boatner, "Pulsed-Laser Deposition of Solid-Solution Films Using Segmented Targets," *Thin Solid Films* **312**, 156 (1998).

H.-M. Christen, E. D. Specht, D. P. Norton, M. F. Chisholm, and L. A. Boatner, "Long-Range Ferroelectric Interactions in $KtaO_3/KnbO_3$ Superlattice Structures," *Appl. Phys. Lett.* **72**, 2535 (1998).

R. Coldea, D. A. Tennant, R. A. Cowley, D. F. McMorrow, B. Dorner, and Z. Tylczynski, "Quasi-1D $S = 1/2$ Antiferromagnet Cs_2CuCl_4 in a Magnetic Field," *Phys. Rev. Lett.* **79**, 151 (1997).

R. Coldea, D. A. Tennant, R. A. Cowley, D. F. McMorrow, B. Dorner, and Z. Tylczynski, "The Phase Diagram of a Quasi-1D $S = 1/2$ Heisenberg Antiferromagnet," *J. Magn. Magn. Mater.* **177**, 659 (1998).

A. I. Cooper, J. D. Londono, G. D. Wignall, J. B. McClain, E. T. Samulski, J. S. Lin, A. Dobrynin, M. Rubinstein, A. L. C. Burke, J. M. J. Fréchet, and J. M. DeSimone, "Extraction of a Hydrophilic Compound from Water into Liquid CO_2 Using Dendritic Surfactants," *Nature* **389**, 368 (1997).

V. Corradini, L. Gavioli, and C. Mariani, "Core-Level Photoemission Study of 2D Ordered B/Si(100) Interfaces," *Surf. Sci.* **430**, 126 (1999).

X. Cui, A. List, D. M. Kroeger, A. Goyal, D. F. Lee, J. Mathis, E. D. Specht, P. M. Martin, R. Feenstra, D. T. Verebelyi, D. K. Christen, and M. Paranthaman, "Reel-to-Reel Continuous Deposition of Epitaxial CeO_2 Buffer Layers on Biaxially Textured Ni Tapes by Electron-Beam Evaporation," *IEEE Trans. Appl. Supercond.* **9**, 1967 (1999).

X. Cui, F. A. List, D. M. Kroeger, A. Goyal, D. F. Lee, J. E. Mathis, E. D. Specht, P. M. Martin, R. Feenstra, D. T. Verebelyi, D. K. Christen, and M. Paranthaman, "Continuous Growth of Epitaxial CeO_2 Buffer Layers on Rolled-Ni Tapes by Electron-Beam Evaporation," *Physica C* **316**, 27 (1999).

P. Dai, H. A. Mook, and F. Dogan, "Incommensurate Magnetic Fluctuations in $YBa_2Cu_3O_{6.6}$," *Phys. Rev. Lett.* **80**, 1738 (1998).

P. Dai, H. A. Mook, and F. Dogan, "Pseudogap and Incommensurate Magnetic Fluctuations in $YBa_2Cu_3O_{6.6}$," *Physica B* **241–243**, 524 (1998).

P. Dai, H. A. Mook, S. M. Hayden, G. Aeppli, T. G. Perring, R. D. Hunt, and F. Dogan, "The Magnetic Excitation Spectrum and Thermodynamics of High-T_c Superconductors," *Science* **284**, 1344 (1999).

K. Daneshvar, E. A. Giess, A. M. Bacon, D. G. Dawes, L. A. Gea, and L. A. Boatner, "Ion Exchange in Potassium Titanyl Phosphate," *Appl. Phys. Lett.* **71**, 756 (1997).

A. Darwish, D. Ila, D. B. Poker, and D. K. Hensley, "Investigation of Mn-Implanted $LiNbO_3$ Applying Electron Paramagnetic Resonance Technique," *Nucl. Instrum. Methods Phys. Res. B* **141**, 679 (1998).

J. M. DeSimone, D. Betts, T. Johnson, J. M. McClain, S. L. Wells, A. Dobrynin, M. Rubinstein, D. Londono, G. D. Wignall, and R. Triolo, "Molecularly Engineered Surfactants for Co_2" *Polym. Preprints* **40**, 435 (1999).

I. D. Desnica-Frankovic, U. V. Desnica. M. Ivanda, D. Gracin, and T. E. Haynes, "Metastable Amorphous Structure in Ion-Implanted GaAs," *Mater. Sci. Forum* **258–262**, 1057 (1997).

U. V. Desnica, I. D. Desnica, M. Ivanda, K. Furic, and T. E. Haynes, "Morphology of the Implantation-Induced Disorder in GaAs Studied by Raman Spectroscopy and Ion Channeling," *Phys. Rev. B* **55**, 16205 (1997).

C. Detlefs, A. H. M. Z. Islam, A. I. Goldman, C. Stassis, and P. C. Canfield, "Determination of Magnetic-Moment Directions Using X-Ray Resonant Exchange Scattering," *Phys. Rev. B* **55**, 680 (1997).

E. C. Dickey, V. P. Dravid, P. D. Nellist, D. J. Wallis, S. J. Pennycook, and A. Revcolevschi, "Structure and Bonding at Ni-ZrO_2(Cubic) Interfaces Formed by the Reduction of a NiO-ZrO_2(Cubic) Composite," *Microsc. Microanal.* **3**, 443 (1997).

E. C. Dickey, V. P. Dravid, P. D. Nellist, D. J. Wallis, and S. J. Pennycook, "Three-Dimensional Atomic Structure of NiO-ZrO_2(Cubic) Interfaces," *Acta Mater.* **46**, 1801 (1998).

P. Doshi, G. E. Jellison, Jr., and A. Rohatgi, "Characterization and Optimization of Absorbing Plasma-Enhanced Chemical Vapor-Deposited Antireflection Coatings for Silicon Photovoltaics," *Appl. Opt.* **36**, 7826 (1997).

C. Doughty, S. M. Gorbatkin, and L. A. Berry, "Spatial Distribution of Cu Sputter Ejected by Very Low Energy Ion Bombardment," *J. Appl. Phys.* **82**, 1868 (1997).

C. Doughty, S. M. Gorbatkin, T. Y. Tsui, G. M. Pharr, and D. L. Medlin, "Hard Boron-Suboxide-Based Films Deposited in a Sputter-Sourced, High-Density Plasma Deposition System," *J. Vac. Sci. Technol. A* **15**, 2623 (1997).

N. J. Dudney, "Radio Frequency Magnetron Sputter Deposition of CaF_2 Films," *J. Vac. Sci. Technol. A* **16**, 615 (1998).

N. J. Dudney, J. B. Bates, R. A. Zuhr, S. Young, J. D. Robertson, H. P. Jun, and S. A. Hackney, "Nanocrystalline $Li_xMn_{2-y}O_4$ Cathodes for Solid State Thin-Film Rechargeable Lithium Batteries," *J. Electrochem. Soc.* **146**, 2455 (1999).

G. Duscher, N. D. Browning, and S. J. Pennycook, "Atomic-Column-Resolved Electron Energy-Loss Spectroscopy," *Phys. Status Solidi (a)* **166**, 327 (1998).

D. Dwight, M. V. Rao, O. W. Holland, G. Kelner, P. H. Chi, J. Kretchmer, and M. Ghezzo, "Nitrogen and Aluminum Implanted in High-Resistivity Silicon Carbide," *J. Appl. Phys.* **82**, 5327 (1997).

A. W. Eberhardt, R. Pandey, J. M. Williams. J. J. Weimer, D. Ila, and R. L. Zimmerman, "The Roles of Residual Stress and Surface Topography on Hardness of Ti-Implanted Ti-6Al-4V," *Mater. Sci. Eng. A* **229**, 147 (1997).

A. G. Eguiluz and W.-D. Shöne, "Electronic Excitations and Correlation Effects in Metals," *J. Mol. Phys.* **94**, 87 (1998).

A. G. Eguiluz, "Reply to Comment on Self-Consistent Calculations of Quasiparticle States in Metals and Semiconductors," *Phys. Rev. Lett.* **83**, 242 (1999).

G. Eres, F. Y. C. Hui, T. Thundat, and D. C. Joy, "Direct Epitaxial Growth of Thin-Film Structures," *J. Vac. Sci. Technol. B* **15**, 2934 (1997).

G. Eres and F. Y. C. Hui, "Advanced Lithography for Nanofabrication," *Tech. Dig.: Chemistry and Physics of Small-Scale Structures* **2**, 65 (1997).

G. Eres, "Application of Supersonic Molecular Jets in Semiconductor Thin-Film Growth," *Crit. Rev. Solid State Mater. Sci.* **23**, 275 (1998).

G. Eres, F. Y. C. Hui, T. G. Thundat, and D. C. Joy, "Nanofabrication by Direct Epitaxial Growth," *J. Microelectron. Eng.* **41/42**, 519 (1998).

F. Ernst. A. Recnik, P. A. Langjahr, P. D. Nellist, and M. Rühle, "Atomistic Structure of Misfit Dislocations in $SrZrO_3/SrTiO_3$ Interfaces," *Acta Mater.* **47**, 183 (1999).

S. C. Erwin and H. H. Weitering, "Theory of the "Honeycomb Chain-Channel" Reconstruction of M/Si(111)3 × 1," *Phys. Rev. Lett.* **81**, 2296 (1998).

A. L. Evelyn, D. Ila, R. L. Zimmerman, K. Bhat, D. B. Poker, and D. K. Hensley, "Resolving the Electronic and Nuclear Effects of MeV Ions in Polymers," *Nucl. Instrum. Methods Phys. Res. B* **127/128**, 694 (1997).

A. L. Evelyn, D. Ila, R. L. Zimmerman, K. Bhat, D. B. Poker, and D. K. Hensley, "Effects of MeV Ions on PE and PVDC," *Nucl. Instrum. Methods Phys. Res. B* **141**, 164 (1998).

A. L. Evelyn, D. Ila, R. L. Zimmerman, K. Bhat, D. B. Poker, D. K. Hensley, C. Klatt, S. Kalbitzer, N. Just, and C. Drevet, "Ion Beam Modification of PES, PS, and PVC Polymers," *Nucl. Instrum. Methods Phys. Res. B* **148**, 1141 (1999).

G. C. Farlow and L. A. Boatner, "Irradiation Effects in MgF_2 Coatings on Si and GaAs Substrates," *Opt. Mater.* **8**, 279 (1997).

R. Feenstra, T. Matsumoto, and T. Kawai, "Scanning Tunneling Microscopy and Spectroscopy Study of Substitution- and Defect-Doped Films of the Infinite-Layer Compound," *Physica C* **282–287**, 105 (1997).

J. A. Fernandez-Baca, E. Fawcett, H. L. Alberts, V. Yu. Galkin, and Y. Endoh, "Effect of Pressure on the Magnetic Phase Diagram of the Antiferromagnetic Spin Density Wave Alloy Cr-1.6% Si," *J. Appl. Phys.* **81**, 3877 (1997).

J. A. Fernandez-Baca, P. Dai, H. Y. Hwang, C. Kloc, and S.-W. Cheong, "Evolution of the Low-Frequency Spin Dynamics in Ferromagnetic Manganites," *Phys. Rev. Lett.* **80**, 4012 (1998).

D. K. Finnemore, K. E. Gray, M. P. Maley, D. O. Welch, D. K. Christen, and D. M. Kroeger, "Coated Conductor Development: An Assessment," *Physica C* **320**, 1 (1999).

R. S. Fishman and X. W. Jiang, "Charge-Density Wave and Magnetic Phase Diagram of Chromium Alloys," *J. Appl. Phys.* **81**, 4201 (1997).

R. S. Fishman and V. S. Viswanath, "Density of States of Chromium Alloys," *Phys. Rev. B* **55**, 8347 (1997).

R. S. Fishman, V. S. Viswanath, and S. H. Liu, "Spin and Charge Dynamics of Chromium Alloys," *Physica B* **237–238**, 432 (1997).

R. S. Fishman, "Magnetic Phase Diagram of Interfacially Rough Fe/Cr Multilayers," *Phys. Rev. B* **57**, 10284 (1998).

R. S. Fishman, X. W. Jiang, and S. H. Liu, "First-Order Paramagnetic-to-Commensurate Phase Transition in Cr Alloys," *Phys. Rev. B* **58**, 414 (1998).

R. S. Fishman and S. H. Liu, "Spin-Wave Gap and Spin Dynamics of γ-Mn Alloys," *Phys. Rev. B* **58**, R5912 (1998).

R. S. Fishman and Z.-P. Shi, "Magnetic Phase Diagram of Fe/Cr Multilayers and Wedges," *J. Phys. Condens. Matter* **10**, L277 (1998).

R. S. Fishman, V. Yu. Galkin, and W. A. Ortiz, "Susceptibility of Dilutely Doped CrFe Alloys," *J. Phys. Condens. Matter* **10**, L347 (1998).

R. S. Fishman, "Helical and Incommensurate Spin-Density Waves in Fe/Cr Multilayers with Interfacial Steps," *Phys. Rev. Lett.* **81**, 4979 (1998).

R. S. Fishman and Z.-P. Shi, "Collinear Spin-Density Wave Ordering in Fe/Cr Multilayers and Wedges," *Phys. Rev. B* **59**, 849 (1999).

R. S. Fishman and S. H. Liu, "Magnetoelastic Effects and Spin Excitations in γ-Mn Alloys," *Phys. Rev. B* **59**, 8681 (1999).

R. S. Fishman and S. H. Liu, "Magnetic Susceptibility of γ-Mn Alloys," *Phys. Rev. B* **59**, 8672 (1999).

R. S. Fishman, "Helical Spin-Density Waves in Fe/Cr Trilayers with Perfect Interfaces," *J. Appl. Phys.* **85**, 5877 (1999).

J. M. Fitz-Gerald, P. D. Rack, T. A. Trottier, M. Ollinger, S. J. Pennycook, H. Gao, and R. K. Singh, "Synthesis of Spherical Luminescent Particulate Coatings," *J. Appl. Phys.* **86**, 1759 (1999).

H. N. Frase, L. J. Nagel, J. L. Robertson, and B. Fultz, "Vibrational Density of States of Nanocrystalline Ni_3Fe," *Philos. Mag. B* **75**, 335 (1997).

H. Frase, B. Fultz, and J. L. Robertson, "Phonons in Nanocrystalline Ni_3Fe," *Phys. Rev. B* **57**, 898 (1998).

R. H. French, H. Müllejans, D. J. Jones, G. Duscher, R. M. Cannon and M. Rühle, "Dispersion Forces and Hamaker Constants for Intergranular Films in Silicon Nitride from Sr-Veels Spectrum Imaging," *Acta Materiali* **46**, 2271 (1998).

V. Yu. Galkin, W. A. Ortiz, and R. S. Fishman, "Local Fe Moment in Commensurate and Incommensurate Spin-Density Wave Cr Matrix," *J. Magn. Magn. Mater.* **186**, L1 (1998).

H. J. Gao, G. S. Canright, S. J. Pang, I. M. Sandler, Z. Q. Xue, and Z. Y. Zhang, "Unique Dendritic Patterns in Organic Thin Films: Experiments and Modeling," *Fractals* **6**, 337 (1998).

H. J. Gao, D. Kumar, K. G. Cho, P. H. Holloway, R. K. Singh, X. Fan, Y. Yan, and S. J. Pennycook, "Epitaxial Growth of Y_2O_3:Eu Thin Films on $LaAlO_3$," *Appl. Phys. Lett.* **75**, 2223 (1999).

H. J. Gao, C. L. Chen, B. Rafferty, S. J. Pennycook, G. P. Luo, and C. W. Chu, "Atomic Structure of Ferroelectric $Ba_{0.5}Sr_{0.5}TiO_3$ Thin Films on $LaAlO_3$," *Appl. Phys. Lett.* **75**, 2542 (1999).

W. L. Gardner, A. P. Baddorf, and W. M. Holber, "Temperature and Concentration Effects on Ozone Ashing of Photoresist," *J. Vac. Sci. Technol A.* **15**, 1409 (1997).

A. W. Garrett, S. E. Nagler, D. A. Tennant, B. C. Sales, and T. Barnes, "Magnetic Excitations in the $S = 1/2$ Alternating Chain Compound $(VO)_2P_2O_7$," *Phys. Rev. Lett.* **79**, 745 (1997).

A. W. Garrett, S. E. Nagler, D. A. Tennant, T. Barnes, and C. C. Torardi, "Magnetic Excitations in $(VO)DPO_4 \cdot 1/2D_2O$," *Physica B* **241–243**, 552 (1998).

L. Gavioli, K. R. Kimberlin, M. C. Tringides, J. F. Wendelken, and Z. Zhang, "Novel Growth of Ag Islands on Si(111): Plateaus with a Singular Height," *Phys. Rev. Lett.* **82**, 129 (1999).

L. A. Gea, L. A. Boatner, H. M. Evans, and R. A. Zuhr, "Optically Active Surfaces Formed by Ion Implantation and Thermal Treatment," *Nucl. Instrum. Methods Phys. Res. B* **127/128**, 553 (1997).

L. A. Gea, J. D. Budai, and L. A. Boatner, "Formation and Phase Transition of VO_2 Precipitates Embedded in Sapphire," *J. Mater. Res.* **14**, 2602 (1999).

D. B. Geohegan, A. A. Puretzky, G. Duscher, and S. J. Pennycook, "Time-Resolved Imaging of Gas Phase Nanoparticle Synthesis by Laser Ablation," *Appl. Phys. Lett.* **72**, 2987 (1998).

D. B. Geohegan, A. A. Puretzky, G. Duscher, and S. J. Pennycook, "Photoluminescence from Gas-Suspended SiO_x Nanoparticles Synthesized by Laser Ablation," *Appl. Phys. Lett.* **73**, 438 (1998).

R. G. Goodrich, P. W. Adams, D. H. Lowndes, and D. P. Norton, "Origin of the Variation of T_c with Superconductivity Layer Thickness and Separation in $YBa_2Cu_3O_{7-x}/PrBa_2Cu_3O_7$ Superlattices," *Phys. Rev. B* **56**, R14299 (1997).

H.-J. Gossmann, T. E. Haynes, P. A. Stolk, D. C. Jacobson, G. H. Gilmer, J. M. Poate, H. S. Luftman, T. K. Mogi, and M. O. Thompson, "The Interstitial Fraction of Diffusivity of Common Dopants in Silicon," *Appl. Phys. Lett.* **71**, 3862 (1997).

A. Goyal, D. P. Norton, D. M. Kroeger, D. K. Christen, M. Paranthaman, E. D. Specht, J. D. Budai, Q. He, B. Saffian, F. A. List, D. F. Lee, E. Hatfield, P. M. Martin, C. E. Klabunde, J. Mathis, and C. Park, "Conductors with Controlled Grain Boundaried: An Approach to the Next Generation, High-Temperature Superconducting Wire," *J. Mater. Res.* **12**, 2924 (1997).

A. Goyal, D. P. Norton, D. K. Christen, E. D. Specht, M. Paranthaman, D. M. Kroeger, J. D. Budai, Q. He, F. A. List, R. Feenstra, H. R. Kerchner, D. F. Lee, E. Hatfield, P. M. Martin, J. Mathis, and C. Park, "Epitaxial Superconductors on Rolling-Assisted Biaxially Textured-Substrates (RABiTS): A Route Toward High Critical Current Density Wire," *Appl. Supercond.* **4**, 403 (1996).

A. Goyal, F. A. List, J. Mathis, M. Paranthaman, E. D. Specht, D. P. Norton, C. Park, D. F. Lee, D. M. Kroeger, D. K. Christen, J. D. Budai, and P. M. Martin, "High Critical Current Density $YBa_2Cu_3O_x$ Tapes Using the RABiTS Approach," *J. Supercond.* **11**, 481 (1998).

A. Goyal, S. X. Ren, E. D. Specht, D. M. Kroeger, R. Feenstra, D. P. Norton, M. Paranthaman, D. F. Lee, and D. K. Christen, "Texture Formation and Grain Boundary Networks in Rolling-Assisted Biaxially Textured Substrates and in Epitaxial YBCO Films on Such Substrates," *Micron* **30**, 463 (1999).

A. Goyal, R. Feenstra, F. A. List, M. Paranthaman, D. F. Lee, D. M. Kroeger, D. B. Beach, J. S. Morrell, T. G. Chirayil, D. T. Verebelyi, X. Cui, E. D. Specht, D. K. Christen, and P. M. Martin, "Using RABiTS to Fabricate High-Temperature Superconducting Wire," *J. Met.* **51**, 19 (1999).

T. Graf, M. F. Hundley, R. Modler, R. Movshovich, J. D. Thompson, D. Mandrus, R. A. Fisher, and N. E. Phillips, "Magnetic Phase Transitions in $CeRh_2Si_2$: Specific Heat, Susceptibility, and Resistance Studies," *Phys. Rev. B* **57**, 7442 (1998).

T. Graf, J. D. Thompson, M. F. Hundley, R. Movshovich, Z. Fisk, D. Mandrus, R. A. Fisher, and N. E. Phillips, "Comparison of $CeRh_2Si_2$ and $CeRh_{2-x}Ru_xSi_2$ Near Their Magnetic-Nonmagnetic Boundaries," *Phys. Rev. B* **78**, 3769 (1997).

H. Graupner, L. Hammer, K. Heinz, and D. M. Zehner, "Oxidation of Low-Index FeAl Surfaces," *Surf. Sci.* **380**, 335 (1997).

T. Graf, M. F. Hundley, R. Modler, R. Movshovich, J. D. Thompson, D. G. Mandrus, R. A. Fisher, and N. E. Phillips, "Magnetic Phase Transitions in $CeRh_2Si_2$: Specific Heat, Susceptibility, and Resistance Studies," *Phys. Rev. B* **57**, 7442 (1998).

R. B. Gregory, T. A. Wetteroth, S. R. Wilson, O. W. Holland, and D. K. Thomas, "Effects of Irradiation Conditions on Exfoliation of H^+-Implanted Silicon Carbide," *Appl. Phys. Lett.* **75**, 2623 (1999).

L. Grigorian, K. A. Williams, S. Fang, G. U. Sumanasekera, A. L. Loper, E. C. Dickey, S. J. Pennycook, and P. C. Eklund, "Reversible Intercalation of Charged Iodine Chains into Carbon Nanotube Ropes," *Phys. Rev. Lett.* **80**, 5560 (1998).

W. A. Hamilton and M. Yethiraj, "Effects of Traveling Surface Acoustic Waves on Neutron Bragg Scattering from Perfect Crystals," *Physica B* **241–243**, 1080 (1998).

W. A. Hamilton and M. Yethiraj, "Effects of Traveling Surface Acoustic Waves on Neutron Bragg Scattering from Perfect Crystals," *Phys. Rev. B* **59**, 3388 (1999).

W. A. Hamilton, P. D. Butler, L. J. Magid, Z. Han, and T. W. Slawecki, "Fast Relaxation of a Hexagonal Poiseuille Shear-Induced Near-Surface Phase in a Threadlike Micellar Solution," *Phys. Rev. E* **60**, R1146 (1999).

L. Hammer, M. Kottcke, W. Weiβ, A. Wimmer, D. M. Zehner, and K. Heinz, "Hydrogen on Mo_xRe_{1-x}(100)—The Impact of Alloying on the Adsorption Structure," *Surf. Sci.* **401**, 455 (1998).

L. Hammer, H. Graupner. V. Blum, K. Heinz, G. W. Ownby, and D. M. Zehner, "Segregation Phenomena on Surfaces of the Ordered Bimetallic Alloy FeAl," *Surf. Sci.* **412/413**, 69 (1998).

F. X. Hart and J. B. Bates, "Lattice Model Calculation of the Strain Energy Density and Other Properties of Crystalline $LiCoO_2$," *J. Appl. Phys.* **83**, 7560 (1998).

K. Haug, Z. Zhang, D. John, C. F. Walters, D. M. Zehner, and E. W. Plummer, "Effects of Hydrogen in Ni(100) Submonolayer Homoepitaxy," *Phys. Rev. B* **55**, R10233 (1997).

M. Hayden, G. Aeppli, P. Dai, H. A. Mook, T. G. Perring, S.-W. Cheong, Z. Fisk, F. Dogan, and T. E. Mason, "Absolute Measurements of the High-Frequency Magnetic Dynamics in High-T_c Superconductors," *Physica B* **241–243**, 756 (1998).

Q. He, D. K. Christen, R. Feenstra, D. P. Norton, M. Paranthaman, E. D. Specht, D. F. Lee, A. Goyal, and D. M. Kroeger, "Growth of Biaxially Oriented Conductive $LaNiO_3$ Buffer Layers on Textured Ni Tapes for High-T_c Coated Conductors," *Physica C* **314**, 105 (1999).

M. Heinrichsmeier, A. Fleszar, W. Hanke, and A. G. Eguiluz, "Non-Local Density-Functional Calculations of the Surface Electronic Structure of Metals: Applications to Al and Pd," *Phys. Rev. B* **57**, 24974 (1998).

D. O. Henderson, A. Ueda, Y. S. Tung, R. Mu, C. W. White, R. A. Zuhr, and J. G. Zhu, "Surface-Phonon Characterization of InP, GaP, and GaAs Quantum Dots Confined in Dielectric Hosts," *J. Phys. D: Appl. Phys.* **30**, 1432 (1997).

D. O. Henderson, M. Wu, A. Ueda, Y. S. Tung, R. Mu, J. Chen, Z. Gu, W. E. Collins, C. W. White, J. D. Budai, A. Meldrum, R. A. Zuhr, and J. G. Zhu, "Selenium Nanoparticles Formed by Ion Implantation into Fused Silica," *Nucl. Instrum. Meth. Phys. Res. B* **141**, 284 (1998).

K. W. Herwig, Z. Wu, P. Dai, H. Taub, and F. Y. Hansen, "Quasielastic Neutron Scattering and Molecular Dynamics Simulation Studies of the Melting Transition in Butane and Hexane Monolayers Absorbed on Graphite," *J. Chem. Phys.* **107**, 5186 (1997).

T. J. Hicks and J. W. Cable, "Moment Clouds in CuMn," *Phys. Rev. B* **58**, 5177 (1998).

P. H. Hofmann, B. G. Briner, M. Doering, H.-P. Rust, E. W. Plummer, and A. M. Bradshaw, "Anisotropic Two-Dimensional Friedel Oscillations," *Phys. Rev. Lett.* **79**, 265 (1997).

P. Hofmann and E. W. Plummer, "Lattice Vibrations at the Be(1010) Surface," *Surf. Sci.* **377–379**, 330 (1997).

O. W. Holland, J. D. Budai, and B. Nielson, "The Role of Defect Excesses in Damage Formation During Ion Implantation at Elevated Temperatures," *Mater. Sci. Eng. A* **253**, 240 (1998).

M. Holt, Z. Wu, H. W. Hong, P. Zschack, P. Jemian, J. Z. Tischler, H. Chen, and T. C. Chiang, "Determination of Phonon Dispersions from X-Ray Transmission Scattering: The Example of Silicon," *Phys. Rev. Lett.* **83**, 3317 (1999).

A. R. Hopkins, P. G. Rasmussen, R. A. Basheer, B. K. Annis, and G. D. Wignall, "Comparison of Phase Separation Structures in Blends of Polyaniline/Camphor Sulfonic Acid and Nylons 6 and 12," *Synth. Met.* **95**, 179 (1998).

A. R. Hopkins, P. G. Rasmussen, R. A. Basheer, B. K. Annis, G. D. Wignall, and W. A. Hamilton, "Investigation of Ordering in Polyaniline Salt Films Prepared from Hexafluoroisopropanol Solutions," *Synth. Met.* **97**, 47 (1998).

M. J. Hostetler, J. E. Wingate, C.-J. Zhong, J. E. Harris, R. W. Vachet, M. R. Clark, J. D. Londono, S. J. Green, J. J. Stokes, G. D. Wignall, G. L. Glish, M. D. Porter, N. D. Evans, and R. W. Murray, "Alkanethiolate Gold Cluster Molecules with Core Radii from 7–26 Å: Borders Between Molecular and Metallic Behavior and Between 2- and 3-Dimensional Monolayers," *Langmuir* **14**, 17 (1998).

C. J. Howard, B. J. Kennedy, "The Orthorhombic and Rhombohedral Phases of $LaGaO_3$—A Neutron Powder Diffraction Study," *J. Phys.: Condens. Matter* **11**, 3229 (1999).

M. Z.-C. Hu, J. T. Zielke, J. S. Lin, and C. H. Byers, "Small-Angle X-Ray Scattering Studies of Thermohydrolytic Polymerization and Colloids Formation in Aqueous Zirconyl Salt Solutions," *J. Mater. Res.* **14**, 103 (1999).

J. Huang, M. S. Lisowski, J. Runt, E. Hall, R. Kean, N. Buehler, and J. S. Lin, "Crystallization and Microstructure of Poly(L-Lactide-*CO*-Meso-Lactide) Copolymers," *Macromol.* **31**, 2593 (1998).

F. Y. C. Hui, G. Eres, and D. C. Joy, "Factors Affecting Resolution in Scanning Electron Beam Induced Patterning of Surface Adsorption Layers," *Appl. Phys. Lett.* **72**, 341 (1998).

H. Y. Hwang, P. Dai, S. W. Cheong. G. Aeppli, H. A. Mook, and B. Batlogg, "Spin Dynamics in Ferromagnetic Perovskite Manganites," *J. Appl. Phys.* **81**, 3967 (1997).

H. Y. Hwang, P. Dai, S.-W. Cheong, G. Aeppli, D. A. Tennant, and H. A. Mook, "Softening and Broadening of the Zone Boundary Magnons in $Pr_{0.63}Sr_{0.37}MnO_3$," *Phys. Rev. Lett.* **80**, 1316 (1998).

P. Hyldgaard and G. D. Mahan, "Phonon Superlattice Transport," *Phys. Rev. B* **56**, 10754 (1997).

N. Igawa, T. Nagasaki, Y. Ishii, K. Noda, H. Ohno, Y. Morii, and J. A. Fernandez-Baca, "Phase-Transformation Study of Metastable Tetragonal Zirconia Powder," *J. Mater. Sci.* **33**, 4747 (1998).

H. Ikeda, M. Takahashi, J. A. Fernandez-Baca, and R. M. Nicklow, "Neutron Study of Fracton Excitations in Percolating Antiferromagnets," *J. Magn. Magn. Mater.* **177–181**, 139 (1998).

H. Ikeda, S. Itoh, M. A. Adams, and J. A. Fernandez-Baca, "Crossover from Homogeneous to Fractal Excitations in the Near-Percolating Heisenberg Antiferromagnet $RbMn_{0.39}Mg_{0.61}F_3$," *J. Phys. Soc. Jpn.* **67**, 3376 (1998).

D. Ila, Z. Wu, C. C. Smith, D. B. Poker, D. K. Hensley, C. Klatt, and S. Kalbitzer, "Post Bombardment Enhanced Optical Absorption in Gold-Implanted Silica," *Nucl. Instrum. Methods Phys. Res. B* **127/128**, 570 (1997).

D. Ila, S. S. Sarkisov, E. K. Williams, C. C. Smith, D. B. Poker, and D. K. Hensley, "Formation of Nanometallic Clusters in Silica by Ion Implantation," *Nucl. Instrum. Methods Phys. Res. B* **141**, 289 (1998).

D. Ila, E. K. Williams, C. C. Smith, D. B. Poker, D. K. Hensley, C. Klatt, and S. Kalbitzer, "Post-Implantation Bombardment Assisted Formation of Colloidal Au in Silica," *Nucl. Instrum. Methods Phys. Res. B* **148**, 1012 (1999).

Z. Islam, I. R. Fisher, J. Zarestky, P. Canfield, C. Stassis, and A. I. Goldman, "A Reinvestigation of Long-Range Magnetic Ordering in Icosahedral Tb-Mg-Zn," *Phys. Rev. B* **57**, R11047 (1998).

T. Isobe, R. A. Weeks, and R. A. Zuhr, "Magnetic Properties of Nanosize Nickel Particles Produced in Silica Glasses by Ion Implantation and Subsequent Annealing," *Solid State Commun.* **105**, 469 (1998).

T. Isobe, T. Toriyama, R. A. Weeks, and R. A. Zuhr, "Chemical Interaction Between Nitrogen and Iron in Silica Glasses via Sequential Ion Implantation," *J. Mater. Res.* **13**, 2144 (1998).

V. Jahns, D. M. Zehner, G. M. Watson, and D. Gibbs, "Structure and Phase Behavior of the Ir(001) Surface: X-Ray Scattering Measurements," *Surf. Sci.* **430**, 55 (1999).

G. E. Jellison, Jr., F. A. Modine, and L. A. Boatner, "Measurement of the Optical Functions of Uniaxial Materials by Two-Modulator Generalized Ellipsometry: Rutile (TiO_2)," *Opt. Lett.* **22**, 1808 (1997).

G. E. Jellison, Jr., and F. A. Modine, "Two-Modulator Generalized Ellipsometry: Experiment and Calibration," *Appl. Opt.* **36**, 8184 (1997).

G. E. Jellison, Jr., and F. A. Modine, "Two-Modulator Generalized Ellipsometry: Theory," *Appl. Opt.* **36**, 8190 (1997).

G. E. Jellison, Jr., F. A. Modine, P. Doshi, and A. Rohatgi, "Spectroscopic Ellipsometry Characterization of Thin-Film Silicon Nitride," *Thin Solid Films* **313–314**, 194 (1998).

G. E. Jellison, Jr., "Spectroscopic Ellipsometry Data Analysis: Measured vs. Calculated Quantities," *Thin Solid Films* **313–314**, 33 (1998).

G. E. Jellison, Jr., and L. A. Boatner, "Optical Functions of Uniaxial ZnO Determined by Generalized Ellipsometry," *Phys. Rev. B* **58**, 3586 (1998).

G. E. Jellison, Jr., "Windows in Ellipsometry Measurements," *Appl. Opt.* **38**, 4784 (1999).

G. E. Jellison, Jr., J. O. Ramey, and L. A. Boatner, "Optical Functions of BiI_3 as Measured by Generalized Ellipsometry," *Phys. Rev. B* **59**, 9718 (1999).

D. E. Jesson, K. M. Chen, S. J. Pennycook, T. Thundat, and R. J. Warmack, "Mechanisms of Strain-Induced Roughening and Dislocation Multiplication in Si_xGe_{1-x} Thin Films," *J. Electron. Mater.* **26**, 1040 (1997).

D. E. Jesson, G. Chen, K. M. Chen, and S. J. Pennycook, "Self-Limiting Growth of Strained Faceted Islands," *Phys. Rev. Lett.* **80**, 5156 (1998).

D. E. Jesson, "Editorial," *Micron* **30**, 1 (1999).

X. W. Jiang and R. S. Fishman, "Coupled Spin- and Charge-Density Waves in Chromium Alloys," *J. Phys.: Condens. Matter* **9**, 3417 (1997).

K.-J. Jin, G. D. Mahan, H. Metiu, and Z. Zhang, "Quantum-Size Effects on the Pattern Formation of Monatomic-Layer High Metal Islands on Surfaces," *Phys. Rev. Lett.* **80**, 1026 (1998).

K.-J. Jin and G. D. Mahan, "Tight-Binding Model of Adsorbate Structures," *Phys. Rev. B* **59**, 13309 (1999).

C. E. Jordan, R. A. Zuhr, and A. R. Marder, "Effect of Phosphorous Surface Segregation on Iron-Zinc Reaction Kinetics During Hot-Dip Galvanizing," *Metall. Mater. Trans. A* **28A**, 2695 (1997).

R. P. Joshi and R. F. Wood, "Molecular Dynamics Monte Carlo Simulations of Grain Boundary Electron Transport in *n*-Silicon," *J. Appl. Phys.* **84**, 3197 (1998).

R. Kalyanaraman, R. D. Vispute, S. Oktyabrsky, K. Dovidenko, K. Jagannadham, J. Narayan, J. D. Budai, N. Parikh, and A. Suvkhanov, "Influence of Oxygen Background Pressure on Crystalline Quality of $SrTiO_3$ Films Grown on MgO by Pulsed-Laser Deposition," *Appl. Phys. Lett.* **71**, 1709 (1997).

B. W. Kang, J. Z. Wu, A. A. Gapud, W. N. Kang, D. K. Christen, and H. R. Kerchner, "Glassy Behavior of Vortex Liquid in High-T_c Superconducting Thin Films," *Phys. Rev. B* **60**, 3088 (1999).

W. N. Kang, B. W. Kang, Q. Y. Chen, J. Z. Wu, S. H. Yun, A. Gapud, J. Z. Qu, W. K. Chu, D. K. Christen, H. R. Kerchner, and C. W. Chu, " Scaling of the Hall Resistivity in Epitaxial $HgBa_2CaCu_2O_{6+\delta}$ Thin Films With Columnar Defects," *Phys. Rev. B* **59**, R9031 (1999).

T. Kaplan, M. Mostoller, and M. F. Chisholm, "Structural Transformation in the 90° Partial Dislocation in Si due to Ga Impurities," *Phys. Rev. B* **58**, 12865 (1998).

S. Katano, Y. Ishii, Y. Morii, H. R. Child, and J. A. Fernandez-Baca, "Upgrade of the Wide-Angle Neutron Diffractometer at the High-Flux Isotope Reactor," *Physica B* **241–243**, 198 (1998).

H. Kawano, R. Kajimoto H. Yoshizawa, J. A. Fernandez-Baca, Y. Tomioka, H. Kuwahara, and Y. Tokura, "Two-Dimensional Anisotropy in a Layered Metallic Antiferromagnet $RE_{1-x}Sr_xMnO_3$ with $x \sim 1/2$," *Physica B* **241–243**, 389 (1998).

C. Kendziora, M. C. Martin, L. Mihaly, L. Forro, and D. G. Mandrus, "Comment on Optical Conductivity of High-T_c Superconductors: From Underdoped to Overdoped," *Phys. Rev. Lett.* **79**, 4935 (1997).

B. J. Kennedy, C. J. Howard, and B. C. Chakoumakos, "Phase Transitions in Perovskite at Elevated Temperatures—A Powder Neutron Diffraction Study," *J. Phys.: Condens. Matter* **11**, 1479 (1999).

B. J. Kennedy, A. K. Prodjosantoso, and C. J. Howard, "Powder Neutron Diffraction Study of the High-Temperature Phase Transitions in $NaTaO_3$," *J. Phys.: Condens. Matter* **11**, 6319 (1999).

B. J. Kennedy, C. J. Howard, and B. C. Chakoumakos, "High-Temperature Phase Transitions in $SrZrO_3$," *Phys. Rev. B* **59**, 4023 (1999).

B. J. Kennedy, C. J. Howard, and B. C. Chakoumakos, "High-Temperature Phase Transitions in $SrHfO_3$," *Phys. Rev. B* **60**, 2972 (1999).

V. Keppens, D. Mandrus, B. C. Sales, B. C. Chakoumakos, P. Dai, R. Coldea, M. B. Maple, D. A. Gajewski, E. J. Freeman, and S. Bennington, "Localized Vibrational Modes in Metallic Solids," *Nature* **395**, 876 (1998).

H. R. Kerchner, D. P. Norton, A. Goyal, J. D. Budai, D. K. Christen, D. M. Kroeger, E. D. Specht, Q. He, M. Paranthaman, D. F. Lee, B. C. Sales, F. A. List, and R. Feenstra, "Alternating Current Losses in Biaxially Textured $YBa_2Cu_3O_{7-\delta}$ Films Deposited on Ni Tapes," *Appl. Phys. Lett.* **71**, 2029 (1997).

H. R. Kerchner, D. P. Norton, A. Goyal, J. D. Budai, D. K. Christen, D. M. Kroeger, M. Paranthaman, D. F. Lee, F. A. List, R. Feenstra, and E. H. Brandt, "Alternating Transport-Current Flow in Superconductive Films: The Role of a Geometrical Barrier to Vortex Motion," *Phys. Rev. B* **60**, 6878 (1999).

V. I. Klimov, Ch. J. Schwarz, D. W. McBranch, and C. W. White, "Initial Carrier Relaxation Dynamics in Ion-Implanted Si Nanocrystals: Femtosecond Transient Absorption Study," *Appl. Phys. Lett.* **73**, 2603 (1998).

V. G. Kogan, P. Miranovic, Lj. Dobrosavljevic-Grujic, W. E. Pickett, and D. K. Christen, "Vortex Lattices in Cubic Superconductors," *Phys. Rev. Lett.* **79**, 741 (1997).

M. Kojima, J. H. Magill, J. S. Lin, and S. N. Magonov, "Structure and Morphology of Biaxially Oriented Films of Polyethylenes," *Chem. Mater.* **9**, 1145 (1997).

T. Kostyrko, M. Bartkowiak, and G. D. Mahan, "Reflection by Defects in a Tight Binding Model of Nanotubes," *Phys. Rev. B* **59**, 3241 (1999).

T. Kosugi, K. Amezawa, N. Yamamoto, S. Kawano, and J. A. Fernandez-Baca, "Neutron Diffraction Studies of the Magnetic Structures of $Tb_{0.76}Y_{0.24}$ Single Crystal Under High Pressure," *J. Phys. Chem. Solids* **60**, 1225 (1999).

M. Kottcke, B. Dötsch, L. Hammer, K. Heinz, K. Müller, and D. M. Zehner, "Deep Layer Oscillatory Segregation and Relaxation of Substitutionally Disordered Mo_xRe_{1-x}(100)," *Surf. Sci.* **376**, 319 (1997).

L. Krusin-Elbaum, D. Lopez, J. R. Thompson, R. Wheeler, J. Ullmann, C. W. Chu, and Q. M. Lin, "Superconductivity Enhanced by Hg Fission," *Nature* **389**, 243 (1997).

L. Krusin-Elbaum, D. López. J. R. Thompson, R. Wheeler, J. Ullmann, C. C. Tsuei, C. W. Chu, and Q. M. Lin, "A Path to High-Field Performance of Cuprate Superconductors Above 100 K with Fission-Induced Defects," *Physica C* **282–287**, 375 (1997).

L. Krusin-Elbaum, G. Blatter, J. R. Thompson, D. K. Petrov, R. Wheeler, J. Ullmann, and C. W. Chu, "Anisotropic Rescaling of a Splayed Pinning Landscape in Hg-Cuprates: Strong Vortex Pinning and Recovery of Variable Range Hopping," *Phys. Rev. Lett.* **81**, 3948 (1998).

W. Ku and A. G. Eguiluz, "Plasmon Lifetime in K: A Case Study of Correlated Electron in Solids Amenable to *Ab Initio* Theory," *Phys. Rev. Lett.* **82**, 2350 (1999).

M. N. Kunchur, D. K. Christen, and B. I. Ivlev, "Decomposition of the Hall Angle in the Mixed State of Superconductors," *Physica C* **307**, 241 (1998).

Y. Kuroiwa, A. Konishi, T. Shobu, Y. Noda, K. Fuchizaki, Y. Morii, Y. Yamada, H. R. Child, H. Chou, and S. C. Moss, "Elastic and Inelastic Neutron Scattering Studies on the Martensitic Phase Transformation in Cu-39at.%Zn Alloy," *J. Phys. Soc. Jpn.* **66**, 1033 (1997).

C. Laermans, V. Keppens, and R. A. Weeks, "Tunneling States in Vitreous GeO_2," *Phys. Rev. B* **55**, 2701 (1997).

B. Lake and D. A. Tennant, "Models of Magnetic Excitations in the Dimer-Chain Compound $CuWO_4$," *Physica B* **234**, 557 (1997).

B. Lake, G. Aeppli, T. E. Mason, A. Schröder, D. F. McMorrow, K. Lefmann, M. Isshiki, M. Nohara, H. Takagi, and S. M. Hayden, "Spin Gap and Magnetic Coherence in a Clean High-Temperature Superconductor," *Nature* **400**, 43 (1999).

M. P. Lambros, E. Sheu, J. S. Lin, and H. A. Pereira, "Interaction of a Synthetic Peptide Based on the Neutrophil-Derived Antimicrobial Protein CAP37 with Dipalmitoyl-Phosphatidylcholine Membranes," *Biochimica et Biophysica Acta* **1329**, 285 (1997).

D. Lamoen and B. N. J. Persson, "Adsorption of Potassium and Oxygen on Graphite: A Theoretical Study," *J. Chem. Phys.* **108**, 3332 (1998).

J. H. Laurer, J. F. Mulling, S. A. Khan, R. J. Spontak, J. S. Lin, and R. Bukovnik, "Thermoplastic Elastomer Gells—II. Effects of Composition and Temperature on Morphology and Gel Rheology," *J. Polym. Sci., Polym. Phys. Ed.* **36**, 2513 (1998).

J. H. Laurer, S. A. Khan, R. J. Spontak, M. M. Satkowski, J. T. Grothaus, S. D. Smith, and J. S. Lin, "Morphology and Rheology of SIS and SEPS Triblock Copolymers in the Presence of a Midblock-Selective Solvent," *Langmuir* **15**, 7947 (1999).

D. F. Lee, M. Paranthaman, J. E. Mathis, A. Goyal, D. M. Kroeger, E. D. Specht, R. K. Williams, F. A. List, P. M. Martin, C. Park, D. P. Norton, and D. K. Christen, "Alternative Buffer Architectures for High Critical Current Density YBCO Superconducting Deposits on Rolling-Assisted Biaxially Textured Substrates," *J. Appl. Phys. Part 2-Lett.* **38**, L178 (1999).

D.-H. Lee, H. Lee, B. Park, D. B. Poker, and L. Riester, "The Effect of Implantation Temperature on the Surface Hardness, Elastic Modulus, and Raman Scattering in Amorphous Carbon," *Appl. Phys. Lett.* **70**, 3104 (1997).

W.-T. Lee, S. A. Werner, J. A. Fernandez-Baca, and R. S. Fishman, "Excitations of the Transversely Polarized Spin Density Waves in Chromium," *Physica B* **241–243**, 622 (1998).

Y. E. Lee, D. P. Norton, and J. D. Budai, "Enhanced Photoluminescence in Epitaxial $ZnGa_2O_4$:Mn Thin-Film Phosphors Using Pulsed-Laser Deposition," *Appl. Phys. Lett.* **74**, 3155 (1999).

S. Lees, M. Capel, D. W. L. Hukins, and H. A. Mook, "Effect of Sodium Chloride Solutions on Mineralized and Unmineralized Turkey Leg Tendon," *Calcf. Tissue Int.* **61**, 74 (1997).

N. N. Lepeshkin, W. Kim, V. P. Safonov, J. G. Zhu, R. L. Armstrong, C. W. White, R. A. Zuhr, and V. M. Shalaev, "Optical Nonlinearities of Metal-Dielectric Composites, *J. Nonlinear Opt. Phys. Mater.* **8**, 191 (1999).

W. Li, D. Z. Wang, J. Y. Lao, Z. F. Ren, J. H. Wang, M. Paranthaman, D. T. Verebelyi, and D. K. Christen, "Epitaxial Superconducting $Tl_{0.5}Pb_{0.5}Sr_{1.6}Ba_{0.4}Ca_2Cu_3O_9$ Films on $LaAlO_3$ by Thermal Spray and Post-Annealing," *Supercond. Sci. Technol.* **12**, L1 (1999).

K. C. Lin, O. W. Holland, L. C. Feldman, and H. H. Weitering, "Surface Characterization of Silicon on Insulator Material," *Appl. Phys. Lett.* **72**, 2313 (1998).

K. F. Lin, J. S. Lin, and C. H. Cheng, "Synthesis, Curing, and Decomposition of Alkylamine-Adducted 3.3′-Bismaleimidodiphenylsulphone Resins," *J. Polym. Sci. A: Polym. Chem.* **35**, 2469 (1997).

F. A. List, A. Goyal, M. Paranthaman, D. P. Norton, E. D. Specht, D. F. Lee, andD. M. Kroeger, "High J(c) YBCO Films on Biaxially Textured Ni with Oxide Buffer Layers Deposited Using Electron Beam Evaporation and Sputtering," *Physica C* **302**, 87 (1998).

B.-G. Liu, J. Wu, E. G. Wang, and Z. Zhang, "Two-Dimensional Pattern Formation in Surfactant-Mediated Epitaxial Growth," *Phys. Rev. Lett.* **83**, 1195 (1999).

G. K. Liu, J. V. Beitz, J. Huang, M. M. Abraham, and L. A. Boatner, "Characterization of Crystal-Field and Nuclear Quadrupole Interactions in the $^5D_1$ State of $^{243}Am^{3+}$ in $LaCl_3$ and $CaWO_4$," *J. Alloys and Compounds* **250**, 347 (1997).

G. K. Liu, S. T. Li, V. V. Zhorin, C.-K. Loong, M. M. Abraham, and L. A. Boatner, "Crystal-Field Splitting, Magnetic Interaction, and Vibronic Excitations of $^{244}Cm^{3+}$ in YPO_4 and $LuPO_4$," *J. Chem. Phys.* **109**, 6800 (1998).

S. Lizzit, K. Pohl, A. Baraldi, G. Comelli, V. Fritzsche, E. W. Plummer, R. Stumpf, and Ph. Hofmann, "Physics of the Be(1010) Surface Core-Level Spectrum" *Phys. Rev. Lett.* **81**, 3271 (1998).

J. D. Londono, R. Dharmapurikar, H. D. Cochran, G. D. Wignall, J. B. McClain, D. E. Betts, D. A. Canelas, J. M. DeSimone, E. T. Samulski, D. Chillura-Martino, and R. Triolo, "The Morphology of Block Copolymer Micelles in Supercritical Carbon Dioxide by Small-Angle Neutron and X-Ray Scattering," *J. Appl. Crystallogr.* **30**, 690 (1997).

J. D. Londono and G. D. Wignall, "The Flory-Huggins Interaction Parameter in Blends of Polystyrene and Poly(*p*-Methylstyrene) by Small-Angle Neutron Scattering," *Macromol.* **30**, 13 (1997).

J. D. Londono, G. D. Wignall, H. D. Cochran, J. B. McClain, D. E. Betts, D. A. Canelas, J. M. DeSimone, E. T. Samulski, and R. Triolo, "Small-Angle Neutron Scattering from Polymers in Supercritical Carbon Dioxide," *Neutron News* **10**, 10 (1999).

C.-K. Loong, K. Suzuya, D. L. Price, B. C. Sales, and L. A. Boatner, "Structure and Dynamics of Phosphate Glasses: From Ultra- to Orthophosphate Composition," *Physica B* **241–243**, 890 (1998).

D. H. Lowndes, C. M. Rouleau, T. Thundat, G. Duscher, E. A. Kenik, and S. J. Pennycook, "Silicon and Zinc Telluride Nanoparticles Synthesized by Pulsed-Laser Ablation: Size Distributions and Nanoscale Structure," *Appl. Surf. Sci.* **127–129**, 355 (1998).

D. H. Lowndes, C. M. Rouleau, T. Thundat, G. Duscher, E. A. Kenik, and S. J. Pennycook, "Silicon and Zinc Telluride Nanoparticles Synthesized by Low-Energy Density Pulsed-Laser Ablation into Ambient Gases," *J. Mater. Res.* **14**, 359 (1999).

D. Lubben, G. Eres, G. E. Jellison, Jr., R. D. Westbrook, and R. F Wood, "Growth and Doping of Si Layers by Molecular-Jet Chemical Vapor Deposition: Device Fabrication," *Appl. Phys. Lett.* **71**, 2812 (1997).

H. H. Madden, R. Landers, G. G. Kleiman, and D. M. Zehner, "Characteristic Losses in Metals: Al, Be, and Ni," *J. Vac. Sci. Technol. A* **16**, 2595 (1998).

H. H. Madden, R. Landers, G. G. Kleiman, and D. M. Zehner, "Oxygen-Induced Changes in Electron-Energy-Loss Spectra for Al, Be, and Ni," *J. Vac. Sci. Technol. A* **17**, 2719 (1999).

L. J. Magid, Z. Han, G. G. Warr, M. A. Cassidy, P. D. Butler, and W. A. Hamilton, "Effect of Counterion Competition on Micellar Growth Horizons for Cetylrimethylammonium Micellar Surfaces: Electrostatics and Specific Binding," *J. Phys. Chem. B* **101**, 7919 (1997).

R. H. Magruder III, R. A. Zuhr, D. K. Hensley, and S. P. Withrow, "Photosensitivity of B-, Si-, and N-Implanted Silica" *Nucl. Instrum. Methods Phys. Res. B* **127/128**, 492 (1997).

R. H. Magruder III, R. A. Weeks, R. A. Zuhr, and D. K. Hensley, "Effects of MeV-Implanted Boron on the Optical Properties of Silica," *J. Non-Cryst. Solids* **222**, 243 (1997).

R. H. Magruder III and R. A. Zuhr, "Modification of the Optical Properties of Ag Nanoclusters by Sequential Implantation of Sc(Ti) and O in Silica," *Nucl. Instrum. Methods Phys. Res. B* **141**, 256 (1998).

R. H. Magruder III, R. A. Weeks, R. A. Zuhr, and D. K. Hensley, "Optical Absorption and Photosensitivity of N-Implanted Silica," *Nucl. Instrum. Methods Phys. Res. B* **141**, 575 (1998).

R. H. Magruder III, R. A. Weeks, R. A. Weller, R. A. Zuhr, and D. K. Hensley, "Formation and Photosensitivity of Defects in Se-Implanted Silica," *J. Non-Cryst. Solids* **239**, 78 (1998).

G. D. Mahan, "Seebeck Coefficient for the Anderson Model," *Phys. Rev. B* **56**, 11833 (1997).

G. D. Mahan, "Thermoelectrics: Materials Which Heat and Cool," *Sci. Spectra Mag.* **10**, 60 (1997).

G. D. Mahan, "Reentrant Superconductivity from the Anhamonic Electron-Phonon Interaction," *Phys. Rev. B* **56**, 8322 (1997).

G. D. Mahan, J. O. Sofo, and M. Bartkowiak, "Multilayer Thermionic Refrigerator and Generator," *J. Appl. Phys.* **83**, 4683 (1998).

G. D. Mahan, W. E. Engler, J. J. Tiemann, and E. Uzgiris, "Ultrasonic Tagging of Light: Theory," *Proc. Natl. Acad. Sci.* **95**, 14015 (1998).

G. D. Mahan and L. M. Woods, "Multilayer Thermionic Refrigeration," *Phys. Rev. Lett.* **80**, 4016 (1998).

G. D. Mahan and M. Bartkowiak, "Wiedemann-Franz Law at Boundaries," *Appl. Phys. Lett.* **74**, 953 (1999).

G. D. Mahan and L. M. Woods, "Phonon-Modulated Electron-Electron Interactions," *Phys. Rev.* **60**, 5276 (1999).

A. Maiti, S. T. Pantelides, M. F. Chisholm, and S. J. Pennycook, "Damage Nucleation and Vacancy-Induced Structural Transformation in Si Grain Boundaries," *Appl. Phys. Lett.* **75**, 2380 (1999).

A. G. Mal'shukov and G. D. Mahan, "Nonlinear Forward Scattering of Light in Opaque Media," *Phys. Rev. B* **57**, 7701 (1998).

K. Malekani, J. A. Rice, and J. S. Lin, "The Effect of Sequential Removal of Organic Matter on the Surface Morphology of Humin," *Soil Sci.* **162**, 333 (1997).

K. Malekani, J. A. Rice, and J. S. Lin, "Fractal Character of Humin and Its Components," *Fractals* **5**, 83 (1997).

L. Mandelkern, R. G. Alamo, G. D. Wignall, and F. C. Stehling, "The Phase Structure of Blends of the Different Polyethylenes," *Trends in Polym. Sci.* **4**, 377 (1996).

D. Mandrus, V. Keppens, B. C. Sales, and J. L. Sarrao, "Unusual Transport and Large Diamagnetism in the Intermetallic Semiconductor $RuAl_2$," *Phys. Rev. B* **58**, 3712 (1998).

D. Mandrus, V. Keppens, and B. C. Chakoumakos, "Spin Glass Formation in Co_2RuO_4," *Mater. Res. Bull.* **34**, 1013 (1999).

L. Mañosa, J. Zarestky, M. Bullock, and C. Stassis, "Low-Lying Phonon Dispersion Curves of $DO_3Cu_3Al(+Be)S$," *Phys. Rev. B* **59**, 9239 (1999).

M. B. Maple, N. R. Dilley, D. A. Gajewski, E. D. Bauer, E. J. Freeman, R. Chau, D. G. Mandrus, and B. C. Sales, "Strongly Correlated Electron Phenomena in Filled Skutterudite Compounds," *Physica B* **259–261**, 8 (1999).

D. C. Marinescu and A. W. Overhauser, "Thermoelectric Flux in Superconducting Rings," *Phys. Rev. B* **55**, 11637 (1997).

D. C. Marinescu and J. J. Quinn, "Exchange and Correlation Corrections to the Response Functions of a Spin-Polarized Electron Gas," *Phys. Rev. B* **56**, 1114 (1997).

D. C. Marinescu, J. J. Quinn, P. Sitko, and K. S. Yi, "Composite Fermions and the Half-Filled State," *Phys. Rev. B* **56**, 14941 (1997).

D. C. Marinescu and J. J. Quinn, "Collective Excitations in a Spin-Polarized Quantum Well," *Phys. Rev. B* **58**, 13762 (1998).

D. C. Marinescu and J. J. Quinn, "Long Wavelength Collective Excitations in a Two-Dimensional Spin-Polarized Electron Gas: A Phenomenological Theory," *Phys. Rev. B* **58**, 15688 (1998).

D. W. M. Marr, M. Wartenberg, K. B. Schwartz, M. M. Agamalian, and G. D. Wignall, "Void Morphology in Polyethylene/Carbon Black Composites," *Macromol.* **30**, 2120 (1997).

J. M. Martin, M. R. Lees, D. McK. Paul, P. Dai, C. Ritter, and Y. J. Bi, "Neutron Diffraction Study of $CeCuGa_3$," *Phys. Rev. B* **57**, 7419 (1998).

P. C. Mason, B. D. Gaulin, R. M. Epand, G. D. Wignall, and J. S. Lin, "Small-Angle Neutron Scattering and Calorimetric Studies of Large Unilamellar Vesicles of the Phospholipid Dipalmitoylphosphatidylcholine," *Phys. Rev. E* **59**, 3361 (1999).

P. C. Mason, B. D. Gaulin, R. M. Epand, G. D. Wignall, and J. S. Lin, "Small-Angle Neutron Scattering Studies of the Fully Hydrated Phospholipid DPPC," *Phys. Rev. E* **59**, 921 (1999).

T. Masuda, A. Fujioka, Y. Uchiyama, I. Tsukada, and K. Uchinokura, "Phase Transition Between Dimerized-Antiferromagnetic and Uniform-Antiferromagnetic Phases in the Impurity-Doped Spin Peierls Cuprate $CuGeO_3$," *Phys. Rev. Lett.* **80**, 4566 (1998).

J. E. Mathis, A. Goyal, F. A. List, P. Paranthaman, D. K. Christen, E. D. Specht, D. M. Kroeger, D. F. Lee, and P. M. Martin, "Biaxially Textured $YBa_2Cu_3O_{7-\delta}$ Conductors on Rolling Assisted Biaxially Textured Substrates with Critical Current Densities of 2–3 Ma/cm^2," *Jpn. J. Appl. Phys.* **37**, L1379 (1998).

I. Matsubara, M. Paranthaman, T. Chirayil, E. Y. Sun, P. M. Martin, D. M. Kroeger, D. T. Verebelyi, and D. K. Christen, "Preparation of Epitaxial $YBa_2Cu_3O_{7-\delta}$ on $SrTiO_3$ Single Crystal using a Solution Process," *Jpn. J. Appl. Phys.* **38**, L727 (1999).

M. Matsuda, K. Katsumata, T. Osafune, N. Motoyama, H. Eisaki, S. Uchida, T. Yokoo, S. M. Shapiro, G. Shirane, and J. L. Zarestky, "Magnetic Excitations and Structural Change in the $S = 1/2$ Quasi-One-Dimensional Magnet $Sr_{14-x}Y_xCu_{24}O_{41}$ $(0 \leq x \leq 1)$," *Phys. Rev. B* **56**, 14499 (1997).

M. Matsuda, K. M. Kojima, Y. J. Uemura, J. L. Zarestky, K. Nakajima, K. Kakurai, T. Yokoo, S. M. Shapiro, and G. Shirane, "Ordering of Oxygen Moments in Ferromagnetic Edge-Sharing CuO_4 Chains in $La_{14-x}Ca_xCu_{24}O_{41}$," *Phys. Rev. B* **57**, 11467 (1998).

H. Matsuoka, T. Ikeda, H. Yamaoka, M. Hashimoto, T. Takahashi, M. M. Agamalian, and G. D. Wignall, "Ultra-Small-Angle Neutron Scattering Study of Colloidal Alloys. I. Contrast Variation Experiments for Mixtures of Hydrogenated and Deuterated Polystyrene Lattices in H_2O/D_2O," *Langmuir* **15**, 293 (1999).

L. Maya, J. R. Thompson, K. J. Song, and R. J. Warmack, "Thermal Conversion of an Iron Nitride-Silicon Precursor into a Ferromagnetic Nanocomposite," *J. Appl. Phys.* **83**, 905 (1998).

A. J. McGibbon, S. J. Pennycook, and D. E. Jesson, "Crystal Structure Retrieval by Maximum Entropy Analysis of Atomic-Resolution Incoherent Images," *J. Microsc.* **195**, 44 (1999).

R. A. McKee, F. J. Walker, and M. F. Chisholm, "Crystalline Oxides on Silicon: The First Five Monolayers," *Phys. Rev. Lett.* **81**, 3014 (1998).

R. J. McQueeney, Y. Petrov, T. Egami, M. Yethiraj, G. Shirane, and Y. Endoh, "Anomalous Dispersion of LO Phonons in $La_{1.85}Sr_{0.15}CuO_4$ at Low Temperatures," *Phys. Rev. Lett.* **82**, 628 (1999).

F. J. Medellin-Rodriguez, P. J. Phillips, J. S. Lin, and R. Campos, "The Triple Melting Behavior of Poly(Ethylene Terephthalate): Molecular Weight Effects," *J. Polym. Sci. B, Polym. Phys.* **35**, 1757 (1997).

F. J. Medellin-Rodriguez, P. J. Phillips, J. S. Lin, and C. A. Avila-Orta, "Triple Melting Behavior of Poly(Ethylene Terephthalate Co-1,4-Cyclohexylene Dimenthylene Terephthalate) Random Copolymers," *J. Polym. Sci. B, Polym. Phys.* **36**, 763 (1998).

A. Meldrum, L. A. Boatner, and R. C. Ewing, "Displacive Radiation Effects in the Monazite- and Zircon-Structure Orthophosphates," *Phys. Rev. B* **56**, 13805 (1997).

A. Meldrum, L. A. Boatner, W. J. Weber, and R. C. Ewing, "Radiation Damage in Zircon and Monazite," *Geochimica et Cosmochimica Acta* **62**, 2509 (1998).

A. Meldrum, L. A. Boatner, and R. C. Ewing, "Effects of Ionizing and Displacive Irradiation on Several Perovskite-Structure Oxides," *Nucl. Instrum. Methods Phys. Res. B* **141**, 347 (1998).

A. Meldrum, S. J. Zinkle, L. A. Boatner, and R. C. Ewing, "A Transient Liquid-Like State in the Displacement Cascades of Zircon, Hafnon, and Thorite," *Nature* **395**, 56 (1998).

A. Meldrum, C. W. White, L. A. Boatner, I. M. Anderson, R. A. Zuhr, E. Sonder, J. D. Budai, and D. O. Henderson, "Microstructure of Sulfide Nanocrystals Formed by Ion Implantation," *Nucl. Instrum. Methods Phys. Res. B* **148**, 957 (1999).

A. Meldrum, R. A. Zuhr, E. Sonder, J. D. Budai, C. W. White, L. A. Boatner, R. C. Ewing, and D. O. Henderson, "Formation of Oriented Particles in an Amorphous Host: ZnS Nanocrystals in Silicon," *Appl. Phys. Lett.* **74**, 697 (1999).

A. Meldrum, S. J. Zinkle, L. A. Boatner, and R. C. Ewing, "Heavy-Ion Irradiation Effects in the ABO_4 Orthosilicates: Decomposition, Amorphization, and Recrystallization," *Phys. Rev. B* **59**, 3981 (1999).

A. Meldrum, L. A. Boatner, S. J. Zinkle, S.-X. Wang, L.-M. Wang, and R. C. Ewing, "Effects of Dose Rate and Temperature on the Crystalline-to-Metamict Transformation in the ABO_4 Orthosilicates," *Canadian Mineralogist* **37**, 207 (1999).

A. V. Melechko, J. Braun, H. H. Weitering, and E. W. Plummer, "Defect-Mediated Two-Dimensional Phase Transition," *Phys. Rev. Lett.* **83**, 999 (1999).

Y. B. Melnichenko, G. D. Wignall, W. A. Van Hook, J. Szydlowski, H. Wilczura, and L. P. Rebelo, "Comparison of Inter- and Intramolecular Correlations of Polystyrene in Poor and θ Solvents via Small-Angle Neutron Scattering," *Macromol.* **31**, 8436 (1998).

Y. B. Melnichenko, M. A. Anisimov, A. A. Povodryev, G. D. Wignall, J. V. Sengers, and W. A. Van Hook, "Sharp Crossover of the Susceptibility in Polymer Solutions Near the Critical Demixing Point," *Phys. Rev. Lett.* **79**, 5266 (1997).

Y. B. Melnichenko, E. Kiran, G. D. Wignall, K. D. Heath, S. Salaniwal, H. D. Cochran, and M. Stamm, "Pressure- and Temperature-Induced Transitions in Solutions of Poly(Dimethylsiloxane) in Supercritical Carbon Dioxide," *Macromol.* **32**, 5344 (1999).

Y. B. Melnichenko, G. D. Wignall, R. N. Compton, and G. Bakale, "Characterization of Fullerenes and Fullerene Derivatives by Small-Angle Neutron Scattering and Transmission Measurements," *J. Chem. Phys.* **111**, 4724 (1999).

V. I. Merkulov, D. H. Lowndes, G. E. Jellison, Jr., A. A. Puretzky, and D. B. Geohegan, "Structure and Optical Properties of Amorphous Diamond Films Prepared by ArF Laser Ablation as a Function of Carbon Ion Kinetic Energy," *Appl. Phys. Lett.* **73**, 2591 (1998).

V. I. Merkulov, D. H. Lowndes, and L. R. Baylor, "Field Emission Studies of Smooth and Nanostructured Carbon Films," *Appl. Phys. Lett.* **75**, 122 (1999).

Y. Michihiro and G. D. Mahan, "Shielding Factors of Ions in Rock-Salt Crystals," *Phys. Rev. B* **56**, 12151 (1997).

S. T. Misture, S. M. Pilgrim, J. C. Hicks, C. T. Blue, E. A. Payzant, and C. R. Hubbard, "Measurement of the Electrostrictive Coefficients of Modified Lead Magnesium Niobate Using Neutron Powder Diffraction," *Appl. Phys. Lett.* **72**, 1042 (1998).

S.-D. Mo, W. Y. Ching, M. F. Chisholm, and G. Duscher, "Electronic Structure of a Grain-Boundary Model in $SrTiO_3$," *Phys. Rev. B* **60**, 2416 (1999).

H. A. Mook and B. C. Chakoumakos, "Incommensurate Fluctuations in $Bi_2Sr_2CaCu_2O_8$," *J. Supercond.* **10**, 389 (1997).

H. A. Mook, P. Dai, R. D. Hunt, and F. Dogan, "Neutron Scattering Studies of the Magnetic Fluctuations in $YBa_2Cu_3O_{7-\delta}$," *J. Phys. Chem. Solids* **59**, 2140 (1998).

H. A. Mook, P. Dai, S. M. Hayden, G. Aeppli, T. G. Perring, and F. Dogan, "Spin Fluctuations in $YBa_2Cu_3O_{6.6}$," *Nature* **395**, 580 (1998).

H. A. Mook and F. Dogan, "Charge Fluctuations in $YBa_2Cu_3O_{7-x}$ High-Temperature Superconductors," *Nature* **401**, 145 (1999).

R. Morton, S. S. Lau, D. B. Poker, P. K. Chu, N. Wang, and K. K. Fung, "Carbon and Group II Acceptor Coimplantation in GaAs," *J. Appl. Phys.* **84**, 4929 (1998).

W. W. Moses, M. J. Weber, S. E. Derenzo, D. Perry, P. Berndahl, and L. A. Boatner, "Prospects for Dense, Infrared Emitting Scintillators," *IEEE Trans. Nucl. Sci.* **45**, 462 (1998).

S. C. Moss, J. L. Robertson, D. A. Neumann, and L. Reinhard, "Anomalous Static Displacements and Their Relation to Lattice Dynamics in $Fe_{0.53}Cr_{0.47}$," *Comp. Mater. Sci.* **8**, 33 (1997).

L. J. Nagel, B. Fultz, and J. L. Robertson, "Phase Equilibria of Co_3V," *J. Phase Equilib.* **18**, 21 (1997).

S. E. Nagler, D. G. Mandrus, and D. A. Tennant, "Spin Waves in $CsVBr_3$," *Physica B* **241–243**, 561 (1998).

S. E. Nagler, "Inelastic Neutron Scattering Studies of Magnetic Excitations at the Oak Ridge National Laboratory," *Neutron News* **10**, 21 (1999).

P. D. Nellist and S. J. Pennycook, "Accurate Structure Determination from Image Reconstruction in ADF STEM," *J. Microsc.* **190**, 159 (1998).

P. D. Nellist and S. J. Pennycook, "Subangstrom Resolution by Underfocused Incoherent Transmission Electron Microscopy," *Phys. Rev. Lett.* **81**, 4156 (1998).

B. J. Neudecker, R. A. Zuhr, B. S. Kwak, J. B. Bates, and J. D. Robertson, "Lithium Manganese Nickel Oxides $Li_x(Mn_yNi_{1-y})_{2-x}O_2$. Part 1: Synthesis and Characterization of Thin Films and Bulk Phases," *J. Electrochem. Soc.* **145**, 4148 (1998).

B. J. Neudecker, R. A. Zuhr, J. D. Robertson, and J. B. Bates, "Lithium Manganese Nickel Oxides $Li_x(Mn_yNi_{1-y})_{2-x}O_2$. Part 2: Electrochemical Studies on Thin-Film Batteries," *J. Electrochem. Soc.* **145**, 4160 (1998).

B. J. Neudecker, R. A. Zuhr, and J. B. Bates, "Lithium Silicon Tin Oxynitride (Li_ySiTON): High-Performance Anode in Thin-Film Lithium-Ion Batteries for Microelectronics," *J. Power Sources* **81–82**, 27 (1999).

E. Neufeld, S. Wang, R. Apetz, Ch. Buchal, R. Carius, C. W. White, and D. K. Thomas, "Effect of Annealing and H_2 Passivation on the Photoluminescence of Si Nanocrystals in SiO_2," *Thin Solid Films* **294**, 238 (1997).

A.-D. Nguyen, K. Murdoch, N. Edelstein, L. A. Boatner, and M. M. Abraham, "Polarization Dependence of Phonon and Electronic Raman Intensities in $PrVO_4$ and $NdVO_4$," *Phys. Rev. B* **56**, 7974 (1997).

J. C. Nipko, C.-K. Loong, M. Loewenhaupt, M. Braden, W. Reichardt, and L. A. Boatner, "Lattice Dynamics of Xenotime: The Phonon Dispersion Relations and Density of States of $LuPO_4$," *Phys. Rev. B* **56**, 11584 (1997).

M. Nishi, K. Kakurai, Y. Fujii, M. Yethiraj, D. A. Tennant, S. E. Nagler, J. A. Fernandez-Baca, O. Fujita, and J. Akimitsu, "Magnetic Excitation of $CuGeO_3$ Under Applied Pressure," *Physica B* **241–243**, 537 (1998).

M. Nishi, K. Kakurai, Y. Fujii, S. Katano, J. Akimitsu, M. Yethiraj, and J. A. Fernandez-Baca, "New Aspects of the b^*-LA Phonon of $CuGeO_3$," *J. Phys. Chem. Solids* **60**, 1109 (1999).

D. P. Norton, C. Park, C. Prouteau, D. K. Christen, M. F. Chisholm, J. D. Budai, S. J. Pennycook, A. Goyal, E. Y. Sun, D. F. Lee, D. M. Kroeger, E. Specht, M. Paranthaman, and N. D. Browning, "Epitaxial $YBa_2Cu_3O_7$ Films on Rolled-Textured Metals for High-Temperature Superconducting Applications," *J. Mater. Sci. Eng. B* **56**, 86 (1998).

D. P. Norton, "Science and Technology of High-Temperature Superconducting Films," *Ann. Rev. Mater. Sci.* **28**, 299 (1998).

D. P. Norton, C. Park, J. D. Budai, S. J. Pennycook, and C. Prouteau, "Plume-Induced Stress in Pulsed-Laser-Deposited CeO_2 Films," *Appl. Phys. Lett.* **74**, 2134 (1999).

M. Okada, A. P. Baddorf, and D. M Zehner, "Hydrogen Adsorption on $Mo_{1-x}Re_x(110)$, x = 0–0.25 Surfaces," *Surf. Sci.* **410**, 237 (1998).

M. Okada, D. B. Poker, and D. M Zehner, "Absolute Deuterium Coverage Determination for the $Mo_{0.75}Re_{0.25}$ (100), (110), and (111) Surfaces," *Surf. Sci.* **417**, 1 (1998).

K. Oikawa, T. Kamiyama, F. Izumi, B. C. Chakoumakos, H. Ikuta, M. Wakihara, J. Li, and Y. Matsui, "Structural Phase Transition of the Spinel-Type Oxide $LiMn_2O_4$," *Solid State Ionics* **109**, 35 (1998).

R. Oslanec, P. Vlcek, W. A. Hamilton, and R. J. Composto, "Crossover of a Block Copolymer Brush in a Polymer Melt From a Stretched-to-Collapsed Conformation," *Phys. Rev. E* **56**, R2383 (1997).

J. G. Ossandon and J. R. Thompson, "Stability of Supercurrents in BiSrCaCuO (Bi-2212) High-T_c Superconductor with Artificially Created Defects," *Superlattices Microstruct.* **23**, 543 (1998).

W. W. Pai, J. Zhang, J. F. Wendelken, and R. J. Warmack, "Magnetic Nanostructures Fabricated by Scanning Tunneling Microscope-Assisted Chemical Vapor Deposition," *J. Vac. Sci. Technol. B* **15**, 785 (1997).

W. W. Pai, A. K. Swan, Z. Zhang, and J. F. Wendelken, "Island Diffusion and Coarsening on Metal (100) Surfaces," *Phys. Rev. Lett.* **79**, 3210 (1997).

W. W. Pai, Z. Zhang, J. F. Zhang, and J. F. Wendelken, "Direct Visualization in Manipulation of Ultrasmall Molecular Objects at Room Temperature," *Surf. Sci. Lett.* **393**, 106 (1997).

W. W. Pai, Z. Zhang, J. Zhang, and J. F. Wendelken, "STM Tips Scientists on Atomic Details," *Chem. & Eng. News* **76**, 27 (1998).

D. Palles, E. Liarokapis, Th. Leventouri, and B. C. Chakoumakos, "The Effect of the Ca Substitution on the Structure and the Raman Active Phonons in $Y_{1-x}Ca_xBa_2Cu_3O_{7-\delta}$," *J. Phys.: Condens. Matter* **10**, 2515 (1998).

L. Pang, M. F. Chisholm, and K. S. Kumar, "{001} Faults in B2 Fe–40 at.% Al–0.7 at.% C–0.5 at.% B," *Philos. Mag. Lett.* **78**, 349 (1998).

N. Papanicolaou, M. V. Rao, B. Molnar, J. Tucker, A. Edwards, O. W. Holland, and M. C. Ridgway, "Ion Implantation in SiC and GaN," *Nucl. Instrum. Methods Phys. Res. B* **148**, 416 (1999).

M. Paranthaman, D. F. Lee, A. Goyal, E. D. Specht, P. M. Martin, X. Cui, J. E. Mathis, R. Feenstra, D. K. Christen, and D. M. Kroeger, "Growth of Biaxially Textured Re_2O_3 Buffer Layers on Rolled-Ni Substrates Using Reactive Evaporation for High-Temperature Superconductivity-Coated Conductors," *Supercond. Sci. Technol.* **12**, 319 (1999).

M. Paranthaman, D. F. Lee, R. Feenstra, A. Goyal, D. T. Verebelyi, D. K. Christen, E. D. Specht, F. A. List, P. M. Martin, D. M. Kroeger, Z. F. Ren, W. Li, D. Z. Wang, Y. L. Lao, and J. H. Wang, "Optimization of Buffer Layer on Rolled-Ni Substrates for High-Current YBCO and Tl,Bi-1223 Coated Conductors Using Ex Situ Precursor Approaches," *IEEE Trans. Appl. Supercond.* **9**, 2268 (1999).

C. Park, D. P. Norton, D. F. Lee, J. D. Budai, D. K. Christen, D. T. Verebelyi, A. Goyal, M. Paranthaman, and D. M. Kroeger, "Bend Strain Tolerance of Critical Currents for $YBa_2Cu_3O_7$ Films Deposed on Rolled-Textured (001) Ni," *Appl. Phys. Lett.* **73**, 1904 (1998).

C. Park, D. P. Norton, D. K. Christen, D. T. Verebelyi, R. Feenstra, J. D. Budai, A. Goyal, D. F. Lee, E. D. Specht, D. M. Kroeger, and M. Paranthaman, "Long-Length Fabrication of YBCO on Rolling Assisted Biaxially Textured Substrates (RABiTS) Using Pulsed-Laser Deposition," *IEEE Trans. Appl. Supercond.* **9**, 2276 (1999).

J.-W. Park, A. J. Pedraza, D. H. Lowndes, and W. R. Allen, "Adhesion Mechanisms of Copper Films Deposited onto Laser-Irradiated Alumina," *J. Mater. Res.* **12**, 3174 (1997).

J.-W. Park, C. M. Rouleau, and D. H. Lowndes, "Heteroepitaxial Growth of *n*-Type CdSe on GaAs(001) by Pulsed-Laser Ablation: Studies of Film-Substrate Interdiffusion and Indium Diffusion," *J. Cryst. Growth* **193**, 516 (1998).

J. W. Park, A. J. Pedraza, and D. H. Lowndes, "The Adhesion of Copper Films Deposited onto Aluminum Nitride," *J. Mater. Sci.* **34**, 1933 (1999).

S. Y. Park, T. Isobe, M. Senna, R. A. Weeks, and R. A. Zuhr, "Effects of KrF Laser Irradiation on Bi Nanoclusters Embedded in *a*-SiO_2 by Ion Implantation," *Appl. Phys. Lett.* **73**, 2687 (1998).

D. McK. Paul, C. V. Tomy, G. M. Aegerter, R. Cubitt, S. H. Lloyd, E. M. Forgan, S. L. Lee, and M. Yethiraj, "Nonlocal Effects and Vortex Lattice Transitions in YNi_2B_2C," *Phys. Rev. Lett.* **80**, 1517 (1998).

A. J. Pedraza, J. D. Fowlkes, and D. H. Lowndes, "Silicon Microcolumn Arrays Grown by Nanosecond Pulsed-Excimer Laser Irradiation," *Appl. Phys. Lett.* **74**, 2322 (1999).

S. J. Pennycook, E. C. Dickey, P. D. Nellist, M. F. Chisholm, Y. Yan, and S. T. Pantelides, "A Combined Experimental and Theoretical Approach to Atomic Structure and Segregation at Ceramic Interfaces," *J. Eur. Ceram. Soc.* **19**, 2211 (1999).

B. N. J. Persson and Z. Zhang, "Theory of Friction: Coulomb Drag Between Two Closely Spaced Solids," *Phys. Rev. B* **57**, 7327 (1998).

L. Petersen, P. T. Sprunger, P. Hofmann, E. Laegsgaard, B. G. Briner, M. Doering, H.-P. Rust, A. M. Bradshaw, F. Besenbacher, and E. W. Plummer, "Direct Imaging of the 2-D Fermi Contour: Fourier Transform STM," *Phys. Rev. B* **57**, R6858 (1998).

O. A. Petrenko, C. Ritter, M. Yethiraj, and D. McK. Paul, "Spin-Liquid Behavior of the Gadolinium Gallium Garnet," *Physica B* **241–243**, 727 (1997).

O. A. Petrenko, C. Ritter, M. Yethiraj, and D. McK. Paul, "Investigation of the Low-Temperature Spin-Liquid Behavior of the Frustrated Magnet Gadolinium Gallium Garnet," *Phys. Rev. Lett.* **80**, 4570 (1998).

O. A. Petrenko, D. McK. Paul, C. Ritter, T. Zeiske, and M. Yethiraj, "Magnetic Frustration and Order in Gadolinium Gallium Garnet," *Physica B* **266**, 41 (1999).

J. M. Pitarke and A. G. Eguiluz, "Surface Energy of a Bounded Electron Gas: Analysis of the Accuracy of the Local-Density Approximation via *Ab Initio* Self-Consistent Field Calculations," *Phys. Rev. B* **57**, 6329 (1998).

E. W. Plummer, "More Than Skin Deep," *Science* **277**, 1447 (1997).

K. Pohl, J.-H. Cho, K. Terakura, M. Scheffler, and E. W. Plummer, "Anomalously Large Thermal Expansion at the (0001) Surface of Beryllium Without Interlayer Anharmonicity," *Phys. Rev. Lett.* **80**, 2853 (1998).

K. Pohl and E. W. Plummer, "Structure of the H-Induced Vacancy Reconstruction of the (0001) Surface of Beryllium," *Phys. Rev. B* **59**, 5324 (1999).

C. Prouteau, G. Duscher, N. D. Browning, and S. J. Pennycook, "Investigation of the Local Superconducting Properties in Ag-Sheathed BSCCO Tapes by STEM," *Physica C* **298**, 1 (1998).

S. Prussin and O. W. Holland, "The Role of Dose and Position on the Concentration of Residual Point Defects in As-Implanted Wafers," *Nucl. Instrum. Methods Phys. Res. B* **127/128**, 18 (1997).

A. A. Puretzky and D. B. Geohegan, "LIF-Imaging and Gas-Phase Diagnostics of Laser-Desorbed Maldi-Matrix Plumes," *Appl. Surf. Sci.* **127–129**, 151 (1998).

A. A. Puretzky and D. B. Geohegan, "Gas-Phase Diagnostics and LIF-Imaging of 3-Hydroxypicolinic Acid MALDI-Matrix Plumes," *Chem. Phys. Lett.* **286**, 425 (1998).

Y. Qian, D. Ila, R. L. Zimmerman, D. B. Poker, L. A. Boatner, and D. K. Hensley, "MeV Silver Ion-Implantation-Induced Changes in Optical Properties of MgO(100)," *Nucl. Instrum. Methods Phys. Res. B* **127/128**, 524 (1997).

A. Radlinski, E. Z. Radlinska, M. Agamalian, G. D. Wignall, B. P. Lindner, and O. G. Randl, "The Fractal Geometry of Rocks," *Phys. Rev. Lett.* **82**, 3078 (1999).

B. Rafferty and S. J. Pennycook, "Toward Atomic Column-by-Column Spectroscopy," *Ultramicroscopy* **78**, 141 (1999).

N. P. Raju, M. Dion, M. J. P. Gingras, T. E. Mason, and J. E. Greedan, "Transition to Long-Range Magnetic Order in the Highly Frustrated Insulating Pyrochlore Antiferromagnet $Gd_2Ti_2O_7$," *Phys. Rev. B* **59**, 14489 (1999).

M. V. Rao, J. A. Gardner, P. H. Chi, D. S. Simons, O. W. Holland, G. Kelner, J. Kretchmer, and M. Ghezzo, "Phosphorous and Boron Implantation in 6H-SiC," *J. Appl. Phys.* **81**, 6635 (1997).

M. V. Rao, D. Nordstrom, J. A. Gardner, A. Edwards, E. G. Roth, G. Kelner, and M. Ridgway, "Ion Implantation in 6H-SiC," *Nucl. Instrum. Methods Phys. Res. B* **127/128**, 655 (1997).

M. V. Rao, J. Gardner, A. Edwards, N. Papanicolaou, G. Kelner, O. W. Holland, M. Ghezzo, and J. Kretchmer, "Ion-Implantation Doping in SiC and Its Device Applications," *Mater. Sci. Forum* **264–268**, 717 (1998).

M. V. Rao, J. Tucker, O. W. Holland, N. Papanicolaou, P. H. Chi, J. W. Kretchmer, and M. Ghezzo, "Donor Ion-Implantation Doping into SiC," *J. Electron. Mater.* **23**, 334 (1999).

M. V. Rao, J. Tucker, M. C. Ridgway, O. W. Holland, N. Papanicolaou, and J. Mittereder, "Ion Implantation in Bulk, Semi-insulating 4H-SiC," *J. Appl. Phys.* **86**, 752 (1999).

A. Rapaport, O. Moteau, M. Bass, L. A. Boatner, and C. Deka, "Optical Spectroscopy and Lasing Properties of Neodymium-Doped Lutetium Orthophosphate," *J. Opt. Soc. Am. B* **16**, 911 (1999).

S. Raymond, T. Yokoo, A. Zheludev, S. E. Nagler, A. Wildes, and J. Akimitsu, "Polarized-Neutron Observation of Longitudinal Haldane-Gap Excitations in Nd_2BaNiO_5," *Phys. Rev. Lett.* **82**, 2382 (1999).

Z. F. Ren, J. Y. Lao, L. P. Guo, J. H. Wang, J. D. Budai, D. K. Christen, A. Goyal, M. Paranthaman, E. D. Specht, and J. R. Thompson, "Epitaxial Film Growth of $Tl_{0.78}Bi_{0.22}Sr_{1.6}Ba_{0.4}Ca_2Cu_3O_9$ on Rolling-Assisted Biaxially Textured Nickel Substrates with YSZ and CeO_2 Buffer Layers," *J. Supercond.* **11**, 159 (1998).

Z. F. Ren, W. Li, D. Z. Wang, J. Y. Lao, J. H. Wang, M. Paranthaman, D. T. Verebelyi, and D. K. Christen, "Growth and Characterization of Superconducting Films $Tl_{0.78}Bi_{0.22}Sr_{1.6}Ba_{0.4}Ca_2Cu_3O_9$ on CeO_2-Buffered Single-Crystal YSZ," *Physica C* **306**, 149 (1998).

Z. F. Ren, W. Li, D. Z. Wang, J. Y. Lao, J. H. Wang, M. Paranthaman, D. T. Verebelyi, D. K. Christen, D. F. Lee, A. Goyal, and D. M. Kroeger, "In-Plane Aligned Superconducting $Tl_{0.78}Bi_{0.22}Sr_{1.6}Ba_{0.4}Ca_2Cu_3O_9$ Films on Rolling-Assisted Biaxially Textured Substrates," *Physica C* **313**, 241 (1999).

Z. F. Ren, J. Y. Lao, W. Li, D. Z. Wang, J. H. Wang, C. C. Tsuei, J. R. Kirtley, D. K. Christen, and D. van der Marel, "Physics and Applications of Thallium-Based Superconductors," *Recent Res. Devel. Appl. Phys.* **2**, 291 (1999).

P. A. Reynolds, J. W. Cable, A. N. Sobolev, and B. N. Figgis, "Structure, Covalence, and Spin Polarization in Tris(Acetylacetonato)Ruthenium(III) Studied by X-Ray and Polarized Neutron Diffraction," *J. Chem. Soc., Dalton Trans.* **1**, 559 (1998).

J. L. Robertson, G. E. Ice, C. J. Sparks, X. Jiang, P. Zschack, F. Bley, S. Lefebvre, and M. Bessiere, "Local Atomic Arrangements in $Fe_{63.2}Ni_{36.8}$ Invar from Diffuse X-Ray Scattering Measurements," *Phys. Rev. Lett.* **82**, 2911 (1999).

M. T. Robinson, "Attractive Interaction Potentials and the Binary Collision Approximation," *Radiat. Eff. Defect Solids* **141**, 1 (1997).

A. J. Rondinone, A. C. S. Samia, and Z. J. Zhang, "Superparamagnetic Relaxation and Magnetic Anisotropy Energy Distribution in $CoFe_2O_4$ Spinel Ferrite Nanocrystallites," *J. Phys. Chem. B* **103**, 6876 (1999).

E. G. Roth, O. W. Holland, V. C. Venezia, and B. Nielsen, "Methods of Defect-Engineering Shallow Junctions Formed by B^+-Implantation in Si," *J. Electron. Mater.* **26**, 1349 (1997).

E. G. Roth, O. W. Holland, and D. K. Thomas, "Control of Diffusion of Implanted Boron in Preamorphized Si: Elimination of Interstitial Defects at the Amorphous-Crystal Interface," *Appl. Phys. Lett.* **74**, 679 (1999).

C. M. Rouleau and D. H. Lowndes, "Growth of *p*-Type ZnTe and *n*-Type CdSe Films on GaAs(001) by Pulsed-Laser Ablation," *Appl. Surf. Sci.* **127–129**, 418 (1998).

R. Russo, D. B. Geohegan, R. F. Haglund, Jr., and K. Murakami, eds., "Proceedings of the Fourth International Conference on Laser Ablation," *Appl. Surf. Sci.* **127/129**, (1998).

B. C. Sales, "Novel Thermoelectric Materials," *Curr. Opin. Solid State Mater. Sci.* **2**, 284 (1997).

B. C. Sales, D. Mandrus, B. C. Chakoumakos, V. Keppens, and J. R. Thompson, "Filled Skutterudite Antimonides: Electron Crystals and Phonon Glasses?" *Phys. Rev. B* **56**, 15081 (1997).

B. C. Sales, L. A. Boatner, and J. O. Ramey, "Intermediate-Range Order in Simple Metal Phosphate Glasses: The Effect of Metal Cations on the Phosphate Anion Distribution," *J. Non.-Cryst. Solids* **232–234**, 107 (1998).

B. C. Sales, J. U. Otaigbe, G. H. Beall, L. A. Boatner, and J. O. Ramey, "HPLC Study of the Structure of Zinc-Phosphate-Based Glasses," *J. Non.-Cryst. Solids* **226**, 287 (1998).

B. C. Sales, "Electron Crystals and Phonon-Glasses: A New Path to Improved Thermoelectric Materials," *Mater. Res. Bull.* **23**, 14 (1998).

B. C. Sales, B. C. Chakoumakos, D. G. Mandrus, and J. W. Sharp, "Atomic-Displacement Parameters and the Lattice Thermal Conductivity of Clathrate-Like Thermoelectric Compounds," *J. Solid State Chem.* **146**, 528 (1999).

I. M. Sandler, G. S. Canright, and Z. Zhang, "Spontaneous Chiral Symmetry Breaking in Two-Dimensional Aggregation," *Phys. Lett. A* **245**, 233 (1998).

I. M. Sandler, G. S. Canright, H. Gao, S. Pang. Z. Xue, and Z. Y. Zhang, "Chiral Patterns Arising from Electrostatic Growth Models," *Phys. Rev. B* **58**, 6015 (1998).

S. S. Sarkisov, E. K. Williams, M. Curley, D. Ila, P. Venkateswarlu, D. B. Poker, and D. K. Hensley, "Third-Order Optical Nonlinearity of Colloidal Metal Nanoclusters Formed by MeV Ion Implantation," *Nucl. Instrum. Methods Phys. Res. B* **141**, 294 (1998).

T. Sasaki, F. Kooli, M. Iida, Y. Michiue, S. Takenouchi, Y. Yajima, F. Izumi, B. C. Chakoumakos, and M. Watanabe, "A Mixed Alkali Metal Titanate with the Lepidocrocite-Like Layered Structure—Preparation, Crystal Structure, Protonic Form, and Acid Base Intercalation Properties," *Chem. Mater.* **10**, 4123 (1998).

W. D. Schöne and A. G. Eguiluz, "Self-Consistent Calculations of Quasiparticle States in Metals and Semiconductors," *Phys. Rev. Lett.* **81**, 1662 (1998).

E. Schroer, S. Hopfem, P. Werner, U. Gösele, G. Duscher, M. Rühle and T. Y. Tan, "Oxide Precipitation at Silicon Grain Boundaries," *Appl. Phys. Lett.* **20**, 327 (1997).

H. Seto, G. D. Wignall, R. Triolo, D. Chillura-Martino, and S. Komura, "Small-Angle Neutron Scattering Studies of Critical Phenomena in a Three-Component Microemulsion," *Prog. Colloid Polym. Sci.* **106**, 104 (1997).

Z. P. Shi and R. S. Fishman, "Interplay Between Spin-Density Wave and Proximity Magnetic Layers," *Phys. Rev. Lett.* **78**, 1351 (1997).

Z. P. Shi and R. S. Fishman, "Role of Cr Antiferromagnetism on Interlayer Magnetic Coupling in Fe/Cr Multilayered Systems," *J. Magn. Magn. Mater.* **199**, 391 (1999)

M. L. Simpson, W. B. Dress, M. N. Ericson, G. E. Jellison, Jr., D. N. Sitter, and A. L. Wintenberg, "A Photo-Spectrometer Realized in a Standard Integrated Circuit Process," *Rev. Sci. Instrum.* **69**, 377 (1998).

M. L. Simpson, G. S. Sayler, S. Ripp, D. E. Nivens, B. M. Applegate, M. J. Paulus, and G. E. Jellison, Jr., "Bioluminescent Bioreporter Integrated Circuits: Novel Whole-Cell Biosensors," *Trends in Biotechnology* **16**, 333 (1998).

M. L. Simpson, G. E. Jellison, Jr., M. N. Ericson, W. B. Dress, D. N. Sitter, and A. L. Wintenberg, "Photo-Spectroscopy Using CMOS Compatible Photodiodes," *IEEE Trans. Elect. Dev.* **46**, 905 (1999).

A. Singhal, L. M. Toth, G. Beaucage, J. S. Lin, and J. Peterson, "Growth and Structure of Zirconium Hydrous Polymers in Aqueous Solutions," *J. Colloid Interface Sci.* **194**, 470 (1997).

A. Singhal, G. Beaucage, M. T. Harris, L. M. Toth, K. D. Keefer, J. S. Lin, M. Z.-C. Hu, and J. R. Peterson, "Structure and Growth Kinetics of Zirconium Hydrous Polymers in Organic Solutions," *J. Non-Cryst. Solids* **246**, 197 (1999).

Z. Slanic, D. P. Belanger, and J. A. Fernandez-Baca, "Random-Field Critical Scattering at High Magnetic Concentration in the Ising Antiferromagnet $Fe_{0.93}Zn_{0.07}F_2$," *J. Magn. Magn. Mater.* **177–181**, 171 (1998).

Z. Slanic, D. P. Belanger, and J. A. Fernandez-Baca, "Equilibrium Random-Field Ising Critical Scattering in the Antiferromagnet $Fe_{0.93}Zn_{0.07}F_2$," *Phys. Rev. Lett.* **82**, 426 (1999).

K. Sohlberg, S. J. Pennycook, and S. T. Pantelides, "Hydrogen and the Structure of the Transition Aluminas," *J. Am. Chem. Soc.* **121**, 7493 (1999).

V. F. Solovyov, H. J. Wiesmann, M. Suenaga, and R. Feenstra, "Thick $YBa_2Cu_3O_7$ Films by Post Annealing of the Precursor by High-Rate e-Beam Deposition on $SrTiO_3$ Substrates," *Physica* C **309**, 269 (1998).

K. J. Song, J. R. Thompson, M. Yethiraj, D. K. Christen, C. V. Tomy, and D. McK. Paul, "Nonlocal Current-Field Relation and the Vortex-State Magnetic Properties of YNi_2B_2C," *Phys. Rev. B* **59**, R6620 (1999).

E. D. Specht, H.-M. Christen, D. P. Norton, and L. A. Boatner, "X-Ray Diffraction Measurement of the Effect of Layer Thickness on the Ferroelectric Transition in Epitaxial $KtaO_3/KnbO_3$ Multilayers," *Phys. Rev. Lett.* **80**, 4317 (1998).

E. D. Specht, A. Goyal, D. F. Lee, F. A. List, D. M. Kroeger, M. Paranthaman, R. K. Williams, and D. K. Christen, "Cube-Textured Nickel Substrates for High-Temperature Superconductors," *Supercond. Sci Technol.* **11**, 945 (1998).

S. Spooner and X.-L. Wang, "Diffraction Peak Displacement in Residual Stress Samples Due to Partial Burial of the Sampling Volume," *J. Appl. Crystallogr.* **30**, 449 (1997).

S. Spooner, C. R. Hubbard, X.-L. Wang, E. A. Payzant, and M. C. Wright, "Engineering Applications of Neutron Scattering at the High-Flux Isotope Reactor," *Neutron News* **10**, 26 (1999).

P. T. Sprunger, L. Petersen, E. W. Plummer, E. Laegsgaard, and F. Besenbacher, "Giant Friedel Oscillations on the Beryllium(0001) Surface," *Science* **275**, 7764 (1997).

C. Stassis, M. Bullock, J. Zarestky, P. Canfield, A. Goldman, G. Shirane, and S. Shapiro, "Phonon Mode Coupling in Superconducting $LuNi_2B_2C$," *Phys. Rev. B* **55**, 18678 (1997).

C. Stassis and A. I. Goldman, "Neutron and X-Ray Scattering Studies of RNi_2B_2C (R = Rare Earth) Single Crystals," *J. Alloys and Comp.* **250**, 603 (1997).

C. Stassis, J. Zarestky, A. I. Goldman, P. Canfield, G. Shirane, and S. Shapiro, "Anomalous Phonons Below T_c in Superconducting RNi_2B_2C (R = Lu, Y)," *Physica C* **317–318**, 127 (1999).

S. Stemmer, G. Duscher, T. Scheu, C. Kahn, and A. H. Heuer, "The Reaction Between a Ti_2Ni Shape-Memory Thin Film and Silicon," *J. Mater. Res.* **12**, 1734 (1997).

B. Sternlieb, C. Stassis, A. Goldman, P. Canfield, and S. Shapiro, "Single-Crystal Neutron Diffraction Study of the Magnetic Structure of $TmNi_2B_2C$," *J. Appl. Phys.* **81**, 4937 (1997).

M. Strobel, K.-H. Heinig, W. Möller, A. Meldrum, D. S. Zhou, C. W. White, and R. A. Zuhr, "Ion Beam Synthesis of Gold Nanoclusters in SiO_2: Computer Simulations Versus Experiments," *Nucl. Instrum. Methods Phys. Res. B* **147**, 343 (1999).

R. R. Stumpf, J. M. Carpinelli, and H. H. Weitering, "Apparent Charge Transfer at the Ge_xPb_{1-x}/Ge(111) Interface," *Phys. Rev. B* **59**, 15779 (1999).

Z. Suo and Z. Zhang, "Epitaxial Films Stabilized by Long-Range Forces," *Phys. Rev. B* **54**, 5116 (1998).

E. Y. Sun, A. Goyal, D. P. Norton, C. Park, D. M. Kroeger, M. Paranthaman, and D. K. Christen, "High-Resolution Transmission Electron Microscopy/Analytical Electron Microscopy Characterization of Epitaxial Oxide Multilayers Fabricated by Laser Ablation on Biaxially Textured Ni," *Physica C* **321**, 29 (1999).

K. Suzuya, C.-K. Loong, D. L. Price, B. C. Sales, and L. A. Boatner, "The Structure of Lead-Indium Phosphate and Lead-Scandium Phosphate Glasses," *J. Non-Cryst. Solids* **258**, 48 (1999).

A. K. Swan, Z.-P. Shi, J. F. Wendelken, and Z. Zhang, "Flux-Dependent Scaling Behavior in Cu(100) Submonolayer Homoepitaxy," *Surf. Sci. Lett.* **391**, L1205 (1997).

J. Szydlowski, L. P. Rebelo, H. Wilczura, M. Dadmun, Y. Melnichenko, G. D. Wignall, and W. A. Van Hook, "Comparison of SANS and DLS Hydrodynamic Correlation Lengths for a Polystyrene/Methyl-Cyclohexane Solution in the Vicinity of Temperature- or Pressure-Induced Critical Demixing," *Physica B* **241–243**, 1035 (1998).

N. Taga, M. Maekawa, Y. Shigesato, I. Yasui, M. Kamei, and T. E. Haynes, "Deposition of Heteroepitaxial In_2O_3 Thin Films by Molecular Beam Epitaxy," *Jpn. J. Appl. Phys.* **37**, 6524 (1998).

T. Takada, E. Akiba, F. Izumi, and B. C. Chakoumakos, "Structure Refinement of $Li_4Mn_5O_{12}$ with Neutron and X-Ray Powder Diffraction Data," *J. Solid State Chem.* **130**, 74 (1997).

T. Takada, H. Hayakawa, E. Akiba, F. Izumi, and B. C. Chakoumakos, "Novel Synthesis Process and Structure Refinements of $Li_4Mn_5O_{12}$ for Rechargeable Lithium Batteries," *J. Power Sources* **68**, 613 (1997).

T. Taylor, D. Ila, R. L. Zimmerman, J. C. Cochrane, P. R. Ashley, D. B. Poker, and D. K. Hensley, "Temperature Effects on the Fabrication of Optical Channels in Planar GaAs/AlGaAs Waveguides Using MeV Ions," *Nucl. Instrum. Methods Phys. Res. B* **141**, 704 (1998).

N. C. Beck Tan, L. Balogh, S. F. Trevino, D. A. Tomalia, and J. S. Lin, "A Small-Angle Scattering Study of Dendrimer-Copper Sulfide Nanocomposites," *Polymer* **40**, 2537 (1999).

T. Taylor, D. Ila, R. L. Zimmerman, P. R. Ashley, D. B. Poker, and D. K. Hensley, "Optical Changes Induced in GaAs/AlGaAs Waveguides by MeV Ion Bombardment," *Nucl. Instrum. Methods Phys. Res. B* **127/128**, 442 (1997).

D. A. Tennant, S. E. Nagler, A. W. Garrett, T. Barnes, and C. C. Torardi, "Excitation Spectrum and Superexchange Pathways in the Spin Dimer $VODPO_4 \cdot 1/2D_2O$," *Phys. Rev. Lett.* **78**, 4998 (1997).

D. A. Tennant, S. E. Nagler, T. Barnes, A. W. Garrett, J. Riera, and B. C. Sales, "Excitations and Possible Bound States in the $S = 1/2$ Alternating Chain Compound $(VO)_2P_2O_7$," *Physica B* **241–243**, 501 (1998).

M. M. Thackeray, M. F. Mansuetto, and J. B. Bates, "Structural Stability of $LiMn_2O_4$ Electrodes for Lithium Batteries," *J. Power Sources* **68**, 153 (1997).

J. R. Thompson, L. Krusin-Elbaum, D. K. Christen, K. J. Song, M. Paranthaman, J. L. Ullmann, J. Z. Wu, Z. F. Ren, J. H. Wang, J. E. Tkaczyk, and J. A. DeLuca, "Current Density Enhancements of the Highest T_c Superconductors with GeV Protons," *Appl. Phys. Lett.* **71**, 536 (1997).

J. R. Thompson, J. G. Ossandon, L. Krusin-Elbaum, K. J. Song, D. K. Christen, and J. L. Ullman, "Quantum Constraints on Technological Superconductors," *Appl. Phys. Lett.* **74**, 3699 (1999).

A. Triolo, J. S. Lin, and R. Triolo, "Combined SANS and SAXS Experiments in Polyolefins-Hydrogenated Oligo Cyclo Pentadiene (HOCP) Blends," *Physica A* **249**, 362 (1998).

Y.-C. Tsai, M. J. A. Johnson, D. J. Mindiola, C. C. Cummins, W. T. Klooster, and T. F. Koetzle, "A Cyclometalated Resting State for a Reactive Molybdenum Amide: Favorable Consequences of β-Hydrogen Elimination Including Reductive Cleavage, Coupling, and Complexation," *J. Am. Chem. Soc.* **121**, 10426 (1999).

Y. Tsunoda, N. Hiruma, J. L. Robertson, and J. W. Cable, "Spin-Density-Wave Clusters in PdMn Spin-Glass Alloys," *Phys. Rev. B* **56**, 11051 (1997).

Y.-S. Tung, A. Ueda, R. Mu, M. Wu, J. Chen, Z. Gu, D. O. Henderson, W. E. Collins, C. W. White, and R. A. Zuhr, "Annealing Behavior of Tin-Implated Silica," *Nucl. Instrum. Methods Phys. Res. B* **141**, 279 (1998).

C. M. Turner, N. B. Sheller, M. D. Foster, B. Lee, S. Corona-Galvan, R. P. Quirk, B. Annis, and J. S. Lin, "Effect of Chain Topology on Ordered Structure in Block Copolymers: Comparison of a Heteroarm A_2B_2 Star with its Linear Diblock Analog," *Macromol.* **31**, 4372 (1998).

A. Ueda, R. Mu, Y.-S. Tung, M. Wu, W. E. Collins, D. O. Henderson, C. W. White, R. A. Zuhr, J. D. Budai, A. Meldrum, P. W. Wang, and X. Li, "Interaction of F_n-Centers with Gold Nanocrystals

Produced by Gold Ion Implantation in MgO Single Crystals," *Nucl. Instrum. Methods Phys. Res. B* **141**, 261 (1998).

D. Vaknin, L. L. Miller, J. L. Zarestky, and D. C. Johnston, "Elastic and Quasielastic Neutron Scattering Study of the Spin 1/2 Square Lattice Antiferromagnet $Sr_2CuO_2Cl_2$," *Physica C* **274**, 331, (1997).

D. Vaknin, L. L. Miller, and J. L. Zarestky, "Stacking of the Square Lattice Antiferromagnetic Planes in $Ca_2CuO_2C_{12}$," *Phys. Rev. B* **56**, 8351 (1997).

D. Vaknin, J. P. Koster, J. L. Zarestky, Z. R. Wang, J. A. Fernandez-Baca, and D. C. Johnston, "Magnetic Neutron Diffraction from the Magnetic Clusters in Single-Crystal $BaCuO_{2+x}$," *Phys. Rev. B* **57**, 465 (1998).

D. Vaknin, J. L. Zarestky, B. C. Chakoumakos, A. Goñi, P. J. Pagliuso, T. Rojo, and G. E. Barberis, "Weakly ($x = 0$) and Randomly ($x = 0.033$) Coupled Ising Antiferromagnetic Planes in $(Li_{1-3x}Fe_x)$ $NiPO_4$ Compounds," *Phys. Rev. B* **60**, 1100 (1999).

V. C. Venezia, D. J. Eaglesham, T. E. Haynes, A. Agarwal, D. C. Jacobson, H.-J. Gossmann, and F. H. Baumann, "Depth Profiling of Vacancy Clusters in MeV-Implanted Si Using Au Labeling," *Appl. Phys. Lett.* **73**, 2980 (1998).

V. C. Venezia, T. E. Haynes, A. Agarwal, L. Pelaz, H.-J. Gossmann, D. C. Jacobson, and D. J. Eaglesham, "Mechanism for the Reduction of Interstitial Supersaturations in Medium-Energy Ion-Implanted Silicon Following MeV Co-Implantation," *Appl. Phys. Lett.* **74**, 1299 (1999).

D. T. Verebelyi, C. Prouteau, R. Feenstra, and D. K. Christen, "Critical Current of YBCO Grain Boundaries in Large Magnetic Fields," *IEEE Trans. Appl. Supercond.* **9**, 2655 (1999).

R. D. Vispute, J. Narayan, and J. D. Budai, "High-Quality Optoelectronic Grade Epitaxial AlN Films on α-Al_2O_3, Si, and 6H-SiC by Pulsed-Laser Deposition," *Thin Solid Films* **299**, 94 (1997).

V. S. Viswanath and R. S. Fishman, "Low-Frequency Charge Dynamics of Incommensurate Chromium Alloys," *J. Appl. Phys.* **81**, 4204 (1997).

J. M. Vitek, S. A. David, and L. A. Boatner, "Microstructural Development in Single-Crystal, Nickel-Base Superalloy Welds," *Science and Technology of Welding and Joining* **1**, 109 (1997).

T. Wagner, G. Duscher and R. Kirchheim, "Decomposition of the ZrO_2-Electrolyte in Contact with Ni: Structure and Composition of the Ni/Electrolyte Interface," *J. Mater. Res.* **14**, 3340 (1999).

N. Wakabayashi, R. M. Nicklow, S. Katano, Y. Ishii, H. R. Child, H. G. Smith, and J. A. Fernandez-Baca, "Calculation of Thermal Diffuse Scattering," *Physica B* **241–243**, 320 (1998).

N. Wakabayashi, J. W. Cable, and J. L. Robertson, "Magnetic Structures of Dy in Applied Fields," *Physica B* **241–243**, 517 (1998).

C. Waldfried, D. Welipitiya, C. W. Hutchings, H. S. V. de Silva, G. A. Gallup, P. A. Dowben, W. W. Pai, J. Zhang, J. F. Wendelken, and N. M. Boag, "Preferential Bonding Orientations of Ferrocene on Surfaces," *J. Phys. Chem. B* **101**, 9782 (1997).

T. A. Walker, S. R. Raghaven, J. R. Royer, S. D. Smith, G. D. Wignall, Y. Melnichenko, S. A. Khan, and R. J. Spontak, "Enhanced Miscibility of Low-Molecular-Weight Polystyrene/Polyisoprene Blends in Supercritical Co_2," *J. Phys. Chem. B* **103**, 5472 (1999).

D. J. Wallis, N. D. Browning, S. Sivananthan, P. D. Nellist, and S. J. Pennycook, "Atomic-Layer Graphoepitaxy for Single-Crystal Heterostructures," *Appl. Phys. Lett.* **70**, 3113 (1997).

C.-M. Wang, X. Pan, H. Gu, G. Duscher, M. J. Hoffmann, R. C. Cannon, and M. Rühle, "Transient Growth Bands in Rare-Earth Glass-Based Silicon Nitride," *J. Am. Ceram. Soc.* **80**, 1397 (1997).

H. Wang, M. Bartkowiak, F. A. Modine, R. B. Dinwiddie, L. A. Boatner, and G. D. Mahan, "Nonuniform Heating in Zinc Oxide Varistors Studied by Infrared Imaging and Computer Simulation," *J. Am. Ceram. Soc.* **81**, 2013 (1998).

X.-L. Wang, E. A. Payzant, B. Taljat, C. R. Hubbard, and J. R. Keiser, "Experimental Determination of the Residual Stresses in a Spiral Weld Overlay Tube," *Mater. Sci. Eng. A* **232**, 31 (1997).

X.-L. Wang, S. Spooner, and C. R. Hubbard, "Theory of the Peak Shift Anomaly Due to Partial Burial of the Sampling Volume in Neutron Diffraction Residual Stress Measurements," *J. Appl. Crystallogr.* **31**, 52 (1998).

G. M. Watson, D. Gibbs, D. M. Zehner, M. Yoon, and S. G. J. Mochrie, "Orientational Phase Diagram of the Stepped Au(001) Surface," *Surf. Sci.* **407**, 59 (1998).

P. A. Weimann, T. D. Jones, M. A. Hillmyer, F. S. Bates, J. D. Londono, Y. B. Melnichenko, and G. D. Wignall, "Phase Behavior of Isotactic Polypropylene-Poly(Ethylene/Ethylethylene) Random Copolymer Blends," *Macromol.* **30**, 12 (1997).

H. H. Weitering and J. M. Carpinelli, "Electronic Properties of the Ag/Ge(111) Interface," *Surf. Sci.* **384**, 240 (1997).

H. H. Weitering, J. M. Carpinelli, A. V. Meleshko, J. Zhang, M. Bartkowiak, and E. W. Plummer, "Defect-Mediated Condensation of a Charge Density Wave," *Science* **285**, 2107 (1999).

M. K. Weldon, M. Collot, Y. J. Chabal, V. C. Venezia, A. Agarwal, T. E. Haynes, D. J. Eaglesham, S. B. Christman, and E. E. Chaban, "The Mechanism of Silicon Exfoliation Induced by Hydrogen/Helium Co-Implantation," *Appl. Phys. Lett.* **73**, 3721 (1998).

C. W. White, J. D. Budai, S. P. Withrow, J. G. Zhu, S. J. Pennycook, R. A. Zuhr, D. M. Hembree, Jr., D. O. Henderson, R. H. Magruder, M. J. Yacaman, G. Mondragon, and S. Prawer, "Encapsulated Nanocrystals and Quantum Dots Formed by Ion Beam Synthesis," *Nucl. Instrum. Methods Phys. Res. B* **127/128**, 545 (1997).

C. W. White, J. D. Budai, S. P. Withrow, J. G. Zhu, E. Sonder, R. A. Zuhr, A. Meldrum, D. M. Hembree, Jr., D. O. Henderson, and S. Prawer, "Encapsulated Semiconductor Nanocrystals Formed in Insulators by Ion Beam Synthesis," *Nucl. Instrum. Methods Phys. Res. B* **141**, 228 (1998).

C. W. White, A. Meldrum, J. D. Budai, S. P. Withrow, E. Sonder, R. A. Zuhr, D. M. Hembree, Jr., M. Wu, and D. O. Henderson, "Formation of CdS and CdSe Nanocrystals by Sequential Ion Implantation," *Nucl. Instrum. Methods Phys. Res. B* **148**, 991 (1999).

G. D. Wignall, "Neutron Scattering Studies of Polymers in Supercritical Carbon Dioxide," *J. Phys.: Condens. Matter* **11**, R157 (1999).

E. K. Williams, D. Ila, S. Sarkisov, P. Venkateswarlu, D. B. Poker, and D. K. Hensley, "Loss Measurements and Stoichiometric Dependence of Ti- and O-Implanted $LiNbO_3$ Waveguides," *Nucl. Instrum. Methods Phys. Res. B* **127/128**, 512 (1997).

E. K. Williams, D. Ila, A. Darwish, D. B. Poker, S. S. Sarkisov, M. J. Curley, J.-C. Wang, V. L. Svetchnikov, and H. W. Zandbergen, "Characterization of Silver Colloids Formed in $LiBbO_3$ by Ag and O Implantation at Room and Elevated Temperatures," *Nucl. Instrum. Methods Phys. Res. B* **148**, 1074 (1999).

E. K. Williams, D. Ila, S. Sarkisov, M. Curley, J. C. Cochrane, D. B. Poker, D. K. Hensley, and C. Borel, "Study of Effects of MeV, Ag, and Au Implantation on the Optical Properties of $LiNbO_3$," *Nucl. Instrum. Methods Phys. Res. B* **141**, 268 (1998).

J. M. Williams and J. R. Miner, "Ion Implantation of Silicon Nitride Ball Bearings," *Nucl. Instrum. Methods Phys. Res. B* **127/128**, 981 (1997).

R. K. Williams, J. O. Scarbrough, J. M. Schmitz, and J. R. Thompson, "Thermal Conductivity of Polycrystalline $YBa_2Cu_4O_8$ from 10 to 300 K," *Phys. Rev. B* **57**, 10923 (1998).

R. G. Wilson, J. M. Zavada, X. A. Cao, R. K. Singh, S. J. Pearton, H. J. Gao, S. J. Pennycook, M. Fu, J. A. Sekhar, V. Scarvepalli, R. J. Shu, J. Han, D. J. Rieger, J. C. Zolper, and C. R. Abernathy, "Redistribution and Activation of Implanted S, Se, Te, Be, Mg, and C in GaN," *J. Vac. Sci. Technol. A* **17**, 1226 (1999).

A. Wischnewski, U. Buchenau, A. J. Dianoux, W. A. Kamitakahara, and J. L. Zarestky, "Neutron Scattering Analysis of Low-Frequency Modes in Silica," *Philos. Mag. B* **77**, 579 (1998).

A. Wischnewski, U. Buchenau, A. J. Dianoux, W. A. Kamitakahara, and J. L. Zarestky, "Sound-Wave Scattering in Silica," *Phys. Rev. B* **57**, 2662 (1998).

S. P. Withrow, C. W. White, A. Meldrum, J. D. Budai, D. M. Hembree, Jr., and J. C. Barbour, "Effects of Hydrogen in the Annealing Environment on Photoluminescence from Si Nanoparticles in SiO_2," *J. Appl. Phys.* **86**, 396 (1999).

R. F. Wood, K. R. Chen, J. N. Leboeuf, A. A. Puretzky, and D. B. Geohegan, "Dynamics of Plume Propagation and Splitting During Pulsed-Laser Ablation," *Phys. Rev. Lett.* **79**, 1571 (1997).

R. F. Wood, J. N. Leboeuf, K. R. Chen, D. B. Geohegan, and A. A. Puretzky, "Dynamics of Plume Propagation, Splitting, and Nanoparticle Formation During Pulsed-Laser Ablation," *Appl. Surf. Sci.* **127–129**, 151 (1998).

R. F. Wood, J. N. Leboeuf, D. B. Geohegan, A. A. Puretzky, and K. R. Chen, "Dynamics of Plume Propagation and Splitting During Pulsed-Laser Ablation of Si in He and HAr," *Phys. Rev. B* **58**, 1533 (1998).

L. M. Woods and G. D. Mahan, "Nonlinear Electron-Phonon Heat Exchange," *Phys. Rev. B* **57**, 7679 (1998).

Z. Wu, H. W. Hong, R. Aburano, P. Zschack, P. Jemian, J. Z. Tischler, H. D. Chen, D. A. Luh, and T. C. Chiang, "Pattern of X-Ray Scattering by Thermal Phonons in Si," *Phys. Rev. B* **59**, 3283 (1999).

Y. Xin, S. J. Pennycook, N. D. Browning, P. D. Nellist, S. Sivananthan, F. Omnès, B. Beaumont, J.-P. Faurie, and P. Gibart, "Direct Observation of the Core Structures of Threading Dislocations in GaN," *Appl. Phys. Lett.* **72**, 2680 (1998).

Y. Xin, N. D. Browning, S. Rujirawat, S. Savananthan, Y. P. Chen, P. D. Nellist, and S. J. Pennycook, "Investigation of the Evolution of Single-Doman (111)B CdTe Films by Molecular Beam Epitaxy on Miscut (001)Si Substrate," *J. Appl. Phys.* **84**, 4292 (1998).

Y. Xin, S. Rujiwarat, R. Sporken, N. D. Browning, S. Sivananthan, S. J. Pennycook, and N. K. Dhar, "The Effect of As Passivation on the MBE Growth of CdTe (111) on Si (111) Substrates," *Appl. Phys. Lett.* **75**, 349 (1999).

J. Xu, E. G. Roth, O. W. Holland, A. P. Mills, Jr., and R. Suzuki, "Vacancy Defects in Solid-Phase Epitaxial-Grown Layers of Self-Implanted Si," *Appl. Phys. Lett.* **74**, 679 (1999).

J. Xu, A. P. Mills, Jr., R. Suzuki, E. G. Roth, and O. W. Holland, "Impurity-Vacancy Defects in Implanted Float-Zone and Czochralski-Si," *Appl. Surf. Sci.* **149**, 193 (1999).

Y. Yan, S. J. Pennycook, Z. Xu, and D. Viehland, "Determination of the Ordered Structures of $Pb(Mg_{1/3}Nb_{2/3})O_3$ and $Ba(Mg_{1/3}Nb_{2/3})O_3$ by Atomic-Resolution Z-Contrast Imaging," *Appl. Phys. Lett.* **72**, 3145 (1998).

Y. Yan, M. F. Chisholm, G. Duscher, and S. J. Pennycook, "Atomic Structure of a 27°[001] Tilt Grain Boundary in MgO," *J. Electron Microsc.* **47**, 115 (1998).

Y. Yan, M. F. Chisholm, G. Duscher, A. Maiti, S. J. Pennycook, and S. T. Pantelides, "Impurity-Induced Structural Transformation of a MgO Grain Boundary," *Phys. Rev. Lett.* **81**, 3675 (1998).

Y. Yan, S. J. Pennycook, J. Dai, R. P. H. Chang, A. Wang, and T. J. Marks, "Polytypoid Structures in Annealed In_3O_3-ZnO Films," *Appl. Phys. Lett.* **73**, 2585 (1998).

Y. Yan, S. J. Pennycook, and A. P. Tsai, "Direct Imaging of Local Chemical Disorder and Columnar Vacancies in Ideal Decagonal Al-Ni-Co Quasicrystals," *Phys. Rev. Lett.* **81**, 5145 (1998).

Y. Yan, S. J. Pennycook, and A. P. Tsai, "Reply to 'Comment on Direct Imaging of Local Chemical Disorder and Columnar Vacancies in Ideal Decagonal Al-Ni-Co Quasicrystals,'" *Phys. Rev. Lett.* **82**, 4367 (1999).

Y. Yan, S. J. Pennycook, M. Terauchi, and M. Tanaka, "Atomic Structures of Oxygen-Associated Defects in AlN Ceramics," *Microscopy and Microanalysis* **5**, 352 (1999).

C.-Y. Yang, S. E. Babcock, A. Goyal, M. Paranthaman, F. A. List, D. P. Norton, D. M. Kroeger, and A. Ichinose, "Microstructure of Electron-Beam-Evaporated Exitaxial Yttria-Stabilized Zirconia/CeO_2 Bilayers on Biaxially Textured Ni Tape," *Physica C* **307**, 87 (1998).

N. Yarykin, C. R. Cho, G. A. Rozgonyi, and R. A. Zuhr, "The Impact of In Situ Photoexcitation on the Formation of Vacancy-Type Complexes in Silicon Implanted at 85 and 295 K," *Appl. Phys. Lett.* **75**, 241 (1999).

M. Yethiraj, D. McK. Paul, C. V. Tomy, and E. M. Forgan, "Neutron Scattering Study of the Flux Lattice in YNi_2B_2C," *Phys. Rev. Lett.* **78**, 4849 (1997).

M. Yethiraj, D. McK. Paul, C. V. Tomy, and J. R. Thompson, "Square Flux Lines in YNi_2B_2C," *Phys. Rev. B* **58**, R14767 (1998).

M. Yethiraj, "Vortex Lattice Structures in $YBa_2Cu_3O_7$," *Neutron News* **10**, 16 (1999).

M. Yethiraj, H. Kawano, D. McK. Paul, C. V. Tomy, H. Takeya, and H. Yoshizawa, "Nonlocal Effects in the Superconductor $YNi_2{}^{11}B_2C$," *J. Phys. Chem. Solids* **60**, 1059 (1999).

M. Yethiraj, D. K. Christen, D. McK. Paul, P. Miranovic, and J. R. Thompson, "Flux-Lattice Symmetry in V_3Si: Nonlocal Effects in a High-κ Superconductor," *Phys. Rev. Lett.* **82**, 5112 (1999).

M. Yoon, S. G. J. Mochrie, M. W. Tate, S. M. Gruner, and E. F. Eikenberry, "Periodic Faceting of a Si(113) Surface Miscut Toward [110]," *Surf. Sci.* **411**, 70 (1998).

M. Yoon, B. C. Larson, J. Z. Tischler, T. E. Haynes, J.-S. Chung, G. E. Ice, and P. Zschack, "Use of X-Ray Microbeams for Cross-Section Depth Profiling of MeV Ion-Implantation-Induced Defect Clusters in Si," *Appl. Phys. Lett.* **75**, 2791 (1999).

H. Yoshizawa, H. Kawano, J. A. Fernandez-Baca, H. Kuwahara, and Y. Tokura, "Anisotropic Spin Waves in a Metallic Antiferromagnet $Nd_{0.45}Sr_{0.55}MnO_3$," *Phys. Rev. B* **58**, R571 (1998).

H. Yoshizawa, R. Kajimoto, H. Kawano, J. A. Fernandez-Baca, Y. Tomioka, H. Kuwahara, and Y. Tokura, "Magnetic Ordering and Spin Fluctuations in Nearly Half-Doped Manganites," *Mater. Sci. Eng. B* **63**, 125 (1999).

S. M. Yunus, J. A. Fernandez-Baca, M. A. Asgar, F. U. Ahmed, and M. A. Hakim, "Neutron Diffraction Studies of the Magnetic Disorder in $Zn_xMg_{0.8-x}Ni_{0.2}Fe_2O_4$ Ferrite with x = 0.0, 0.2, 0.4, and 0.6," *Physica B* **262**, 112 (1999).

J. Zhang and E. W. Plummer, "Surface Lattice Dynamics of $La_{0.65}Ca_{0.35}MnO_3$ Across the Curie Temperature," *Surf. Sci.* **393**, 64 (1997).

J. Zhang, Ismail, P. J. Rous, A. P. Baddorf, and E. W. Plummer, "Periodic Lattice Distortion Accompanying the Charge-Density Wave Transition for Sn/Ge(111)," *Phys. Rev. B* **60**, 2860 (1999).

Z. Y. Zhang, F. Wu, and M. G. Lagally, "An Atomistic View of Si(001) Homoepitaxy," *Ann. Rev. Mater. Sci.* **27**, 525 (1997).

Z. Y. Zhang, Q. Niu, and C.-K. Shih, "Electronic Growth of Metallic Overlayers on Semiconductor Substrates," *Phys. Rev. Lett.* **80**, 5381 (1998).

Z. J. Zhang, Z. L. Wang, B. C. Chakoumakos, and J. S. Yin, "Temperature Dependence of Cation Distribution and Oxidation State in Magnetic Mn-Fe Ferrite Nanocrystals," *J. Am. Chem. Soc.* **120**, 1800 (1998).

J. H. Zhao, K. Tone, S. R. Weiner, M. A. Caleca, H. Du, and S. P. Withrow, "Evaluation of Ohmic Contacts to *p*-type 6H-SiC Created by C and Al Coimplantation," *IEEE Electron Device Lett.* **18**, 375 (1997).

A. Zheludev, S. Maslov, G. Shirane, Y. Sasago, N. Koide, K. Uchinokura, D. A. Tennant, and S. E. Nagler, "The Square-Lattice Spiral Magnet $Ba_2CuGe_2O_7$ in an In-Plane Magnetic Field," *Phys. Rev. B* **56**, 14006 (1997).

R. L. Zimmerman, D. Ila, D. B. Poker, and S. P. Withrow, "Permeability Control of GPC Drug Delivery System," *Nucl. Instrum. Methods Phys. Res. B* **127/128**, 1023 (1997).

R. L. Zimmerman, D. Ila, E. K. Williams, S. S. Sarkisov, D. B. Poker, and D. K. Hensley, "Fabrication of Copper and Gold Nanoclusters in MgO (100) by MeV Ion Implantation," *Nucl. Instrum. Methods Phys. Res. B* **141**, 308 (1998).

R. L. Zimmerman, D. Ila, E. K. Williams, D. B. Poker, D. K. Hensley, C. Klatt, and S. Kalbitzer, "Ion Beam Synthesis of Au and Cu Nanoclusters in MgO," *Nucl. Instrum. Methods Phys. Res. B* **148**, 1064 (1999).

R. A. Zuhr and R. H. Magruder, III, "Optical Properties of Multi-Component Metallic Nanoclusters Formed in Silica by Sequential Ion Implantation," *J. Surf. Sci. Soc. Japan* **18**, 269 (1997).

R. A. Zuhr, R. H. Magruder, III, and T. S. Anderson, "Formation and Optical Properties of Intermetallic Nanoclusters Formed by Sequential Ion Implantation," *Surf. Coat. Technol.* **103–104**, 401 (1998).

J.-K. Zuo and J. F. Wendelken, "Evolution of Mound Morphology in Reversible Homoepitaxy on Cu(100)," *Phys. Rev. Lett.* **78**, 2791 (1997).

J.-K. Zuo and J. F. Wendelken, "Kinetic Processes in the Transition from Ag(111) Crystallites to $(\sqrt{3} \times \sqrt{3})R30°$ Domains for Ag/Si(111)-7 × 7," *Phys. Rev. B* **56**, 3897 (1997).

BOOKS AND PROCEEDINGS

M. M. Agamalian, R. G. Alamo, J. D. Londono, L. Mandelkern, S. Spooner, F. C. Stehling, and G. D. Wignall, "Ultrahigh Resolution Small-Angle Neutron Scattering Investigations of Liquid-Liquid Phase Separation in Linear Low-Density Polyethylene," p. 205 in *Morphological Control in Multiphase Polymer Mixtures*, ed. by R. M. Briber, C. C. Han, and D. G. Peiffer, Materials Research Society, Warrendale, Pennsylvania, 1997.

M. M. Agamalian, R. G. Alamo, J. D. Londono, L. Mandelkern, F. C. Stehling, and G. D. Wignall, "Phase Behavior of Blends of Linear and Branched Polyethylenes via Small- and Ultra-Small-Angle Neutron Scattering," p. 74 in *Polymeric Materials Science and Engineering*, American Chemical Society, Washington, D.C., 1998.

A. Agarwal, D. J. Eaglesham, H.-J. Gossmann, L. Pelaz, S. B. Herner, D. C. Jacobson, T. E. Haynes, and Yu. E. Erokhin, "Boron-Enhanced Diffusion of Boron from Ultralow Energy Boron Implantation," p. 1232 in *Semiconductor Silicon 1998*, ed. by H. Huff, U. Gösele, and H. Tsuya, The Electrochemical Society, Pennington, New Jersey, 1998.

B. E. Allman, A. Cimmino, A. G. Klein, and W. A. Hamilton, "Metal Micro-Arrays for Collimating Neutrons and X Rays," p. 175 in *X-Ray Microfocusing: Applications and Techniques*, ed. by I. McNulty, SPIE—The International Society for Optical Engineering, Bellingham, Washington, 1998.

M. Bartkowiak, G. D. Mahan, M. G. Comber, and M. A. Alim, "Computer Simulations of ZnO Varistor Failures," p. 253 in *Electrically Based Microstructural Characterization II*, ed. by R. A. Gerhardt, M. A. Alim, and S. R. Taylor, Materials Research Society, Warrendale, Pennsylvania, 1998.

M. Bartkowiak, "Current Localization, Nonuniform Heating, and Failures of ZnO Varistors," p. 221 in *Electrically Based Microstructural Characterization II*, ed. by R. A. Gerhardt, M. A. Alim, and S. R. Taylor, Materials Research Society, Warrendale, Pennsylvania, 1998.

M. Bartkowiak and G. D. Mahan, "Boundary Effects in Thin-Film Thermoelectrics," p. 265 in *Thermoelectric Materials 1998—The Next Generation Materials for Small-Scale Refrigeration and Power Generation Applications*, ed. by T. M. Tritt, H. B. Lyon, Jr., G. D. Mahan, and M. G. Kanatzidis, Materials Research Society, Warrendale, Pennsylvania, 1999.

J. B. Bates, N. J. Dudney, and B. Neudecker, "Rechargeable Thin-Film Lithium and Lithium-Ion Batteries," p. 45 in *Proceedings of The First Hawaii Battery Conference*, ed. by A. N. Dey, ARAD Enterprises, Hilo, Hawaii, 1998.

J. B. Bates, N. J. Dudney, B. Neudecker, and B. Wang, "Thin-Film Lithium Batteries," p. 453 in *New Trends in Electrochemical Technology: Energy Storage Systems in Electronics*, ed. by T. Osaka and M. Datta, Gordon and Breach, Newark, New Jersey, 1999.

N. D. Browning, J. P. Buban, C. Prouteau, G. Duscher, M. F. Chisholm, and S. J. Pennycook, "Determining Atomic-Structure Property Relationships at Grain Boundaries in High-T_c Superconductors," p. 657 in *Proceedings of Microscopy and Microanalysis 1997*, ed. by G. W. Bailey, R. V. W. Dimlich, K. B. Alexander, J. J. McCarthy, and T. P. Pretlow, Springer-Verlag, New York, 1997.

N. D. Browning, D. J. Wallis, and S. J. Pennycook, "Determination of the Three-Dimensional Atomic Structure at Internal Interfaces by Electron Energy Loss Spectroscopy," p. 13 in *Atomic-Resolution Microscopy of Surfaces and Interfaces*, ed. by D. J. Smith, Materials Research Society, Pittsburgh, Pennsylvania, 1997.

N. D. Browning, J. P. Buban, C. Prouteau, D. Verebelyi, D. P. Norton, D. K. Christen, S. J. Pennycook, and P. D. Nellist, "Investigating the Atomic-Scale Superconducting Properties of Grain Boundaries in High-T_c Superconductors," p. 599 in *Proceedings of the Fourteenth International Congress on Electron Microscopy*, ed. by H. A. C. Benavides and M. J. Yacaman, Institute of Physics Publishing, Bristol, United Kingdom, 1998.

S. B. Cahn, G. D. Mahan, and B. E. Nadgorny, *A Guide to Physics Problems*, Part 2, Plenum Press, New York, New York, 1997.

M. A. Caleca, H. Du, J. R. Flemish, and S. P. Withrow, "*p*-type Doping of SiC by Aluminium Implantation for Advanced Device Applications," p. 63 in *Covalent Ceramics III: Science and Technology of Non-Oxides*, ed. by A. F. Hepp, P. N. Kumta, J. J. Sullivan, G. S. Fischman, and A. E. Kaloyeros, Materials Research Society, Warrendale, Pennsylvania, 1997.

Y. Cheong, H. Du, and S. P. Withrow, "Effects of Aluminum Implantation on the Oxidation Behavior of Silicon Nitride in a Sodium-Nitrate-Oxygen Gas Mixture," p. 665 in *Modification and Synthesis by Ion Beam Processing*, ed. by D. Alexander, N. Cheung, B. Park, and W. Skorupa, Materials Research Society, Warrendale, Pennsylvania, 1997.

M. F. Chisholm, A. Maiti, S. J. Pennycook, and S. T. Pantelides, "Vacancy Formation and Vacancy-Induced Structural Transformation in Si Grain Boundaries," p. 161 in *Proceedings of the Ninth International Conference on Intergranular and Interphase Boundaries in Materials*, ed. by P. Lejcek and V. Paidar, Trans Tech Publications, Ltd., Zürich, Switzerland, 1999.

M. F. Chisholm, R. Buczko, M. Mostoller, T. Kaplan, A. Maiti, S. T. Pantelides, and S. J. Pennycook, "Atomic Structure and Properties of Extended Defects in Silicon," p. 3 in *Polycrystalline Semiconductors V—Bulk Materials, Thin Films, and Devices*, ed. by J. H. Werner, H. P. Strunk, and H. W. Schock, Scitech Publications Ltd., Zürich, Switzerland, 1999.

C. R. Cho, R. A. Brown, O. Kononchuk, N. Yarykin, G. Rozgonyi, and R. A. Zuhr, "In Situ Deep-Level Transient Spectroscopy of Defect Evolution in Silicon Following Ion Implantation at 80 K," p. 73 in *Silicon Front-End Technology—Materials Processing and Modeling*, ed. by N. Cowern, P. Griffin, D. Jacobson, and P. Packan, Materials Research Society, Warrendale, Pennsylvania, 1999.

C. R. Cho, N. Yarykin, G. A. Rozgonyi, and R. A. Zuhr, "In Situ Photoexcitation-Induced Suppression of Point Defect Generation in Ion-Implanted Silicon," p. 187 in *Si Front-End Processing—Physics and Technology of Dopant-Defect Interactions*, ed. by Hans-Joachim L. Gossmann, T. E. Haynes, M. E. Law, A. N. Larsen, and S. Odanaka, Materials Research Society, Warrendale, Pennsylvania, 1999.

D. K. Christen, H. R. Kerchner, D. P. Norton, A. Goyal, J. D. Budai, R. Feenstra, Q. He, C. E. Klabunde, D. M. Kroeger, D. F. Lee, F. A. List, M. Paranthaman, B. Saffian, E. D. Specht, and M. F. Chisholm, "Superconducting Transport Properties of High-J_C Biaxially Aligned $YBa_2Cu_3O_{7-}$ Deposits on Metallic Tape Substrates," p. 112 in *Proceedings of 1997 International Workshop on Superconductivity*, ed. by Koji Kajimura and Eric E. Hellstrom, International Superconductivity Technology Center, Big Island, Hawaii, 1997.

D. K. Christen, D. P. Norton, A. Goyal, J. D. Budai, R. Feenstra, Q. He, C. E. Klabunde, D. M. Kroeger, D. F. Lee, F. A. List, M. Paranthaman, B. Saffian, E. D. Specht, and M. F. Chisholm, "Fabrication and Properties of High-J_c, Biaxially Aligned $YBa_2Cu_3O_{7-}$ Thick Films on Metallic Tape Substrates," p. 94 in *Proceedings of the International Workshop on Critical Currents in Superconductors for Practical Applications*, World Scientific, Singapore, 1998.

J.-S. Chung, N. Tamura, G. E. Ice, B. C. Larson, J. D. Budai, and W. P. Lowe, "X-Ray Microbeam Measurement of Local Texture and Strain in Metals," p. 169 in *Materials Reliability in Microelectronics IX*, ed. by C. A. Volkert, A. H. Verbruggen, and D. Brown, Materials Research Society, Warrendale, Pennsylvania, 1999.

A. Cimmino, B. E. Allman, A. G. Klein, W. A. Hamilton, I. S. Anderson, B. Hamelin, P. Hoghoj, and P. Bastie, "Microarray Collimators for X Rays and Neutrons," p. 376 in *Micromachining and Microfabrication Process Technology IV*, SPIE—The International Society for Optical Engineering, Bellingham, Washington, 1998.

R. Devanthan, W. J. Weber, and L. A. Boatner, "Response of Zircon to Electron and Ne^+ Irradiation," p. 419 in *Phase Transformations and Systems Driven Far from Equilibrium*, ed. by E. Ma, P. Bellon, M. Atzmon, and R. Trivedi, Materials Research Society, Warrendale, Pennsylvania, 1998.

E. C. Dickey, V. P. Dravid, P. D. Nellist, D. J. Wallis, and S. J. Pennycook, "A Combined Techniques Approach to Studying Heterophase Interfaces Using HREM, Z-Contrast Imaging, and EELS," p. 45 in *Atomic-Resolution Microscopy of Surfaces and Interfaces*, ed. by D. J. Smith and R. J. Hamers, Materials Research Society, Warrendale, Pennsylvania, 1997.

G. Duscher, S. Köstlmeier, B. Meyer, C. Elsässer, and N. D. Browning, "*Ab Initio* Calculations of Density of States for Ti-Oxide," p. 961 in *Proceedings of Microscopy and Microanalysis 1997*, ed. by G. W. Bailey, R. V. W. Dimlich, K. B. Alexander, J. J. McCarthy, and T. P. Pretlow, Springer-Verlag, New York, 1997.

G. Duscher, F. Banhart, H. Müllejans, S. J. Pennycook, and M. Rühle, "Atomic Structure of Si-SiO_2 Interface," p. 459 in *Proceedings of Microscopy and Microanalysis 1997*, ed. by G. W. Bailey, R. V. W. Dimlich, K. B. Alexander, J. J. McCarthy, and T. P. Pretlow, Springer-Verlag, New York, 1997.

G. Duscher, S. J. Pennycook, N. D. Browning, R. Rupangudi, C. Takoudis, H.-J. Gao, and R. Singh, "Structure, Composition, and Strain Profiling of Si/SiO_2 Interfaces," p. 191 in *Characterization and Metrology for ULSI Technology: 1998 International Conference*, ed. by D. G. Seiler, A. C. Diebold, W. M. Bullis, T. J. Shaffner, R. McDonald, and E. J. Walters, The American Institute of Physics, Woodbury, New York, 1998.

A. G. Eguiluz and W. Ku, "*Ab Initio* Studies of Electronic Excitations in Solids," p. 32 in *Electron Correlations and Materials Properties*, ed. by A. Gonis and N. Kioussis, Plenum Press, New York, 1999.

A. L. Evelyn, D. Ila, R. L. Zimmerman, K. Bhat, D. B. Poker, and D. K. Hensley, "Effects of MeV Ion Beams on Polymers," p. 499 in *Materials Modification and Synthesis by Ion Beam Processing*, ed. by D. E. Alexander, N. W. Cheung, B. Park, and W. Skorupa, Materials Research Society, Warrendale, Pennsylvania, 1997.

X. Fan, E. C. Dickey, S. J. Pennycook, L. Grigorian, P. Eklund, R. S. Buczko, and S. T. Pantelides, "Direct Observation of Iodine Atomic Chains in I-Doped Carbon Nanotubes," p. 144 in *Proceedings of Microscopy and Microanalysis 1999*, ed. by G. W. Bailey, W. G. Jerome, S. McKernan, J. F. Mansfield, and R. L. Price, Springer-Verlag New York, Inc., New York, 1999.

X. Fan, E. C. Dickey, and S. J. Pennycook, "Z-Contrast Imaging and EELS Analysis of Chromium-Doped Diamond-Like Carbon," p. 650 in *Proceedings of Microscopy and Microanalysis 1999*, ed. by G. W. Bailey, W. G. Jerome, S. McKernan, J. F. Mansfield, and R. L. Price, Springer-Verlag New York, Inc., New York, 1999.

K. D. Finkelstein, J. Z. Tischler, and B. C. Larson, "Inelastic X-Ray Scattering at Modest Energy Resolution," p. 80 in *Synchrotron Radiation Instrumentation*, ed. by E. Fontes, American Institute of Physics, Woodbury, New York, 1997.

H. J. Gao, Y. Yan, J. Fitz-Gerald, D. Kumar, R. K. Singh, and S. J. Pennycook, "Z-Contrast Scanning Transmission Electron Microscopy of Nanometer-Scale-Coated Particulate Materials," p. 756 in *Proceedings of Microscopy and Microanalysi 1998*, ed. by G. W. Bailey, K. B. Alexander, W. G. Jerome, M. G. Bond, and J. J. McCarthy, Springer-Verlag New York, Inc., New York, 1998.

H. J. Gao, B. Rafferty, C. L. Chen, R. K. Singh, and S. J. Pennycook, "Misfit Dislocation Core Structures at $Ba_{0.5}Sr_{0.5}TiO_3/LaAlO_3$ Interfaces," p. 612 in *Proceedings of Microscopy and Microanalysis 1999*, ed. by G. W. Bailey, W. G. Jerome, S. McKernan, J. F. Mansfield, and R. L. Price, Springer-Verlag New York, Inc., New York, 1999.

A. A. Gapud, J. Z. Wu, S. L. Yan, Y. Y. Xie, B. W. Kang, Z. F. Ren, S. H. Yun, M. P. Siegal, D. K. Christen, J. R. Thompson, and H. R. Kerchner, "Magnetic and Flux Pinning in Hg-Based HTS Thin Films," p. 217 in *Proceedings of the Eighth U.S.-Japan Workshop on High-T_c Superconductors*, ed. by J. Schwartz, Rose Printing Company, Inc., Tallahassee, Florida, 1998.

L. Gea, S. Honda, L. A. Boatner, T. E. Haynes, B. C. Sales, F. A. Modine, A. Meldrum, J. D. Budai, and L. Beckers, "A New Approach to the Fabrication of 'Smart' Near-Surface Nanostructure Composites," p. 137 in *Surface-Controlled Nanoscale Materials for High-Added-Value Applications*, ed. by K. E. Gonsalves, M.-I. Baraton, J. X. Chen, and J. A. Akkara, Materials Research Society, Warrendale, Pennsylvania, 1998.

D. B. Geohegan, A. A. Puretzky, G. Duscher, and S. J. Pennycook, "Photoluminescence from Gas-Suspended Nanoparticles Synthesized by Laser Ablation: A Pathway to Optimized Nanomaterials," p. 47 in *Proceedings of the First NIMC International Symposium on Photoreaction Control and Photofunctional Materials*, ed. by M. Kubota, National Institute of Materials and Chemistry, Tsukuba, Japan, 1998.

D. B. Geohegan, A. A. Puretzky, G. Duscher, and S. J. Pennycook, "Time-Resolved Imaging and Photoluminescence of Gas-Suspended Nanoparticles Synthesized by Laser Ablation: Dynamics, Transport, Collection, and Ex Situ Analysis," p. 47 in *Advances in Laser Ablation of Materials*, ed. by R. K. Singh, D. H. Lowndes, D. B. Chrisey, J. Narayan, T. Kawai, and E. Fogarassy, Materials Research Society, Warrendale, Pennsylvania, 1998.

D. B. Geohegan, A. A. Puretzky, A. Meldrum, G. Duscher, and S. J. Pennycook, "In Situ Diagnostics of Nanomaterial Synthesis by Laser Ablation: Time-Resolved Photoluminescence Spectra and Imaging of Gas-Suspended Nanoparticles Deposited for Thin Films" p. 359 in *Microcrystalline and Nanocrystalline Semiconductors* ed. by L. Canham, M. Sailor, K. Tanaka, and C.-C. Tsai, Materials Research Society, Warrendale, Pennsylvania, 1998.

H.-J. Gossmann, T. E. Haynes, M. E. Law, A. N. Larson, and S. Odanaka, editors, *Silicon Front-End Processing—Physics and Technology of Dopant-Defect Interactions*, Materials Research Society, Warrendale, Pennsylvania, 1999.

A. Goyal, D. P. Norton, M. Paranthaman, J. D. Budai, E. D. Specht, D. K. Christen, D. M. Kroeger, Q. He, B. Saffian, F. A. List, D. Lee, C. Klabunde, and P. Martin, "Fabrication of High Critical-Current-Density Superconducting Tapes by Epitaxial Deposition of YBCO Thick Films on Biaxially Textured Metal Substrates," p. 685 in *Advances in Superconductivity IX*, ed. by S. Nakajima and M. Murakami, Springer-Verlag, Tokyo, Japan, 1998.

A. Goyal, D. P. Norton, M. Paranthaman, E. D. Specht, Q. He. F. A. List, D. M. Kroeger, D. K. Christen, and J. D. Budai, "Low-Cost Single-Crystal-Like Substrates for Practical High-Efficiency Solar Cells," p. 377 in *Proceedings of the First Conference on Future Generation Photovoltaic Technologies*, American Institute of Physics, Woodbury, New York, 1998.

R. B. Gregory, O. W. Holland, D. K. Thomas, T. A. Wetteroth, and S. R. Wilson, "The Effects of Damage on Hydrogen-Implant-Induced Thin-Film Separation from Bulk Silicon Carbide," p. 33 in *Wide-Band Gap Semiconductors for High-Power, High-Frequency, and High-Temperature Applications*, ed. by S. Binari, A. Burk, M. Melloch, and C. Nguyen, Materials Research Society, Warrendale, Pennsylvania, 1999.

R. F. Haglund, Jr., C. N. Afonso, G. Battaglin, M. Godbole, F. Gonella, J. D. Hamilton, D. H. Lowndes, R. H. Magruder III, P. Mazzoldi, D. H. Osborne, Jr., and J. Solis, "Effects of Laser and Particle Beams on the Synthesis and Nonlinear Optical Response of Nanostructures," p. 90 in *Laser Applications in Microelectronic and Optoelectronic Manufacturing II*, ed. by J. J. Dubowski, SPIE—The International Society for Optical Engineering, Bellingham, Washington, 1997.

R. F. Haglund, Jr., G. Lüpke, D. H. Osborne, H. Chen, R. H. Magruder III, and R. A. Zuhr, "Ultrafast Relaxation Processes in Au Quantum Dots at High-Pulse-Repetition Frequencies," p. 356 in *Ultrafast Phenomena XI*, ed. by T. Elsaesser, J. G. Fujimoto, D. A. Wiersma, and W. Zinth, Springer-Verlag, Berlin and Heidelberg, 1998.

R. F. Haglund, Jr., C. N. Afonso, L. C. Feldman, F. Gonella, G. Leupke, R. H. Magruder III, P. Mazzoldi, D. H. Osborne, J. Solis, and R. A. Zuhr, "Mesoscale Engineering of Nanocomposite Nonlinear Optical Materials," p. 327 in *Atomistic Mechanisms in Beam Synthesis and Irradiation of Materials*, ed. by J. C. Barbour, S. Roorda, D. Ila, and M. Tsujioka, Materials Research Society, Warrendale, Pennsylvania, 1998.

J. D. Hamilton, M. R. Papantonakis, R. F. Haglund, Jr., M. Godbole, and D. H. Lowndes, "Atomic-Force Microscopy of Gold Nanocrystallites on Smooth and Stepped Strontium Titanate Surfaces," p. 85 in *Atomic-Resolution Microscopy of Surfaces and Interfaces*, ed. by D. J. Smith, Materials Research Society, Warrendale, Pennsylvania, 1998.

R. J. Hanrahan, Jr., S. P. Withrow, and M. Puga-Lambers, "Measurements of the Diffusion of Iron and Carbon in Single-Crystal NiAl Using Ion Implantation and Secondary Ion Mass Spectrometry," p. 227 in *Diffusion Mechanisms in Crystalline Materials*, ed. by C. R. A. Catlow, N. Cowern, D. Farkas, Y. Mishin, and G. Yogi, Materials Research Society, Warrendale, Pennsylvania, 1998.

D. K. Hensley, D. K. Thomas, and D. B. Poker, "A Timeshared Foreline and Roughing Vacuum System," p. 135 in *Proceedings of the Thirty-First Symposium of the Northeastern Accelerator Personnal*, ed. by F. Dworschakand and R. Holzle, World Scientific, Singapore, 1999.

O. W. Holland and E. G. Roth, "Rutherford Backscattering Spectrometry," p. 262 in *Materials and Process Characterization of Ion Implantation—A Review of Methods*, ed. by C. B. Yarling and M. Current, Ion Beam Press, Austin, Texas, 1997.

O. W. Holland and E. G. Roth, "Implantation Processing of Si: A Unified Approach to Understanding Ion-Induced Defects and Their Impact," p. 95 in *Proceedings of the Fourth International Conference on Materials and Process Characterization for VLSI 1997*, ed. by X. F. Zong, D. G. Seiler, and L. G. Song, Asia-Pacific Microanalysis Association, Shanghai, China, 1997.

S. Honda, F. A. Modine, A. Meldrum, J. D. Budai, T. E. Haynes, L. A. Boatner, and L. A. Gea, "Ion-Implantation/Annealing-Induced Precipitation of Nanophase Ferromagnetic Particles in Yttrium-Stabilized ZrO_2," p. 225 in *Microstructural Processes in Irradiated Materials*, ed. by R. C. Ewing, G. E. Lucas, J. S. Williams, and S. J. Zinkle, Materials Research Society, Warrendale, Pennsylvania, 1999.

E. M. Hunt, J. M. Hampikian, D. B. Poker, and N. D. Evans, "Ion-Implantation-Induced Formation of Aluminum Nanoparticles in Alumina Via Reduction," p. 409 in *Surface and Coatings Technology*, Vol. 104, ed. by D. B. Poker, S. P. Withrow, J. M. Williams, and B. D. Sartwell, Elsevier Science SA, Lausanne, Switzerland, 1998.

D. Ila, Z. Wu, R. L. Zimmerman, S. Sarkisov, Y. Qian, D. B. Poker, and D. K. Hensley, "Formation of Silver Metal Nanoclusters in MgO by MeV Ag Implantation," p. 417 in *Materials Modification and Synthesis by Ion Beam Processing*, ed. by D. E. Alexander, N. W. Cheung, B. Park, and W. Skorupa, Materials Research Society, Warrendale, Pennsylvania, 1997.

D. Ila, Z. Wu, R. L. Zimmerman, S. Sarkisov, C. C. Smith, D. B. Poker, and D. K. Hensley, "Application of MeV Ion Implantation in the Formation of Nano-Metallic Clusters in Photorefractive Materials," p. 143 in *Nanophase and Nanocomposite Materials II*, ed. by S. Komarneni, J. C. Parker, and H. J. Wollenberger, Materials Research Society, Warrendale, Pennsylvania, 1997.

G. E. Jellison, Jr., D. B. Geohegan, D. H. Lowndes, A. A. Puretzky, and V. I. Merkolov, "Characterization of Pulsed-Laser-Deposited Amorphous Carbon Films by Spectroscopic Ellipsometry," p. 349 in *Advances in Laser Ablation of Materials*, ed. by R. K. Singh, D. B. Chrisey, D. H. Lowndes, J. Narayan, E. Fogarassy, and T. Kawai, Materials Research Society, Warrendale, Pennsylvania, 1998.

G. E. Jellison, Jr., F. A. Modine, and L. A. Boatner, "Measurements of the Optical Functions of Uniaxial Crystals Using 2-Modulator Generalized Ellipsometry (2-MGE)," p. 232 in *Proceedings of International Symposium on Optical Science, Engineering, and Instrumentation*, SPIE—The International Society for Optical Engineering, Bellingham, Washington, 1998.

G. E. Jellison, Jr., F. A. Modine, and C. Chen, "Calibration Procedures for a Two-Modulator Generalized Ellipsometer," p. 3754 in *Proceedings of the Forty-Fourth Annual Meeting—The International Symposium on Optical Science, Engineering, and Instrumentation*, SPIE—The International Society for Optical Engineering, Bellingham, Washington, 1999.

D. E. Jesson, K. M. Chen, G. Chen, and S. J. Pennycook, "Stress-Induced Morphological Evolution of Si_xGe_{1-x} Thin Films," p. 67 in *Technical Digest of the Seventh International Symposium on Silicon*

Molecular Beam Epitaxy, ed. by D. C. Houghton, J.-M. Baribeau, and H. Lafontaine, National Research Council of Canada, Ottawa, Canada, 1997.

D. E. Jesson, K. M. Chen, S. J. Pennycook, T. Thundat, and R. J. Warmack, "Mechanisms of Strain-Induced Surface Ripple Formation and Dislocation Multiplication in Si_xGe_{1-x} Thin Films," p. 239 in *Microscopy of Semiconducting Materials 1997*, ed. by A. G. Cullis and J. L Hutchison, Institute of Physics Publishing, Bristol, United Kingdom, 1997.

D. E. Jesson, "Growth Phenomena in Superlattices," p. F1:1 in *Handbook of Thin-Film Process Technology*, Institute of Physics Publishing, Bristol, United Kingdom, 1997.

D. E. Jesson, "Morphological Evolution of Strained Semiconductor Films," p. 195 in *Morphological Organization in Epitaxial Growth and Removal*, Vol. 14, ed. by Z. Zhang and M. G. Lagally, World Scientific Press, Singapore, 1998.

T. Kamiyama, K. Oikawa, E. Akiba, R. Kanno, I. Nakai, M. Wakihara, K. Mori, S. Torii, F. Izumi, and B. C. Chakoumakos, "Power Diffraction in Materials Science Using the Kens Cold-Neutron Source," in *Materials Research Using Cold Neutrons at Pulsed Neutron Sources*, ed. by P. Thiyagarajan, F. Trouw, B. Marzec, and C.-K. Loong, Argonne National Laboratory, Argonne, Illinois, 1999.

V. Keppens, D. Mandrus, and L. A. Boatner, "Chemical and Sonochemical Approaches to the Formation of VO_2 Films and VO_2-Impregnated Materials," p. 439 in *Chemical Aspects of Electronic Ceramics Processing*, ed. by P. N. Kumta, A. F. Hepp, D. N. Beach, J. J. Sullivan, and B. Arkles, Materials Research Society, Warrendale, Pennsylvania, 1998.

M. Kim, N. D. Browning, S. J. Pennycook, K. Sohlberg, and S. T. Pantelides, "The Origin of Electrical Activity at Grain Boundaries in Perovskites," p. 110 in *Proceedings of Microscopy and Microanalysis 1999*, ed. by G. W. Bailey, W. G. Jerome, S. McKernan, J. F. Mansfield, and R. L. Price, Springer-Verlag New York, Inc., New York, 1999.

L. Krusin-Elbaum, D. K. Petrov, D. López, J. R. Thompson, R. Wheeler, J. L. Ullmann, C. W. Chu, and Q. M. Lin, "Enhanced Supercurrents Above 100 K in Mercury Cuprates via Fission of Mercury," p. 158 in *Proceedings of the Eighth U.S.-Japan Workshop on High-T_c Superconductors*, ed. by J. Schwartz, Rose Printing Company, Inc., Tallahassee, Florida, 1998.

M. N. Kunchur, D. K. Christen, and B. I. Ivlev, "Transport Behavior in Superconductors at Extreme Dissipation Levels," p. 135 in *Proceedings of the International Symposium on Advances in Superconductivity: New Materials, Critical Currents, and Devices*, Tata Institute of Fundamental Research, Bombay, India, 1998.

B. C. Larson, "X-Ray Scattering Applications Using Pulsed X-Ray Sources," p. 10 in *Time Structure of X-Ray Sources and Its Applications*, ed. by A. K. Freund, H. P Freund, and M. R. Howells, SPIE—The International Society for Optical Engineering, Bellingham, Washington, 1998.

Y. E. Lee, C. M. Rouleau, C. Park, and D. P. Norton, "$ZnGa_2O_4$ Thin-Film Phosphors Grown by Pulsed-Laser Ablation," p. 59 in *Luminescent Materials*, ed. by J. Mckittrick, B. D. Bartolo, and K. Mishra, Materials Research Society, Warrendale, Pennsylvania, 1999.

H. Liu, F. Fernandez, W. Jai, and L. A. Boatner, "Transient Grating in a $KnbO_3/KtaO_3$ Superlattice" p. 182 in *Optical Diagnostic Methods for Inorganic Transmissive Materials*, Vol. 3425, ed. by R. U. Datla and L. M. Hanssen, SPIE—The International Society for Optical Engineering, Bellingham, Washington, 1998.

D. H. Lowndes, "Growth and Doping of Compound Semiconductor Films by Pulsed-Laser Ablation," p. 475 in *Experimental Methods in the Physical Sciences*, ed. by J. C. Miller and R. F. Haglund, Jr., Academic Press, San Diego, California, 1998.

D. H. Lowndes, V. I. Merkulov, A. A. Puretzky, D. B. Geohegan, G. E. Jellison, Jr., C. M. Rouleau, and T. Thundat, "Amorphous Diamond Films Synthesized by Pulsed-Laser Ablation: Influence of Carbon Ion Kinetic Energy and Laser Wavelength," p. 325 in *Advances in Laser Ablation of Materials*, ed. by R. K. Singh, D. H. Lowndes, D. B. Chrisey, J. Narayan, E. Fogarassy, and T. Kawai, Materials Research Society, Warrendale, Pennsylvania, 1998.

D. H. Lowndes, V. I. Merkulov, A. J. Pedraza, J. D. Fowlkes, A. A. Puretzky, D. B. Geohegan, and G. E. Jellison, Jr., "Surface Engineering of Silicon and Carbon by Pulsed-Laser Ablation," p. 113 in *Surface Engineering: Science and Technology I*, ed. by A. Kumar, The Minerals, Metals, and Materials Society, Warrendale, Pennsylvania, 1999.

G. D. Mahan, "Good Thermoelectrics," p. 81 in *Solid State Physics*, Vol. 51, ed. by H. Ehrenreich and F. Spaepen, Academic Press, San Diego, California, 1997.

G. D. Mahan, "Rare-Earth Thermoelectrics," p. 223 in *Thermoelectric Materials—New Directions and Approaches*, ed. by T. M. Tritt, H. B. Lyon, Jr., G. D. Mahan, and M. G. Kanatzidis, Materials Research Society, Warrendale, Pennsylvania, 1997.

G. D. Mahan, "Rare-Earth Thermoelectrics," p. 265 in *Proceedings of the Sixteenth International Conference on Thermoelectrics*, The Institute of Electrical and Electronics Engineers, Piscataway, New Jersey, 1997.

G. D. Mahan, "Thermionic Refrigeration," p. 459 in *Thermoelectric Materials 1998—The Next Generation Materials for Small-Scale Refrigeration and Power Generation Applications*, ed. by T. M. Tritt, H. B. Lyon, Jr., G. D. Mahan, and M. G. Kanatzidis, Materials Research Society, Warrendale, Pennsylvania, 1999.

G. D. Mahan, "Multilayer Thermionic Refrigeration," p. 459 in *Proceedings of the Eighteenth International Conference on Thermoelectrics*, The Institute of Electrical and Electronics Engineers, Piscataway, New Jersey, 1999.

A. Maiti, M. F. Chisholm, S. J. Pennycook, and S. T. Pantelides, "Cooperative Chemical Rebonding in the Segregation of Impurities in Silicon Grain Boundaries," p. 213 in *Defects in Electronic Materials II*, ed. by J. Michel, T. Kennedy, K. Wada, and K. Thonke, Materials Research Society, Warrendale, Pennsylvania, 1997.

K. Malekani, J. A. Rice, and J. S. Lin, "Fractal Characterization of the Surface of the Humin Fraction of Soil Organic Matter," p. 367 in *Fractal Frontiers*, ed. by M. M. Novak and T. G. Dewey, World Scientific Publishing Company, Singapore, 1997.

D. Mandrus, B. C. Sales, V. Keppens, B. C. Chakoumakos, P. Dai, L. A. Boatner, R. K. Williams, J. R. Thompson, T. W. Darling, A. Migliori, M. B. Maple, D. A. Gajewski, and E. J. Freeman, "Filled-Skutterudite Antimonides: Validation of the Electron-Crystal Phonon-Glass Approach to New Thermoelectric Materials," p. 199 in *Thermoelectric Materials—New Directions and Approaches*, ed. by T. M. Tritt, H. B. Lyon, Jr., G. D. Mahan, and M. G. Kanatzidis, Materials Research Society, Warrendale, Pennsylvania, 1997.

D. Mandrus, V. Keppens, B. C. Chakoumakos, G. E. Granroth, and S. E. Nagler, "A Neutron Diffraction Study of $Co_2Ru_{1-x}Mn_xO_4$ Spinels," p. 177 in *Solid-State Chemistry of Inorganic Materials II*, ed. by E. M. McCarron III, H-C. zur Loye, S. M. Kauzlarich, and A. W. Sleight, Materials Research Society, Warrendale, Pennsylvani, 1999.

D. W. M. Marr, M. Wartenberg, K. B. Schwartz, M. M. Agamalian, and G. D. Wignall, "Void Morphology in Polyethyene/Carbon Black Composites," p. 173 in *Morphological Control in Multiphase Polymer Systems*, ed. by R. M. Briber, C. C. Han, and D. G. Peiffer, Materials Research Society, Warrendale, Pennsylvania, 1997.

L. Maya, M. Paranthaman, J. R. Thompson, T. Thundat, and R. J. Stevenson, "Ferromagnetic Nanocomposite Films from Thermally Labile Nitride Precursors," p. 213 in *Nanophase and Nanocomposite Materials II*, ed. by S. Komarneni, J. C. Parker, and H. J. Wollenberger, Materials Research Society, Warrendale, Pennsylvania, 1997.

A. Meldrum, L. A. Boatner, and R. C. Ewing, "Electron-Irradiation-Induced Crystallization of Amorphous Orthophosphates," p. 697 in *Microstructure Evolution During Irradiation*, ed. by T. Diaz de la Rubia, G. S. Was, I. M. Robertson, and L. W. Hobbs, Materials Research Society, Warrendale, Pennsylvania, 1997.

A. Meldrum, L. A. Boatner, and R. C. Ewing, "Phase Transitions During Ion-Beam Irradiation of the Perovskite-Structure Oxides," p. 401 in *Phase Transformations and Systems Driven Far From Equilibrium*, ed. by E. Ma, P. Bellon, M. Atzmon, and R. Trivedi, Materials Research Society, Warrendale, Pennsylvania, 1998.

A. Meldrum, L. A. Boatner, C. W. White, and D. O. Henderson, "Radiation Effects in Nonmetals: Amorphization, Phase Decomposition, and Nanoparticles," p. 135 in *Microstructural Processes in Irradiated Materials*, ed. by R. C. Ewing, G. E. Lucas, J. S. Williams, and S. J. Zinkle, Materials Research Society, Warrendale, Pennsylvania, 1999.

A. Meldrum, S. P. Withrow, R. A. Zuhr, C. W. White, L. A. Boatner, J. D. Budai, I. M. Anderson, D. O. Henderson, M. Wu, A. Ueda, and R. Mu, "Microstructure and Size Distribution of Compound Semiconductor Nanocrystals Synthesized by Ion Implantation," p. 317 in *Microcrystalline and Nanocrystalline Semiconductors*, ed. by L. T. Canham, M. J. Sailor, K. Tanaka, and C. C. Tsai, Materials Research Society, Warrendale, Pennsylvania, 1999.

A. Meldrum, S. J. Zinkle, L. A. Boatner, M. Wu, R. Mu, A. Ueda, D. O. Henderson, and R. C. Ewing, "Radiation Effects in Zircon, Hafnon, and Thorite: Implications for Pu Disposal," p. 395 in *Microstructure Processes in Irradiated Materials*, ed. by S. Zinkle, G. Lucas, R. Ewing, and J. Williams, Materials Research Society, Warrendale, Pennsylvania, 1999.

Y. B. Melnichenko, G. D. Wignall, R. N. Compton, G. Bakale, and K. A. Affholter, "Characterization of Fullerenes and Fullerene Derivatives by Small-Angle Neutron Scattering and Transmission Measurements," p. 622 in *Recent Advances in the Chemistry and Physics of Fullerenes and Related Materials*, ed. by K. M. Kadish and R. S. Ruoff, The Electrochemical Society, Pennington, New Jersey, 1997.

Y. B. Melnichenko, G. D. Wignall, and W. A. Van Hook, "The Phase Diagram of Polymer Solutions Below the Theta Temperature from SANS," p. 311 in *Polymeric Materials Science and Engineering*, American Chemical Society, Washington, D.C., 1998.

V. I. Merkulov, D. H. Lowndes, L. R. Baylor, G. E. Jellison, Jr., A. A. Puretzky, and D. B. Geohegan, "Pulsed-Laser-Deposited Amorphous Diamond and Related Materials: Synthesis, Characterization, and Field Emission Properties," p. 495 in *Laser Applications in Microelectronic and Optoelectronic Manufacturing IV*, ed. by J. J. Dubowski, H. Helvajian, E. W. Kreutz, and K. Sugioka, SPIE—The International Society for Optical Engineering, Bellingham, Washington, 1999.

F. A. Modine, "Time Domain Response of Electrical Ceramics—Micro to Megaseconds," p. 203 in *Electrically Based Microstructural Characterization II*, ed. by R. A. Gerhardt, M. A. Alim, and S. R. Taylor, Materials Research Society, Warrendale, Pennsylvania, 1998.

F. A. Modine, L. A. Boatner, M. Bartkowiak, G. D. Mahan, H. Wang, and R. B. Dinwiddie, "Influence of Ceramic Microstructure on Varistor Electrical Properties," p. 469 in *Dielectric Ceramic Materials*, ed. by K. M. Nair and A. S. Bhalla, The American Ceramic Society, Westerville, Ohio, 1999.

W. W. Moses, M. J. Weber, S. E. Derenzo, D. Perry, P. Berdahl, L. Schwarz, U. Sasum, and L. A. Boatner, "Recent Results in a Search for Inorgnic Scintillators for X- and Gamma-Ray Detection," p. 358 in *Proceedings of the International Conference on Inorganic Scintillators and Their Applications*, Shanghai Institute of Ceramics/Chinese Academy of Sciences, Shanghai, China, 1998.

H. Müllejans, R. H. Franch, G. Duscher, and M. Rühle, "Improved Measurement and Analysis of Series of Valence Electron Energy Loss Spectra and the Local Electronic Structure," p. 943 in *Proceedings of Microscopy and Microanalysis 1997*, ed. by G. W. Bailey, R. V. W. Dimlich, K. B. Alexander, J. J. McCarthy, and T. P. Pretlow, Springer-Verlag, New York, 1997.

P. D. Nellist and S. J. Pennycook, "Quantitative Information from Image Processing in ADF STEM," p. 1149 in *Proceedings of Microscopy and Microanalysis 1997*, ed. by G. W. Bailey, R. V. W. Dimlich, K. B. Alexander, J. J. McCarthy, and T. P. Pretlow, Springer-Verlag, New York, 1997.

P. D. Nellist and S. J. Pennycook, "Quantitative Sub-Ångstrom Imaging through ADF STEM," p. 129 in *Proceedings of the Fourteenth International Congress on Electron Microscopy*, ed. by H. A. C. Benavides and M. J. Yacaman, Institute of Physics Publishing, Bristol, United Kingdom, 1998.

P. D. Nellist and S. J. Pennycook, "Atomic-Resolution Z-Contrast Imaging of Ultradispersed Catalysts," p. 399 in *Proceedings of Electron Microscopy and Analysis 1997*, ed. by J. M. Rodenburg, Institute of Physics, Bristol, United Kingdom, 1997.

P. D. Nellist, Y. Xin, and S. J. Pennycook, "Direct Structure Determination by Atomic-Resolution Incoherent STEM Imaging," p. 109 in *Proceedings of Electron Microscopy and Analysis 1997*, ed. by J. M. Rodenburg, Institute of Physics, Bristol, United Kingdom, 1997.

E. Neufeld, S. Wang, R. Apetz, Ch. Buchal, R. Carius, C. W. White, and D. K. Thomas, "Effect of Annealing and H_2 Passivation on the Photoluminescence of Si Nanocrystals in SiO_2," p. 238 in *Nanostructured Materials: Clusters, Composites, and Thin Films*, ed. by M. Moskovits and V. Shalaev, American Chemical Society, Washington, D.C., 1997.

D. P. Norton, C. Park, B. Saffian, J. D. Budai, A. Goyal, D. K. Christen, D. M. Kroeger, D. F. Lee, and Q. He, "Epitaxial Growth of Oxide Thin Films on (001) Metal Surfaces Using Pulsed-Laser Deposition," p. 401 in *Epitaxial Oxide Thin Films III*, ed. by D. Schlom, C. Eom, M. Hawley, C. Foster, and J. Speck, Materials Research Society, Warrendale, Pennsylvania, 1997.

D. P. Norton, A. Goyal, J. D. Budai, D. K. Christen, C. Park, D. M. Kroeger, E. D. Specht, Q. He, B. Saffian, M. Paranthaman, C. E. Klabunde, D. F. Lee, B. C. Sales, and F. A. List, "Epitaxial $YBa_2Cu_3O_7$ on Biaxially Textured (001) Ni: An Approach to High Critical-Current-Density Superconducting Tapes," p. 35 in *Proceedings of the 1997 International Workshop on Superconductivity*, Superconductivity Technology Center, Tokyo, Japan, 1997.

D. P. Norton, J. D. Budai, A. Goyal, D. H. Lowndes, D. M. Kroeger, D. K. Christen, M. Paranthaman, and E. D. Specht, "Low-Cost Metal Substrates for Films with Aligned Grain Structures," p. 175 in *Proceedings of the First Conference on Future Generation Photovoltaic Technologies*, ed. by R. D. McConnell, American Institute of Physics, Woodbury, New York, 1998.

D. P. Norton, "Science and Technology of High-Temperature Superconducting Films," p. 299 in *Annual Review of Materials Science*, Vol. 28, ed. by O. Auciello, Annual Reviews Inc., Palo Alto, California, 1998.

J. G. Ossandon, J. R. Thompson, L. Krusin-Elbaum, K. J. Song, D. K. Christen, and J. L. Ullmann, "Stabilization of Magnetic Flux in BSCCO-2212/Ag Tapes Subjected to 0.8-GeV Proton Irradiation," p. 645 in *Science and Engineering of HTC Superconductivity*, ed. by P. Vincenzini, TECHNA Srl, Faenza, Italy, 1999.

J. U. Otaigbe, B. C. Sales, and G. H. Beal, "Understanding and Controlling Melt Crystallization of Glassy Phosphate Polymers," p. 338 in *Polymer Materials Science and Engineering*, American Chemical Society, Washington, D.C., 1997.

S. T. Pantelides, S. J. Pennyook, M. F. Chisholm, A. Maiti, Y. Yan, F. Reboredo, and M. Ferconi, "Complex Atomic-Scale Structures in Solids by a Combination of Theory and Microscopy," p. 760 in *Proceedings of Microscopy and Microanalysis 1998*, ed. by G. W. Bailey, K. B. Alexander, W. G. Jerome, M. G. Bond, and J. J. McCarthy, Springer-Verlag New York, Inc., New York, 1998.

M. Paranthaman, A. Goyal, D. P. Norton, F. A. List, E. D. Specht, D. K. Christen, D. M. Kroeger, J. D. Budai, Q. He, B. Saffian, D. Lee, and P. Martin, "Development of Biaxially Textured Buffer Layers on Rolled-Ni Substrates for High-Current $YBa_2Cu_3O_{7-y}$-Coated Conductors," p. 669 in *Advances in Superconductivity IX*, ed. by S. Nakajima and M. Murakami, Springer-Verlag, Tokyo, Japan, 1998.

M. Paranthaman and B. C. Chakoumakos, "Synthesis and Characterization of Bulk $HgBa_2Ca_{n-1}Cu_nO_{2n+n+\delta}$ (n = 1, 2, 3, 4) Superconductors," p. 133 in *Studies of High-Temperature Superconductors*, Vol. 26, ed. by A. Narlikar, Nova Science Publishers, Commack, New York, 1998.

M. Paranthaman, F. A. List, D. F. Lee, A. Goyal, R. Feenstra, D. P. Norton, C. Park, D. T. Verebelyi, D. K. Christen, P. M. Martin, E. D. Specht, and D. M. Kroeger, "Fabrication of High-Current $YBa_2Cu_3O_{7-y}$-Coated Conductors Using Rolling-Assisted Biaxially Textured Substrates," p. 169 in *Ninth Cimtec-World Forum on New Material*, ed. by P. Vincenzini, Techna Srl, Forli, Italy, 1999.

M. Paranthaman, S. S. Shoup, D. B. Beach, J. S. Morrell, A. Goyal, E. D. Specht, J. E. Mathis, D. T. Verebelyi, and D. K. Christen, "Growth of Textured Buffer Layers and Superconductors on Rolled-Ni Substrates Using Sol-Gel Alkoxide," p. 185 in *Ninth Cimtec-World Forum on New Materials*, ed. by P. Vincenzini, Techna Srl, Forli, Italy, 1999.

J. Park, C. M. Rouleau, and D. H. Lowndes, "Study of Substrate Diffusion in Epitaxial *n*-type CdSe Films Grown on GaAs(001) by Pulsed-Laser Ablation," p. 27 in *Advances in Laser Ablation of Materials*, ed. by R. K. Singh, D. H. Lowndes, D. B. Chrisey, J. Narayan, E. Fogarassy, and T. Kawai, Materials Research Society, Warrendale, Pennsylavnia, 1998.

A. J. Pedraza and D. H. Lowndes, "Surface Engineering Using Excimer Lasers," p. 829 in *High-Power Laser Ablation*, ed. by C. R. Phipps, SPIE–The International Society for Optical Engineering, Bellingham, Washington, 1998.

S. J. Pennycook, E. C. Dickey, D. J. Wallis, N. D. Browning, and P. D. Nellist, "Atomic-Resolution Electron Energy Loss Spectroscopy of Interfaces," p. 947 in *Proceedings of Microscopy and Microanalysis 1997*, ed. by G. W. Bailey, R. V. W. Dimlich, K. B. Alexander, J. J. McCarthy, and T. P. Pretlow, Springer-Verlag, New York, 1997.

S. J. Pennycook, M. F. Chisholm, and P. D. Nellist, "Toward Sub-Å Resolution Through Incoherent Imaging," p. 1167 in *Proceedings of Microscopy and Microanalysis 1997*, ed. by G. W. Bailey, R. V. W. Dimlich, K. B. Alexander, J. J. McCarthy, and T. P. Pretlow, Springer-Verlag, New York, 1997.

S. J. Pennycook, P. D. Nellist, M. F. Chisholm, N. D. Browning, D. J. Wallis, and E. C. Dickey, "Determination of Atomic Structure at Surfaces and Interfaces by High-Resolution STEM," p. 3 in *Atomic-Resolution Microscopy of Surfaces and Interfaces*, ed. by D. J. Smith and R. Hamers, Materials Research Society, Warrendale, Pennsylvania, 1997.

S. J. Pennycook, M. F. Chisholm, G. Duscher, A. Maiti, and S. T. Pantelides, "Atomic-Scale Characterization of Semiconductor Interfaces by Scanning Transmission Electron Microscopy," p. 3 in *Proceedings of the Fourth International Conference on Materials and Process Characterization for VLSI 1997*, ed. by X. F. Zong, D. G. Seiler, and L. G. Song, Asia-Pacific Microanalysis Association, Shanghai, China, 1997.

S. J. Pennycook, J. Buban, C. Prouteau, M. F. Chisholm, P. D. Nellist, and N. D. Browning, "The Atomic-Scale Origins of Grain Boundary Superconducting Properties," p. 688 in *Proceedings of Microscopy and Microanalysi 1998*, ed. by G. W. Bailey, K. B. Alexander, W. G. Jerome, M. G. Bond, and J. J. McCarthy, Springer-Verlag New York, Inc., New York, 1998.

S. J. Pennycook, S. T. Pantelides, M. F. Chisholm, A. Maiti, and Y. Yan, "Atomic-Scale Structures in Complex Solids by Z-Contrast STEM and First-Principles Theory," p. 575 in *Proceedings of Fourteenth International Congress on Electron Microscopy*, H. A. C. Benavides and M. J. Yacaman, Institute of Physics Publishing, Bristol, United Kingdom, 1998.

S. J. Pennycook, M. F. Chisholm, Y. Yan, G. Duscher, and S. T. Pantelides, "A Combined Experimental and Theoretical Approach to Atomic-Scale Characterization," p. 48 in *Proceedings of the International Symposium on Atomic-Level Characterizations for New Materials and Devices 1997*, ed. by H. Yurimoto and S. Ichimura, Japan Society for the Promotion of Science, Tokyo, Japan, 1998.

S. J. Pennycook, "Diffraction Channeling and the Production of Secondary Excitations," p. 688 in *Proceedings of Microscopy and Microanalysis 1999*, ed. by G. W. Bailey, W. G. Jerome, S. McKernan, J. F. Mansfield, and R. L. Price, Springer-Verlag New York, Inc., New York, 1999.

S. J. Pennycook, G. Duscher, R. S. Buczko, and S. T. Pantelides "The Si/SiO_2 Interface: Atomic Structures, Composition, Strain, and Energetics," p. 122 in *Proceedings of Microscopy and Microanalysis 1999*, ed. by G. W. Bailey, W. G. Jerome, S. McKernan, J. F. Mansfield, and R. L. Price, Springer-Verlag New York, Inc., New York, 1999.

C. Prouteau, G. Duscher, D. K. Christen, N. D. Browning, S. J. Pennycook, M. F. Chisholm, D. P. Norton, A. Goyal, and C. Park, "Correlation of Transport Properties with Grain Boundary Atomic Structure in High-T_c Superconducting Films and Tapes," p. 1015 in *Advances in Superconductivity X*, ed. by K. Osamura, and I. Hirabayashi, Springer-Verlag, Hong Kong, 1998.

C. Prouteau, G. Duscher, N. D. Browning, S. J. Pennycook, D. Verebelyi, D. K. Christen, M. F. Chisholm, and D. P. Norton, "Investigation of the Local Superconducting Properties at Grain Boundaries in High-T_c Superconductors," p. 690 in *Proceedings of Microscopy and Microanalysis 1998*, ed. by G. W. Bailey, K. B. Alexander, W. G. Jerome, M. G. Bond, and J. J. McCarthy, Springer-Verlag New York, Inc., New York, 1998.

M. Rappaz, D. Corrigan, and L. A. Boatner, "Analysis of Ripple Formation in Single-Crystal Spot Welds," p. 713 in *Proceedings of International Conference on Modeling of Casting, Welding, and Advanced Solidification Processes VIII*, ed. by B. G. Thomas and C. Beckermann, The Minerals, Metals, and Materials Society, Warrendale, Pennsylvania, 1998.

E. G. Roth, O. W. Holland, and A. Meldrum, "Manipulating Ion-Induced Defects to Improve Implantation Processing of Silicon," p. 938 in *Proceedings of the Eighth International Symposium on Silicon Materials Science and Technology*, ed. by H. Huff, U. Gösele, and H. Tsuya, The Electrochemical Society, Pennington, New Jersey, 1998.

E. Roth, O. W. Holland, and J. L. Duggan, "Solutions to Defect-Related Problems in Implanted Silicon by Controlled Injection of Vacancies by High-Energy Ion Irradiation," p. 804 in *Proceedings of Fifteenth International Conference on the Application of Accelerators in Research and Industry*, ed. by J. L. Duggan and I. L. Morgan, American Institute of Physics, College Park, Maryland, 1999.

R. Russo, D. B. Geohegan, R. F. Haglund, Jr., and K. Murakami, editors., *Proceedings of the Fourth International Conference on Laser Ablation*, Elsevier Science Publishers B.V., Amsterdam, the Netherlands, 1998.

B. C. Sales, B. C. Chakoumakos, D. Mandrus, J. W. Sharp, N. R. Dilley, and M. B. Maple, "Atomic-Displacement Parameters: A Useful Tool in the Search for New Thermoelectric Materials?" p. 13 in *Thermoelectric Materials 1998—The Next Generation Materials for Small-Scale Refrigeration and Power Generation Applications*, ed. by T. M. Tritt, H. B. Lyon, Jr., G. D. Mahan, and M. G. Kanatzidis, Materials Research Society, Warrendale, Pennsylvania, 1999.

S. Sarkisov, E. K. Williams, M. Curley, C. C. Smith, D. Ila, P. Venkateswarlu, D. B. Poker, and D. K. Hensley, "Mechanisms of Formation of Nonlinear Optical Light Guide Structures in Metal Cluster Composites Produced by Ion Beam Implantation," p. 357 in *Atomistic Mechanisms in Beam Synthesis and Irradiation of Materials*, ed. by J. C. Barbour, S. Roorda, and D. Ila, Materials Research Society, Warrendale, Pennsylvania, 1999.

M. L. Simpson, D. H. Lowndes, G. E. Jellison, Jr., M. N. Ericson, W. B. Dress, J. C. Arnott, and M. A. Guillorn, "Single-Chip Photo-Spectrometers Realized in Standard Complementary-Metal-Oxide-Semiconductor (CMOS) Technology," p 449 in *Proceedings of the Forty Fourth Annual International Instrumentation Symposium*, International Society for Measurement and Control, Research Triangle Park, North Carolina, 1998.

M. L. Simpson, G. S. Sayler, S. Ripp, D. E. Nivens, B. M. Applegate, M. J. Paulus, and G. E. Jellison Jr., "Bioluminescent Bioreporter Integrated Circuits (BBICs): Novel Whole-Cell Biosensors," p. 354 in *Technical Digest of 1998 Solid-State Sensors and Actuators Workshop*, The Institute of Electrical and Electronics Engineers, Inc., Piscataway, New Jersey, 1998.

M. L. Simpson, G. S. Sayler, S. Ripp, M. J. Paulus, and G. E. Jellison, Jr., "Bioluminescent Bioreporter Integrated Circuits (BBICs)," p. 202 in *Smart Structures and Materials 1998: Smart Electronics and NMES*, ed. by V. K. Varadon, P. J. McWhorter, R. A. Singh, and M. J. Vellekoop, SPIE—The International Society for Optical Engineering, Bellingham, Washington, 1998.

R. K. Singh, D. H. Lowndes, D. B. Chrisey, E. Fogarassy, and J. Narayan, editors, *Advances in Laser Ablation of Materials*, Materials Research Society, Warrendale, Pennsylvania, 1998.

J. O. Sofo and G. D. Mahan, "Electron Structure and Transport Properties of $CoSb_3$: A Narrow Band-Gap Semiconductor," p. 315 in *Thermoelectric Materials 1998—The Next Generation Materials for Small-Scale Refrigeration and Power Generation Applications*, ed. by T. M. Tritt, H. B. Lyon, Jr., G. D. Mahan, and M. G. Kanatzidis, Materials Research Society, Warrendale, Pennsylvania, 1999.

K. Sohlberg, S. J. Pennycook, and S. T. Pantelides, "The Role of Hydrogen in the Structure of γ-Alumina," p. 165 in *Advanced Catalytic Materials 1998*, ed. by P. Lednor, D. Nagaki, and L. Thompson, Materials Research Society, Warrendale, Pennsylvania, 1999.

S. Spooner and E. B. S. Purdue, "Neutron and X-Ray Scattering Studies of the Metallurgical Condition and Residual Stresses in Weldalite Welds," p. 297 in *Advances in X-Ray Analysis*, Vol. 39, ed. by J. V. Gilfrich, Plenum Press, New York, 1997.

S. Spooner, "Small-Angle Neutron Scattering Modeling of Copper-Rich Precipitates in Steel," p. 489 in *Microstructure Evolution During Irradiation*, ed. by I. M. Robertson, G. S. Was, L. Hobbs, and T. D. de la Rubia, Materials Research Society, Warrendale, Pennsylvania, 1997.

N. Tamura, J.-S. Chung, G. E. Ice, B. C. Larson, J. D. Budai, J. Z. Tischler, M. Yoon, E. L. Williams, and W. P. Lowe, "Strain and Texture in Al-Interconnect Wires Measured by X-Ray Microbeam Diffraction," p. 175 in *Materials Reliability in Microelectronics IX*, ed. by C. A. Volkert, A. H. Verbruggen , and D. Brown, Materials Research Society, Warrendale, Pennsylvania, 1999.

N. Tanaka, S. J. Pennycook, T. Fujiwara, T. Fukunaga, and U. Mizutani, "High-Resolution Observation of $Si_{100-x}V_x$ Amorphous Alloys by HAADF-STEM," p. 719 in *Proceedings of Microscopy and Microanalysis 1997*, ed. by G. W. Bailey, R. V. W. Dimlich, K. B. Alexander, J. J. McCarthy, and T. P. Pretlow, Springer-Verlag, New York, 1997.

J. R. Thompson, J. G. Ossandon, L. Krusin-Elbaum, K. J. Song, D. K. Christen, M. Paranthaman, J. Z. Wu, and J. L. Ullmann, "J_c and Vortex Pinning Enhancements in Bi-, Tl-, and Hg-Based Cuprate Superconductors via GeV Proton Irradiation," p. 146 in *Proceedings of the Eighth U.S.-Japan Workshop on High-T_c Superconductors*, ed. by J. Schwartz, Rose Printing Company, Inc., Tallahassee, Florida, 1998.

J. R. Thompson, "Mercury Cuprate High-T_c Superconductors: What Do Their Magnetic Properties Reveal?" p. 113 in *Studies of High-Temperature Superconductors*, Vol. 26, ed. by. A. V. Narlikar, Nova Science Publishers, Inc., Commack, New York, 1998.

J. Z. Tischler, B. C. Larson, and P. Zschack, "Variation of Q with Energy in Mosaic Analyzers for Inelastic X-Ray Measurements," p. 140 in *Synchrotron Radiation Instrumentation*, ed. by E. Fontes, American Institute of Physics, Woodbury, New York, 1997.

T. M. Tritt, H. B. Lyon, Jr., G. D. Mahan, and M. G. Kanatzidis, editors, *Thermoelectric Materials—New Directions and Approaches*, Materials Research Society, Warrendale, Pennsylvania, 1997.

T. M. Tritt, H. B. Lyon, Jr., G. D. Mahan, and M. G. Kanatzidis, editors, *Thermoelectric Materials 1998—The Next Generation Materials for Small-Scale Refrigeration and Power Generation Applications*, Materials Research Society, Warrendale, Pennsylvania, 1999.

A. Trukhin and L. A. Boatner, "Electronic Structure of $ScPO_4$ Single Crystals: Optical and Photoelectric Properties," p. 573 in *Materials Science Forum*, Trans Tech Publications Ltd., Zurich, Switzerland, 1997.

A. Ueda, M. Wu, R. Mu, Y.-S. Tung, D. O. Henderson, A. Meldrum, R. A. Zuhr, J. D. Budai, C. W. White, J. C. Keay, and L. C. Feldman, "Temperature Dependence and Annealing Effects of Absorption Edges for Selenium Quantum Dots Formed by Ion Implantation in Silica Glass," p. 481 in *Phase Transformations and Systems Driven Far From Equilibrium*, ed. by E. Ma, P. Bellon, M. Atzmon, and R. Trivedi, Materials Research Society, Warrendale, Pennsylvania, 1998.

V. C. Venezia, T. E. Haynes, A. Agarwal, H.-J. Gossmann, and D. J. Eaglesham, "Enhanced Diffusion of Dopants in Vacancy Supersaturations Produced by MeV Implantation," p. 303 in *Defects and Diffusion in Silicon Processing*, ed. by S. Coffa, T. Diaz de la Rubia, P. A. Stolk, and C. S. Rafferty, Materials Research Society, Warrendale, Pennsylvania, 1997.

V. C. Venezia, D. J. Eaglesham, T. E. Haynes, A. Agarwal, D. C. Jacobson, H.-J. Gossmann, T. Friessnegg, and B. Nielsen, "Vacancy Supersaturations Produced by High-Energy Ion Implantation," p. 926 in *Semiconductor Silicon 1998*, ed. by H. Huff, U. Gösele, and H. Tsuya, The Electrochemical Society, Pennington, New Jersey, 1998.

V. C. Venezia, T. E. Haynes, A. Agarwal, D. J. Eaglesham, O. W. Holland, M. K. Weldon, and Y. J. Chabal, "The Role of Implantation Damage in the Production of Silicon-on-Insulator Films by Co-Implantation of He^+ and H^+," p. 1385 in *Semiconductor Silicon 1998*, ed. by H. Huff, U. Gösele, and H. Tsuya, The Electrochemical Society, Pennington, New Jersey, 1998.

V. C. Venezia, T. E. Haynes, A. Agarwal, H.-J. Gossmann, L. Pelaz, D. C. Jacobson, D. J. Eaglesham, and J. L. Duggan, "Defects and Diffusion in MeV-Implanted Silicon," p. 784 in *Proceedings of the Fifteenth International Conference on Applications and Accelerators in Research and Industry*, ed. by J. L. Duggan and I. V. Morgan, American Institute of Physics, New York, 1999.

K. C. Walter, J. M. Williams, J. S. Woodring, M. Nastasi, D. B. Poker, and C. P. Munson, "Properties of Ion-Implanted Ti-6Al-4V Processed Using Beam Line and PSII Techniques," p. 627 in *Materials Modification and Synthesis by Ion Beam Processing*, ed. by D. E. Alexander, N. W. Cheung, B. Park, and W. Skorupa, Materials Research Society, Warrendale, Pennsylvania, 1997.

W. J. Weber, R. Devanathan, A. Meldrum, L. A. Boatner, R. C. Ewing, and L. M. Wang, "The Effect of Temperature and Damage Energy on Amorphization in Zircon," p. 367 in *Microstructural Processes in Irradiated Materials*, ed. by R. C. Ewing, G. Lucas, J. Williams, and S. Zinkle, Materials Research Society, Warrendale, Pennsylvania, 1999.

D. Welipitiya, C. N. Borca, P. A. Dowben, I. Gobulukoglu, H. Jiang, B. W. Robertson, and J. Zhang, "Fabrication of Micro-Scale Magnetic Nickel Features by Selective Area Organometallic Chemical Vapor Deposition," p. 257 in *Magnetic Ultrathin Films, Multilayers, and Surfaces—1997*, ed. by D. D. Chambliss, J. G. Tobin, D. Kubinski, K. Barmak, W. J. M. de Jonge, T. Katayama, A. Schuhl, and P. Dederichs, Materials Research Society, Warrendale, Pennsylvania, 1997.

J. F. Wendelken, A. K. Swan, W. W. Pai, and J.-K. Zuo, "Morphology and Energy Barriers in Homoepitaxial Growth and Coarsening: A Case Study for Cu(100)," p. 320 in *Morphological Organization in Epitaxial Growth and Removal*, ed. by Z. Zhang and M. Lagally, World Scientific Publishing, New York, 1999.

C. W. White, J. D. Budai, A. L. Meldrum, S. P. Withrow, R. A. Zuhr, E. Sonder, A. Puretzky, D. B. Geohegan, J. G. Zhu, and D. O. Henderson, "Ion Beam Synthesis of CdS, ZnS, and PbS Compound Semiconductor Nanocrystals," p. 399 in *Atomistic Mechanisms in Beam Synthesis and Irradiation of Materials*, ed. by J. C. Barbour, D. Ila, S. Roorda, and M. Tsujioka, Materials Research Society, Warrendale, Pennsylvania, 1998.

C. W. White, S. P. Withrow, A. Meldrum, J. D. Budai, D. M. Hembree, J. G. Zhu, D. O. Henderson, and S. Prawer, "Optical Properties of Si Nanocrystals Formed in SiO_2 by Ion Implantation," p. 249 in *Amorphous and Microcrystalline Silicon Technology*, ed. by S. Wagner, M. Hack, H. M. Branz, R. Schropp, and I. Shimizu, Materials Research Society, Warrendale, Pennsylvania, 1998.

C. W. White, A. Meldrum, E. Sonder, J. D. Budai, R. A. Zuhr, S. P. Withrow, and D. O. Henderson, "Formation of $ZnAl_2O_4$ and $MgAl_2O_4$ Spinel in Al_2O_3 by Ion Implantation," p. 219 in *Microstructural Processes in Irradiated Materials*, ed. by S. J. Zinkle, G. Lucas, R. Ewing, and J. Williams, Materials Research Society, Warrendale, Pennsylvania, 1999.

G. D. Wignall and Y. B. Melnichenko, "Dimensions of Polystyrene Coils in the Critical Region of Phase Demixing," p. 306 in *Polymeric Materials Science and Engineering*, American Chemical Society, Washington, D.C., 1998.

E. K. Williams, D. Ila, S. Sarkisov, M. Curley, D. B. Poker, D. K. Hensley, and C. Borel, "Study of the Effects of MeV Ag, Cu, Au, and Sn Implantation on the Optical Properties of $LiNbO_3$," p. 363 in *Atomistic Mechanisms in Beam Synthesis and Irradiation of Materials*, ed. by J. C. Barbour, S. Roorda, and D. Ila, Materials Research Society, Warrendale, Pennsylvania, 1999.

J. M. Williams, B. D. Sartwell, D. B. Poker, and S. P. Withrow, editors, *Surface and Coatings Technology*, Vol. 104, Elsevier Science SA, Lausanne, Switzerland, 1998.

Y. Xin, D. J. Wallis, N D. Browning, S. Sivananthan, S. J. Pennycook, and C. J. Humphreys, "Interfaces and Defects in Opto-Electronic Semiconductor Films Studied by Atomic-Resolution STEM," p. 461 in *Proceedings of Microscopy and Microanalysis 1997*, ed. by G. W. Bailey, R. V. W. Dimlich, K. B. Alexander, J. J. McCarthy, and T. P. Pretlow, Springer-Verlag, New York, Inc., New York, 1997.

Y. Xin, N. D. Browning, S. J. Pennycook, P. D. Nellist, S. Sivananthan, J.-P. Faurie, and P. Gibart, "Direct Observation of Threading Dislocations in GaN by High-Resolution Z-Contrast Imaging," p. 660 in *Proceedings of Microscopy and Microanalysis 1998*, ed. by G. W. Bailey, K. B. Alexander, W. G. Jerome, M. G. Bond, and J. J. McCarthy, Springer-Verlag New York, Inc., New York, 1998.

Y. Xin, N. D. Browning, S. J. Pennycook, P. D. Nellist, Y. P. Chen, S. Rujirawat, S. Sivananthan, F. Omnès, B. Beaumont, J.-P. Faurie, and P. Gibart, "Direct Observations of Defect Structures in Optoelectronic Materials by Z-Contrast STEM," p. 427 in *Proceedings of the Fourteenth International Congress on Electron Microscopy*, ed. by H. A. C. Benavides and M. J. Yacaman, Institute of Physics Publishing, Bristol, United Kingdom, 1998.

Y. Xin, S. Rujiwarat, G. Brill, N. D. Browning, and S. J. Pennycook, "Investigating the Effect of As and Te Passivation on the MBE Growth of CdTe (111) on Si (111) Substrates," p. 724 in *Proceedings of Microscopy and Microanalysis 1999*, ed. by G. W. Bailey, W. G. Jerome, S. McKernan, J. F. Mansfield, and R. L. Price, Springer-Verlag New York, Inc., New York, 1999.

Y. Xin, S. Rujirawat, G. Brill, N. D. Browning, S. J. Pennycook, S. Sivananthan, and R. Sporken, "Investigating the Effect of As and Te Passivation on the MBE Growth of CdTe (111) on Si (111) Substrates," p. 724 in *Proceedings of Microscopy and Microanalysis 1999*, ed. by G. W. Bailey, W. G. Jerome, S. McKernan, J. F. Mansfield, and R. L. Price, Springer-Verlag New York, Inc., New York, 1999.

Y. Yan, M. F. Chisholm, and S. J. Pennycook, "Atomic Structure of a Symmetric 27°[001] Tilt Grain Boundary in MgO," p. 653 in *Proceedings of Microscopy and Microanalysis 1997*, ed. by G. W. Bailey, R. V. W. Dimlich, K. B. Alexander, J. J. McCarthy, and T. P. Pretlow, Springer-Verlag, New York, Inc., New York, 1997.

Y. Yan, M. F. Chisholm, G. Duscher, S. J. Pennycook, A. Maiti, and S. T. Pantelides, "First-Principles Simulations and Z-Contrast Imaging of Impurities at ⟨001⟩ Tilt Grain Boundaries in MgO," p. 181 in *Microscopic Simulation of Interfacial Phenomena in Solids and Liquids*, ed. by P. D. Bristowe, S. R. Phillpot, D. G. Stroud, and J. R. Smith, Materials Research Society, Warrendale, Pennsylvania, 1998.

Y. Yan, Z. Xu, D. Viehland, and S. J. Pennycook, "Z-Contrast Imaging of Ordered Structures in $Pb(Mg_{1/3}Nb_{2/3})O_3$ and $Ba(Mg_{1/3}Nb_{2/3})O_3$," p. 554 in *Proceedings of Microscopy and Microanalysis 1998*, ed. by G. W. Bailey, K. B. Alexander, W. G. Jerome, M. G. Bond, and J. J. McCarthy, Springer-Verlag New York, Inc., New York, 1998.

Y. Yan, M. F. Chisholm, and S. J. Pennycook, "Atomic Structures of Inversion Domain Boundaries and Dislocations in Sintered AlN," p. 788 in *Proceedings of Microscopy and Microanalysis 1998*, ed. by G. W. Bailey, K. B. Alexander, W. G. Jerome, M. G. Bond, and J. J. McCarthy, Springer-Verlag New York, Inc., New York, 1998.

Y. Yan and S. J. Pennycook, "Atomic-Resolution Z-Contrast Imaging of Decagonal Quasicrystals: A Nucleation and Growth Mechanism," p. 192 in *Proceedings of Microscopy and Microanalysis 1999*, ed. by G. W. Bailey, W. G. Jerome, S. McKernan, J. F. Mansfield, and R. L. Price, Springer-Verlag New York, Inc., New York, 1999.

Y. Yan, Z. Xu, X. Lu, D. Viehland, M. Al-Jassim, and S. J. Pennycook, "Structural Determination of a Novel Defect in $SrBi_2Ta_2O_9$ Using Atomic-Resolution Z-Contrast Imaging," p. 112 in *Proceedings of Microscopy and Microanalysis 1999*, ed. by G. W. Bailey, W. G. Jerome, S. McKernan, J. F. Mansfield, and R. L. Price, Springer-Verlag New York, Inc., New York, 1999.

Z. Zhang, Z.-P. Shi, and K. Haug, "Diffusion and Dissociation of Two-Dimensional Islands on FCC Metal (100) Surfaces," p. 103 in *Surface Diffusion: Atomistic and Collective Processes*, ed. by M. C. Tringides, Plenum Press, New York, 1997.

J. G. Zhu, C. W. White, S. P. Withrow, J. D. Budai, R. Mu, and D. O. Henderson, "Synthesis and Physical Properties of Semiconductor Nanocrystals Formed by Ion Implantation," p. 198 in *Nanostructured Materials: Clusters, Composites, and Thin Films*, ed. by V. M. Shalaev and M. Moskovits, American Chemical Society, Washington, D.C., 1997.

R. L. Zimmerman, D. Ila, D. B. Poker, and S. P. Withrow, "Permeability Control of GPC Drug Delivery by Ion Implantation," p. 957 in *Application of Accelerators in Research and Industry*, ed. by J. L. Duggan and I. L. Morgan, American Institute of Physics, Woodbury, New York, 1997.

R. A. Zuhr, R. H. Magruder III, and T. S. Anderson, "Formation and Optical Properties of Intermetallic Nanoclusters Formed by Sequential Ion Implantation," p. 401 in *Surface and Coatings Technology*, Vol. 104, ed. by D. B. Poker, S. P. Withrow, J. M. Williams, and B. D. Sartwell, Elsevier Science SA, Lausanne, Switzerland, 1998.

R. A. Zuhr, J. D. Budai, P. G. Datskos, A. Meldrum, K. A. Thomas, R. J. Warmack, C. W. White, L. C. Feldman, M. Strobel, and K.-H. Heinig, "Nanostructured Arrays Formed by Finely Focused Ion Beams," p. 251 in *Microcrystalline and Nanocrystalline Semiconductors*, ed. by M. J. Sailor, C. C. Tsai, L. T. Canham, and K. Tanaka, Materials Research Society, Warrendale, Pennsylvania, 1999.

REPORTS

J. B. Bates and C. Schmidt, *Development of Thin-Film Batteries for Implantation of Medical Devices*, CRADA Final Report, C/ORNL96-0419, Lockheed Martin Energy Research Corporation, Oak Ridge, Tennessee (March 1998).

J. B. Bates and E. Saaski, *Development of a Thin-Film Battery-Powered Hazard Card and Other Microelectronic Devices*, CRADA Final Report, C/ORNL94-0285, Lockheed Martin Energy Research Corporation, Oak Ridge, Tennessee (March 1998).

L. A. Boatner and M. Urbanik, *The Growth of Large Single Crystals of MgO*, CRADA Final Report, C/ORNL/92-0091, Lockheed Martin Energy Research Corporation, Oak Ridge, Tennessee (June 1997).

L. A. Boatner and S. Samuelson, *Growth of Large Detector Crystals*, CRADA Final Report, C/ORNL/94-0274, Lockheed Martin Energy Research Corporation, Oak Ridge, Tennessee (June 1997).

D. H. Lowndes, editor, *Nanoscale Science, Engineering and Technology Research Directions*, A Report of the Nanoscience/Nanotechnology Group, Basic Energy Sciences Program, U. S. Department of Energy (September 1999).

S. E. Nagler, "Magnetic Fluctuations and Phonons in $SrRuO_3$," in *The Rutherford Appleton Laboratory ISIS Facility Annual Report 1996–1997*, Rutherford Appleton Laboratory (August 1997).

V. Narayanamurti, J. B. Roberto, G. Aeppli, A. Bienenstock, J. M. Gibson, S. Girvin, M. Ketchen, E. Kramer, J. S. Langer, C. A. Murray, V. A. Parsegian, P. S. Peercy, J. M. Phillips, R. C. Richardson, F. Spaepen, and K. R. Sreenivasan, *The Physics of Materials: How Science Improves Our Lives*, National Research Council, National Academy Press, Washington, D.C., 1997.

V. Narayanamurti and J. B. Roberto, *Condensed Matter and Materials Physics: Basic Research for Tomorrow's Technology*, National Research Council, National Academy Press (1999).

J. M. Williams and J. R. Miner, "Performance Improvement of Silicon Nitride Ball Bearings by Ion Implantation," CRADA Final Report, C/ORNL-93-0099, Lockheed Martin Energy Research Corporation, Oak Ridge, Tennessee (1998).

PATENTS GRANTED

S. W. Allison, M. R. Cates, L. A. Boatner, and G. T. Gillies, *High-Temperature Thermometric Phosphors for Use in a Temperature Sensor*, U.S. Patent No. 5,730,528 (March 24, 1998).

S. W. Allison, L. A. Boatner, and B. C. Sales, *Very High Numerical Aperture Light Transmitting Device*, U.S. Patent No. 5,812,729 (September 22, 1998).

J. B. Bates and N. J. Dudney, *Electrolyte for an Electrochemical Cell*, U.S. Patent No. 5,597,660 (January 28, 1997).

L. A. Boatner, S. W. Allison, Michael R. Cates, and George T. Gillies, *High-Temperature Thermometric Phosphors*, U.S. Patent No. 5,885,484 (March 23, 1999).

L. A. Boatner and L. A. Gea, *VO_2 Precipitates for Self-Protected Optical Surfaces*, U.S. Patent No. 5,885,665 (March 23, 1999).

A. Goyal, J. D. Budai, D. M. Kroeger, D. P. Norton, E. D. Specht, and D. K. Christen, *Structures Having Enhanced Biaxial Texture and Method of Fabricating Same*, U.S. Patent No. 5,739,086 (April 14, 1998).

A. Goyal, J. D. Budai, D. M. Kroeger, D. P. Norton, E. D. Specht, and D. K. Christen, *Structures Having Enhanced Biaxial Texture and Method of Fabricating Same*, U.S. Patent No. 5,741,377 (April 21, 1998).

A. Goyal, J. D. Budai, D. M. Kroeger, D. P. Norton, E. D. Specht, and D. K. Christen, *Structures Having Enhanced Biaxial Texture and Method of Fabricating Same*, U.S. Patent No. 5,898,020 (April 27, 1999).

A. Goyal, J. D. Budai, D. M. Kroeger, D. P. Norton, E. D. Specht, and D. K. Christen, *Structures Having Enhanced Biaxial Texture and Method of Fabricating Same*, U.S. Patent No. 5,958,599 (September 28, 1999).

T. E. Haynes, *Method of Forming Electrical Pathways in Indium-Tin-Oxide Coatings*, U.S. Patent No. 5,607,731 (March 4, 1997).

O. W. Holland and D. K. Thomas, *A Processing Method for Forming Dislocation-Free Sol and Other Materials for Semiconductor Use*, U.S. Patent No. 5,661,044 (April 26, 1997).

G. E. Jellison, Jr. and F. A. Modine, *Two Modulator Generalized Ellipsometer for Complete Mueller Matrix Measurement*, U.S. Patent No. 5,956,147 (September 21, 1999).

D. H. Lowndes, A. J. Pedraza, J. J. DeSilva, and R. A. Kumar, *Method for Adhesion of Metal Films to Ceramics*, U.S. Patent No. 5,703,341 (December 30, 1997).

A. D. McMillan, F. A. Modine, R. J. Lauf, M. A. Alim, G. D. Mahan, and M. Bartkowiak, *Rare-Earth-Doped Zinc Oxide Varistors*, U.S. Patent No. 5,854,586 (December 29, 1998).

R. A. Zuhr, T. E. Haynes, and A. Golanski, *Apparatus and Method for Selective Area Deposition of Thin Films on Electrically Biased Substrates*, U.S. Patent No. 5,910,220 (June 8, 1999).

THESES

C. Cantoni, "Pulsed-Laser Deposition and Characterization of $Nd_{1+x}Ba_{2-x}Cu_3O_y$ Films on Single-Crystal and Nickel Substrates," Ph.D. Thesis, Univerista' Deglistudidisalerno, Salerno, Italy, 1999.

J. Carpinelli, "Charge-Ordering Transition in Ultrathin Metal Films," Ph.D. Thesis, The University of Tennessee, Knoxville, Tennessee, 1997.

A. Hanbicki, "The Interaction of Hydrogen with Alloy Surfaces," Ph.D. Thesis, The University of Tennessee, Knoxville, Tennessee, 1997.

Ismail, "The Structure and Dynamics of Magnesium Surfaces," Ph.D. Thesis, The University of Tennessee, Knoxville, Tennessee, 1999.

B.-O, Kim, "Surface Collective Excitations in Reduced Dimensionality," Ph.D. Thesis, The University of Tennessee, Knoxville, Tennessee, 1999.

K. Pohl, "The Surfaces of Beryllium and Their Interaction with Hydrogen," Ph.D. Thesis, The University of Tennessee, Knoxville, Tennessee, 1997.

K.-J. Song, "Superconducting Study of the Intermetallic YNi_2B_2C Single Crystal and Several High-T_c Materials," Ph.D. Thesis, The University of Tennessee, Knoxville, Tennessee, 1999.

V. C. Venezia, "Evolution of Vacancy Supersaturation in MeV Si-Implanted Silicon," Ph.D. Thesis, University of North Texas, 1999.

C. Walters, "The Interaction of Hydrogen with the Cu(100) Surface," Ph.D. Thesis, The University of Tennessee, Knoxville, Tennessee, 1997.

PAPERS PRESENTED AT TECHNICAL MEETINGS

Workshop on AC Losses, San Francisco, California, April 3–4, 1997:

H. R. Kerchner, D. P. Norton, A. Goyal, J. D. Budai, D. K. Christen, D. M. Kroeger, E. D. Specht, Q. He, M. Paranthaman, D. F. Lee, B. C. Sales, and F. A. List, "Alternating Transport Current in $YBa_2Cu_3O_{7-\delta}$/RABiTS Tape"

Fourth International Workshop on Measurement, Characterization, and Modeling of Ultrashallow Doping Profiles in Semiconductors, Research Triangle Park, North Carolina, April 6, 1997:

A. Agarwal, H.-J. Gossmann, D. J. Eaglesham, D. C. Jacobson, T. E. Haynes, Y. E. Erokhin, R. Simonton, and J. M. Poate, "0.5- to 5-keV Ion Implantation for Ultrashallow Junctions"

Tenth International Conference on Microscopy of Semiconducting Materials, Oxford, United Kingdom, April 7–10, 1997:

M. F. Chisholm, A. Maiti, S. J. Pennycook, and S. T. Pantelides, "Direct Determination of Dopant Segregation Sites at Grain Boundaries"

D. E. Jesson, K. M. Chen, S. J. Pennycook, T. Thundat, and R. J. Warmack, "Mechanisms of Strain-Induced Surface Ripple Formation and Dislocation Multiplication in Si_xGe_{1-x} Thin Films" (invited paper)

Fractals in the Natural and Applied Sciences, Estes Park, Colorado, April 7–11, 1997:

K. Malekani, J. A. Rice, and J. S. Lin, "Fractal Characterization of the Surface of the Humin Fraction of Soil Organic Matter" (invited paper)

1997 Annual Meeting of South Carolina Academy of Science, Columbia, South Carolina, April 11, 1997:

R. D. Bailey, D. D. DesMarteau, J.-T. Liu, J.-J. Ma, C. W. Martin, W. T. Pennington, M-H. Tu, and J. S. Lin, "Structural Characterization of Perfluorinated Ionomer Membranes"

American Chemical Society Meeting, San Francisco, California, April 13, 1997:

J. U. Otaigbe, B. C. Sales, and G. H. Beal, "Understanding and Controlling Melt Crystallization of Glassy Phosphate Polymers"

Workshop on Photoemission, Santa Barbara, California, April 17–19, 1997:

G. D. Mahan, "Photoemission" (invited paper)

American Society for Artificial Internal Organs (ASAIO) Forty-Third Annual Conference, Atlanta, Georgia, May 1–3, 1997:

J. B. Bates and N. J. Dudney, "Thin-Film Rechargeable Lithium Batteries for Implantable Devices"

1997 Joint Annual Meeting, American Chemical Society, Florida Sections, Orlando, Florida, May 2–3, 1997:

M. H. Kim, R. G. Alamo, J. S. Lin, and B. K. Annis, "SAXS Studies of Isotactic Polypropylene and Ethylene and Propylene Random Copolymers"

The American Ceramic Society Annual Meeting, Cincinnati, Ohio, May 4–7, 1997:

L. A. Boatner, H.-M. Christen, and R. Feenstra, "Potassium Tantalate and Potassium Tantalate Niobate Substrates for the Growth of Epitaxial Thin Films and Superlattice Structures" (invited paper)

L. A. Boatner, B. C. Sales, and S. C. Sanchez, "Alkali-Lead-Iron Phosphate Glasses for Glass-to-Metal Seal Applications"

C. Park, D. P. Norton, A. Goyal, D. K. Christen, J. D. Budai, and M. Paranthaman, "The Effect of Buffer Layer Composition and Thickness for High-J_c YBCO Films Deposited on Biaxially Oriented Metallic Substrates"

H. Wang, R. B. Dinwiddie, F. A. Modine, L. A. Boatner, M. Bartkowiak, and G. D. Mahan, "Infrared Imaging of Nonuniform Heating in ZnO Varistors"

Electrochemical Society Meeting on Fullerenes, Montreal, Canada, May 4–9, 1997:

Y. B. Melnichenko, G. D. Wignall, R. N. Compton, G. Bakale, and K. A. Affholter, "Characterization of Fullerenes and Fullerene Derivatives by Small-Angle Neutron Scattering and Transmission Measurements" (invited paper)

Seventeenth Werner Brandt Workshop on Charged-Particle Penetration Phenomena, Charlottesville, Virginia, May 7–9, 1997:

A. G. Eguiluz, "Electronic Excitations and Correlation Effects on Metals" (invited paper)

Second International Conference on Spectroscopic Ellipsometry, Charleston, South Carolina, May 12–15, 1997:

G. E. Jellison, Jr., F. A. Modine, P. Doshi, and A. Rohatgi, "Spectroscopic Ellipsometry Characterization of Thin-Film Silicon Nitride"

G. E. Jellison, Jr., "Spectroscopic Ellipsometry Data Analysis: Measured vs. Calculated Quantities" (invited paper)

G. E. Jellison, Jr., F. A. Modine, and L. A. Boatner, "Two-Modulator Spectroscopic Ellipsometry"

Engineering Foundation Conference on Ion Beam Modification of Ceramics and Semiconductors, Il Ciocco, Italy, May 18–23, 1997:

A. Agarwal, D. J. Eaglesham, H.-J. Gossmann, T. E. Haynes, D. C. Jacobson, Y. Erokhin, and J. M. Poate, "Critical Issues in Ion Implantation of Silicon Below 5 keV: Defects and Diffusion"

T. E. Haynes, "Critical Issues in Ion Implantation of Silicon Below 5 keV" (invited paper)

O. W. Holland, "The Effects of Ion-Induced Damage on Implantation Processing of Semiconductors" (invited paper)

D. Ila, R. L. Zimmerman, Y. Qian, J. Wu, D. B. Poker, and D. K. Hensley, "Ion-Beam-Induced Change in the Optical Properties of Suprasil-1 and MgO"

Workshop on Pseudogap in High-Temperature Superconductors, Chicago, Illinois, May 19–20, 1997:

H. A. Mook, "Neutron Scattering Studies of Spin and Charge Fluctuations in High-Temperature Superconductors" (invited paper)

Workshop on Inelastic and Resonant Inelastic X-Ray Scattering at the National Synchrotron Light Source 1997 Annual Users' Meeting, Upton, New York, May 19–21, 1997:

B. C. Larson, "Many-Body and Band-Structure Effects in the Dynamical Structure Factor of Aluminum" (invited paper)

Swedish Materials Research Consortium Meeting, Solbacka, Sweden, May 21, 1997:

G. D. Mahan, "Grain Boundaries" (invited paper)

1997 Polymer Symposium, Houston, Texas, May 23–25, 1997:

W. C. Ko, T. T. Wu, and J. S. Lin, "Influence of Spinning Speed on Microstructural Changes of Poly(Ethylene-2,6-Naphthalate) Fibers"

International Workshop on Tl- and Hg-Based Superconducting Materials, Cambridge, United Kingdom, May 25–28, 1997:

Z. F. Ren, L. P. Guo, J. Y. Lao, J. H. Wang, D. K. Christen, and D. J. Miller, "From Thin Films to Thick Conductors of (Tl,Bi)-1223"

Forty-First International Conference on Electron, Ion, and Photon Beam Technology and Nanofabrication 1997, Dana Point, California, May 27–30, 1997:

G. Eres and F. Y. C. Hui, "Direct Epitaxial Growth of Thin-Film Structures"

F. Y. C. Hui and G. Eres, "Resistless Electron Beam Lithography"

American Association of Crystal Growth, Lake Tahoe, California, June 1–4, 1997:

D. E. Jesson, "Instability and Metastability During Strained-Layer Epitaxy" (invited paper)

Summer School on Molecular Dynamics Simulations of Thin-Film Growth and Computational Physics, Beijing, China, June 2–5, 1997:

Z. Zhang, J.-H. Cho, Q. Niu, C.-K. Shih, and Z. Suo, "Electronic Growth of Metal Overlayers on Semiconductor Substrates" (invited paper)

American Society for Mass Spectrometry, Palm Springs. California, June 3, 1997:

R. Hettich, D. Mandrus, L. A. Boatner, M. Kele, and G. Guiochon, "Laser Desorption FTICR for the Study of the Sonochemistry of Fullerenes in Various Solvents"

1997 International Workshop on Superconductivity, Third Joint ISTEC/MRS Workshop, Big Island, Hawaii, June 15–18, 1997:

D. K. Christen, H. R. Kerchner, D. P. Norton, A. Goyal, J. D. Budai, R. Feenstra, Q. He, C. E. Klabunde, D. M. Kroeger, D. F. Lee, F. A. List, M. Paranthaman, B. Saffian, E. D. Specht, and M. F. Chisholm, "Superconducting Transport Properties of High-J_c Biaxially Aligned $YBa_2Cu_3O_{7-\delta}$ Deposits on Metallic Tape Substrates" (invited paper)

D. P. Norton, A. Goyal, J. D. Budai, D. K. Christen, C. Park, D. M. Kroeger, E. D. Specht, Q. He, B. Saffian, M. Paranthaman, C. E. Klabunde, D. F. Lee, B. C. Sales, and F. A. List, "Epitaxial $YBa_2Cu_3O_7$ on Biaxially Textured (001) Ni: An Approach to High Critical Current Density Superconducting Tapes" (invited paper)

Fifty Years of the Correlation Problem, Cedar Key, Florida, June 15–19, 1997:

A. Eguiluz and W.-D. Shöne, "Electronic Excitations and Correlation Effects in Metals" (invited paper)

International Workshop on Vortex Matter in High-Temperature Superconductors, Ascona, Switzerland, June 15–20, 1997:

J. R. Thompson, "J_c-Enhancement in Tl/Hg Superconductors by GeV Protons" (invited paper)

United States National Conference on Synchrotron Radiation Instrumentation, CHESS Users' Meeting, Ithaca, New York, June 16–20, 1997:

K. D. Finkelstein, J. Z. Tischler, and B. C. Larson, "Inelastic X-Ray Scattering at Modest Energy Resolution"

B. C. Larson, "Inelastic X-Ray Scattering Investigations of Electron Correlations in Simple and Not-So-Simple Metals" (invited paper)

J. Z. Tischler, B. C. Larson, and P. Zschack, "Variation of Q with Energy in Mosaic Analyzers for Inelastic X-Ray Measurements"

Fourteenth University Conference on Glass Science, Lehigh University, Bethlehem, Pennsylvania, June 17–20, 1997:

R. H. Magruder III, R. W. Weeks, R. A. Zuhr, and D. K. Hensley, "Effects of MeV-Implanted Boron on the Optical Properties of Silica"

Fifty-Seventh Annual Conference on Physical Electronics, Eugene, Oregon, June 18–21, 1997:

A. Hanbicki and E. W. Plummer, "New Insight into the Role of *d*-Electrons in Surface Chemical Reactivity: The Interaction of Hydrogen with NiAl" (invited paper)

K. C. Lin, H. H. Weitering, O. W. Holland, and L. C. Feldman, "Surface Characterization of Silicon on Insulator Materials" (invited paper)

Eighth Workshop on Surface Dynamics: Phonons, Adsorbate Vibrations, and Diffusion, Munchen, Germany, June 18–21, 1997:

J. G. Skofronick, R. L. Banerjee, E. A. Akhadov, J. A. Li, S. A. Safron, T. Trelenberg, D. Bonart, and L. A. Boatner, "Progress Report on the Surface Structure and Dynamics of $KtaO_3$ by Helium Atom Scattering"

Gordon Conference on Ion Containing Polymers, New London, New Hampshire, June 22–27, 1997:

R. D. Bailey, D. D. DesMarteau, J.-T. Liu, J.-J. Ma, C. W. Martin, W. T. Pennington, M.-H. Tu, and J. S. Lin, "Structural Characterization of Perfluorinated Ionomer Membranes"

The Thirteenth Symposium on Thermophysical Properties, Boulder, Colorado, June 22–27, 1997:

Y. B. Melnichenko, G. D. Wignall, M. A. Anisimov, A. A. Povodyrev, and J. V. Sengers, "Sharp Crossover Between the Mean-Field Critical Behavior and the Ising-Like Critical Behavior in Solutions of Polystyrene and Deuterocyclohexane" (invited paper)

Y. B. Melnichenko and G. D. Wignall, "Structure of Polymer Solutions in Poor Solvents" (invited paper)

H. Wang, R. B. Dinwiddie, F. A. Modine, L. A. Boatner, M. Bartkowiak, and G. D. Mahan, "Thermal Boundary Resistance at Solid-Solid Interfaces Studied by High-Resolution Infrared Imaging"

Fourth Asian Textile Conference, Taipei, Taiwan, Republic of China, June 24–25, 1997:

W. C. Ko, Y. J. Huang, J. S. Perng, and J. S. Lin, "Quantitatve SAXS Studies on Morphological Development of Poly(Ethylene Terephthalate) During a Staple Fiber Manufacturing Process"

Seventy-First Colloid and Surface Science Symposium, Newark, Delaware, June 29–July 2, 1997:

H. N. Patrick, S. Manne, I. A. Aksay, P. D. Butler, and W. A. Hamilton, "Adsorbed Structures of Nonionic Surfactants and Solid/Solution Interfaces: A Comparison of AFM and Neutron Reflectivity Results"

Seventh International Symposium on Silicon Molecular Beam Epitaxy, Banff, Alberta, Canada, July 13–17, 1997:

D. E. Jesson, K. M. Chen, G. Chen, and S. J. Pennycook, "Mechanisms of Stress-Induced Morphological Evolution of Si_xGe_{1-x} Thin Films" (invited paper)

American Crystollographic Association 1997 Annual Meeting, St. Louis, Missouri, July 19–25, 1997:

M. Agamalian, G. D. Barker, A. Drews, C. J. Glinka, and G. D. Wignall, "Recent Developments in the Ultra Small-Angle Neutron Scattering (USANS) Instrumentation" (invited paper)

B. C. Chakoumakos, B. C. Sales, and D. G. Mandrus, "Stuffed Skutterudite Antimonides as New Thermoelectric Materials"

W. A. Hamilton, P. D. Butler, J. B. Hayter, L. J. Magid, and Z. Han, "Neutron Scattering Studies of Near-Surface Structures in Surfactant Systems"

A. Singhal, S. Shoup, M. Paranthaman, D. Beach, and J. S. Lin, "Growth Study of Rare-Earth Oxide Polymers in Organic Solutions" (invited paper)

A. Singhal, G. Beaucage, L. M. Toth, J. S. Lin, and M. Harris, "SAXS Study on Zirconium Hydrous Polymers in Solutions" (invited paper)

Ninth International Conference on Scanning Tunneling Microscopy/Spectroscopy and Related Techniques, Hamburg, Germany, July 20–25, 1997:

W. W. Pai, Z. Zhang, J. Zhang, and J. F. Wendelken, "Direct Visualization in Manipulation of Stable Molecular Radicals at Room Temperature"

J. F. Wendelken, W. W. Pai, A. K. Swan, and Z. Zhang, "Cluster Diffusion and Coarsening in Submonolayer Homoepitaxy on Cu(100) and Ag(100)"

Nineteenth Conference on Defects in Semiconductors, Aveiro, Portugal, July 21–25, 1997:

I. D. Desnica-Frankoviae, U. V. Desnica, and T. E. Haynes, "Establishment of Quantitative Correlation Between Raman and RBS Disorder Assessment: Accumulation of Damage in $^{30}Si^{+}$-Implanted GaAs"

I. D. Desnica-Frankoviae, U. V. Desnica, M. Ivanda, and T. E. Haynes, "Metastable Amorphous Structure in Ion-Implanted GaAs"

Fourth International Conference on Laser Ablation, Monterey, California, July 21–25, 1997:

D. B. Geohegan and A. A. Puretzky, "Gas-Phase Diagnostics of Nanoparticle Synthesis by Laser Ablation into a Background Gas"

D. H. Lowndes, C. M. Rouleau, T. Thundat, G. Duscher, E. A. Kenik, and S. J. Pennycook, "Silicon and Zinc Telluride Nanoparticles Synthesized by Pulsed-Laser Ablation: Size Distributions and Nanoscale Structure"

A. A. Puretzky and D. B. Geohegan, "Life-Imaging and Gas-Phase Diagnostics of Laser-Desorbed Maldi-Matrix Plumes" (invited paper)

C. M. Rouleau, D. H. Lowndes, J. D. Budai, and T. Thundat, "Growth and *p*-Type Doping of Epitaxial II-VI Compound Semiconductor Films by Pulsed-Laser Ablation in Ammonia"

C. M. Rouleau, and D. H. Lowndes, "Growth of *p*-Type ZnTe and *n*-Type CdSe Films on GaAs(001) by Pulsed-Laser Ablation"

R. F. Wood, J. N. Leboeuf, K. R. Chen, D. B. Geohegan, and A. A. Puretzky, "Dynamics of Plume Propagation and Splitting During Pulsed-Laser Ablation"

Gordon Research Conference on Chemistry at Interfaces, Meriden, New Hampshire, July 21–26, 1997:

P. D. Butler, W. A. Hamilton, J. B. Hayter, L. J. Magid, P. J. Kreke, and T. M. Slawecki, "The Effect of a Quartz/Liquid Interface on Bulk Solution Structures Under Flow—A Neutron Study"

International Cryogenic Materials Conference, Portland, Oregon, July 27–August 1, 1997:

D. P. Norton, D. K. Christen, A. Goyal, J. D. Budai, D. M. Kroeger, C. Park, E. D. Specht, Q. He, M. Paranthaman, D. F. Lee, and F. A. List, "High-Critical-Current Y-123-Thick Films on Industrially Scalable Substrates for Conductor Applications" (invited paper)

International Conference on Magnetism and Magnetic Materials, Cairns, Australia, July 27–August 1, 1997:

W. Bao, C. Broholm, G. Aeppli. S. A. Carter, P. Dai, C. D. Front, J. M. Honig, and P. Metcalf, "Magnetic Correlations in a Classic Mott System"

R. Coldea, D. A. Tennant, R. A. Cowley, D. F. McMorrow, B. Dorner, and Z. Tylczynski, "The Phase Diagram of a Nearly 1D $S = 1/2$ Heisenberg Antiferromagnet"

H. Ikeda, M. Takahashi, J. A. Fernandez-Baca, and R. M. Nicklow, "Neutron Study of Fracton Excitations in Percolating Antiferromagnets"

G. J. McIntyre, A. J. Campbell, D. McK. Paul, G. Balakrishnan, S. E. Nagler, and B. C. Chakoumakos, "Twinning in Magnetic Diffraction Data of Cubic Perovskites: $SrRuO_3$ and $La_{1-x}Sr_xMnO_3$"

Z. Slanic, D. P. Belanger, and J. A. Fernandez-Baca, "Random-Field Critical Scattering at High-Magnetic Concentration in the Ising Antiferromagnet $Fe_{0.93}Zn_{0.07}F_2$"

Basic Energy Sciences Advisory Committee Meeting, Gaithersburg, Maryland, July 30–August 1, 1997:

H. A. Mook, "High-Flux Isotope Reactor" (invited paper)

Workshop on Flux, Quantum, and Mesoscopic Effects in Superconducting Materials and Devices, Santa Fe, New Mexico, August 4, 1997:

D. K. Christen, "High-J_c Coated Conductors: Advances and Outlook" (invited paper)

J. R. Thompson, L. Krusin-Elbaum, L. Civale, G. Blatter, D. K. Christen, C. Feild, and A. D. Marwick, "Superfast Vortex Creep at Low Fields in $YBa_2Cu_3O_7$ Single Crystals with Columnar Defects"

Microscopy and Microanalysis 1997, Cleveland, Ohio, August 10–14, 1997:

N. D. Browning, J. P. Buban, C. Prouteau, G. Duscher, M. F. Chisholm, and S. J. Pennycook, "Determining Atomic-Structure Property Relationships at Grain Boundaries in High-T_c Superconductors" (invited paper)

G. Duscher, S. Köstlmeier, B. Meyer, C. Elsässer, and N. D. Browning, "*Ab Initio* Calculations of Density of States for Ti-Oxide"

G. Duscher, F. Banhart, H. Müllejans, S. J. Pennycook, and M. Rühle, "Atomic Structure of Si-SiO_2 Interface"

P. D. Nellist and S. J. Pennycook, "Quantitative Information from Image Processing in ADF STEM" (invited paper)

S. J. Pennycook, E. C. Dickey, D. J. Wallis, N. D. Browning, and P. D. Nellist, "Atomic-Resolution Electron Energy Loss Spectroscopy of Interfaces" (invited paper)

S. J. Pennycook, M. F. Chisholm, and P. D. Nellist, "Toward Sub-Å Resolution Through Incoherent Imaging" (invited paper)

C. Prouteau, G. Duscher, N. D. Browning, and S. J. Pennycook, "Investigation of the Local Superconducting Properties in Ag-Sheathed BSCCO Tapes by STEM"

Y. Xin, D. J. Wallis, N D. Browning, S. Sivananthan, S. J. Pennycook, and C. J. Humphreys, "Interfaces and Defects in Opto-Electronic Semiconductor Films Studied by Atomic-Resolution STEM"

Y. Yan, M. F. Chisholm, and S. J. Pennycook, "Atomic Structure of a Symmetric 27°[001] Tilt Grain Boundary in MgO"

International Workshop (182nd WE Heraeus Seminar) on Challenges in Predictive Process Simulation, Wandlitz, Germany, August 17–20, 1997:

A. Agarwal, T. E. Haynes, D. J. Eaglesham, H.-J. Gossmann, L. Pelaz, S. B. Herner, and D. C. Jacobson, "Modeling Enhanced Diffusion of Implanted Dopants Based on Physical Understanding of the Phenomena" (invited paper)

International Conference on Neutron Scattering, Toronto, Canada, August 17–21, 1997:

M. Agamalian, J. G. Barker, D. K. Christen, A. Drews, D. J. Glinka, H. Matsuoka, and G. D. Wignall, "Diffraction from a Thick Transparent Perfect Crystal and Adaptation of the Bonse-Hart Technique for Neutron Scattering"

C. Broholm, W. Bao, G. Aeppli, P. Dai, C. D. Frost, J. M. Honig, and P. Metcalf, "Neutron Scattering Studies of Metallic and Insulating Phases of V_2O_3"

P. D. Butler, W. A. Hamilton, L. J. Magid. T. Slawecki, and J. B. Hayter, "Effect of a Solid/Liquid Interface on Bulk Solution Structures Under Flow"

B. C. Chakoumakos, "Systematics of Atomic Displacement Parameters in Perovskite Oxides"

B. C. Chakoumakos, S. E. Nagler, S. T. Misture, and H. M. Christen, "High-Temperature Structural Behavior of $SrRuO_3$"

P. Dai, H. A. Mook, S. M. Hayden, G. Aeppli, T. Perring and F. Dogan, "Inelastic Neutron Scattering Studies of Magnetic Dynamics in Underdoped $YBa_2Cu_3O_{6.6}$"

P. Dai, H. A. Mook, and F. Dogan, "Pseudogap and Incommensurate Magnetic Flucutations in $YBa_2Cu_3O_{6.6}$"

R. Doubble, S. M. Hayden, P. Dai, H. A. Mook, A. G. Equiluz, and C. Frost, "Direct Observation of Paramagnons in Pd"

J. A. Fernandez-Baca, P. Dai, S. E. Nagler, B. C. Chakoumakos, J. W. Cable, P. Schiffer, N. Kalechofsky, M. Roy, and Y.-K. Tsue, "Structural and Magnetic Properties of $La_{0.5}Ca_{0.5}MnO_3$"

A. W. Garrett, S. E. Nagler, D. A. Tennant, T. Barnes, and C. C. Torardi, "Magnetic Excitations in $(VO)HPO_4 \cdot 1/2H_2O$"

W. A. Hamilton and M. Yethiraj, "Effects of Traveling Surface Acoustic Waves on Neutron Bragg Scattering from Perfect Crystals"

S. M. Hayden, G. Aeppli, P. Dai, H. A. Mook, T. G. Perring, S.-W. Cheong, Z. Fisk, F. Dogan, and T. E. Mason, "Absolute Measurements of the High-Frequency Magnetic Dynamics in High-T_c Superconductors" (invited paper)

S. Katano, Y. Ishii, Y. Morii, H. R. Child, and J. A. Fernandez-Baca, "Upgrade of the Wide-Angle Neutron Diffractometer at the High Flux Isotope Reactor"

H. Kawano, H. Yoshizawa, J. A. Fernandez-Baca, Y. Tomioka, H. Kuwahara, and Y. Tokura, "Two-Dimensional Anisotropy in a Layered Metallic Antiferromagnet $RE_{1-x}Sr_xMnO_3$ with $x \sim 1/2$" (invited paper)

W.-T. Lee, S. A. Werner, J. A. Fernandez-Baca, and R. S. Fishman, "Excitations of the Transversely Polarized Spin Density Waves in Chromium"

C.-K. Loong, K. Suzuya, B. C. Sales, and L. A. Boatner, "Structure and Dynamics of Phosphate Glasses: From Ultra- to Orthophosphate Composition" (invited paper)

L. Magid, Z. Han, P. D. Butler, W. A. Hamilton, and J. B. Hayter, "Counterion Competition as a Means to Tune Micellar Morphology, Intermicellar Interactions, and Solution Viscoelasticity"

P. M. Mason, B. D. Gaulin, R. M. Epand, G. D. Wignall, and J. S. Lin, "Coherent and Incoherent Ripples in Dipalmitoylphosphatidayl-Chlorine in Excess Water"

Y. B. Melnichenko, G. D. Wignall, and W. A. Van Hook, "Structural and Thermodynamic Properties of Polymer Solutions via SANS"

S. E. Nagler, D. G. Mandrus, and D. A. Tennant, "Spin Waves in $CsVBr_3$"

M. Nishi, K. Kakurai, Y. Fujii, M. Yethiraj, D. A. Tennant, S. E. Nagler, J. A. Fernandez-Baca, O. Fujita, and J. Akimitsu, "Magnetic Excitation of $CuGeO_3$ Under Applied Pressure"

S. Spooner, X. L. Wang, E. A. Payzant, and C. R. Hubbard, "Neutron Scattering Residual Stress Measurements in Metallurgically Complicated Systems"

J. Suzuki, Y. Todate, M. Tanaka, and J. A. Fernandez-Baca, "Magnetic Short-Range Order of $LuFeMgO_4$"

J. Szydlowski, L. P. Rebelo, H. Wilczura, M. Dadmun, Y. Melnichenko, G. D. Wignall, and W. A. Van Hook, "Comparison of SANS and Hydrodynamic Correlation Lengths of Polystyrene Solutions in the Vicinity of Temperature or Pressure-Induced Critical Demixing"

D. A. Tennant, "Neutron Scattering Measurements in Dimerized Spin Systems" (invited paper)

D. A. Tennant, S. E. Nagler, T. Barnes, A. W. Garrett, J. Riera, and B. C. Sales, "Excitations and Possible Bound States in the $S = 1/2$ Alternating Chain Compound $(VO)_2P_2O_7$" (invited paper)

N. Wakabayashi, R. M. Nicklow, S. Katano, Y. Ishii, H. R. Child, H. G. Smith, and J. A. Fernandez-Baca, "Calculation of Thermal Diffusive Scattering"

N. Wakabayashi, J. W. Cable, and J. L. Robertson, "Magnetic Structures of Dy in Applied Fields"

S. L. Wells, J. B. McClain, J. D. Londono, R. Triolo, D. E. Betts, D. A. Canelas, H. D. Cochran, E. T. Samulski, G. D. Wignall, M. Rubinstein, and J. M. DeSimone, "Characterization of Polymers and Amphiphiles in Co_2"

G. D. Wignall, J. D. Londono, J. B. McClain, and J. M. DeSimone, "Neutron Scattering Characterization of Polymers in Supercritical CO_2"

M. Yethiraj, D. McK. Paul, C. V. Tomy, and E. M. Forgan, "Vortex Lattice Structures in YNi_2B_2C"

Workshop on Materials Research Using Cold Neutrons at Pulsed Sources, Argonne, Illinois, August 25–27, 1997:

T. Kamiyama, K. Oikawa, E. Akiba, R. Kanno, I. Nakai, M. Wakihara, K. Mori, S. Torii, F. Izumi, and B. C. Chakoumakos, "Power Diffraction in Materials Science Using the Kens Cold-Neutron Source"

International Conference on Thermoelectrics, Dresden, Germany, August 25–27, 1997:

G. D. Mahan, "Rare-Earth Thermoelectrics"

Sixteenth General Conference of the Condensed Matter Division of the European Physical Society, Leuven, Belgium, August 25–28, 1997:

V. Keppens, B. C. Sales, D. Mandrus, T. W. Darling, and A. Migliori, "Elastic Response of Filled and Unfilled Skutterudite Antimonides" (invited paper)

B. C. Larson, "Inelastic X-Ray Scattering Study of Electronic Correlations in Metals" (invited paper)

E. W. Plummer, "Screening at a Metal Surface: From Friedel Oscillations to Charge Density Waves" (invited paper)

One-Hundred Ninety-Second Meeting of the Electrochemical Society, Inc., and Forty-Eighth Annual Meeting of the International Society of Electrochemistry, Paris, France, August 31–September 5, 1997:

J. B. Bates, N. J. Dudney, A. Ueda, P. Jun, and S. A. Hackney, "Oriented $LiCoO_2$ Films and High-Rate Thin-Film Lithium Batteries"

B. J. Neudecker, R. A. Zuhr, and J. B. Bates, "Performance of Silicon Tin Carbon Oxynitride Thin-Film Anodes"

International Conference on Silicon Carbide and Nitrides 1997, Stockholm, Sweden, September 1–5, 1997:

M. V. Rao, J. Gardner, A. Edwards, N. Papanicolaou, G. Kelner, O. W. Holland, M. Ghezzo, and J. Kretchmer, "Ion Implantation Doping in SiC and its Device Applications"

Electron Microscopy and Analysis 1997, Cambridge, United Kingdom, September 2–5, 1997:

P. D. Nellist and S. J. Pennycook, "Atomic-Resolution Z-Contrast Imaging of Ultradispersed Catalysts"

P. D. Nellist, Y. Xin, and S. J. Pennycook, "Direct Structure Determination by Atomic-Resolution Incoherent STEM Imaging"

International Conference on Laser Surface Processing, Limoges, France, September 8–12, 1997:

D. B. Geohegan and A. A. Puretzky, "Gas-Phase Studies of Laser Ablation Materials Synthesis Processes in Vacuum and Background Gases" (invited paper)

1997 Conference on Spectroscopies in Novel Superconductors, Falmouth, Massachusetts, September 14–18, 1997:

H. A. Mook, P. Dai, R. D. Hunt, and F. Dogan, "Neutron Scattering Studies of the Magnetic Fluctuations in $YBa_2Cu_3O_{7-\delta}$" (invited paper)

Radiation Effects in Insulators-9, Knoxville, Tennessee, September 14–19, 1997:

A. Darwish, D. Ila, D. B. Poker, and D. K. Hensley, "Investigation of Mn-Implanted $LiNbO_3$ Applying Electron Paramagnetic Resonance Technique"

A. L. Evelyn, D. Ila, R. L. Zimmerman, K. Bhat, D. B. Poker, and D. K. Hensley, "Effects of MeV Ions on PE and PVDC"

L. A. Gea, S. Honda, T. E. Haynes, B. C. Sales, F. A. Modine, and L. A. Boatner, "Formation of Magnetostrictive Particles in Transparent Oxide Single Crystals"

D. Ila, S. S. Sarkisov, E. K. Williams, C. C. Smith, D. B. Poker, and D. K. Hensley, "Formation of Nanometallic Clusters in Silica by Ion Implantation"

A. Meldrum, R. C. Ewing, and L. A. Boatner, "Effects of Displacive and Ionizing Radiation on Several Perovskite-Structure Compounds"

S. S. Sarkisov, E. K. Williams, M. Curley, D. Ila, P. Venkateswarlu, D. B. Poker, and D. K. Hensley, "Third-Order Optical Nonlinearity of Colloidal Metal Nanoclusters Formed by MeV Ion Implantation"

T. Taylor, D. Ila, R. L. Zimmerman, J. C. Cochrane, P. R. Ashley, D. B. Poker, and D. K. Hensley, "Temperature Effects on the Fabrication of Optical Channels in Planar GaAs/AlGaAs Waveguides Using MeV Ions"

C. W. White, J. D. Budai, J. G. Zhu, S. P. Withrow, R. A. Zuhr, E. Sonder, D. O. Henderson, and D. M. Hembree, Jr., "Ion Beam Synthesis of Compound Semiconductor Nanocrystals and Quantum Dots"

E. K. Williams, D. Ila, S. S. Sarkisov, M. Curley, J. C. Cochrane, D. B. Poker, D. K. Hensley, and C. Borel "Study of Effects of MeV Ag and Au Implantation on the Optical Properties of $LiNbO_3$"

E. K. Williams, D. Ila, T. R. Watkins, D. B. Poker, and D. K. Hensley, "An X-Ray Diffraction Study of MeV He^+-Bombarded $LiNbO_3$"

S. P. Withrow, C. W. White, J. D. Budai, J. G. Zhu, D. M. Hembree, Jr., and S. Prawer, "Optical Properties of Silicon Nanocrystals Formed by Ion Implantation into SiO_2"

R. L. Zimmerman, D. Ila, E. K. Williams, S. S. Sarkisov, D. B. Poker, and D. K. Hensley, "Fabrication of Copper and Gold Nanoclusters in MgO (100) By MeV Ion Implantation"

Joint American Materials Society (AMS) and The Minerals, Metals, and Materials Society (TMS) David A. Smith Symposium, Indianapolis, Indiana, September 15–18, 1997:

M. F. Chisholm, "Structure and Properties of Dislocations and Grain Boundaries in Silicon" (invited paper)

International Conference on Micro- and Nanofabrication, Athens, Greece, September 15–18, 1997:

G. Eres, F. Y.-C. Hui, T. G. Thundat, and D. C. Joy, "Nanofabrication by Direct Epitaxial Growth" (invited paper)

Seventh International Conference on the Structure of Noncrystalline Materials (NCM7), Sardegna, Italy, September 15–19, 1997:

B. C. Sales, L. A. Boatner, and J. O. Ramey, "Intermediate-Range Order in Metal Phosphate Glasses: The Effect of Metal Cations on the Phosphate Anion Distribution"

Seventeenth European Conference on Surface Science, Enschede, The Netherlands, September 16–19, 1997:

K. C. Lin, H. H. Weitering, O. W. Holland, and L. C. Feldman, "Surface Characterization of Silicon-on-Insulator (SOI) Materials)" (invited paper)

Surface Modification of Metals by Ion Beams, Gatlinburg, Tennessee, September 21–26, 1997:

S. Honda, L. Gea, T. E. Haynes, B. C. Sales, F. A. Modine, L. A. Boatner, and K. Oura, "Magnetostrictive Particles Embedded in the Near-Surface Region of Oxide Crystals"

R. A. Zuhr, R. H. Magruder III, and T. S. Anderson, "Formation and Optical Properties of Intermetallic Nanoclusters Formed by Sequential Ion Implantation"

EP2DS-12 Workshop, University of Tokyo, Tokyo, Japan, September 21–26, 1997:

D. C. Marinescu, J. J. Quinn, and K. S. Yi, "Coupled Spin and Charge Collective Excitations in a Spin-Polarized Electron Gas"

Centre Européen de Calcul Atomique and Moléculaire Conference on Surfaces and Interfaces Near Equilibrium, Lyon, France, September 22–24, 1997:

Z. Zhang, "Electronic Growth of Ultrathin Metallic Overlayers on Semiconductors Substrates" (invited paper)

International Conference on Inorganic Scintillators and Their Applications, Shanghai, China, September 22–25, 1997:

W. W. Moses, M. J. Weber, S. E. Derenzo, D. Perry, P. Berdahl, L. Schwarz, U. Sasum, and L. A. Boatner, "Recent Results in a Search for Inorganic Scintillators for X- and Gamma-Ray Detection"

Twelfth International Conference on the Electronic Properties of Two-Dimensional Systems, Tokyo, Japan, September 22–26, 1997:

D. C. Marinescu, J. J. Quinn, and K. S. Yi, "Composite Fermions in a Spherical Surface and Electron-Hole Symmetry"

D. C. Marinescu, J. J. Quinn, and K. S. Yi, "Coupled Spin and Charge Collective Excitations in a Spin-Polarized Electron Gas"

Twenty-First International Symposium on the Scientific Basis for Nuclear Waste Management, Davos, Switzerland, September 28–October 3, 1997:

G. K. Liu, J. S. Luo, C.-K. Loong, M. M. Abraham, J. V. Beitz, J. K. Bates, and L. A. Boatner, "Self-Radiation-Induced Anisotropic Structure Damage in ^{244}Cm-Doped Orthophosphate $LuPO_4$"

Eastern Regional Conference on Crystal Growth and Epitaxy, Atlantic City, New Jersey, September 29–October 1, 1997:

D. Corrigan, L. A. Boatner, G. Workman, and L. Adcock, "Application of Alloy Single Crystals to Studying the Effects of Gravity on Morphological and Microstructural Evolution"

1997 IEEE International SOI Conference, Fish Camp, California, October 6–9, 1997:

A. Agarwal, T. E. Haynes, V. Venezia, D. J. Eaglesham, M. K. Weldon, Y. J. Chabal, and O. W. Holland, "Efficient Production of Silicon-on-Insulator Films by Coimplantation of He^+ with H^+"

M. K. Weldon, V. E. Marisco, Y. J. Chabal, M. Collot, Y. Caudano, S. B. Christman, E. E. Chaban, D. C. Jacobson, W. L. Brown, J. Sapjeta, C.-M. Hsieh, C. A. Goodwin, A. Agarwal, T. E. Haynes, and W. B. Jackson, "Mechanism of Silicon Exfoliation by Hydrogen Implantation and He, Li, and Si Coimplantation"

Joint Meeting of the Texas Section of the American Physical Society and the Greater Southwest Implant Users' Group, Denton, Texas, October 9–10, 1997:

T. E. Haynes, "Defects and Diffusion in Ultrashallow II of Silicon" (invited paper)

Thirty-First Symposium of Northeastern Accelerator Personnel, Jülich, Germany, October 12–15, 1997:

D. K. Hensley, D. K. Thomas, and D. B. Poker, "A Timeshared Foreline and Roughing Vacuum System"

Advanced Nonaqueous Battery Technology Research and Development Workshop, Hunt Valley, Maryland, October 15–17, 1997:

J. B. Bates and N. J. Dudney, "Thin-Film Rechargeable Lithium Batteries" (invited paper)

Forty-Fourth American Vacuum Society Meeting, San Jose, California, October 20–24, 1997:

A. P. Baddorf and V. Jahns, "Thermal Dependence of FCC(001) Surface Structure: Failure of the Quasiharmonic Model"

V. Jahns, A. P. Baddorf, D. M. Zehner, and D. Gibbs, "Surface Relaxation on the Clean and Hydrogen-Covered Ru(0001) Surface Determined by X-Ray Diffraction"

W. W. Pai, A. K. Swan, Z. Zhang, and J. F. Wendelken, "Island Diffusion and Coarsening on Metal (100) Surfaces"

D. M. Zehner, J. P. Pierce, and C. F. Walters, "Is Feibelman Correct? Structure of the Clean Ru(0001) Surface"

Bowdoin College Science Symposium, Brunswick, Maine, October 24–27, 1997:

G. E. Jellison, Jr., "Spectroscopic Ellipsometry: A Technique for Measuring Thin Films" (invited paper)

International Superconductor Symposium on Advances in Superconductivity (ISS '97), Gifu, Japan, October 27–31, 1997:

C. Prouteau, G. Duscher, D. K. Christen, N. D. Browning, S. J. Pennycook, M. F. Chisholm, D. P. Norton, A. Goyal, and C. Park, "Correlation of Transport Properties with Grain Boundary Atomic Structure in High-T_c Superconducting Films and Tapes"

Antiferromagnetics: Materials, Characterization and Interfaces, Tuscaloosa, Alabama, November 3–4, 1997:

S. E. Nagler, "Antiferromagnetism and Neutron Scattering (invited paper)

International Conference on Materials and Process Characterization for VLSI, Shanghai, China, November 4–7, 1997:

O. W. Holland and E. G. Roth, "Implantation Processing of Si: A Unified Approach to Understanding Ion-Induced Defects and Their Impact" (invited paper)

S. J. Pennycook, M. F. Chisholm, G. Duscher, A. Maiti, and S. T. Pantelides, "Atomic-Scale Characterization of Semiconductor Interfaces by Scanning Transmission Electron Microscopy" (invited paper)

Twentieth Anniversary of the Center for Research on Physics, Hermosillo, Sonora, Mexico, November 5–7, 1997:

A. G. Eguiluz, "Electronic Excitations and Correlation Effects in Metals: Recent Theoretical and Experimental Developments" (invited paper)

Southeastern Section Fall Meeting of the American Physical Society, Nashville, Tennessee, November 6–8, 1997:

H. J. Gao, Z. Q. Xue, H. Y. Chen, S. J. Pang, and S. J. Pennycook, "Ultrahigh Density Data Storage on a New Organic Charge Transfer Complex System"

A. K. Swan, W. W. Pai, Z. Zhang, and J. F. Wendelken, "Island Diffusion and Coarsening on Metal (100) Surfaces"

C. F. Walters, J. P. Pierce, and D. M. Zehner, "H/Ru(0001): ERD Measurements of Coverage and Sticking Coefficient"

Physics of Manganites, Ruthenates, and Related Materials, Tallahassee, Florida, November 9–11, 1997:

S. E. Nagler, "Magnetization Density of $SrRuO_3$" (invited paper)

Eighteenth IUVSTA Workshop on Diffusion and Growth in Ultrathin Layers, Newcastle, Australia, November 11–17, 1997:

Z. Zhang, "Electronic Growth of Ultrathin Metallic Overlayers on Semiconductor Substrates" (invited paper)

ISSP, Tokyo, Japan, November 21, 1997:

E. W. Plummer, "Novel Applications of STM" (invited paper)

International Symposium on Atomic-Level Characterizations for New Materials and Devices 1997, Maui, Hawaii, November 23–28, 1997:

S. J. Pennycook, M. F. Chisholm, Y. Yan, G. Duscher, and S. T. Pantelides, "A Combined Experimental and Theoretical Approach to Atomic-Scale Characterization" (invited paper)

Fifth JRCAT International Symposium on Atom Technology, Tokyo, Japan, November 26, 1997;

J. Zhang, E. W. Plummer, and P. A. Dowben, "Bulk and Surface Properties of Perovskite Manganites" (invited paper)

Fall Meeting of the Materials Research Society, Boston, Massachusetts, December 1–5, 1997:

A. Agarwal, H.-J. Gossmann, D. J. Eaglesham, L. Pelaz, D. C. Jacobson, T. E. Haynes, J. Jackson, and Y. E. Erokhin, "Reduction of Transient Diffusion from 1–5 keV Si^+ Ion Implantation Due to Surface Annihilation of Interstitials"

M. Bartkowiak, G. D. Mahan, M. G. Comber, and M. A. Alim, "Computer Simulation of ZnO Varistor Failures"

M. Bartkowiak, "Current Localization, Nonuniform Heating, and Failures of ZnO Varistors"

R. Benedek, D. A. Shashkov, D. N. Seidman, D. A. Muller, J. Silcox, M. F. Chisholm, and L. H. Yang, "Atomic Structure of a Polar Ceramic/Metal Interface: {222}MgO/Cu"

J. D. Budai, C. W. White, S. P. Withrow, and R. A. Zuhr, "Effect of Substrate Recrystallization on Semiconductor Nanocrystals Formed Ion Implantation"

D. K. Christen, D. P. Norton, R. Feenstra, M. Paranthaman, A. Goyal, J. D. Budai, E. D. Specht, M. F. Chisholm, C. S. Prouteau, Z. F. Ren, J. Y. Lao, L. P. Guo, and J. H. Wang, "Superconducting Properties of HTS Films on Textured Metallic Tape Substrates: Prospects for a New Generation of Wires"

A. Darwish, D. Ila, D. P. Poker, and D. K. Hensley, "Investigation of Mn-Implanted $LiNbO_3$ Applying Electron Paramagnetic Resonance"

R. Devanthan, W. J. Weber, and L. A. Boatner, "Response of Zircon to Electron and Ne^+ Irradiation"

N. J. Dudney, J. B. Bates, R. A. Zuhr, and J. D. Robertson, "Amorphous $Li_xMn_{2-y}O_4$ Cathodes for Thin-Film Batteries"

A. L. Evelyn, D. Ila, R. L. Zimmerman, K. Bhat, D. B. Poker, and D. K. Hensley, "Study of the Effects of MeV Ions on PS and PES"

R. Feenstra, D. K. Christen, J. D. Budai, M. Bukshpun, and R. H. Hammond, "Formation of Thick YBaCuO Epitaxial Films with a BaF_2 Process"

L. Gea, S. Honda, L. A. Boatner, T. E. Haynes, B. C. Sales, F. A. Modine, A. Meldrum, J. D. Budai, and L. Beckers, "A New Approach to the Fabrication of 'Smart' Near-Surface Composites"

D. B. Geohegan, A. A. Puretzky, G. Duscher, and S. J. Pennycook, "Gas-Phase Imaging and Spectroscopic Diagnostics for Control of Photoluminescent Nanoparticle Synthesis by Laser Ablation"

W. A. Hamilton, P. D. Butler, J. B. Hayter, L. J. Magid, Z. Han, and T. M. Slawecki, "Flow-Induced Near-Surface and Bulk Structures in a Threadlike Micellar Surfactant System"

D. Ila, E. K. Williams, S. S. Sarkisov, D. P. Poker, and D. K. Hensley, "Change in the Optical Properties of Sapphire Induced by Ion Implantation"

D. Ila, R. L. Zimmerman, E. K. Williams, C. C. Smith, S. Sarkisov, D. B. Poker, and D. K. Hensley, "Ion-Beam-Induced Change in the Optical Properties of Photorefractive Materials"

D. E. Jesson, "Self-Organization of Coherently Strained Islands by Cooperative Nucleation" (invited paper)

H. R. Kerchner, D. P. Norton, A. Goyal, R. Feenstra, J. E. Tkaczyk, J. A. DeLuca, and D. K. Christen, "Alternating Current Losses in $YBa_2Cu_3O_{7-\delta}$ and $TlBa_2Ca_2Cu_3O_x$ Films"

V. Keppens, D. Mandrus, and L. A. Boatner, "Chemical and Sonochemical Approaches to the Formation of VO_2 Films and VO_2-Impregnated Materials"

A. Maiti, M. F. Chisholm, S. J. Pennycook, and S. T. Pantelides, "Structural Transformation of Grain Boundaries by Vacancy Segregation"

A. Meldrum, L. A. Boatner, and R. C. Ewing, "Heavy-Ion-Irradiation of Barium and Strontium Titanate: The Effects of Thermally Induced Phase Transitions and Irradiation Temperature"

A. Meldrum and N. M. Halden, "Fine-Scale Oscillatory Banding in Otoliths from Arctic Charr (Salveninus Alpinus) and Pike (Esox Lucius)"

A. Meldrum, L. A. Boatner, and R. C. Ewing, "Phase Transitions During Ion-Beam Irradiation of the Perovskite-Structure Oxides"

F. A. Modine, "Time-Domain Response of Electrical Ceramics—Micro to Megaseconds" (invited paper)

M. Noginov, D. Ila, E. K. Williams, D. B. Poker, and G. Loutts, "Optical Properties of Neodynamium Implanted $Y_3Al_5O_{12}$ and Al_2O_3"

C. Park, D. P. Norton, D. K. Christen, R. Feenstra, J. D. Budai, A. Goyal, D. M. Kroeger, and M. Paranthanman, "The Effect of Bend Strain on the Critical Current of YBCO Films Deposited on Biaxially Oriented Metallic Substrates"

A. A. Puretzky, D. B. Geohegan, G. Duscher, S. J. Pennycook, and C. W. White, "Laser Ablation Synthesis and Gas-Phase Photoluminescence Diagnostics of Isolated Nanoparticles and Fractal Nanoparticle Aggregates"

E. G. Roth and O. W. Holland, "Defect-Impurity Interactions in Silicon and Silicon-On-Insulator"

S. Sarkisov, D. Ila, R. L. Zimmerman, E. K. Williams, P. Venkateswarlu, D. B. Poker, and D. K. Hensley, "Third-Order Optical Nonlinearity of Colloidal Metal Nanoclusters Formed by MeV Ion Implantation"

S. Sarkisov, E. K. Williams, M. Curley, C. C. Smith, D. Ila, P. Venkateswarlu, D. B. Poker, and D. K. Hensley, "Mechanisms of Formation of Nonlinear Optical Light Guide Structures in Metal Cluster Composites Produced by Ion Beam Implantation"

C. C. Smith, S. Sarkisov, E. K. Williams, D. B. Poker, and D. K. Hensley, "The Optical Properties of Ion-Implanted Silica"

T. Taylor, D. Ila, R. L. Zimmerman, J. C. Cochrane, P. R. Ashley, D. B. Poker, and D. K. Hensley, "Thermal Stability of the Optical Channels in Planar GaAs/AlGaAs Waveguides Produced by MeV Ions"

Y. S. Tung, R. Mu, A. Ueda, M. Wu, D. O. Henderson, C. W. White, and R. A. Zuhr, "Study of Gold Concentration Profiles and Structures of Silicon in Gold-Implanted Silicon"

A. Ueda, R. Mu, Y. S. Tung, M. Wu, D. O. Henderson, C. W. White, R. A. Zuhr, and A. Meldrum, "Temperature-Dependent Band Gap of Selenium Quantum Dots Formed by Ion Implantation into Silica Glass and Sapphire Substrates"

V. C. Venezia, T. E. Haynes, A. Agarwal, H.-J. Gossmann, S. B. Herner, D. J. Eaglesham, and L. Riciputi, "Spatial Isolation of Vacancy Supersaturations Produced by MeV Implantation Using Thin, Self-Supporting Membranes"

C. W. White, J. D. Budai, A. Meldrum, S. P. Withrow, R. A. Zuhr, E. Sonder, A. Puretzky, D. B. Geohegan, J. G. Zhu, and D. O. Henderson, "Ion Beam Synthesis of CdS, ZnS, and PbS Compound Semiconductor Nanocrystals"

E. K. Williams, D. Ila, S. Sarkisov, M. Curley, D. B. Poker, D. K. Hensley, and C. Borel "Study of the Effects of MeV, Ag, Cu, Au, and Sn Implantation on the Optical Properties of $LiNbO_3$"

E. K. Williams, D. Ila, T. R. Watkins, D. K. Hensley, and D. B. Poker, "MeV He Ion-Beam-Induced Disorder in $LiNbO_3$ Crystal"

M. H. Wu, J. L. Chen. A. Ueda, R. Mu, Y. S. Tung, D. O. Henderson, C. W. White, R. A. Zuhr, and J. D. Budai, "Optical Properties of Ion-Implanted Selenium Nanocrystals"

Y. Xin, S. J. Pennycook, N. D. Browning, P. D. Nellist, S. Sivananthan, J.-P. Faurie, and P. Gilbart, "Direct Observations of Atomic Structures of Defects in GaN by High-Resolution Z-Contrast STEM"

Y. Yan, M. F. Chisholm, S. J. Pennycook, A. Maiti, and S. T. Pantelides, "Impurity-Induced Structural Transformation of an MgO Grain Boundary"

IEEE International Electron Device Meeting, Washington, D.C., December 7–10, 1997:

A. Agarwal, D. J. Eaglesham, H.-J. Gossmann, L. Pelaz, S. B. Herner, D. C. Jacobson, T. E. Haynes, Y. Erokhin, and R. Simonton, "Boron-Enhanced-Diffusion of Boron: The Limiting Factor for Ultra-Shallow Junctions"

Eighth U.S.-Japan Workshop on High-Temperature Superconductors, Tallahassee, Florida, December 7–10, 1997:

A. A. Gapud, J. Z. Wu, S. L. Yan, Y. Y. Xie, B. W. Kang, Z. F. Ren, S. H. Yun, M. P. Siegal, D. K. Christen, J. R. Thompson, and H. R. Kerchner, "Magnetic and Flux Pinning in Hg-Based HTS Thin Films"

L. Krusin-Elbaum, D. K. Petrov, D. López, J. R. Thompson, R. Wheeler, J. L. Ullmann, C. W. Chu, and Q. M. Lin, "Enhanced Supercurrents Above 100 K in Mercury Cuprates via Fission of Mercury"

J. R. Thompson, J. G. Ossandon, L. Krusin-Elbaum, K. J. Song, D. K. Christen, M. Paranthaman, J. Z. Wu, and J. L. Ullmann, "J_c and Vortex Pinning Enhancements in Bi-, Tl-, and Hg-Based Cuprate Superconductors Via GeV Proton Irradiation"

Fourth International Workshop on Oxide Electronics, Bethesda, Maryland, December 9–12, 1997:

D. P. Norton, C. Park, C. Prouteau, D. K. Christen, M. F. Chisholm, J. D. Budai, A. Goyal, E. Y. Sun, D. F. Lee, D. M. Kroeger, E. Specht, and M. Paranthaman, "Epitaxial $YBa_2Cu_3O_7$ Films on Rolled-Textured Metals for High-Temperature Superconducting Applications" (invited paper)

DARPA Workshop on New Cooling Technology, December 11, 1997:

G. D. Mahan, "Thermodynamics of Microcooling" (invited paper)

International Semiconductor Device Research Symposium, Charlottesville, Virginia, December 11–13, 1997:

J. Gardner, A. Edwards, M. V. Rao, N. Papanicolaou, G. Kelner, and O. W. Holland, "Ion Implantation Doping of Silicon Carbide"

International Workshop on Statistical and Condensed Matter Physics, Taiwan, December 18–20, 1997:

Z. Y. Zhang, "Two-Dimensional Pattern Formation in Epitaxial Growth: Fractals, Dendrites, and Compact Islands" (invited paper)

Z. Y. Zhang, "Atomic-Scale Manipulation of Growth Kinetics in Thin-Film Epitaxy" (invited paper)

Z. Y. Zhang, "Novel Formation Mechanisms and Physical Properties of Ultrathin Metallic Overlayers on Semiconductor Substrates" (invited paper)

Joint MMM-Intermag 1998, San Francisco, California, January 5, 1998:

Z.-P. Shi and R. S. Fishman, "Magnetic Switch for Spin Dynamics Control in Thin Films"

The First Hawaii Battery Conference (HBC98), Kona, Big Island, Hawaii, January 5–7, 1998:

J. B. Bates, N. J. Dudney, and B. Neudecker, "Rechargeable Thin-Film Lithium and Lithium-Ion Batteries" (invited paper)

Department of Energy Superconductivity Wire Development Workshop, St. Petersburg, Florida, January 29, 1998:

D. K. Christen, "Substrate Effects on Film Growth, Grain Boundaries, and Flux Pinning in Coated Conductors" (invited paper)

Twelfth Annual Symposium on Surface and Interface Sciences, Piscataway, New Jersey, February 10, 1998:

Z. Zhang, "Quantum Theory of Metal Overlayer Growth on Semiconductor Substrates" (invited paper)

International Workshop on Interfaces, Schloss Ringberg, Germany, March 3–5, 1998:

G. Duscher and M. F. Chisholm, "Atomistic Origin of Copper Embrittlement by Bismuth" (invited paper)

First NIMC International Symposium on Photoreaction Control and Photofunctional Materials, Tsukuba, Japan, March 16–18, 1998:

D. B. Geohegan, A. A. Puretzky, G. Duscher, and S. J. Pennycook, "Photoluminescence from Gas-Suspended Nanoparticles Synthesized by Laser Ablation: A Pathway to Optimized Nanomaterials" (invited paper)

March Meeting of the American Physical Society, Los Angeles, California, March 16–20, 1998:

T. Barnes, J. Riera, and D. A. Tennant, "A Study of the $S = 1/2$ Alternating Chin Using Novel Multiprecision Methods" [*Bull. Am. Phys. Soc.* **43**, 51 (1998)]

G. Canright, "Spontaneous Chiral Pattern Formation in Growth of Achiral Crystals" [*Bull. Am. Phys. Soc.* **43**, 507 (1998)] (invited paper)

J.-H. Cho, "Novel Formation Mechanisms and Transport Properties of Ultrathin Metallic Overlayers on Semiconductor Substrates" [*Bull. Am. Phys. Soc.* **43**, 385 (1998)] (invited paper)

D. K. Christen, C. Prouteau, D. Verebelyi, G. Duscher, N. D. Browning, S. J. Pennycook, M. F. Chisholm, D. P. Norton, C. Park, and E. D. Specht, "Superconducting Transport Properties of Single Grain Boundaries in Large Magnetic Fields: Correlations with Atomic Structure" [*Bull. Am. Phys. Soc.* **43**, 847 (1998)]

R. Coldea, D. A. Tennant, R. A. Cowley, D. F. McMorrow, Z. Tylczynski, and C. Wouters, "Excitations and Quantum Renormalization of a Quasi-1D $S = 1/2$ Antiferromagnet in a Magnetic Field" [*Bull. Am. Phys. Soc.* **43**, 50 (1998)]

J. A. Fernandez-Baca, P. Dai, H. Y. Hwang, S.-W. Cheong, and C. Kloc, "Evolution of the Low-Frequency Spin Dynamics in Ferromagnetic Manganites" [*Bull. Am. Phys. Soc.* **43**, 540 (1998)]

E. E. Fullerton, C. H. Sowers, S. D. Bader, and J. L. Robertson, "Spin-Density-Wave and Proximity Magnetism in Itinerant Antiferromagnetic Cr/Cr-Mn Superlattices" [*Bull. Am. Phys. Soc.* **43**, 33 (1998)]

L. Gavioli, K. R. Kimberlin, M. C. Tringides J. F. Wendelken, and Z. Zhang, "Correlations Between Morphology and Transport Properties of Ag Overlayers on Si(111)" [*Bull. Am. Phys. Soc.* **43**, 385 (1998)]

G. E. Granroth, M. W. Meisel, B. H. Ward, D. R. Talham, J. W. Lynn, R. W. Erwin, B. C. Chakoumakos, and S. E. Nagler, "Neutron Scattering Measurements of the $S = 2$ Haldane Gap Material $MnCl_3(C_{10}D_8N_2)$" [*Bull. Am. Phys. Soc.* **43**, 734 (1998)]

Ph. Hofmann, "Surface Electronic Structure Determined by Scanning Tunneling Microscopy" [*Bull. Am. Phys. Soc.* **43**, 649 (1998)] (invited paper)

Ismail and E. W. Plummer, "Temperature-Dependent Surface Structure: Mg(1010)" [*Bull. Am. Phys. Soc.* **43**, 46 (1998)] (invited paper)

H. R. Kerchner, D. P. Norton, A. Goyal, J. D. Budai, D. K. Christen, D. M. Kroeger, E. D. Specht, M. Paranthaman, D. F. Lee, B. C. Sales, and F. A. List, "Comparison of AC Transport Current Flow in Superconductive Films" [*Bull. Am. Phys. Soc.* **43**, 848 (1998)]

V. Keppens, D. Mandrus, B. C. Sales, T. W. Darling, and A. Migliori, "Local Modes in Filled Skutterudite Antimonides" [*Bull. Am. Phys. Soc.* **43**, 460 (1998)]

M.-H. Kim, R. G. Alamo, L. Mandelkern, J. S. Lin, and B. K. Annis, "The Crystallite Structure of Isotactic Polypropylenes and Propylene Copolymers by SAXS" [*Bull. Am. Phys. Soc.* **43**, 435 (1998)]

B. C. Larson, J. Z. Tischler, A. G. Eguiluz, and A. Fleszar, "Band Structure and Many-Body Local-Field Effects in the Energy-Loss Spectrum of Aluminum" [*Bull. Am. Phys. Soc.* **43**, 661 (1998)]

S. Liu, C. Jayanthi, G. C. John, S.-Y. Wu, Z. Zhang, and M. G. Lagally, "Dynamics and Energetics of Si Adatoms on Si(100)" [*Bull. Am. Phys. Soc.* **43**, 180 (1998)]

S. Lizzit, Ph. Hofmann, K. Pohl, A. Baraldi, G. Comelli, V. Fritzche, R. Stumpf, and E. W. Plummer, "Oscillatory Surface Core Level Shifts Be(1010)" [*Bull. Am. Phys. Soc.* **43**, 397 (1998)]

D. Mandrus, V. Keppens, and B. C. Chakoumakos, "Unexpected Spin Freezing in the Ruthenate Spinel CO_2RuO_4" [*Bull. Am. Phys. Soc.* **43**, 949 (1998)]

H. A. Mook, "Incommensurate Magnetic Fluctuations in High-T_c Superconductors" [*Bull. Am. Phys. Soc.* **43**, 62 (1998)] (invited paper)

S. E. Nagler, D. A. Tennant, T. Barnes, and B. C. Sales, "Field Dependence of the Magnetic Excitations in the Alternating Chain $(VO)_2P_2O_7$" [*Bull. Am. Phys. Soc.* **43**, 51 (1998)]

J. G. Ossandon, J. R. Thompson, L. Krusin-Elbaum, D. K. Christen, and J. L. Ullmann, "Vortex Pinning Energy Enhancements in BSCCO-2212/Ag Tapes with Fission-Generated Columnar Defects" [*Bull. Am. Phys. Soc.* **43**, 414 (1998)]

W. W. Pai, E. W. Plummer, L. Bartels, G. Meyer, K. H. Rieder, and Q. Niu, "Complex Wave Patterns Observed in Scanning Tunneling Microscopy" [*Bull. Am. Phys. Soc.* **43**, 649 (1998)] (invited paper)

S. T. Pantelides, "Atomic Dynamics and Defect Evolution During Oxygen Precipitation and Oxidation of Silicon" [*Bull. Am. Phys. Soc.* **43**, 446 (1998)] (invited paper)

C. Prouteau, G. Duscher, D. K. Christen, N. D. Browning, S. J. Pennycook, and M. F. Chisholm, "Grain Boundary Structure and Transport Properties in High-T_c Superconductors" [*Bull. Am. Phys. Soc.* **43**, 849 (1998)]

B. C. Sales, D. Mandrus, B. C. Chakoumakos, V. Keppens, J. R. Thompson, T. W. Darling, A. Migliori, M. B. Maple, D. A. Gajewski, and E. J. Freeman, "Filled Skutterudite Antimonides: Electron Crystals and Phonon Glasses" [*Bull. Am. Phys. Soc.* **43**, 461 (1998)]

Z. Slanic, D. P. Belanger, and J. A. Fernandez-Baca, "Random Field Critical Scattering Behavior in the Dilute Antiferromagnet $Fe_xZn_{1-x}F_2$ for High Magnetic Concentration $x = 0.93$" [*Bull. Am. Phys. Soc.* **43**, 551 (1998)]

K. J. Song, J. R. Thompson, D. K. Christen, M. Yethiraj, C. V. Tomy, and D. Mck. Paul, "Nonlocal Superconducting Effects in Single-Crystal YNi_2B_2C" [*Bull. Am. Phys. Soc.* **43**, 503 (1998)]

E. D. Specht, H.-M. Christen, D. P. Norton, and L. A. Boatner, "Effect of Layer Thickness on the Ferroelectric Transition in Epitaxial $KtaO_3/KnbO_3$ Multilayers" [*Bull. Am. Phys. Soc.* **43**, 285 (1998)]

P. T. Sprunger and D. M. Zehner, "Surface Reconstruction of FeAl (110), (210), and (310) Studied with STM, LEED, and AES" [*Bull. Am. Phys. Soc.* **43**, 651 (1998)]

A. K. Swan and C. Hwang, "Ag Overlayer Effects on Magnetization of Ultrathin Fe Films on Ag(100)" [*Bull. Am. Phys. Soc.* **43**, 175 (1998)]

D. A. Tennant and S. E. Nagler, "Effects of Ordering on the Excitation Spectrum of $KCuF_3$" [*Bull. Am. Phys. Soc.* **43**, 427 (1998)]

J. Z. Tischler, B. C. Larson, A. G. Eguiluz, and A. Fleszar, "The Energy Dependence of the Many-Body Local-Field Factor in Aluminum" [*Bull. Am. Phys. Soc.* **43**, 661 (1998)]

G. D. Wignall, "Phase Behavior of Linear and Branched Polyethylenes via SANS and USANS" [*Bull. Am. Phys. Soc.* **43**, 9 (1998)]

J. F. Wendelken, "Morphological Evolution During and After Reversible Homoepitaxy on Cu(100)" [*Bull. Am. Phys. Soc.* **43**, 505 (1998)] (invited paper)

R. F. Wood, S. B. Sinnott, Y. Yan, and S. J. Pennycook, "*Ab Initio* Structure Calculations of a Low-Angle Tile Grain Boundary in Rutile" [*Bull. Am. Phys. Soc.* **43**, 534 (1998)]

Y. Yan, M. F. Chisholm, G. Duscher, A. Maiti, S. J. Pennycook, and S. T. Pantelides, "Impurity-Induced Structural Transformation of a Grain Boundary in MgO" [*Bull. Am. Phys. Soc.* **43**, 440 (1998)] (invited paper)

M. Yoon and S. G. J. Mochrie, "Disordering of Si(001) (2×1) Reconstruction at 1446 K Studied by X-Ray Scattering" [*Bull. Am. Phys. Soc.* **43**, 762 (1998)]

M. Yoon and S. G. J. Mochrie, "Growth Kinetics of Ge/Si(001) Studied by X-Ray Scattering" [*Bull. Am. Phys. Soc.* **43**, 776 (1998)]

H. Zajonz, V. Jahns, D. Gibbs, A. P. Baddorf, and D. M. Zehner, "Evolution of the Stripe Phase Reconstruction of Cu/Ru(0001)" [*Bull. Am. Phys. Soc.* **43**, 110 (1998)]

J. Zhang, P. Dai, Y. Tomioka, and Y. Tokura, "Unusual Magnon Behavior in $La_{0.7}Ca_{0.3}MnO_3$" [*Bull. Am. Phys. Soc.* **43**, 539 (1998)]

T. Zhang, J.-H. Cho, E. W. Plummer, and Z. Zhang, "Can Surface Relaxation be Determined from Bulk Properties?" [*Bull. Am. Phys. Soc.* **43**, 108 (1998)]

Z. Zhang and Z. Suo, "Stressed Films Stabilized by Various Long-Range Forces" [*Bull. Am. Phys. Soc.* **43**, 182 (1998)]

A. Zheludev, S. Maslov, G. Shirane, Y. Sasago, N. Koide, K. Uchinokura, D. A. Tennant, and S. E. Nagler, "The Dzyaloshinskii-Spiral Magnet $Ba_2CuGe_2O_7$ in an In-Plane Magnetic Field" [*Bull. Am. Phys. Soc.* **43**, 646 (1998)]

Workshop on Computational Methods for Materials Science Applications, Silver Springs, Maryland, March 19, 1998:

S. J. Pennycook, "A Combined Experimental and Theoretical Approach to Atomic-Scale Structures in Complex Solids" (invited paper)

1998 International Conference on Characterization and Metrology for ULSI Technology, Gaithersburg, Maryland, March 23–27, 1998:

G. Duscher, S. J. Pennycook, H.-J. Gao, N. D. Browning, and R. Singh, "Structure, Composition, and Strain Profiling of Si/SiO_2 Interfaces" (invited paper)

American Chemical Society Meeting, Dallas, Texas, March 29–April 2, 1998:

M. M. Agamalian, R. G. Alamo, J. D. Londono, L. Mandelkern, F. C. Stehling, and G. D. Wignall, "Phase Behavior of Blends of Linear and Branched Polyethylenes via Small- and Ultrasmall-Angle Neutron Scattering" (invited paper)

P. D. Butler, W. A. Hamilton, L. J. Magid, T. M. Slawecki, and J. B. Hayter, "Effect of Fluid Flow on Surfactant Aggregates Near a Solid Wall" (invited paper)

U.S./Japan Symposium on Surface Science, Park City, Utah, March 29–April 4, 1998:

A. K. Swan and C. Hwang, "Ag Overlayer Effects on Magnetization of Ultrathin Fe Films on Ag(100)"

Workshop on AC Losses, San Francisco, California, April 3–4, 1998.

H. R. Kerchner, D. P. Norton, A. Goyal, J. D. Budai, D. K. Christen, D. M. Kroeger, E. D. Specht, Q. He, M. Paranthaman, D. F. Lee, B. C. Sales, and F. A. List, "Alternating Transport Current in $YBa_2Cu_3O_{7-\delta}$/RABiTS Tape" (invited paper)

Spring Meeting of the Materials Research Society, San Francisco, California, April 13–17, 1998:

A. Agarwal, D. J. Eaglesham, H.-J. Gossmann, S. B. Herner, L. Pelaz, D. C. Jacobson, and T. E. Haynes, "Boridation-Enhanced Diffusion of Boron" (invited paper)

C. R. Cho, R. A. Brown, O. Kononchuk, N. Yarykin, G. Rozgonyi, and R. A. Zuhr, "In Situ Deep-Level Transient Spectroscopy of Defect Evolution in Silicon Following Ion Implantation at 80 K"

J. D. Demaree, J. D. Kleinmeyer, D. Ila, D. B. Poker, and D. K. Hensley, "Mechanical Behavior of Optical Materials Bombarded by High Doses of Various Ions"

D. B. Geohegan, A. A. Puretzky, G. Duscher, and S. J. Pennycook, "Time-Resolved Imaging and Photoluminescence of Gas-Suspended Nanoparticles Synthesized by Laser Ablation: Dynamics, Transport, Collection, and Ex Situ Analysis" (invited paper)

H.-J. Gossmann, A. Agarwal, D. J. Eaglesham, G. H. Gilmer, S. B. Herner, D. C. Jacobson, L. Pelaz, M. Jaraiz, V. Venezia, T. E. Haynes, J. M. Poate, and Y. E. Erokhin, "Transient-Enhanced Diffusion" (invited paper)

R. J. Hanrahan, Jr., S. P. Withrow, and M. Puga-Lambers, "Measurements of the Diffusion of Iron and Carbon in Single-Crystal NiAl Using Ion Implantation and Secondary Ion Mass Spectrometry"

Q. He, D. K. Christen, J. D. Budai, E. D. Specht, R. Feenstra, D. F. Lee, A. Goyal, D. P. Norton, M. Paranthaman, F. A. List, and D. M. Kroeger, "Depositions of Epitaxial Noble Metal Buffer Layers on Textured Ni Tapes by Sputtering for the Fabrication of Flexible High-J_c HTS Wires"

D. Ila, D. B. Poker, D. K. Hensley, C. Klatt, and S. Kalbitzer, "Radiation-Induced Formation of Gold Nanoclusters in Suprasil"

G. E. Jellison, Jr., D. B. Geohegan, D. H. Lowndes, A. A. Puretzky, and V. I. Merkolov, "Characterization of Pulsed-Laser-Deposited Amorphous Carbon Films by Spectroscopic Ellipsometry"

D. H. Lowndes, V. I. Merkulov, A. A. Puretzky, D. B. Geohegan, G. E. Jellison, Jr., C. M. Rouleau, and T. Thundat, "Amorphous Diamond Films Deposited by Pulsed-Laser Ablation: The Optimum Carbon-Ion Kinetic Energy and Effects of Laser Wavelength"

J. Park, C. M. Rouleau, and D. H. Lowndes, "Study of Substrate Diffusion in Epitaxial *n*-Type CdSe Films Grown on GaAs (001) by Pulsed-Laser Ablation"

E. Roth and O. W. Holland, "Novel Solutions to Defect-Related Problems in Ion-Implanted Silicon"

N. C. Beck Tan, L. Balogh, S. F. Trevino, D. A. Tomalia, and J. S. Lin, "Characterization of Dendrimer-Based Nanocomposites by SAXS and SANS" (invited paper)

V. C. Venezia, A. Agarwal, D. J. Eaglesham, T. E. Haynes, H.-J. Gossmann, and D. C. Jacobson, "Using Au Decoration to Study Vacancy Clusters Produced by MeV Si^+ Implantation"

C. W. White, S. P. Withrow, A. Meldrum, J. D. Budai, D. M. Hembree, J. G. Zhu, D. O. Henderson, and S. Prawer, "Optical Properties of Si Nanocrystals Formed in SiO_2 by Ion Implantation"

Conference on Partnering for Functional Genomics Research, Oak Ridge, Tennessee, April 16–17, 1998:

J. B. Roberto, "The Spallation Neutron Source: Ushering in the Decade of the Neutron" (invited paper)

Frontiers of Electron Microscopy in Materials Science, Irsee, Germany, April 19–24, 1998:

N. D. Browning, E. M. James, H. O. Moltaji, S. Stemmer, G. Duscher, Y. Xin, C. Proteau, S. J. Pennycook, and P. D. Nellist, "Determining the Structure-Property Relationships at Internal Interfaces Through Correlated Z-Contrast Imaging and EELS" (invited paper)

M. F. Chisholm, Y. Yan, G. Duscher, S. J. Pennycook, and S. T. Pantelides, "A Combined Experimental and Theoretical Approach to Atomic-Scale Characterization"

G. Duscher, S. J. Pennycook, N. D. Browning, K. Johnson, and V. P. Dravid, "Atom-Column-Resolved EELS at a Mn-Doped $SrTiO_3$ Grain Boundary"

P. D. Nellist and S. J. Pennycook, "Quantitative Structure and Composition Determination from ADF STEM Images"

The University of Tennessee College of Arts and Sciences Board of Visitors, Oak Ridge, Tennessee, April 24, 1998:

J. B. Roberto, "The Spallation Neutron Source" (invited paper)

Next Generation Photovoltaic Thin-Film Workshop, Golden, Colorado, April 27–28, 1998:

D. H. Lowndes, "Substrates for Films with Aligned Grain Structures" (invited paper)

One-Hundredth Annual Meeting of the American Ceramic Society, Cincinnati, Ohio, May 3–6, 1998:

N. J. Dudney, T. Suwannasiri, J. Xu, and J. B. Bates, "Thin-Film Materials for Rechargeable Lithium Batteries and Their Incorporation into Hybrid Batteries" (invited paper)

F. A. Modine, L. A. Boatner, M. Bartkowiak, G. D. Mahan, H. Wang, and R. B. Dinwiddie, "Influence of Ceramic Microstructure on Varistor Electrical Properties," (invited paper)

T. Suwannasiri, N. J. Dudney, J. Xu, and J. B. Bates, "$LiMn_2O_4$ and $LiCoO_2$ Thick-Film Cathodes in Solid State Lithium Batteries"

H. Wang, F. A. Modine, M. Bartkowiak, and R. B. Dinwiddie, "Thermal Boundary Resistance Studied by Infrared Imaging"

One-Hundred Ninety-Third Electrochemical Society Meeting, San Diego, California, May 3–8, 1998:

A. Agarwal, D. J. Eaglesham, H.-J. Gossmann, L. Pelaz, S. B. Herner, D. C. Jacobson, T. E. Haynes, and Y. Erokhin, "Boron-Enhanced Diffusion of Boron from Ultralow Energy Boron Implantation"

A. Agarwal, V. C. Venezia, T. E. Haynes, D. J. Eaglesham, and O. W. Holland, "Efficient Silicon-On-Insulator Films by Coimplantation of He^+ with H^+"

E. G. Roth, O. W. Holland, G. S. Harris, and D. Theodore, "Manipulating Ion-Induced Defects to Improve Implantation Processing of Silicon"

G. U. Sumanasekara, L. Grigorian, J. Alleh, K. A. Williams, S. Fang, E. C. Dickey, S. J. Pennycook, A. Rinzler, A. M. Rao, G. D. Mahan, R. E. Smalley, and P. C. Eklund, "Doping-Induced Changes in the Optical and Electrical Properties of Single-Wall Carbon Nanotubes (SWNTs)"

V. C. Venezia, D. J. Eaglesham, T. E. Haynes, A. Agarwal, D. C. Jacobson, H.-J. Gossmann, T. Friessnegg, and B. Nielsen, "Vacancy Supersaturations Produced by High-Energy Ion Implantation"

V. C. Venezia, T. E. Haynes, A. Agarwal, D. J. Eaglesham, O. W. Holland, M. K. Weldon, and Y. J. Chabal, "The Role of Implantation Damage in the Production of Silicon-on-Insulator Films by Coimplantation of He^+ and H^+"

3M and ORNL Technology Fair, St. Paul Minnesota, May 6, 1998:

D. K. Christen, "3M/ORNL/LANL/Southwire CRADA: ORNL/3M Focus Areas" (invited paper)

Sixth European Conference on Surface Crystallography, La Grande Motte, France, May 10–13, 1998:

E. W. Plummer, "The Interplay Between Electronic and Geometric Distortions at a Surface: The Charge Density Wave in the Sn(pb)/Ge(111) System" (invited paper)

Workshop on Pulsed-Laser Deposition Technological Barriers: Research Needs and Opportunities, Arlington, Virginia, May 12–13, 1998:

D. H. Lowndes, "Role of the National Laboratories" (invited paper)

National Synchrotron Light Source Users' Meeting, Upton, New York, May 18–21, 1998:

A. P. Baddorf, "Effect of Temperature on Surface Vibrations and Structure" (invited paper)

East Tennessee Chapter of the American Vacuum Society, Knoxville, Tennessee, May 21, 1998:

W. A. Hamilton, "Neutron Reflectometry" (invited paper)

S. E. Nagler, "Magnetic Neutron Scattering" (invited paper)

E. W. Plummer, "Electron Density Waves at Surfaces: From Friedel Oscillations to Charge Density Waves" (invited paper)

G. D. Wignall, "Polymers and Disordered Systems"

Midwest Microscopy and Microanalysis Society Annual Meeting, Chicago, Illinois, May 21–22, 1998:

S. J. Pennycook, M. F. Chisholm, Y. Yan, G. Duscher, and S. T. Pantelides, "A Combined Experimental and Theoretical Approach to Atomic-Scale Characterization of Interfaces" (invited paper)

1998 SEM Spring Conference, Houston, Texas, June 1-3, 1998:

S. Spooner and E. B. S. Pardue, "Neutron and X-Ray Scattering Studies of the Metallurgical Condition and Residual Stresses in Aluminum Welds"

Twenty-Second International Workshop on Condensed Matter Theories," Nashville, Tennessee, June 1-6, 1998:

K. Sohlberg, S. J. Pennycook, and S. T. Pantelides, "Theory of the Complex Structure of Alumina Phases" (invited paper)

Danish Physical Society Meeting, Copenhagen, Denmark, June 2–4, 1998:

E. W. Plummer, "Surfaces: A Playground for Physics in Reduced Dimensionality"

Second International Conference on Stripes and High-T_c Superconductivity, Rome, Italy, June 2–6, 1998:

H. A. Mook, F. Dogan, and B. C. Chakoumakos, "Magnetic and Charge Fluctuations in High-T_c Superconductors" (invited paper)

American Vacuum Society Symposium, Cleveland, Ohio, June 3, 1998:

S. J. Pennycook, M. F. Chisholm, Y. Yan, G. Duscher, and S. T. Pantelides, "A Combined Experimental and Theoretical Approach to Atomic-Scale Structures in Complex Solids" (invited paper)

Gordon Conference on Laser Interactions with Materials, Andover, New Hampshire, June 7–12, 1998:

D. P. Norton, "Energetic Ion Effect in Pulsed-Laser Deposition" (invited paper)

International Conference and Workshop on CMR-Related Phenomena in Transition-Metal Oxides, Melbourne, Australia, June 7–12, 1998:

J. Zhang, "Spin Dynamics in the Ferromagnetic Phase of Colossal Magnetoresistance Materials" (invited paper)

International Conference on Modeling of Casting, Welding, and Advanced Solidification Processes VIII, San Diego, California, June 8–12, 1998:

M. Rappaz, D. Corrigan, and L. A. Boatner, "Analysis of Ripple Formation in Single-Crystal Spot Welds"

AC Loss Workshop, Oak Ridge, Tennessee, June 10, 1998:

H. R. Kerchner, "Comparison of AC Transport Current Flow in Superconductive Films—The Important Role of a Barrier to Vortex Entry" (invited paper)

Third International Symposium on Metallic Multilayers, Vancouver, Canada, June 11, 1998:

Z.-P. Shi and R. S. Fishman, "The Role of Cr Antiferromagnetism on Interlayer Magnetic Coupling in Fe/Cr Multilayered Systems"

ACP 98 CAP Congress, Waterloo, Ontario, Canada, June 14–17, 1998:

P. F. Kelly, R. S. Fishman, and G. P. Bierwagen, "Density Fluctuations in Systems with a Binary Mixture of Hard Spheres"

Physical Electronics Conference, University Park, Pennsylvania, June 14–17, 1998:

K. Yoo, H. H. Weitering, A. P. Baddorf, O. W. Holland, D. M. Zehner, and L. C. Feldman, "Transport Properties of Silicon Surfaces"

J. Zhang, W. W. Pai, and E. W. Plummer, "Direct Visualization of Low-Dimensional Dielectric Response Function"

Ninth International Conference on Modern Materials and Technologies (CIMTEC '98), Florence, Italy, June 14–19, 1998:

E. C. Dickey and S. J. Pennycook, "Atomic Structure and Chemistry of Oxide Composite Interfaces"

G. Duscher, N. D. Browning, and S. J. Pennycook, "Atom-Column-Resolved Analysis of a Grain Boundary in $SrTiO_3$"

J. G. Ossandon, J. R. Thompson, L. Krusin-Elbaum, K. J. Song, D. K. Christen, and J. L. Ullmann, "Stabilization of Magnetic Flux BSCCO-2212/Ag Tapes Subjected to 0.8-GeV Proton Irradiation"

Vortex Dynamics Workshop, Hachimantai, Iwate Prefecture, Japan, June 21–26, 1998:

J. R. Thompson, K. J. Song, M. Yethiraj, D. K. Christen, C. V. Tomy, and D. McK. Paul, "Effects of Nonlocal Superconductivity in YNi_2B_2C" (invited paper)

Twelfth International Conference on Ion Implantation Technology (ITT/98), Kyoto, Japan, June 22–26, 1998:

A. Agarwal, H.-J. Gossmann, D. C. Jacobson, D. J. Eaglesham, M. Sosnowski, J. M. Poate, I. Yamada, J. Matsuo, and T. E. Haynes, "Transient-Enhanced Diffusion from Implantation of Molecular Decaborane Ions"

A. Agarwal, H.-J. Gossmann, D. J. Eaglesham, S. B. Herner, D. C. Jacobson, and T. E. Haynes, "Transient- and Boron-Enhanced Diffusion (TED and BED) From Ultralow Energy Ion Implantation"

Japan Research Center for Atom Technology Workshop on Phase Control of Colossal Magnetoresistive Oxides, Maui, Hawaii, June 24–27, 1998:

J. Zhang, "Unusual Magnon Behavior in Manganites" (invited paper)

Tsukuba Meeting on Vortex Matter Physics, Tsukuba, Japan, June 29, 1998:

J. R. Thompson, "Two Influences for Vortices: Pinning by 'Nonideal' Columnar Defects and Effects of Non-Local Superconductivity" (invited paper)

Gordon Conference on Correlated Electron Systems, Plymouth, New Hampshire, July 1998:

H. H. Weitering, "Density Waves and Mott Insulators on Triangular Surface Lattices" (invited paper)

Ninth International Conference on Intergranular and Interphase Boundaries in Materials, Prague, Czech Republic, July 6–9, 1998:

M. F. Chisholm, A. Maiti, S. J. Pennycook, and S. T. Pantelides, "Direct Determination of Dopant Segregation Sites at Grain Boundaries"

M. F. Chisholm, A. Maiti, S. J. Pennycook, and S. T. Pantelides, "Vacancy Formation and Vacancy-Induced Structural Transformation in Si Grain Boundaries"

G. Duscher, M. F. Chisholm, U. Alber, S. J. Pennycook, and M. Rühle, "The Mechanism of Embrittlement of Copper by Bismuth"

A. Maiti, M. F. Chisholm, S. J. Pennycook, and S. T. Pantelides, "Vacancy-Induced Structural Transformation of Si Grain Boundaries"

Y. Yan, M. F. Chisholm, G. Duscher, A. Maiti, S. J. Pennycook, and S. T. Pantelides, "Impurity-Induced Structural Transformation of an MgO Grain Boundary"

Ninth International Meeting on Lithium Batteries, Edinburgh, Scotland, United Kingdom, July 12–17, 1998:

B. J. Neudecker, R. A. Zuhr, and J. B. Bates, "Lithium Silicon Tin Oxynitride (Li_ySiTON): High-Performance Anode in Thin-Film Lithium-Ion Batteries for Microelectronics" (invited paper)

Eleventh International Conference on Ultrafast Phenomena, Garmisch-Partenkirchen, Germany, July 12–17, 1998:

R. F. Haglund, Jr., G. Lüpke, D. H. Osborne, H. Chen, R. H. Magruder III, and R. A. Zuhr, "Ultrafast Relaxation Processes in Au Quantum Dots at High Pulse Repetition Frequencies"

Third Pacific Rim International Conference on Advanced Materials and Processing, Honolulu, Hawaii, July 12–16, 1998:

S. A. David, J. M. Vitek, S. S. Babu, L. A. Boatner, and R. W. Reed, "Welding of Nickel-Base Superalloy Single Crystals" (invited paper)

Microscopy & Microanalysis 98, Atlanta, Georgia, July 12–16, 1998:

H. J. Gao, Y. Yan, J. Fitz-Gerald, D. Kumar, R. K. Singh, and S. J. Pennycook, "Z-Contrast Scanning Transmission Electron Microscopy of Nanometer-Scale Coated Particulate Materials"

S. T. Pantelides, S. J. Pennyook, M. F. Chisholm, A. Maiti, Y. Yan, F. Reboredo, and M. Ferconi, "Complex Atomic-Scale Structures in Solids by a Combination of Theory and Microscopy," (invited paper)

S. J. Pennycook, J. Buban, C. Prouteau, M. F. Chisholm, P. D. Nellist, and N. D. Browning, "The Atomic-Scale Origins of Grain Boundary Superconducting Properties" (invited paper)

C. Prouteau, G. Duscher, N. D. Browning, S. J. Pennycook, D. Verebelyi, D. K. Christen, M. F. Chisholm, and D. P. Norton, "Investigation of the Local Superconducting Properties at Grain Boundaries in High-T_C Superconductors"

Y. Yan, M. F. Chisholm, and S. J. Pennycook, "Atomic Structures of Inversion Domain Boundaries and Dislocations in Sintered AlN"

Y. Yan, Z. Xu, D. Viehland, and S. J. Pennycook, "Z-Contrast Imaging of Ordered Structures in $Pb(Mg_{1/3}Nb_{2/3})O_3$ and $Ba(Mg_{1/3}Nb_{2/3})O_3$"

Y. Xin, N. D. Browning, S. J. Pennycook, P. D. Nellist, S. Sivananthan, J.-P. Faurie, and P. Gibart, "Direct Observation of Threading Dislocations in GaN by High-Resolution Z-Contrast Imaging"

Y. Xin, N. D. Browning, S. J. Pennycook, P. D. Nellist, Y. P. Chen, S. Rujirawat, S. Sivananthan, F. Omnès, B. Beaumont, J.-P. Faurie, and P. Gibart, "Direct Observations of Defect Structures in Optoelectronic Materials by Z-Contrast STEM"

Telluride Summer Research Center Workshop on Magnetoresistive Oxide, Telluride, Colorado, July 13–18, 1998:

J. A. Fernandez-Baca, "Spin Dynamics of the CMR Manganites $Ln_{1-x}A_xMnO_3$ ($x \sim 0.30$)" (invited paper)

Friends of Oak Ridge, Oak Ridge, Tennessee, July 16, 1998:

S. E. Nagler, "Neutrons and One-Dimensional Magnetism" (invited paper)

American Crystallographic Association Meeting, Washington, D.C., July 18–23, 1998:

B. C. Chakoumakos, B. C. Sales, D. G. Mandrus, and V. Keppens, "Anisotropic Displacement Parameters in Filled Skutterudites" (invited paper)

M. Agamalian, M. Hashimoto, H. Matsuoka, T. Takahashi, G. D. Wignall, and H. Yamaoka, "Ultrasmall-Angle X-Ray and Neutron Scattering (USAXS and USANS) Structural Studies of Colloidal Systems" (invited paper)

W. Klooster, B. Craven, B. C. Chakoumakos, and C. Johnson, "Thermal Vibrations in Alpha-Glycine from Neutron Diffraction"

International Symposium on Optical Science, Engineering, and Instrumentation, SPIE, San Diego, California, July 19–24, 1998:

G. E. Jellison, Jr., F. A. Modine, and L. A. Boatner, "Measurements of the Optical Functions of Uniaxial Crystals Using 2-Modulator Generalized Ellipsometry (2-MGE)"

H. Liu, F. Fernandez, W. Jai, and L. A. Boatner, "Transient Grating in a $KNbO_3/KTaO_3$ Superlattice"

A. J. Pedraza and D. H. Lowndes, "Surface Engineering Using Excimer Lasers"

M. L. Simpson, D. H. Lowndes, G. E. Jellison and M. N. Ericson, "Single-Chip Photo-Spectrometers Realized in Standard Complementary-Metal-Oxide-Semiconductor (CMOS) Technology"

International Vacuum Microelectronics Conference, Asheville, North Carolina, July 19–24, 1998:

D. H. Lowndes, "An Addressable Field Emission Array for E-Beam Lithography Using Planar, Plused-Laser-Deposited Amorphous Diamond Cathodes"

Society of Photo-Optical Instrumentation Engineers Annual Meeting on Time Structure of X-Ray Sources and Its Applications, San Diego, California, July 19–24, 1998:

B. C. Larson, "X-Ray Scattering Applications Using Pulsed X-Ray Sources" (invited paper)

Molecular Simulations Inc. Materials User Group, Atlanta, Georgia, July 21–22, 1998:

K. Sohlberg, S. J. Pennycook, and S. T. Pantelides, "Theory of the Complex Structure of Alumina Phases" (invited paper)

Centre Européen de Calcul Atomique and Moléculaire Conference on Surfaces and Interfaces Far From Equilibrium, Lyon, France, July 27–29, 1998:

Z. Zhang, "Quantum Nature of Ultrathin Metallic Overlayer Growth on Semiconductor Substrates" (invited paper)

Seventeenth General Meeting of the International Mineralogical Association, Toronto, Ontario, Canada, August 9–14, 1998:

B. C. Chakoumakos, Th. Leventouri, and V. Perdikatsis, "Atomic Displacements in Carbonate Apatite"

LANSCE User Group Meeting, Los Alamos, New Mexico, August 10–12, 1998:

S. Nagler, "Neutrons and Quantum Antiferromagnetic Chains" (invited paper)

SemiMag 13, Nijmegan, Holland, August 10–14, 1998:

D. C. Marinescu, J. J. Quinn, and A. Wojs, "Collective Excitations in a 2D Electron System: Canted Field Geometry"

New Developments in High-Temperature Ceramics, Istanbul, Turkey, August 12–15, 1998:

S. J. Pennycook, M. F. Chisholm, Y. Yan, G. Duscher, N. D. Browning, K. Johnson, V. P. Dravid, and S. T. Pantelides, "A Combined Experimental and Theoretical Approach to Atomic-Scale Characterization of Ceramic Interfaces" (invited paper)

Second Polish-U.S. Conference on High-Temperature Superconductivity, Wroclaw, Poland, August 16–22, 1998:

J. R. Thompson, "Vortex Pinning and Critical Currents in High-T_c Superconductors: Enhancements with Random Columnar Defects" (invited paper)

American Chemical Society Meeting, Boston, Massachusetts, August 24–28, 1998:

J. Huang, M. S. Lisowski, J. Runt, E. S. Hall, R. T. Kean, N. Buehler, and J. S. Lin, "Crystallization and Microstructure of Poly(L-Lactide-Co-Meso-Lactide) Copolymers"

Y. B. Melnichenko, G. D. Wignall, and W. A. Van Hook, "The Phase Diagram of Polymer Solutions Below the Theta Temperature from SANS"

G. D. Wignall and Y. B. Melnichenko, "Dimensions of Polystyrene Coils in the Critical Region of Phase Demixing"

First Annual Chinese-American Frontiers of Science Symposium, Irvine, California, August 28–30, 1998:

Z. Zhang, Fundamental Mechanisms of Thin-Film Growth" (invited paper)

Ion Beam Modification of Materials–98, Amsterdam, The Netherlands, August 31–September 4, 1998:

A. L. Evelyn, D. Ila, R. L. Zimmerman, K. Bhat, D. B. Poker, D. K. Hensley, Ch. Klatt, S. Kalbitzer, and N. Just, "Ion Beam Modification of Polymers Containing Cross-Linking Enhancers"

A. Meldrum, C. W. White, L. A. Boatner, R. A. Zuhr, and D. O. Henderson, "Microstructure of Sulfide Nanocrystals Formed by Ion Implantation Techniques"

A. Meldrum, S. J. Zinkle, L. A. Boatner, and R. C. Ewing, "Evidence for Thermal Spikes and Cascade Quenching in the Zircon-Structure Orthosilicates"

S. Sarkisov, M. Curley, E. K. Williams, D. Ila, V. Svetchnikov, V. Pan, D. B. Poker, and D. K. Hensley, "Nonlinear Light Guiding Structures Produced by MeV Silver Implantation of Lithium Niobate"

C. W. White, A. Meldrum, J. D. Budai, S. P. Withrow, E. Sonder, R. A. Zuhr, D. M. Hembree, M. Wu, and D. O. Henderson, "Formation of CdS and CdSe Nanocrystals by Sequential Ion Implantation"

E. K. Williams, D. Ila, A. Darwish, D. B. Poker, and D. K. Hensley, "Characterization of Silver Colloids Formed in $LiNbO_3$ by Ag and O Implantation at Room and Elevated Tmperatures"

Fourteenth International Vacuum Congress, Birmingham, England, August 31–September 4, 1998:

Ismail, J.-H. Cho, Z. Zhang, and E. W. Plummer, "Oscillatory Interplanar Relaxation and Thermal Expansion at a Metal Surface: Mg(1010)"

I. Furman, O. Biham, M. Karimi, J.-K. Zuo, A. K. Swan, J. F. Wendelken, and G. Vidali, "Diffusion and Growth of Cu/Cu(001): Models and Experiment"

Fourteenth International Congress on Electron Microscopy, Cancun Mexico, August 31–September 4, 1998:

N. D. Browning, J. P. Buban, C. Prouteau, D. Verebelyi, D. P. Norton, D. K. Christen, S. J. Pennycook, and P. D. Nellist, "Investigating the Atomic-Scale Superconducting Properties of Grain Boundaries in High-T_c Superconductors"

P. D. Nellist and S. J. Pennycook, "Quantitative Sub-Ångstrom Imaging through ADF STEM"

S. J. Pennycook, S. T. Pantelides, M. F. Chisholm, A. Maiti, and Y. Yan, "Atomic-Scale Structures in Complex Solids by Z-Contrast STEM and First-Principles Theory" (invited paper)

Y. Xin, N. D. Browning, S. J. Pennycook, P. D. Nellist, Y. P. Chen, S. Rujirawat, S. Sivananthan, F. Omnès, B. Beaumont, J.-P. Faurie, and P. Gibart, "Direct Observations of Defect Structures in Optoelectronic Materials by Z-Contrast STEM"

Silica from S (Synthesis) to A (Application), Mulhouse, France, September 1–4, 1998:

T. Isobe, T. Nakajima, M. Senna, R. A. Weeks, and R. A. Zuhr, "Surface Modification of Silica Glasses by Sequential Ion Implantation of Ferromagnetic Components in the Fe-B System"

Toward Atomic-Resolution Analysis, Port Ludlow, Washington, September 6–11, 1998:

S. J. Pennycook and B. Rafferty, "Toward Atomic Column-by-Column Spectroscopy," (invited paper)

S. J. Pennycook, M. F. Chisholm, Y. Yan, G. Duscher, and S. T. Pantelides "A Combined Experimental and Theoretical Approach to Atomic-Scale Structures in Complex Solids" (invited paper)

Eighth International Workshop on Slow Positron Beam Techniques for Solids and Surfaces, Cape Town, South Africa, September 6–12, 1998:

J. Xu, A. P. Mills, Jr., R. Suzuki, E. G. Roth, and O. W. Holland, "Impurity-Vacancy Defects in Implanted Float-Zone and Czochralski-Si"

Workshop on Advanced Materials for Extreme Environments: New Experimental Opportunities in Neutron Scattering, Argonne, Illinois, September 11–12, 1998:

L. A. Boatner, A. Meldrum, B. C. Chakoumakos, and M. J. Mitchell, "The Lanthanide Orthophosphates: Chemically Durable, Radiation-Resistant, High-Temperature Ceramics" (invited paper)

B. C. Chakoumakos, B. J. Kennedy, and C. J. Howard, "High-Temperature Crystal Structure Systematics of Oxide Perovskites" (invited paper)

SPIE Micromachining and Microfabrication, Santa Clara, California, September 11–12, 1998:

B. E. Allman, A. Cimmino, A. G. Klein, and W. A. Hamilton, "Metal Micro-Arrays for Collimating Neutrons and X-Rays" [*SPIE Proceedings* **3449**, 175 (1998)]

A. Cimmino, B. E. Allman, A. G. Klein, W. A. Hamilton, I. S. Anderson, I. B. Hamelin, P. Hoghoj, and P. Bastie, "Micro-Array Collimators for X Rays and Neutrons" [*SPIE Proceedings* **3511**, 376 (1998)]

1998 Applied Superconductivity Conference, Palm Desert, California, September 13–18, 1998:

Q. He, D. K. Christen, R. Feenstra, D. P. Norton, M. Paranthaman, E. D. Specht, D. F. Lee, A. Goyal, and D. M. Kroeger, "Growth of Biaxially Oriented Conductive Buffer Layers on Textured Nickel Tapes Used for High-Temperature Superconductors"

C. Park, D. P. Norton, D. K. Christen, D. Verebelyi, D. Lee, R. Feenstra, J. D. Budai, A. Goyal, D. M. Kroeger, M. Paranthaman, and E. Specht, "Long-Length Fabrication of YBCO on Rolling-Assisted Biaxially Textured Substrates (RABiTS-TM) Using Pulsed-Laser Deposition"

D. T. Verebelyi, D. K. Christen, C. Prouteau, G. Duscher, N. D. Browning, S. J. Pennycook, M. F. Chisholm, D. P. Norton, C. Park, and E. D. Specht, "Correlations Between Superconducting Transport Properties and Atomic Structure of YBCO Single Grain Boundaries in Large Magnetic Fields"

Fifth International Symposium on Polycrystalline Semiconductors, Schwäbisch-Gmünd, Germany, September 13–18, 1998:

M. F. Chisholm, R. Buczko, M. Mostoller, T. Kaplan, A. Maiti, S. T. Pantelides, and S. J. Pennycook, "Atomic Structure and Properties of Extended Defects in Silicon" (invited paper)

Third International Meeting of Pacific Rim Ceramic Society, Advances in Photonic Glasses, Seoul, South Korea, September 20–23, 1998:

R. H. Magruder III, R. A. Weeks, R. A. Zuhr, and D. K. Hensley, "Oxygen-Related Defect Center Formation in MeV-Energy Boron-Implanted Silica"

Eighth International Conference on Heavy-Ion Accelerator Technology, Chicago, Illinois, October 5–9, 1998:

D. K. Hensley, "1998 Laboratory Report to Heavy Ion Accelerator Technology (HIAT) for the Surface Modification and Characterization Research Center at Oak Ridge National Laboratory"

Ninth User's Meeting for the Advanced Photon Source, Argonne, Illinois, October 13–15, 1998:

J. D. Budai, "The Use of X-Ray Microbeams in Materials Science" (invited paper)

International Workshop on Inelastic X-Ray Scattering, Montauk, Long Island, New York, October 18–21, 1998:

B. C. Larson, J. Z. Tischler, A. Fleszar, and A. G. Eguiluz, "Correlation and Band Structure Effects in the Electronic Energy Loss Spectra of Al: An Experimental Perspective" (invited paper)

Exploration of Subsurface Phenomena by Particle Scattering, Monterey, California, October 19–23, 1998:

W. A. Hamilton, P. D. Butler, L. J. Magid, Z. Han, T. M. Slawecki, and B. Hammouda, "Kinetics of a Hexagonal Poiseille Shear-Induced Near-Surface Phase in a Semidilute Threadlike Micellar Solution"

H. Zajonz, D. Gibbs, A. P. Baddorf, and D. M. Zehner, "Growth of Strained Epitaxial Cu Films on Ru(0001) Monitored by Surface X-Ray Diffraction" (invited paper)

Basic Energy Sciences Advisory Committee, Gaithersburg, Maryland, October 26, 1998:

J. B. Roberto, "An Overview of the High Flux Isotope Reactor and the HFIR Reflector Replacement and Neutron Scattering Upgrades Projects" (invited paper)

Workshop on Materials Science and Mechanics Interfaces, La Jolla, California, October 26–30, 1998:

S. J. Pennycook, M. F. Chisholm, Y. Yan, G. Duscher, N. D. Browning, J. P. Buban, K. Johnson, V. P. Dravid, E. C. Dickey, and S. T. Pantelides, "Interface Structure/Property Relationships Through Atomic-Resolution Imaging, Spectroscoy, and Theory" (invited paper)

Electrochemical Society Meeting, Boston, Massachusetts, November 1–6, 1998:

A. Ueda, J. B. Bates, and R. A. Zuhr, "Three-Dimensional Metal-Doped $LiMn_2O_4$ Thin Films"

A. Ueda, J. B. Bates, and R. A. Zuhr, "Structure and Electrochemical Properties of $LiMn_2O_4$ Thin Films"

Forty-Fifth International Symposium of the American Vacuum Society, Baltimore, Maryland, November 2–6, 1998:

N. Noh, A. P. Baddorf, and H. H. Weitering, "Surface Structural Study of Ultrathin Si(111) on SiO_2"

W. W. Pai and J. F. Wendelken, "Edge Barriers and Mass Transport on Metal (100) Surfaces"

H. Zajonz, D. Gibbs, A. P. Baddorf, and D. M. Zehner, "Evolution and Structure of the Stripe Phase of Cu/Ru(0001)"

Fifteenth International Conference on the Applications of Accelerators in Research and Industry, Denton, Texas, November 4–7, 1998:

L. Gea, S. Honda, L. A. Boatner, T. E. Haynes, F. A. Modine, A. Meldrum, and J. D. Budai, "The Formation of 'Smart' Nanocomposite Surfaces by Ion Beam Techniques" (invited paper)

T. E. Haynes, "Lift-Off of Thin Semiconductor Layers by H and He Ion Implantation" (invited paper)

E. Roth, O. W. Holland, and J. L. Duggan, "Solutions to Defect-Related Problems in Implanted Silicon by Controlled Injection of Vacancies by High-Energy Ion Irradiation"

V. C. Venezia, T. E. Haynes, A. Agarwal, H.-J. Gossmann, L. Pelaz, D. C. Jacobson, D. J. Eaglesham, and J. L. Duggan, "Defects and Diffusion in MeV-Implanted Silicon" (invited paper)

R. L. Zimmerman, D. Ila, E. K. Williams, S. S. Sarkisov, D. B. Poker, and D. K. Hensley, "New Optical Properties of MgO after MeV Metal Ion Implantation"

First International Symposium on Atom Processing and Novel Properties in Nanoscopic Materials, Osaka, Japan, November 9–11, 1998:

S. J. Pennycook, M. F. Chisholm, Y. Yan, G. Duscher, N. D. Browning, D. B. Geohegan, A. A. Puretzky, A. Kadavanich, S. J. Rosenthal, and S. T. Pantelides, "Functional Interfaces Through Atomic-Resolution Imaging, Spectroscopy, and Theory" (invited paper)

MMM'98, Miami, Florida, November 9–12, 1998:

R. S. Fishman, "Helical Spin-Density Wave in Fe/Cr Trilayers with Perfect Interfaces"

M. Zheng, J. Shen, P. Ohresser, Ch. V. Mohan, M. Klana, J. Barthel, and J. Kirscher, "Influence of Growth Temperature on the Spin Reorientation of Ni/Cu(100) Ultrathin Films"

International Symposium on Surfaces and Interfaces: Properties of Different Symmetry Crossings, Tokyo, Japan, November 19–21, 1998:

E. W. Plummer, "Surfaces: A Playground for Physics in Reduced Dimensionality" (invited paper)

Seventh ISSP International Symposium: Frontiers in Neutron Scattering Research, Tokyo, Japan, November 24–27, 1998:

T. Kosugi, K. Amezawa, N. Yamamoto, S. Kawano, and J. A. Fernandez-Baca, "Neutron Diffraction Studies of the Magnetic Structures of $Tb_{0.76}Y_{0.24}$ Single Crystal Under High Pressure"

M. Nishi, K. Kakurai, Y. Fujii, S. Katano, J. Akimitsu, M. Yethiraj, and J. A. Fernandez-Baca, "New Aspects of the b^*-LA Phonon of $CuGeO_3$"

M. Yethiraj, H. Kawano, D. McK. Paul, C. V. Tomy, H. Takeya, and H. Yoshizawa, "Nonlocal Effects in the Superconductor $YNi_2{}^{11}B_2C$"

H. Yoshizawa, R. Kajimoto, H. Kawano, J. A. Fernandez-Baca, Y. Tomioka, H. Kuwahara, and Y. Tokura, "Magnetic Ordering and Spin Fluctuations in Nearly Half-Doped Manganites"

Fall Meeting of the Materials Research Society, Boston, Massachusetts, November 30–December 4, 1998:

M. Bartkowiak and G. D. Mahan, "Boundary Effects in Thin-Film Thermoelectrics"

J. D. Budai, C. W. White, A. Meldrum, S. P. Withrow, R. A. Zuhr, L. E. McNeil, K. J. Price, and A. Suvkhanov, "Ion Beam Synthesis of GaN Nanocrystals in Sapphire"

C. Cantoni, D. P. Norton, D. M. Kroeger, M. Paranthaman, D. K. Christen, D. Verebelyi, R. Feenstra, D. F. Lee, and E. D. Specht, "Phase Stability for the In Situ Growth of $Nd_{1+x}Ba_{2-x}Cu_3O_Y$ Films Using Pulsed-Laser Deposition"

D. K. Christen, D. T. Verebelyi, R. Feenstra, D. P. Norton, C. Park, Q. He, C. S. Prouteau, M. F. Chisholm, J. D. Budai, E. D. Specht, A. Goyal, M. Paranthaman, D. F. Lee, and D. M. Kroeger, "Superconducting Transport in Coated Conductors and Related Model Systems"

E. C. Dickey, X. Fan, S. J. Pennycook, L. Grigorian, and P. C. Eklund, "Z-Contrast STEM Imaging and Electron Energy Loss Spectroscopy of I-Intercalated Carbon Nanotube Ropes"

G. Duscher, A. A. Puretzky, D. B. Geohegan, and S. J. Pennycook, "Chemical Analysis of Individual SiO_x Nanoparticles"

D. B. Geohegan, A. A. Puretzky, S. J. Pennycook, A. Meldrum, and G. Duscher, "In Situ Diagnostics of Nanomaterial by Laser Ablation: Time-Resolved Photoluminescence Spectra and Imaging of Gas-Suspended Nanoparticles Deposited for Thin Films"

D. O. Henderson, M. Wu, R. Mu, A. Ueda, C. W. White, A. Meldrum, A. Hepp, and E. Gordon, "Silicon Quantum Dots Embedded in Silica" (invited paper)

S. Honda, F. A. Modine, A. Meldrum, J. D. Budai, T. E. Haynes, L. A. Boatner, and L. A. Gea, "Ion-Implantation/Annealing-Induced Precipitation of Nanophase Ferromagnetic Particles in Yttrium-Stabilized ZrO_2"

G. E. Jellison, Jr., G. Eres, F. Hai, G.-C. Yi, C. Chen, and S. P. Withrow, "Amorphous Silicon Nitride Grown by Energetic Beams"

D. E. Jesson, G. Chen, K. M. Chen, and S. J. Pennycook, "Instability and Metastability During Strained-Layer Epitaxy" (invited paper)

A. V. Kadavanich, M. M. Erwin, T. Kippeny, S. J. Rosenthal, and S. J. Pennycook, "Atomic-Scale Analysis of the Interface in CDSE Nanocrystal/MEH-PPV Composites"

H. R. Kerchner, D. P. Norton, A. Goyal, J. D. Budai, R. Feenstra, D. F. Lee, D. M. Kroeger, and D. K. Christen, "Barrier-to-Vortex Entry Raises Both Critical Current and ac Loss in Superconductive Films"

Y. E. Lee, D. P. Norton, J. D. Budai, S. J. Pennycook, C. Rouleau, and G. E. Jellison, Jr., "Growth and Characterization of $ZnGa_2O_4$:Mn Thin-Film Phosphors Using Pulsed-Laser Ablation"

G. D. Mahan, "Thermionic Refrigeration" (invited paper)

D. Mandrus, V. Keppens, B. C. Chakoumakos, G. E. Granroth, and S. E. Nagler, "A Neutron Diffraction Study of $Co_2Ru_{1-x}Mn_xO_4$ Spinels"

A. Meldrum, L. A. Boatner, C. W. White, and D. O. Henderson, "Radiation Effects in Nonmetals: Amorphization, Phase Decomposition, and Nanoparticles" (invited paper)

A. Meldrum, C. W. White, L. A. Boatner, R. A. Zuhr, I. M. Anderson, D. O. Henderson, M. Wu, A. Ueda, and R. Mu, "Microstructure and Size Distribution of Compound Semiconductor Nanocrystals Synthesized by Ion Implantation"

A. Meldrum, S. J. Zinkle, L. A. Boatner, M. Wu, R. Mu, A. Ueda, D. O. Henderson, and R. C. Ewing, "Radiation Effects in Zircon, Hafnon, and Thorite: Implications for Pu Disposal"

D. P. Norton, C. Park, D. B. Geohegan, A. Puretzky, and J. D. Budai, "Plume-Induced Stress and Texture in Pulsed-Laser-Deposited CeO_2 Films"

W. W. Pai, "Post Growth Morphological Evolution in Metallic Homoepitaxy" (invited paper)

C. Park, D. P. Norton, D. K. Christen, D. Verebelyi, D. Lee, R. Feenstra, J. D. Budai, A. Goyal, D. M. Kroeger, M. Paranthaman, and E. D. Specht, "Pulsed-Laser Deposition of YBCO Film and Oxide Buffer Layers on 1- × 10-cm Rolling Assisted Biaxially Textured Substrates (RABiTS-TM)"

C. M. Rouleau, S. Kang, and J. W. Park, "Pulsed-Laser Ablation and RF Magnetron Sputtering of $MgIn_20_4$: Film Growth and Phase Competition"

B. C. Sales, B. C. Chakoumakos, D. Mandrus, J. W. Sharp, N. R. Dilley, and M. B. Maple, "Atomic Displacement Parameters: A Useful Tool in the Search for New Thermoelectric Materials?" (invited paper)

J. Shen, "Growth of Ultrathin Magnetic Films by Pulsed-Laser Deposition" (invited paper)

J. O. Sofo and G. D. Mahan, "Electronic Structure and Transport Properties of $CoSb_3$: A Narrow Band-Gap Semiconductor"

K. Sohlberg, S. J. Pennycook, and S. T. Pantelides, "The Role of Hydrogen in the Structure of γ–Alumina"

A. K. Swan and C. Hwang, "The Magnetic States of Fe on Rh(100)"

W. J. Weber, R. Devanathan, A. Meldrum, L. A. Boatner, R. C. Ewing, and L. M. Wang, "The Effect of Temperature and Recoil Spectra on Amorphization in Zircon"

J. F. Wendelken, J. K. Zuo, and W. W. Pai, "Edge Barriers and Smoothening on Cu(100) at Room Temperature"

C. W. White, A. Meldrum, E. Sonder, J. D. Budai, R. A. Zuhr, S. P. Withrow, and D. O. Henderson, "Formation of $ZnAl_2O_4$ and $MgAl_2O_4$ Spinel in Al_2O_3 by Ion Implantation"

S. P. Withrow, C. W. White, J. D. Budai, A. L. Meldrum, J. C. Barbour, and D. M. Hembree, Jr., "Effect of Hydrogen on Photoluminescence from Si Nanocrystals in SiO_2"

H. Zajonz, D. Gibbs, V. Jahns, A. P. Baddorf, and D. M. Zehner, "Structure and Dynamics of Strained Epitaxial Cu Films on Ru(0001) During Growth"

Y. Zhang, S. Vijayalakshmi, H. Grebel, J. Federici, and C. W. White, "Ion-Implanted Ordered Array of Silica Spheres"

Z. Zhang, J.-H. Cho, Q. Niu, C.-K. Shih, and Z. Suo, "Quantum Theory of Thin-Film Growth"

Z. Zhang, "What's Magic About Metallic Thin-Film Growth?"

R. A. Zuhr, J. D. Budai, P. G. Datskos, A. Meldrum, K. A. Thomas, R. J. Warmack, C. W. White, L. C. Feldman, M. Strobel, and K.-H. Heinig, "Nanostructured Arrays Formed by Finely Focused Ion Beams"

The Fifth International Workshop on Oxide Electronics, College Park, Maryland, December 7–8, 1998:

Y. E. Lee, D. P. Norton, and J. D. Budai, "Epitaxial Growth and Luminescent Properties of Mn-Doped $ZnGa_2O_4$ Films"

D. P. Norton, J. D. Budai, C. Park, Y. E. Lee, D. B. Geohegan, and A. Puretzky, "Plume-Induced Stress in Epitaxial Dielectric Films Grown by Pulsed-Laser Deposition"

Solid State Sciences Committee Meeting, Washington, D.C., December 9, 1998:

J. B. Roberto, "Report of the National Research Council Committee on Condensed-Matter and Materials Physics" (invited paper)

International Conference on Novel Formation Mechanisms and Physical Properties of Nanostructures, Hsinchu, Taiwan, December 12–15, 1998:

E. W. Plummer, "Surfaces: A Playground for Physics in Reduced Dimensionality"

Annual Meeting of the Condensed Matter Physics Section of the F.O.M., Veldhoven, the Netherlands, December 15–16, 1998:

H. H. Weitering, "Density Waves and Mott Insulators on Triangular Surface Lattices" (invited paper)

International Conference on High-Temperature Materials, Maui, Hawaii, January 1–4, 1999:

Z. Zhang, "What's Magic About Metallic Thin-Film Growth?" (invited paper)

1999 Aspen Winter Conference on Condensed Matter: Quantum Criticality, Aspen, Colorado, January 3–9, 1999:

S. E. Nagler, "Excitations in S - 1/2 Antiferromagnetic Chains" (invited paper)

The Second Hawaii Battery Conference, Big Island, Hawaii, January 4–7, 1999:

J. B. Bates, B. J. Neudecker, and N. J. Dudney, "Recent Developments in Thin-Film Lithium and Lithium-Ion Batteries" (invited paper)

Lawrence Symposium on Critical Issues in Epitaxy, Mesa, Arizona, January 6–9, 1999:

O. W. Holland, D. Fathy, and W.-K. Chu, "Epitaxial Layer Formation by Hydrogen Ion Implantation in Si, SiC, and $SrTiO_3$ and the Role of Hydrogen in Ion-Assisted Cuts"

D. E. Jesson, "Cooperative Nucleation, Self-Limiting Growth, and Shape Transitions During Strained-Layer Epitaxy" (invited paper)

Miami Conference on High-Temperature Superconductivity, Miami, Florida, January 11, 1999:

H. A. Mook, "Neutron Scattering Measurements of Spin and Charge Fluctuations in High-Temperature Superconductors" (invited paper)

SPIE Photonics West Conference, San Jose, California, January 23–29, 1999:

V. I. Merkulov, D. H. Lowndes, L. R. Baylor, G. E. Jellison, Jr., A. A. Puretzky, and D. B. Geohegan, "Pulsed-Laser-Deposited Amorphous Diamond and Related Materials: Synthesis, Characterization, and Field Emission Properties"

Semiconductor Process Analysis and Control (SEMIPAC) 1999, San Antonio, Texas, January 24–27, 1999:

G. E. Jellison, Jr., C. Chen, E. B. Grann, and M. L. Simpson, "Generalized Ellipsometry for Pattern Analysis"

Metrology Gate Dielectric Video Conference, Oak Ridge, Tennessee, February 9, 1999:

G. E. Jellison, Jr., "Spectroscopic Ellipsometry of Silicon Nitride" (invited paper)

Basic Energy Sciences Advisory Committee, Gaithersburg, Maryland, February 24, 1999:

J. B. Roberto, "The High Flux Isotope Reactor: Current Activities and Response to the BESAC Review" (invited paper)

J. B. Roberto, "Report of the National Research Council Committee on Condensed-Matter and Materials Physics" (invited paper)

Oak Ridge Associated Universities Council Meeting, Oak Ridge, Tennessee, February 25, 1999:

J. B. Roberto, "Research Opportunities in Neutron Scattering at ORNL: The Spallation Neutron Source and Upgrades at HFIR" (invited paper)

The Minerals, Metals, and Materials Society (TMS) Annual Meeting, San Diego, California, February 28–March 4, 1999:

D. H. Lowndes, V. I. Merkulov, A. J. Pedraza, J. D. Fowlkes, A. A. Puretzky, D. B. Geohegan, and G. E. Jellison, Jr., "Surface Engineering of Silicon and Carbon by Pulsed-Laser Ablation" (invited paper)

Symposium in Honor of Professor Linhard, Aarhus, Denmark, March 14, 1999:

E. W. Plummer, "The Impact of Linhard Response in Two Dimensions"

Workshop on Exotic Oxides, Upton, New York, March 18–20, 1999:

H. A. Mook, "Spin and Charge Fluctuations in High-Temperature Superconductors" (invited paper)

S. E. Nagler, "Some Recent Results on Ruthenates and Related Systems" (invited paper)

Centennial Meeting of the American Physical Society, Atlanta, Georgia, March 20–26, 1999:

E. A. Akhadov, T. W. Trelenberg, J. A. Li, J. G. Skofronick, S. A. Safron, and L. A. Boatner, "Studies of the Surface Metastable Structure of $KTaO_2$ (001) by Helium Atom Scattering" [*Bull. Am. Phys. Soc.* **44**, 1223 (1999)]

A. P. Baddorf, "Growth and Dynamics of Strained-Cu Films on Ru(0001)" [*Bull. Am. Phys. Soc.* **44**, 185 (1999)] (invited paper)

E. D. Bauer, R. Chau, N. R. Dilley, M. B. Maple, D. Mandrus, and B. C. Sales, "Pressure Dependence of the Electrical Resistivity of Filled Skutterudites $LnFe_4Sb_{12}$ (Ln = Ce, Yb) [*Bull. Am. Phys. Soc.* **44**, 1379 (1999)]

J. D. Budai, N. Tamura, J.-S. Chung, G. E. Ice, D. P. Norton, C. Park, J. Z. Tischler, B. C. Larson, A. Goyal, D. Lee, E. Williams, and W. P. Lowe, "Crystallographic Tilting of Oxide Films on Textured Metal Substrates Investigated by X-Ray Microbeams" [*Bull. Am. Phys. Soc.* **44**, 1901 (1999)]

B. C. Chakoumakos, Th. Leventouri, H. Y. Moghaddam, and V. Perdikatsis, "Neutron Crystallography of Carbonate-Substituted Hydroxyapatite" [*Bull. Am. Phys. Soc.* **44**, 532 (1999)]

M. F. Chisholm, "Interfacial Structure and Properties of Commensurate Crystalline Oxides on Silicon" [*Bull. Am. Phys. Soc.* **44**, 1585 (1999)] (invited paper)

N. R. Dilley, E. D. Bauer, M. B. Maple, B. C. Chakoumakos, F. Freiberg, and A. Migliori, "Thermoelectric Properties of Intermediate Valent Yb-Filled Skutterudite Compounds" [*Bull. Am. Phys. Soc.* **44**, 1380 (1999)]

A. Eguiluz, J. M. Sullivan, and W. Ku, "Electronic Excitations in Transition Metals of the 3D and 4D Rows with Shallow Core States" [*Bull. Am. Phys. Soc.* **44**, 546 (1999)]

M. Enderle, S. E. Nagler, H. Schwenk, B. Luethi, and W. Assmus, "Magnetic Excitations in $(VO)_2P_2O_7$" [*Bull. Am. Phys. Soc.* **44**, 1884 (1999)]

R. Feenstra, A. Goyal, D. T. Verebelyi, D. K. Christen, M. Paranthaman, D. F. Lee, E. D. Specht, D. M. Kroeger, P. N. Arendt, R. F. DePaula, and J. R. Groves, "Single-Crystal-Like Supercurrent Transport in RABiTS and IBAD Type YBCO-Coated Conductors Due to Grain-to-Grain Correlations" [*Bull. Am. Phys. Soc.* **44**, 1067 (1999)]

D. B. Geohegan and A. A. Puretzky, "Gas-Phase Nanoparticle Formation During Pulsed-Laser Deposition" [*Bull. Am. Phys. Soc.* **44**, 1367 (1999)]

D. B. Geohegan, A. A. Puretzky, S. J. Pennycook, A. Meldrum, and G. Duscher, "Time-Resolved Characterization of Nanomaterial Synthesis by Laser Ablation" [*Bull. Am. Phys. Soc.* **44**, 1583 (1999)]

G. E. Granroth, W. Montfrooij, D. G. Mandrus, and S. E. Nagler, "Neutron Scattering Studies of the Quasi 1-D Ising Ferromagnet $CoCl_2 \cdot 2D_2O$" [*Bull. Am. Phys. Soc.* **44**, 1885 (1999)]

C. Hwang, T. Miller, Y. Paggel, T.-C. Chiang, A. K. Swan, and D. M. Zehner, "Origin of the Enhancement of Surface Magneto-Optic Kerr Intensity with the Presence of a Ag Overlayer on Fe/Ag(001)" [*Bull. Am. Phys. Soc.* **44**, 1437 (1999)]

Ismail, J. Zhang, A. P. Baddorf, E. W. Plummer, and P. J. Rous, "The Periodic Lattice Distortion Accompanying the Charge-Density Wave Transition for Sn/Ge(111)" [*Bull. Am. Phys. Soc.* **44**, 422 (1999)]

A. V. Kadavanich, S. J. Pennycook, T. Kippeny, M. M. Erwin, and S. J. Rosenthal, "Atomic-Resolution Scanning TEM and EELS of Colloidal CdSe Nanocrystals" [*Bull. Am. Phys. Soc.* **44**, 290 (1999)]

S. Kang, G.-C. Yi, C. M. Rouleau, D. H. Lowndes, and C. Chen, "Nitride Buffer Layers for Epitaxial Growth of GaN on Si" [*Bull. Am. Phys. Soc.* **44**, 1061 (1999)]

H. R. Kerchner, D. P. Norton, A. Goyal, J. D. Budai. R. Feenstra, D. K. Christen, D. M. Kroeger, E. D. Specht, M. Paranthaman, D. F. Lee, F. A. List, and E. H. Brandt, "Power Loss of AC Transport Current Flow in Superconductive Films" [*Bull. Am. Phys. Soc.* **44**, 1594 (1999)]

W. Ku and A. Eguiluz, "Plasmon Lifetime in K: A Case Study of Correlated Electrons in Solids Amenable to *Ab Initio* Theory" [*Bull. Am. Phys. Soc.* **44**, 201 (1999)]

B. C. Larson, J. Z. Tischler, A. Fleszar, and A. G. Eguiluz, "Inelastic X-Ray Investigation of Folded-Plasmon Fano Resonance and Electronic Correlations in Aluminum" [*Bull. Am. Phys. Soc.* **44**, 215 (1999)]

Th. Leventouri, H. Y. Moghaddam, B. C. Chakoumakos, and V. Perdikatsis, "Atomic-Displacement Parameters of a Carbonate Apatite from Powder Neutron Diffraction Data" [*Bull. Am. Phys. Soc.* **44**, 532 (1999)]

J. A. Li, T. W. Trelenberg, E. A. Akhadov, J. G. Skofronick, S. A. Safron, and L. A. Boatner, "Dynamics of the Surface of $KtaO_3$ (001) by Helium Atom Scattering" [*Bull. Am. Phys. Soc.* **44**, 1224 (1999)]

D. H. Lowndes, "Pulsed-Laser Deposition and Surface Modification of Carbon and Silicon" [*Bull. Am. Phys. Soc.* **44**, 1367 (1999)] (invited paper)

G. D. Mahan, "Thermionic Refrigeration," [*Bull. Am. Phys. Soc.* **44**, 459 (1999)] (invited paper)

L. Mandelkern, G. D. Wignall, J. D. Londono, R. G. Alamo, and M. H. Kim, "The Morphology of Blends of Linear and Short-Chain-Branched Polyethylenes in the Solid State by Neutron Scattering and Differential Scanning Calorimetry" [*Bull. Am. Phys. Soc.* **44**, 531 (1999)]

D. G. Mandrus, R. S. Fishman, B. C. Chakoumakos, J. R. Thompson, V. Keppens, J. C. Bryan, and L. Forro, "Metal-Insulator Transition in a Magnetically Frustrated Lattice: The Pyrochlore $Cd_2Os_2O_7$" [*Bull. Am. Phys. Soc.* **44**, 330 (1999)]

P. Mason, B. Gaulin, R. Epand, G. D. Wignall, and J. S. Lin, "Structural Studies of the Ripple Phase in Multilamellar and Large Unilamellar Vesicles of DPPC" [*Bull. Am. Phys. Soc.* **44**, 1876 (1999)]

F. J. Medellin-Rodriguez, C. A. Avila-Orta, and J. S. Lin, "Crystallization at Low Times and Melting Studies of PET In Terms of Molecular Weight" [*Bull. Am. Phys. Soc.* **44**, 1560 (1999)]

A. Meldrum, R. A. Zuhr, L. A. Boatner, C. W. White, E. Sonder, D. O. Henderson, and R. C. Ewing, "Amorphization and Oxidation of Silicon Containing Embedded ZnS Nanocrystals" [*Bull. Am. Phys. Soc.* **44**, 1858 (1999)]

Y. Melnichenko and G. D. Wignall, "Molecular Weight Scaling in Critical Polymer Solutions" [*Bull. Am. Phys. Soc.* **44**, 1756 (1999)]

S. E. Nagler, G. E. Granroth, Y. Nagata, H. Fujino, J. Akimitsu, and S. Katano, "Inelastic Neutron Scattering Measurement of the Ladder-Rung Structure Factor in $Sr_{2.5}Ca_{11.5}Cu_{24}O_{41}$" [*Bull. Am. Phys. Soc.* **44**, 129 (1999)]

M. Nishi, S. Katano, K. Kakurai, Y. Fujii, J. Akimitsu, M. Yethiraj, and J. A. Fernandez-Baca, "New Aspects of the b^*-LA Phonon of $CuGeO_3$" [*Bull. Am. Phys. Soc.* **44**, 1724 (1999)]

Q. Niu, "Berry Phase and Adiabatic Spin Dynamics" [*Bull. Am. Phys. Soc.* **44**, 1558 (1999)] (invited paper)

M. Noh, H. H. Weitering, and A. P. Baddorf, "Surface Structural and Spectroscopic Study of Ultrathin Si(111) on SiO_2" [*Bull. Am. Phys. Soc.* **44**, 1327 (1999)]

A. A. Puretzky, D. B. Geohegan, G. B. Hurst, M. V. Buchanan, and B. S. Luk'yanchuk, "Imaging of Vapor Plumes Produced by Matrix-Assisted Laser Desorption: A New Sharpening Effect" [*Bull. Am. Phys. Soc.* **44**, 686 (1999)]

C. M. Rouleau, D. H. Lowndes, S. Kang, G.-C. Yi, and C. Chen, "Liquid Target Pulsed-Laser Ablation for Growth of Group-III Nitrides" [*Bull. Am. Phys. Soc.* **44**, 1061 (1999)]

B. C. Sales, D. Mandrus, B. C. Chakoumakos, and J. W. Sharp, "Atomic-Displacement Parameters and Thermal Conductivity" [*Bull. Am. Phys. Soc.* **44**, 458 (1999)]

H. Smith, B. C. Chakoumakos, and J. A. Fernandez-Baca, "Magnetic and Crystal Structures of the Alkali Superoxides" [*Bull. Am. Phys. Soc.* **44**, 1172 (1999)]

K. Sohlberg, S. J. Pennycook, and S. T. Pantelides, "Catalytic Aluminas—A Reactive Sponge" [*Bull. Am. Phys. Soc.* **44**, 1029 (1999)]

K. J. Song, J. R. Thompson, D. K. Christen, D. G. Mandrus, M. Yethiraj, C. V. Tomy, and D. McK. Paul, "Superconducting and Magnetic Properties of YNi_2B_2C Single Crystal," [*Bull. Am. Phys. Soc.* **44**, 1591 (1999)]

J. M. Sullivan and A. Eguiluz, "Electron Correlations and the Compton Profile of Li" [*Bull. Am. Phys. Soc.* **44**, 547 (1999)]

N. Tamura, J.-S. Chung, G. E. Ice, B. C. Larson, J. D. Budai, M. Yoon, J. Z. Tischler, E. L. Williams, and W. P. Lowe, "X-Ray Microbeam Measurement of Strain in Al Interconnects" [*Bull. Am. Phys. Soc.* **44**, 1183 (1999)]

J. Z. Tischler, M. Yoon, B. C. Larson, D. H. Lowndes, G. Eres, and P. Zschack, "Time-Resolved X-Ray Diffraction Study of $SrTiO_3$ Homoepitaxy During Pulsed-Laser Deposition" [*Bull. Am. Phys. Soc.* **44**, 1210 (1999)]

T. W. Trelenberg, J. A. Li, E. A. Akhadov, J. G. Skofronick, S. A. Safron, and L. A. Boatner, "Observation of a Surface Phase Transition in $KtaO_3$(001) by Helium Atom Scattering (HAS)," [*Bull. Am. Phys. Soc.* **44**, 1223 (1999)]

D. T. Verebelyi, D. K. Christen, R. Feenstra, and C. Prouteau, "Critical Current of YBCO Grain Boundaries in High-Magnetic Field" [*Bull. Am. Phys. Soc.* **44**, 692 (1999)]

T. Walker, S. Khan, R. Spontak, and G. D. Wignall, "Enhanced Miscibility in UCST Polymer Blends in the Presence of Supercritical Carbon Dioxide" [*Bull. Am. Phys. Soc.* **44**, 531 (1999)]

B. C. Watson, M. W. Meisel, D. A. Jensen, G. E. Fanucci, D. R. Talham, G. E. Granroth, and S. E. Nagler, "Magnetic Properties of Two $S = 1/2$ Ladder-Like Compounds" [*Bull. Am. Phys. Soc.* **44**, 128 (1999)]

J. F. Wendelken, W. W. Pai, and Z. Zhang, "Nanocluster Growth Under the Influence of Coulombic Forces" [*Bull. Am. Phys. Soc.* **44**, 706 (1999)]

G. D. Wignall, Y. Melnichenko, and A. Van Hook, "Intramolecular Correlations of a Polymer in Poor and Theta Solvents" [*Bull. Am. Phys. Soc.* **44**, 1756 (1999)]

S. P. Withrow, C. W. White, A. Meldrum, J. D. Budai, J. C. Barbour, and D. M. Hembree, Jr., "Enhancement of Luminescence from Si Nanocrystals in SiO_2 by Incorporation of Hydrogen" [*Bull. Am. Phys. Soc.* **44**, 1584 (1999)]

M. Yethiraj, D. K. Christen, and D. Mck. Paul, "Flux-Lattice Symmetry in V_3Si" [*Bull. Am. Phys. Soc.* **44**, 1484 (1999)]

K. J. Yoo, H. H. Weitering, and A. P. Baddorf, "Correlation Between Surfaces States and Transport Properties of Silicon Surfaces" [*Bull. Am. Phys. Soc.* **44**, 1168 (1999)]

M. Yoon, B. C. Larson, J. Z. Tischler, J.-S. Chung, G. E. Ice, T. E. Haynes, and P. Zschack, "Use of X–Ray Microbeams for Depth Profiling of MeV Ion-Implantation-Induced Defect Clusters in Si" [*Bull. Am. Phys. Soc.* **44**, 1045 (1999)]

R. A. Zuhr, J. D. Budai, P. D. Datskos, A. Meldrum, K. A. Thomas, R. J. Warmack, C. W. White, L. C. Feldman, M. Strobel, and K.-H. Heinig, "Nanostructured Arrays Formed by Finely Focused Ion Beams" [*Bull. Am. Phys. Soc.* **44**, 1182 (1999)]

Annual Meeting of the American Chemical Society, Anaheim, California, March 21–25, 1999:

J. M. DeSimone, D. Betts, T. Johnson, J. M. McClain, S. L. Wells, A. Dobrynin, M. Rubinstein, D. Londono, G. D. Wignall, and R. Triolo, "Molecularly Engineered Surfactants for Co_2"

German Physical Society Meeting, Muenster, Germany, March 22–26, 1999:

J. R. Thompson, "Vortex Pinning and Critical Currents in High-T_c Superconductors: Enhancements with Random Columnar Defects" [*Verhandlungen der Deutschen Physikalischen Gesellschaft* **34**, 1010 (1999)] (invited paper)

Tenth European Union of Geosciences, Strasbourg, France, March 28–April 1, 1999:

A. Meldrum, L. A. Boaner, S. J. Zinkle, and R. C. Ewing, "Ion Irradiation Effects in the Zircon-Structure Orthosilicates"

March Meeting of the American Physical Society, 1999 Particle Accelerator Conference, New York, New York, March 29–April 2, 1999:

R. S. Fishman and S. H. Liu, "Helical Spin-Density Waves in Fe/Cr Multilayers"

Spring Meeting of the Materials Research Society, San Francisco, California, April 5–9, 1999:

J. D. Budai, N. Tamura, J.-S. Chung, D. P. Norton, G. E. Ice, B. C. Larson, J. Z. Tischler, C. Park, D. Lee, E. L. Williams, and W. P. Lowe, "X-Ray Microbeam Investigation of Epitaxial Oxide Films on Textured Metal Substrates"

C. R. Cho, N. Yarykin, G. A. Rozgonyi, and R. A. Zuhr, "In Situ Photoexcitation-Induced Suppression of Point Defect Generation in Ion-Implanted Silicon"

J.-S. Chung, N. Tamura, G. E. Ice, B. C. Larson, and J. D. Budai, "X-Ray Microbeam Measurement of Local Texture and Strain in Thin Films"

R. B. Gregory, O. W. Holland, D. K. Thomas, T. A. Wetteroth, and S. R. Wilson, "The Effects of Damage on Hydrogen-Implant-Induced Thin-Film Separation from Bulk Silicon Carbide"

A. V. Kadavanich, T. Kippeny, M. M. Erwin, S. J. Rosenthal, and S. J. Pennycook, "Z-Contrast STEM Imaging and EELS of CdSe Nanocrystals: Toward the Analysis of Individual Nanocrystal Surfaces"

Y. E. Lee, C. M. Rouleau, C. Park, and D. P. Norton, "$ZnGa_2O_4$ Thin-Film Phosphors Grown by Pulsed-Laser Ablation"

L. Pelaz, G. H. Gilmer, H.-J. Gossmann, V. C. Venezia, T. E. Haynes, M. Jaraiz, L. A. Bailon, and J. Barbolla, "Effects of Dose, Dose-Rate, and Implant Temperature on Transient-Enhanced Diffusion: Atomistic Simulations and Experiments"

N. Tamura, J.-S. Chung, G. E. Ice, B. C. Larson, J. D. Budai, J. Z. Tischler, M. Yoon, E. L. Williams, and W. P. Lowe, "Strain and Texture in Al-Interconnect Wires Measured by X-Ray Microbeam Diffraction"

V. C. Venezia, T. E. Haynes, H.-J. Gossmann, A. Agarwal, L. Pelaz, D. C. Jacobson, and D. J. Eaglesham, "Formation and Stability of Vacancy Clusters in MeV-Implanted Si"

D. L. Windt, J. D. Torre, G. H. Gilmer, J. Sapjeta, R. Kalyanaraman, F. H. Baumann, P. O. O'Sullivan, D. Dunn, and R. Hull, "Growth and Structure of Metallic Barrier Layer and Interconnect Films I: Experiments"

Z. Zhang, "Self-Organized Formation of Quantum Dots of Almost Any Material on Any Substrate" (invited paper)

Workshop on ac Losses, Palo Alto, California, April 8–9, 1999:

H. R. Kerchner, D. P. Norton, A. Goyal, J. D. Budai, D. K. Christen, D. M. Kroeger, M. Paranthaman, D. F. Lee, F. A. List, R. Feenstra, and E. H. Brandt, "Alternating Transport-Current Flow in Superconductive Films—The Important Role of a Barrier-to-Vortex Entry"

Scanning 99, Chicago, Illinois, April 11–14, 1999:

S. J. Pennycook, M. Kim, N. D. Browning, K. Sohlberg, R. Buczko, and S. T. Pantelides, "Probing the Origin of Interfacial Properties by STEM" (invited paper)

American Vacuum Society International Conference on Metallurgical Coatings and Thin Films, San Diego, California, April 12–16, 1999:

G. E. Jellison, Jr., "Two-Modulator Generalized Ellipsometry: Applications to Anisotropic Materials" (invited paper)

Werner Brandt Conference, Baraloche, Argentina, April 16, 1999:

E. W. Plummer, "The Effect of Broken Symmetry in Reduced Dimensionality" (invited paper)

Commercialization Advances in Large-Scale Production of Carbon Nanotubes, Washington, D.C., April 22–23, 1999:

D. B. Geohegan, A. A. Puretzky, X. Fan, S. J. Pennycook, G. Duscher, M. Guillorn, M. L. Simpson, and R. D. Seals, "Time-Resolved Diagnostics of Nanomaterial Synthesis—Targeting Nanotubes"

One-Hundred First Annual Meeting of the American Ceramic Society, Indianapolis, Indiana, April 25–28, 1999:

N. J. Dudney, J. B. Bates, and F. X. Hart, "Hysteresis in the Reversible Lithium Insertion Reactions of Thin-Film Electrode Materials"

J. M. Hanchar, L. A. Boatner, and P. D. Townsend, "Cathodoluminescence Spectroscopy of the Trivalent Rare-Earth Elements in Synthetic $REEPO_4$, YPO_4, and $ScPO_4$"

A. Meldrum, L. A. Boatner, and R. C. Ewing, "Radiation Effects in Lanthanide-Bearing ABO_4 Compounds Proposed for Nuclear Waste Disposal" (invited paper)

F. A. Modine, "Composite Dielectric Materials for Electrical Switching" (invited paper)

One-Hundred Ninety-Fifth Meeting of the Electrochemical Society, Seattle, Washington, May 2–7, 1999:

B. J. Neudecker, R. A. Zuhr, and J. B. Bates, "Lithium Thin-Film Batteries with Sn_3N_4, Zn_3N_2, and In Situ Plated Li Anodes" (invited paper)

Eleventh International Conference on Small-Angle Scattering, Upton, New York, May 17–20, 1999:

M. M. Agamalian, R. G. Alamo, J. D. Londono, L. Mandelkern, and G. D. Wignall, "Phase Behavior of Blends of Linear and Branched Polyethylenes on Micon-Length Scales via Ultra Small-Angle Neutron Scattering (USANS)"

J. S. Lin, M. Agamalian, and G. D. Wignall, "Recent Applications and Performance of the ORNL USANS Facility"

Y. B. Melnichenko, G. D. Wignall, and W. A. Van Hook, "Inter- and Intramolecular Correlations in Supercritical and Liquid Polymer Solutions via Small-Angle Neutron Scattering"

Y. B. Melnichenko, G. D. Wignall, and W. A. Van Hook, "Molecular Weight Scaling in Critical Polymer Solutions"

A. P. Radlinski, E. Z. Radlinska, M. Agamalian, G. D. Wignall, P. Lindner, and O. G. Randl, "The Fractal Microstructure of Petroliferous Sedimentary Rocks"

D. W. Schaefer, N. Raman, R. Pekala, S. Mohnor, T. Rieker, M. Agamalian, and J. S. Lin, "Multilevel Structure of Colloidal Aggregates"

F. Triolo, A. Triolo, R. Triolo, D. Betts, J. McClain, J. M. De Simone, G. D. Wignall, B. Demè, D. C. Steytler, and R. K. Heenan, "Critical Micellization Density: A SAS Structural Study of the Unimer-Aggregate Transition of Block-Copolymers in Supercritical Co_2"

F. Triolo, A. Triolo, M. Agamalian, J. S. Lin, R. K. Heenan, G. Lucido, and R. Triolo, "Fractal Approach in Petrography: Combining USANS, SANS, and IANS"

Ninth Conference on Computational Research on Materials, Morgantown, West Virginia, May 19–21, 1999:

K. Sohlberg, "A Computational Investigation of Unusual Chemistry of Catalytic Aluminas" (invited paper)

International Conference on Rational Approaches to New Materials Design and Synthesis, Philadelphia, Pennsylvania, May 20–21, 1999:

K. Sohlberg, "Understanding the Chemical Structure and Properties of Alumina-Based Catalysts Through Synergism Between Theory and Experiment" (invited paper)

American Crystallographic Association Annual Meeting, Buffalo, New York, May 22–27, 1999:

B. C. Chakoumakos, B. C. Sales, D. G. Mandrus, J. W. Sharp, G. S. Nolas, N. R. Dilley, and M. B. Maple, "Thermal Conductivity from Atomic Displacement Parameters"

National Synchrotron Light Source (NSLS) Users' Meeting, Upton, New York, May 24–26, 1999:

J. D. Budai, "Grain-by-Grain Microbeam Studies of Epitaxial Growth of Oxide Films on Vicinal Substrates" (invited paper)

International Conference on Next Generation Materials and Devices for Si-Based Microelectronics, Shanghai, China, May 30–June 2, 1999:

H. H. Weitering, "Surface Characterization and Electrical Transport of Ultrathin Silicon Layers on SiO_2" (invited paper)

Tennessee Technology Summit, Knoxville, Tennessee, June 1–6, 1999:

D. B. Poker, "The Surface Modification and Characterization User Center" (invited paper)

Spring Meeting of the European Materials Research Society, Strasbourg, France, June 1–4, 1999:

D. H. Lowndes, V. I. Merkulov, A. A. Puretzky, D. B. Geohegan, G. E. Jellison, Jr., J. D. Fowlkes, and A. J. Pedraza, "Pulsed-Laser Deposition and Surface Modification of Carbon and Silicon" (invited paper)

D. H. Lowndes, J. D. Fowlkes, and A. J. Pedraza, "Early Stages of Pulsed-Laser Growth of Silicon Microcolumns and Microcones in Air and SF_6"

Third Spanish Neutron Scattering School, Oviedo, Spain, June 2–5, 1999:

J. A. Fernandez-Baca, "Inelastic Neutron Scattering" (invited paper)

Ninth Workshop on Surface Dynamics (SURPHON9), Charlottesville, Virginia, June 2–6, 1999:

J. A. Li, T. W. Trelenberg, E. A. Akhadov, E. Kintzel, S. A. Safron, J. G. Skofronick, and L. A. Boatner, "Structure and Dynamics of $KTaO_3$(001) via Elastic and Inelastic Helium Atom Scattering" (invited paper)

J. A. Li, T. W. Trelenberg, E. A. Akhadov, J. G. Skofronick, S. A. Safron, and L. A. Boatner, "Surface Metastable Structure of $KTaO_3$(001) by Helium Atom Scattering,"

Twelfth International Conference on Solid State Ionics, Thessaloniki, Greece, June 6–12, 1999:

J. B. Bates, N. J. Dudney, B. J. Neudecker, A. Ueda, and C. D. Evans, "Thin-Film Lithium and Lithium-Ion Batteries" (invited paper)

U.S. Materials Science User Group Meeting, Lexington, Kentucky, June 10–11, 1999:

K. Sohlberg, S. Pennycook, and S. T. Pantelides, "Unusual Chemistry of Catalytic Alumina Surfaces" (invited paper)

Fifteenth University Conference on Glass Science, Rolla, Missouri, June 20–23, 1999:

C.-K. Loong, L. A. Boatner, and J. Y. Wang, "Magnetic and Thermodynamic Properties of Rare-Earth Orthophosphates and Pentaphosphates"

B. C. Sales, L. A. Boatner, and J. O. Ramey, "Chromatographic Studies of the Structures of Amorphous Phosphates: A Review" (invited paper)

Third French Electron Microscopy Meeting, Orsay, France, June 28–July 2, 1999:

G. Duscher, S. J. Pennycook, and S. T. Pantelides, "Atomic-Column-Resolved Analysis at Semiconductor Interfaces" (invited paper)

Forty-First Electronic Materials Conference, Santa Barbara, California, June 30–July 2, 1999:

Y. Xin, N. D. Browning, S. J. Pennycook, S. Sivananthan, R. Sporken, F. Omnés, B. Beaumont, J. P. Faurie, and P. Gibart, "Atomic-Scale Analysis of Defect Structures and Properties in III-Nitride Materials by Z-Contrast Imaging and EELS in STEM"

Y. Zheng, Z. F. Guan, S. S. Lau, D. Hansen, T. F. Kuech, T. E. Haynes, T. F. Hoechbauer, and M. Nastasi, "Ion-Cutting of GaSb Wafers"

Ninth European Meeting on Ferroelectricity, Prague, Czechoslovakia, July 1999:

E. Farhi, A. K. Tagantsev, B. Hehlen, R. Currat, L. A. Boatner, and E. Courtens, "The Broad Brillouin Doublet and CP of $KtaO_3$: Second Sound vs. Two-Phonon Difference Scattering"

V. Trepakov, M. Savinov, L. Jastrabik, J. Licher, S. Kapphan, and L. A. Boatner, "Dielectric Properties and Phase Transitions in $K_{1-x}Li_xTa_{1-y}Nb_yO_3$:Cu"

Science and Technology of Magnetic Oxides 99, La Jolla Advanced Topics Research School, La Jolla, California, July 5–9, 1999:

P. Dai, "Spin and Lattice Dynamics in Colossal Magnetoresistance Manganites" (invited paper)

Ninth International Workshop on Critical Currents, Madison, Wisconsin, July 7–10, 1999:

J. R. Thompson, J. G. Ossandon, L. Krusin-Elbaum, K. J. Song, D. K. Christen, and J. L. Ullmann, "Quantum Constraints on Technological Superconductors: Bi-2212/Ag Tapes with Randomly Oriented Columnar Defects"

D. T. Verebelyi, R. Feenstra, A. Goyal, D. K. Christen, C. Prouteau, P. N. Arendt, R. F. DePaula, and J. R. Groves, "Effects of Grain Boundaries on the Critical Current of YBCO Coated Conductors"

Gordon Research Conference on Processing Far-From-Equilibrium, Plymouth, New Hampshire, July 11–16, 1999:

D. H. Lowndes, "Hyperthermal Ablation Beams for Film Growth and Surface Microstructural Engineering"(invited paper)

DOE Workshop on Advanced Lithium Solid State Batteries, Towson, Maryland, July 13–15, 1999:

N. J. Dudney, "Addition of a Thin-Film Inorganic Solid Electrolyte (Lipon) as a Protective Film in Lithium Batteries with a Liquid Electrolyte" (invited paper)

Scanning Transmission Microscopy 1999, Seoul, Korea, July 18–22, 1999:

E. W. Plummer, "Surfaces: A Playground for Physics in Reduced Dimensionality with Broken Symmetry"

Society of Photo-Optical Instrumentation Engineers Forty-Fourth Annual Meeting—The International Symposium on Optical Science, Engineering, and Instrumentation, Denver, Colorado, July 18–23, 1999:

G. E. Jellison, Jr., F. A. Modine, and C. Chen, "Calibration Procedures for a Two-Modulator Generalized Ellipsometer"

T. Yoshida, Y. Yamada, N. Suzuki, T. Makino, T. Orii, K. Murakami, D. B. Geohegan, D. H. Lowndes, and M. J. Aziz, "Crystallinity and Light-Emitting Properties of Nanostructured SiGe Alloys Prepared by Pulsed-Laser Ablation in Inert Background Gases"

Radiation Effects in Insulators—10, Jena, Germany, July 18–23, 1999:

A. L. Evelyn, D. Ila, R. L. Zimmerman, M. G. Rodrigues, D. B. Poker, and D. K. Hensley, "Radiation-Enhanced Increased Porosity and Roughness of Biomaterials"

D. Ila, E. K. Williams, D. B. Poker, and D. K. Hensley, "Post Implantation Irradiation-Induced Nucleation of Nano-Crystals"

S. S. Sarkisov, M. J. Curley, E. K. Williams, D. Ila, C. Banks, J.-C. Wang, D. B. Poker, and D. K. Hensley, "Nonlinear Optical Waveguides Produced by MeV Ion Implantation in $LiNbO_3$"

E. K. Williams, D. Ila, P. R. Ashley, C. Maurer, D. B. Poker, and D. K. Hensley, "Channel Waveguides Produced in AlGaAs/GaAs MQW Structure by MeV Ion Bombardment"

R. L. Zimmerman, D. Ila, E. K. Williams, B. Gasic, A. Elsamadicy, A. L. Evelyn, D. Larkin, D. B. Poker, and D. K. Hensley, "Gold, Silver, and Copper Nanocrystal Formation in SiC by MeV Implantation"

Fifth International Conference on Laser Ablation, Goettingen, Germany, July 19–23, 1999:

D. B. Geohegan and A. A. Puretzky, "Dynamics of Materials Synthesis by Laser Ablation" (invited paper)

C. M. Rouleau, S. Kang, and D. H. Lowndes, "Pulsed-KrF Laser-Deposited GaN/TiN/Si(111) Heterostructures by Sequential TiN and Liquid Ga Laser Ablation"

AFOSR/MURI Kick-Off Meeting, Nashville, Tennessee, July 22-23, 1999

G. Duscher, S.J. Pennycook, and S.T. Pantelides, "Application of Atomic-Resolution Z-Contrast STEM to Radiation-Induced Defects"

Twentieth International Conference on Defects in Semiconductors, Berkeley, California, July 26–30, 1999:

S. J. Pennycook, M. F. Chisholm, Y. Yan, G. Duscher, and S. T. Pantelides, "A Combined Experimental and Theoretical Approach to Grain-Boundary Structure and Segregation" (invited paper)

V. C. Venezia, T. E. Haynes, A. Agarwal, H.-J. Gossmann, L. Pelaz, D. C. Jacobson, and D. J. Eaglesham, "Evolution of Vacancy Supersaturations in MeV Si-Implanted Silicon" (invited paper)

Microscopy and Microanalysis 1999, Portland, Oregon, August 1–5, 1999:

X. Fan, E. C. Dickey, S. J. Pennycook, L. Grigorian, P. Eklund, R. S. Buczko, and S. T. Pantelides, "Direct Observation of Iodine Atomic Chains in I-Doped Carbon Nanotubes"

X. Fan, E. C. Dickey, and S. J. Pennycook, Z-Contrast Imaging and EELS Analysis of Chromium-Doped Diamond-Like Carbon"

H.-J. Gao, B. Rafferty, C. L. Chen, R. K. Singh, and S. J. Pennycook, "Misfit Dislocation Core Structures at $Ba_{0.5}Sr_{0.5}TiO_3/LaAlO_3$ Interfaces"

M. Kim, N. D. Browning, S. J. Pennycook, K. Sohlberg, and S. T. Pantelides, "The Origin of Electrical Activity at Grain Boundaries in Perovskites"

S. J. Pennycook, "Diffraction Channeling and the Production of Secondary Excitations" (invited paper)

S. J. Pennycook, G. Duscher, R. S. Buczko, and S. T. Pantelides "The Si/SiO_2 Interface: Atomic Structures, Composition, Strain, and Energetics" (invited paper)

S. J. Pennycook, B. Rafferty, and P. D. Nellist, "Z-Contrast Imaging in an Aberration-Corrected STEM" (invited paper)

Y. Xin, S. Rujirawat, G. Brill, N. D. Browning, S. J. Pennycook, S. Sivananthan, and R. Sporken, "Investigating the Effect of As and Te Passivation on the MBE Growth of CdTe(111) on Si(111) Substrates"

Y. Yan and S. J. Pennycook, "Atomic-Resolution Z-Contrast Imaging of Decagonal Quasicrystals: A Nucleation and Growth Mechanism"

Y. Yan, Z. Xu, X. Lu, D. Viehland, M. Al-Jassim, and S. J. Pennycook, "Structural Determination of a Novel Defect in $SrBi_2Ta_2O_9$ Using Atomic-Resolution Z-Contrast Imaging"

Forty-Eighth Denver X-Ray Conference, Denver, Colorado, August 2–6, 1999:

J. D. Budai, G. E. Ice, B. C. Larson, N. Tamura, J.-S. Chung, J. Z. Tischler, D. P. Norton, E. L. Williams, and W. P. Lowe, "Synchrotron X-Ray Microdiffraction Study of Epitaxial Oxide Films on Textured Nickel Substrates"

Y. B. Melnichenko, G. D. Wignall, J. D. Londono, K. D. Heath, S. Salaniwal, H. D. Cochran, E. Kiran, and M. Stamm, "In Situ Scattering Characterization of Homopolymers in Supercritical Fluids"

G. D. Wignall, J. D. Londono, R. Triolo, J. B. McClain, D. E. Betts, J. M. DeSimone, and Y. B. Melnichenko, "Small-Angle Neutron Scattering from Block Copolymer Micelles in Supercritical Carbon Dioxide"

Twenty-Second International Conference on Low-Temperature Physics, Espoo and Helsinki, Finland, August 4–11, 1999:

K. J. Song, H. R. Khan, H. J. Kim, and J. R. Thompson, "Properties of Polycrystalline $Hg_{1-x}Bi_xBa_2Ca_2Cu_3O_y$ Superconductors"

K. J. Song, J. R. Thompson, M. Yethiraj, D. K. Christen, D. Mandrus, C. V. Tomy, and D. McK. Paul, "Nonlocal Superconductivity and the Vortex-State Properties of YNi_2B_2C"

J. R. Thompson, J. G. Ossandon, L. Krusin-Elbaum, K. J. Song, D. K. Christen, and J. L. Ullmann, "Quantum Tunneling of Vortices in Bi-2212 with Splayed Columnar Defects"

Twenth-Eighth International Union of Crystallography Congress and General Assembly, Glasgow, Scotland, August 4–13, 1999:

M. Agamalian and G. D. Wignall, "Phase Behavior of Blends of Linear and Branched Polyethylenes via Ultra Small-Angle Neutron Scattering"

B. C. Chakoumakos, B. C. Sales, D. G. Mandrus, J. W. Sharp, and G. S. Nolas, "Thermoelectric Clathrates"

C. J. Howard, B. J. Kennedy, and B. C. Chakoumakos, "Experimental Studies of Octahedral Tilting in Perovskites"

Z. Zhang, "Quantum Effects in Ultrathin Metal Overlayer Epitaxy" (invited paper)

Twelfth International Conference on Textures of Materials, Montreal, Canada, August 9–13, 1999:

W. C. Ko, J. S. Perng, and J. S. Lin, "Analyses of Crystal Orientation and Fibrillar Morphology in High-Speed Melt-Spun Polyethylene Fibers by X-Ray Diffraction and Scattering Techniques" (invited paper)

The Fifth International Conference on Inorganic Scintillators and Their Applications (SCINT 99), Moscow, Russia, August 16–20, 1999:

A. N. Trukhin and L. A. Boatner, "Luminescence Properties of $ScPO_4$ Single Crystals"

DOE-EPSCoR Partners in Scientific Collaboration Conference, Oak Ridge, Tennessee, August 18, 1999:

J. B. Roberto, "New Directions in Materials Research" (invited paper)

Two-Hundred Eighteenth American Chemical Society National Meeting, New Orleans, Louisiana, August 22–26, 1999:

S. A. Baratian, E. S. Hall, A. Blomquist, J. S. Lin, and J. Runt, "Crystallization and Solid State Structure of Poly(Lactide) Copolymers"

S. T. Pantelides, R. Buczko, S. J. Pennycook, "Local and Global Bonding Properties of the Si-SiO_2 Interface" (invited paper)

NATO Advanced Research Workshop on Defects and Surface-Induced Effects in Advanced Perovskites, Jurmala, Latvia, August 23-25, 1999:

W. J. Weber, W. Jiang, S. Thevuthasan, R. E. Williford, A. Meldrum, and L. A. Boatner, "Ion-Beam-Induced Defects and Defect Interactions in Perovskite-Structure Titanates"

Workshop on Superlattices and Microstructures, Cancun, Mexico, August 27–29, 1999:

L. A. Boatner, S. Honda, A. Meldrum, F. A. Modine, T. E. Haynes, L. A. Gea, and J. D. Budai, "Complex Materials—'Smart' and 'Active' Surfaces" (invited paper)

Eighteenth International Conference on Thermoelectrics, Baltimore, Maryland, August 29–September 2, 1999:

G. D. Mahan, "Multilayer Thermionic Refrigeration"

B. C. Sales, B. C. Chakoumakos, D. G. Mandrus, and J. W. Sharp, "Finding New Thermoelectric Compounds Using Crystallographic Data: Atomic Displacement Parameters" (invited paper)

H. H. Weitering, "Growth and Characterization of Epitaxial Metal/Semiconductor Heterostructures for Thermionic Refrigeration"

Second European Neutron Scattering Conference, Budapest, Hungary, September 1–4, 1999:

S. Katano, J. A. Fernandez-Baca, and Y. Yamada, "Phase Transitions, Diffuse Scattering, and Segregation Kinetics in the Colossal Magnetoresistance Material $Pr_{70}Ca_{30}MnO_3$"

New Diagnostic Techniques Based on the Synchrotron Radiation Beams, International Memorial Symposium Devoted to the 70th Anniversary of Professor M. O. Krivoglaz, Alushta, the Crimea, Ukraine, September 6–12. 1999:

G. E. Ice, J.-S. Chung, B. C. Larson, J. D. Budai, J. Z. Tischler, N. Tamura, and W. Lowe, "X-Ray Microdiffraction Studies of Mesoscale Structure and Dynamics Below the Size of Most Polycrystalline Grains" (invited paper)

B. C. Larson, M. Yoon, J. Z. Tischler, G. E. Ice, T. E. Haynes, and P. Zschack, "Microbeam X-Ray Diffuse Scattering Study of Ion-Implanted Defects in Silicon" (invited paper).

Eleventh International Conference on Surface Modification of Metals by Ion Beams, Beijing, China, September 19–24, 1999:

J. D. Budai, C. W. White, A. Meldrum, S. P. Withrow, and R. A. Zuhr, "Ion-Beam Synthesis of Semiconductor Nanocrystals" (invited paper)

Seventh International Conference on Quasicrystals, Stuttgart, Germany, September 20–24, 1999:

S. J. Pennycook and Y. Yan, "Z-Contrast Imaging of Decagonal Quasicrystals: An Atomistic Model of Growth" (invited paper)

Eighth International Conference on Gettering and Defect Engineering in Semiconductor Technology, Lund, Sweden, September 23–27, 1999:

S. T. Pantelides and F. Reboredo, "Hydrogen Aggregation in Silicon and the 'Smart Cut,'" (invited paper)

Seminars

SOLID STATE DIVISION SEMINARS AT ORNL

During this period B. C. Sales served as Seminar Chairman assisted by L. W. Hinton, April 1997–September 30, 1999. The following seminars were held:

"Evaluating Mechanical Properties of Thin Layers Using Nanoindentation and Finite-Element Modeling," J. A. Knapp, Sandia National Laboratories, Albuquerque, New Mexico

"On the Biological Advantage of Chirality," G. Gilat, Wake Forest University, Winston-Salem, North Carolina

"Strong-to-Weak Coupling Transition in Low Misorientation-Angle Thin-Film and Bulk $YBa_2Cu_3O_{7-x}$ Bicrystals," N. Heinig, University of Wisconsin, Madison, Wisconsin

"Properties of Hexaborides: Recent Experiments on Electrical and Magnetic Properties," Z. Fisk, Florida State University, Tallahassee, Florida

"Semiconductor Nanocrystals," L. Brus, Columbia University, New York, New York

"Interaction of Hydrogen with Intrinsic Defects in Si," B. B. Nielsen, University of Aarhus, Aarhus, Denmark

"Atomic Collisions in Solids and Surfaces," V. Ponce, Centro Atomico Bariloche, Bariloche, Argentina

"Magnetic and Electronic Properties of Ruthenates," D. J. Singh, Naval Research Laboratory, Washington, D.C.

"Synthesis of Large Arrays of Well-Aligned Carbon Nanotubes," Z. Ren, State University of New York, Buffalo, New York

"Quantum Monte Carlo Studies of Helium on Graphite," M. Pierce, Florida State University, Tallahassee, Florida

"Thermoelectric Properties of Tellurides," T. M. Tritt, Clemson University, Clemson, South Carolina

"Charge Ordering and Magnetic Transitions in Giant Magnetoresistive (GMR) Oxides," S. K. Mishra, Massachusetts Institute of Technology, Cambridge, Massachusetts

"Multi-Gram Synthesis and Physical Properties of Single-Wall Carbon Nanotubes Produced by the Arc Discharge Method," P. Eklund, University of Kentucky, Lexington, Kentucky

"A New Liquid Phase and Metal-Insulator Transition in 2D Electron Systems," X. C. Xie, Oklahoma State University, Stillwater, Oklahoma

"Optically Doped Thin Films for Photonics Applications," C. Afonso, Instituto de Optica, CSIC, Madrid, Spain

"Studies of Carbon Nanotubue-Based Probes and New Materials: Theory and Experiment," S. Sinnott, University of Kentucky, Lexington, Kentucky

"Sr_2RuO_4: Spin-Triplet Superconductivity and Pseudo Gap?" Y. Liu, Pennsylvania State University, University Park, Pennsylvania

"Fabrication of Functional Nanocomposites by Laser Ablation," T. Sasaki, National Institute of Materials and Chemical Research, Tsukuba, Japan

"Some Experimental Results on Rare-Earth Manganese-Based Magnetic Compounds and Alloys," N. Ali, Southern Illinois University, Carbondale, Illinois

"From Waves to the Surface Fermi Contours: Fourier Transform STM," L. Petersen, University of Aarhus, Aarhus, Denmark

"An Overview of the Structures of High-Index Ge and Si Surfaces," W. Yang, Peking University, Beijing, China

"Ultrathin Epitaxial Transition-Metal Oxide Layers: Superparamagnetism, Polar Surfaces, and Metastable Compounds," T. Himba, University of Groningen, Groningen, the Netherlands

"Microstructure of Metal and Semiconductor Nanocrystals Formed by Ion Implantation," A. Meldrum, ORISE/ORNL Postdoctoral Research Associate

"Ferromagnetism in Low Carrier Density Borides," Z. Fisk, Florida State University, Tallahassee, Florida

"Momentum Distribution Spectroscopy Using Deep Inelastic Neutron Scattering: Recent Progress at ISIS," G. Reiter, University of Houston, Houston, Texas

"Thermomagnetic Probes of Peculiar Transport Effects Below T_c in the Cuprate Superconductors," J. Clayhold, Clemson University, Clemson, South Carolina

"Screened-Exchange Model for Exchange and Correlation Energies," U. Von Barth, Lund University, Lund, Sweden

"Spin Dynamics and Hole Migration in the Spin Ladder, Dimer Chain Materials $Sr_{14-x}Ca_xCu_{24}O_{41}$," R. C. Eccelston, Rutherford Appleton Laboratory, Didcot, United Kingdom

"Synthesis and Properties of Carbon Nanotubes—Oriented Arrays, Raman Spectroscopy, and Applications," A. M. Rao, University of Kentucky, Lexington, Kentucky

"Instabilities in Flux Vortices Driven to High Velocities," M. Kunchur, University of South Carolina, Columbia, South Carolina

"The Electrooptic Effect in Blue Bronze," J. Brill, University of Kentucky, Lexington, Kentucky

"Nanometer-Scale Properties at Atomically Abrupt Interfaces," D. A. Bonnell, University of Pennsylvania, Philadelphia, Pennsylvania

"Geometrical Frustration, Negative Thermal Expansion, and the Physics of Underconstraint," Art Ramirez, Bell Laboratories/Lucent Technologies, Murray Hill, New Jersey

"A Magneto-Elastic Model for the Relaxation of Lanthanide Ions in YBCO Observed by Neutron Spectroscopy," S. W. Lovesey, Rutherford Appleton Laboratory, Didcot, United Kingdom

"Supercritical Fluids: From Phase Transitions to Foams," T. Russell, University of Massachusetts, Amherst, Massachusetts

"The National High Magnetic Field Laboratory: From the Start to the Present," J. E. Crow, Florida State University, Tallahassee, Florida

"Electrons in Quasicrystals," U. Grimm, Technische Universität Chemnitz, Chemnitz, Germany

"Mott-Hubbard Localization," J. Spalek, Purdue University, Lafayette, Indiana

"Computing in a Material World," J. W. Davenport, Brookhaven National Laboratory, Upton, New York

"X-Ray Scattering Studies of Charge and Orbital Ordering in Manganites," L. D. Gibbs, Brookhaven National Laboratory, Upton, New York

"Spin Frustration and a Strong Unidirectional Anisotropy in Bulk SDW Cr Alloys," V. Galkin, Bardin Central Research Institute for Ferrous Metallurgy, Moscow, Russia

"Low-Field Magnetoresistance in Some Perovskite-Structured Manganites," H. R. Khan, FEM, Schwaebisch Gmuend, Germany

"Anamolous Behavior of the Irreversible Magnetization and Time Relaxation in $YBa_2Cu_3O_7$ Single Crystals with Splayed Tracks," A. Silhanek, Comisión Naciónal de Energia Atómica-Centro Atómico Bariloche and Instituto Balseiro, Bariloche, Argentina

LUNCHEON SEMINARS

"Unusual Ferromagnetism in $SrRu0_3$ (and Why You Should Care)," S. Nagler, Solid State Division, ORNL

"Atomic Structures of Grain Boundaries in Metal Oxides," Y. Yan, ORNL/Oak Ridge Institute of Science and Technology

"Ultrasmall Angle Scattering: How Small Can You Get?" M. Agamalian, ORNL/Oak Ridge Institute of Science and Technology

"The Original Pac Man: Cluster Diffusion and Coarsening on Metal (100) Surfaces," J. F. Wendelken, Solid State Division, ORNL

"Cool Semiconductors from Warm Plasmas by Laser-MBE," C. Rouleau, Solid State Division, ORNL

"Current Problems in High-Temperature Superconductors: Intrinsic Origins and Possible Solutions," D. K. Christen, Solid State Division, ORNL

"Unusual Magnetism in Some New Ru-Based Spinels," D. G. Mandrus, Solid State Division, ORNL

"Modeling of Laser Ablation Processes," J.-N. Leboeuf, Fusion Energy Division, ORNL

"Observation of a New Dynamical Diffraction Phenomenon 'Neutron Camel,'" M. Agamalian, ORNL/Oak Ridge Institute of Science and Technology

"Laser Ablation Synthesis of Photoluminescent Nanoparticles: A Nano-Big Bang, Nanogalaxies, and Thin Films," D. B. Geohegan, Solid State Division/ORNL

"Radiometric Dating of the Earth's Ancient Crust," A. Meldrum, ORNL/Oak Ridge Institute of Science and Technology

"Molecular Dance: Brooming Chemical Radicals with a STM," L. Pai, ORNL/Oak Ridge Institute of Science and Technology

"What's Magic About Metal Thin-Film Growth," Z. Zhang, Solid State Division, ORNL

"Shake, Rattle, and Roll: Local Mode Thermodynamics of Filled Skutterudite Antimonides," V. Keppens, ORNL/Oak Ridge Institute of Science and Technology

"Proximity Magnetism in Fe/Cr and Cr/CrMn Multilayers," J. L. Robertson, Solid State Division, ORNL

"Helical Spin-Density Waves in Fe/Cr Multilayers," R. S. Fishman, Solid State Division, ORNL

"Magneto-Optically Active Surfaces and Magnetic Nanocrystals Formed by Ion Implantation and Thermal Processing," S. I. Honda, ORNL/Oak Ridge Institute of Science and Technology

"Gamma-Alumina and Stealth Protons," K. Sohlberg, ORNL/Oak Ridge Institute of Science and Technology

"Nonlinear Optical Characterization of Si/SiO_2 Interfaces and Silicon MMICs," G. Lüpke, Vanderbilt University, Nashville, Tennessee

"The Superconducting Condensation Energy and Antiferromagnetic Spin Fluctuations in High-T_c Superconductors," P. Dai, Solid State Division, ORNL

"Hold That Line! Vortex Trapping by Columnar Defects," J. R. Thompson, Solid State Division, ORNL

"A Micro-Meter Beam from a Kilo-Meter Ring," M. Yoon, Solid State Division, ORNL

"SANS from Polymers in Supercritical CO_2: Spaghetti in a Pressure Cooker," Y. Melnichenko, ORNL/Oak Ridge Institute of Science and Technology

"Materials Research Opportunities in the Energy Efficiency and Renewable Energy (EERE) Programs," T. Schaffhauser, Energy Efficiency and Renewable Energy Program Office, ORNL

"What Everyone Needs to Know About Work-for-Others and Intellectual Property Procedures at ORNL," D. Bradford and F. Damiano, Contracts and Procurement Division, ORNL

"Shake, Rattling, and Rolling to New Materials: What Crystallographers Never Told You!" B. C. Sales, Solid State Division, ORNL

"Rationalizing the Structure of Very Small Silicon-Carbon Clusters: Size Does Matter," Marjorie Bertolus," ORNL/Oak Ridge Institute of Science and Technology

"Short- and Long-Range Magnetic Order in $Co_2Ru_{1-x}Mn_xO_4$ Spinel," Garrett Granroth, ORNL/Oak Ridge Institute of Science and Technology

"Superfluid Helium in Under Half an Hour," Wouter Montfrooij, ORNL/Oak Ridge Institute of Science and Technology

"Electron Field Emission: How I Learned to Love the Dirt," Vladimir Merkulov, ORNL/Oak Ridge Institute of Science and Technology

"The World of Broken Symmetry in Reduced Dimensionality: Surfaces and Interfaces of Layered Transition-Metal Oxides," Ward Plummer, ORNL/UT

"The Small Picture: Visions Beyond the Angstrom," Steve Pennycook, Solid State Division, ORNL

"2-D Phase Transitions: How Does a 2-D Lattice Respond to a Defect?" A. Melechko, ORNL/Oak Ridge Institute of Science and Technology

SURFACE PHYSICS SEMINARS AND JOURNAL CLUB

"Surface Metallization, Dynamics and Reconstruction in Bidimensional Ordered Systems: Si (100) and Be/Si (100)," L. Gavioli, ORNL/Oak Ridge Institute of Science and Technology

"Optical Phase Control of Coherent Electyron Dynamics in Metals," H. Petek, Hitachi Corp., Japan

"Anisotropy and Magnetization Reversal Dynamics in Thin Ferromagnetic Films," J. Erskine, University of Texas, Austin, Texas

"Thermal Expansion of Metal Surfaces," J.-H. Cho, ORNL/Oak Ridge Institute of Science and Technology

"Local Bond Breaking via STM-Induced Excitations," B. N. J. Persson, KFA Juelich, Juelich, Germany

"Coherent Photoelectron Spectroscopy at Surfaces," E. W. Plummer, Solid State Division, ORNL

"H/Ru (0001)," J. P. Pierce, Solid State Division, ORNL

"Can a First-Principles Calculation Validate Zhenyu's Hand Waving Theory?," J-H. Cho, ORNL/Oak Ridge Institute of Science and Technology

"Are There Charge Density Waves on Reconstructed Pt(100)?," W. W. Pai, Solid State Division, ORNL

"The Hydrogen-Inducted Reconstructions of Cu(100): Correlation of Structure, Bonding Sites, Vibrational Lifetimes, and H^2 Desorption," C. Walters

"Growth, Structure, and Properties of Ultrathin Chromium and its Oxide Films on Pt(111)," L. Zhang, Tulane, University, New Orleans, Louisiana

"Collective Excitations in 2D Spin-Polarized Electron Systems," D. C. Marinescu, Solid State Division, ORNL

"The Physics Story behind Oscillatory Interplanar Relaxation," J-H. Cho and R. Ismail, Solid State Division, ORNL

HIGH-T_c SUPERCONDUCTIVITY SEMINARS

"Bi-2223 Tapes for Power Applications," P. Vase, Nordic Superconductor Technologies, Denmark

"Critical Current in a Josephson-Junction-Array Model," D. Agassi, Naval Surface Warfare Center, Carderock Division, West Bethesda, Maryland

"Status of Superconducting Generator Project and LTS/HTS Wire Development in Japan," Y. Aiyama, Technical Committee on Superconducting Power Applications, New Energy and Industrial Technology Development Organization (NEDO), Japan

"Superconductivity of Bi- and Pb-Substituted Hg-1223 Cuprates With T_c ~~ 134 K: One Step Processing," H. R. Khan, Forschungsinstitut fuer Edelmetall und Metallchemie, Schwaebish Gmuend, Germany

LECTURES AND SEMINARS BY DIVISION MEMBERS

M. M. Agamalian—Argonne National Laboratory, Argonne, Illinois, "Recent Developments in the Bonse-Hart Ultra-Small Neutron Scattering Technique"; University of Missouri, Columbia, Missouri, "Dynamical Diffraction Study at the ORNL Bonse-Hart Neutron Double Crystal Diffractometer"; Exxon Research and Engineering Company, Annondale, New Jersey, "Ultra-Small-Angle Neutron Scattering (USANS) Study at the ORNL Bonse-Hart Double Crystal Diffractometer"

J. B. Bates—Dalhousie, Nova Scotia, Canada, "Thin-Film Rechargeable Lithium Batteries"; The University of Tennessee, Knoxville, Tennessee, "Preferred Orientation of $LiCoO_2$ Thin Films—Lattice Calculations of Elastic Strain Energy and Effect on Thin-Film Battery Performance"

L. Beckers—Vanderbilt University, Nashville, Tennessee, "Pulsed-Laser Deposition of Single-Crystal $BaTiO_3$ and $KNbO_3$ Films"

L. A. Boatner—University of North Carolina-Charlotte, Gharlotte, North Carolina, "New Approaches to Understanding the Physics of Welding"; Instituto de Investigation en Materiales, Universidad Nacional Autonoma de Mexico, Mexico City, Mexico, "Potassium Tantalate—A New Substrate for the Growth of Epitaxial Thin Films and Superlattice Structures"; Auditorio Alejandra

Jaidar, Universidad Nacional Autonoma de Mexico, Academia Mexicana de Ciencios Cuernavaca, Mexico, "Living in a Materials World"; Instituto de Fisica–Cuernavaca, Universidad Nacional Autonoma de Mexico, Cuernavaca, Mexico, "The Application of Single Crystals of Stainless Steel to the Study of Weld Microstructures and Surface Morphologies"; The University of Michigan, Ann Arbor, Michigan, "The Lanthanide Orthophosphates for Nuclear and Other Applications"; Clemson University, Clemson, South Carolina, "Smart, Active, and Self-Organized Surfaces"; HTML User Forum, Knoxville, Tennessee,"Smart and Active Nanocomposite Surfaces Formed by Ion Implantation,"; Oak Ridge National Laboratory, Oak Ridge, Tennessee, "Nanocomposite Materials";

J. D. Budai—Purdue University, Lafayette, Indiana, "Synthesis, Microstructure, and Properties of Semiconductor Nanocrystals Formed by Ion-Implantation"

P. D. Butler—Pacific Northwest National Laboratory, Richland, Washington, "Neutron Scattering from Micellar Systems"; National Institute of Standards and Technology, Gaithersburg, Maryland, "Reflection Geometry SANS";

B. C. Chakoumakos— Eaton Elementary School, Lenoir City, Tennessee, "Crystals, Solids, Liquids, and Gases"; Argonne National Laboratory, Argonne, Illinois, "High-Temperature Crystal Structure Systematics of Oxide Perovskites"; Georgia Institute of Technology, Atlanta, Georgia, "Atomic Displacements From Crystal Structure Refinement: What Can They Tell Us?"; The University of Tennessee, Knoxville, Tennessee, "Crystal Structure Refinement Using Neutron Diffraction"; ORISE/ORAU, Oak Ridge, Tennessee, "Crystal Structure–Property Relationships in Technological Materials"

M. F. Chisholm—Max-Planck-Institüt für Metallforschung, Stuttgart, Germany, "Interfaces in Ceramic Materials"; Max-Planck-Institüt für Festkörperforschung, Stuttgart, Germany, "The Atomic and Electronic Structure of Grain Boundaries in Silicon"

D. K. Christen—University of Kansas, Lawrence, Kansas, "Current Problems in High-Temperature Superconductors: Prospects for Improved Conductors"; The University of Tennessee, Knoxville, Tennessee, and University of Kansas, Lawrence, Kansas, "High-Temperature Superconductors: Basic Properties Related to High-Current Conductor Applications"; Golden, Colorado, "Development of Biaxially Textured Metal Tapes for Scalable Approaches to High-T_c-Coated Conductors"

P. Dai—Florida State University, Tallahassee, Florida, "Spin Fluctuations in Bilayer and Single-Layer High-T_c Superconductors"

G. Duscher—Vanderbilt University, Nashville, Tennessee, and University of Pennsylvania, Philadelphia, Pennsylvania, "Atomic-Column-Resolved Electron-Energy-Loss Spectroscopy"; University of Darmstadt, Darmstadt, Germany, "Electrical Activity at Interfaces"; University of Illinois at Urbana-Champaign, Urbana, Illinois, "Spatially Resolved Electron-Energy-Loss Spectroscopy"

G. Eres—Ohio State University, Athens, Ohio, "Semiconductor Thin-Film Growth Using Supersonic Molecular Beams"

J. A. Fernandez-Baca—Southern Illinois University, Carbondale, Illinois, "Neutron Scattering Studies of the Spin Dynamics of the Colossal Magnetoresistance Manganites"; University of Illinois at Urbana-Champaign, Urbana, Illinois, "Spin Dynamics of the Colossal Magnetoresistance Manganites"; University of Missouri, Columbia, Missouri, Waseda University, Tokyo, Japan, and University of Zaragoza, Zaragoza, Spain, "Spin Dynamics of the Colossal Magnetoresistance Manganites $Ln_{1-x}A_xMnO_3$"; University of Alabama, Huntsville, Alabama, "Neutron Scattering from Condensed Matter Systems"

R. S. Fishman—University of Southern Illinois, Carbondale, Illinois, and Ohio University, "Competition Between Interfacial Coupling and Spin-Density Wave Magnetism in Fe/Cr Multilayers and Wedges"

D. B. Geohegan—Harvard University, Cambridge, Massachusetts, "Dynamics of Pulsed-Laser Ablation Relevant to Materials Synthesis and Analysis"; University of Central Florida, Orlando, Florida, "Gas Dynamic Effects on Laser Ablation Materials Synthesis: Amorphous Diamond, Plume Splitting, and Photoluminescent Nanoparticles"

W. A. Hamilton—University of Cincinnati, Cincinnati, Ohio, "Complex Fluid Structures in Surfactant Systems Under Flow"

T. E. Haynes—University of Modena, Modena, Italy, University of Bologna, Bologna, Italy, University of Catania, Catania, Italy, and Ruder Boskovic Institute, Zagreb, Croatia, "Defects and Transient-Enhanced Diffusion of Dopants in Silicon"

J. B. Hayter—Oak Ridge National Laboratory, Oak Ridge, Tennessee, "Neutron Scattering: R&D Briefing for PPG Industries, Inc."; Oak Ridge National Laboratory, Oak Ridge, Tennessee, "Neutron Scattering: R&D Briefing for 3M Corp"

O. W. Holland—Motorola, Mesa, Arizona, "Ion Beam Processing of Si from Low to High Energy—A Unified Approach to the Role of Defects"; University of Houston, Houston, Texas, "Hydrogen-Induced Cleaving of 6H-SiC and Si"

G. E. Jellison, Jr.—Bowdoin College, Brunswick, Maine, "Spectroscopic Ellipsometry: A Technique for Measuring Thin Films"

D. E. Jesson—University of Michigan, Ann Arbor, Michigan, and Brown University, Providence, Rhode Island, "Strain-Induced Morphological Evolution of Si_xGe_{1-x} Thin Films"; Defence Evaluation and Research Agency, Malvern, United Kingdom, "Morphological Evolution of Strained Semiconductor Films"; North Carolina State University, Raleigh, North Carolina, Harvard University, Cambridge, Massachusetts University of Wisconsin, Madison, Wisconsin, and University of Virginia, Charlottesville, Virginia, "Cooperative Nucleation, Self-Limiting Growth, and Shape Transitions of Strained Nanostructures"

B. C. Larson—Alcoa Technical Center, New Kensington, Pennsylvania, "3-D Measurement of Deformation Microstructure in Al(0.2%)Mg Using Submicron Resolution White X-Ray Microbeams"

D. H. Lowndes—Monbuso, Kauai, Hawaii, "Silicon Microcolumns and Nanodiamond Films"; and "Time-Resolved Synchrotron X-Ray Diffraction for Studies of Pulsed-Laser Deposition and Film Growth"; Matsushita Research Institute, Tokyo, Japan, and University of Tsukuba, Institute of Materials Science, Tsukuba, Japan, "Synthesis of Si and ZnTe Nanocrystals by Pulsed-Laser Ablation"; Advances in Science and Technology Series, Oak Ridge Institute for Continued Learning, Oak Ridge, Tennessee, "Thin-Film Growth and Materials Processing by Pulsed-Laser Ablation"

G. D. Mahan—Cornell University, Ithaca, New York, Lund University, Lund, Sweden, Chalmers Technical University, Goteborg, Sweden, and Max-Planck Institute for Complex Systems, Dresden, Germany, "Rare-Earth Thermoelectrics"; SUNY, Buffalo, New York, "Thermoelectrics"; Allied Signal Corporation, "Thermionic Cooling"; Royal Institute of Technology, Stockholm, Sweden, "Many-Body Theory"

D. G. Mandrus—Naval Research Laboratory, Washington, D.C., "Unusual Magnetism in Some New Ru-Based Spinels"; Boston College, Boston, Massachusetts, "Electron Crystals, Phonon Glasses, and Improved Thermoelectric Matrials";

D. C. Marinescu—Vanderbilt University, Nashville, Tennessee, and University of Missouri, Columbia, Missouri, "Thermoelectric Flux in Bimetallic Superconducting Rings"; University of Chicago, Chicago, Illinois, "Optical Properties of 2D Spin Polarized Electron Systems"

Y. B. Melnichenko—University of Tennessee, Knoxville, Tennessee, "Recent Neutron Scattering Studies of Miscibility and Phase Separation in Polymer Solutions and Blends"

H. A. Mook—Vanderbilt University, Nashville, Tennessee, "What Neutrons Can Tell Us About Condensed Matter Physics"; University of California at San Diego, San Diego, California, "Neutron Studies of Condensed Matter"; Stanford University, Palo Alto, California, "Are We Making Progress on the High-T_c Superconductivity Problem?"; University of Illinois at Chicago Circle, Chicago, Illinois "Spin and Charge Flucturations in High-Temperature Superconductors"; Oak Ridge Associated Universities, Oak Ridge, Tennessee, "Spallation Source Neutron Scattering Opportunities"; Aspen Center for Physics, Aspen, Colorado, "Recent Neutron Scattering Results on High-Temperature Superconductors";

S. E. Nagler—The University of Tennessee, Knoxville, Tennessee, "Excitations in Antiferromagnetic Chains"; University of Notre Dame, South Bend, Indiana, "Excitations in Quantum Antiferromagnetic Chains"; Louisiana State University, Baton Rouge, Louisiana, "Neutrons, Spinons, and Antiferromagnetic Chains"; Risø National Laboratory, Roskilde, Denmark, "Spinons, Magnons, and Solitons: Excitations in $S = 1/2$ Antiferromagnetic Chains"

W. W. Pai—Sandia National Laboratories, Livermore, California, "STM Imaging and Manipulation of Chemisorbed Radials on Metal Surfaces"

S. T. Pantelides—National Renewable Energy Laboratory, Golden, Colorado, "*Ab Initio* Simulation of Transport in Molecular Devices"

S. J. Pennycook—University of Florida, Gainesville, Florida, "Determination of Atomic and Electronic Structure of Interfaces by Scanning Transmission Electron Microscopy"; Vanderbilt University, Nashville, Tennessee, Northwestern University, Evanston, Illinois, and University of Alabama at Birmingham, Birmingham, Alabama, "A Combined Experimental and Theoretical Approach to Atomic-Scale Structures in Complex Solids"; International School of Electron Microscopy, Erice, Sicily, Italy, "Novel Methods of Compositional Analysis"; Georgia Institute of Technology, Atlanta, Georgia, "A Combined Experimental and Theoretical Approach to Atomic-Scale Characterization"; Intel, Portland, Oregon, "A Combined Experimental and Theoretical Approach to Interfacial Engineering"; Ford Research Laboratory, Detroit, Michigan, "Combining Microscopy and Theory in Materials Science—Atomic-Scale Structures and Catalysis"; University of Virginia, Charlottesville, Virginia, "A Joint Experimental and Theoretical Approach to the Atomic Structure of Interfaces"; University of Illinois at Urbana-Champaign, Champaign, Illinois, "A Combined Experimental and Theoretical Approach to Interface Structure and Properties"; National Renewable Energy Laboratory, Golden, Colorado, "A Combined Experimenal and Theoretical Approach to Interface Structure and Properties"; Cavendish Laboratory, Cambridge, United Kingdom, "Incoherent Imaging of Atoms at Interfaces";

E. W. Plummer—University of Missouri, Columbia, Missouri, "Electron Waves at Surfaces"; University of Maryland, College Park Maryland, "Electron Density Waves at Surfaces via STM: From Friedel Oscillations to Charge Density Waves"; Florida State University, Gainesville, Florida, Rice University, Houston, Texas, Tulane University, New Orleans, Louisiana, Rutgers University, Piscataway, New Jersey, Johns Hopkins University, Baltimore, Maryland, Florida International University, Miami, Florida, University of Arkansas, Fayetteville, Arkansas, University of Chicago, Chicago, Illinois, and University of Virginia, Charlottesville, Virginia, "Electron Density Waves in Two Dimensions"; National Taiwan University, Taipei, Taiwan, and KFA Jülich, Germany, "The Interplay Between Electron and Geometric Structure at a Surface"; Danish Royal Society, Copenhagen, Denmark, "The Interplay Between Electron and Geometric Structure at a Surface";

D. B. Poker—Materials Research Society, Warrendale, Pennsylvania, "The Surface Modification and Characterization (SMAC) Research Center"

J. J. Quinn—University of Illinois, Chicago, Illinois, "Numerical Studies of Photoluminescence in Fractional Quantum Hall Systems"; University of Illinois, Chicago, Illinois, "Composite Fermion Hierarchy and the Validity of McMean Field Approximation in Fractional Quantum Hall Systems"; Institute of Physics of Techology University of Wroclaw, Wroclaw, Poland, and Max-Planck Institut, Stuttgart, Germany, "The Composite Fermion Hierarchy of Fractional Quantum Hall States"

J. B. Roberto— Motorola, Inc., Mesa, Arizona, "Condensed Matter Research at ORNL"; University of South Carolina, Columbia, South Carolina, "New Directions in Condensed Matter Research at ORNL";

B. C. Sales—University of California-San Diego, San Diego, California, University of Florida, Gainesville, Florida, and University of Cincinnati, Cincinnati, Ohio, "Electron Crystals and Phonon Glasses: A New Approach to Thermoelectric Materials"

J. Shen—Harvard University, Cambridge, Massachusetts, "Magnetism in Two- and One-Dimension: Fe on Cu(111)"

K. Sohlberg—Minnesota Mining & Manufacturing (3M), Minneapolis, Minnesota, and The Johns Hopkins University, Baltimore, Maryland, "How Gamma-Alumina Surfaces Breathe Water and Eat Aluminum"; Long Island University, Brooklyn, New York, "Stealth Protons in Gamma-Alumina May Surreptitiously Assist Catalysis"; Idaho State University, Pocatello, Idaho, "Stealth Protons in Gamma-Alumina May Surreptitiously Assist Catalysis by Acting Like Apes"; Drexel University, Philadelphia, Pennsyvania, "Consequences of Stealth Hydrogen in Gamma-Alumina"

J. R. Thompson—Johannes Guttenberg University, Mainz, Germany, and Research Institute for Noble Metals and Metal Chemistry, Schwäbisch-Gmünd, Germany, "General Critical Current Density (J_c) Enhancements of the Highest T_c Superconductors with GeV Protons"; University of Alberta, "Improving Mother Nature's Gift: Processing High-Temperature Superconductors for High-Current Conduction"; Catholic University of Chile, Santiago, Chile, "Enhancements of Supercurrents in High-T_c Superconductors by Artificial Defects"; Centro Atomico Bariloche, Bariloche, Argentina, "J_c and Vortex Pinning Enhancements in Bi-, Tl-, and Hg-Based Cuprates Superconductors via Proton Irradiation"; Electrotechnical Laboratory, Tsukuba, Japan, "Currents and Columnar Defects in High-T_c Superconductors"; Research Institute for Noble Metals and Metal Chemistry, Schwäbisch-Gmünd, Germany, "Magnetic and Thermal Properties of $Cd_2Os_2O_7$ Near Its Metal-Insulator Transition"; Tandar Accelerator Laboratory of the CNEA, Buenos Aires, Argentina, "GeV Proton-Induced Fission and Why High-T_c Superconductors Like It (Mostly)"; Centro Atomico Bariloche, Bariloche, Argentina, "Effects of a Nonlocal Current-Field Relationship on the Borocarbide Superconductor YNi_2B_2C"; Polish Academy of Sciences, Warsaw, Poland, "Effects of Nonlocal Electrodynamics in YNi_2B_2C and Other Superconductors"

J. Z. Tischler—Ohio University, Athens, Ohio, "Time-Resolved and Microbeam X-Ray Diffraction from Surfaces and Thin Strucures"

H. H. Weitering—Vanderbilt University, Nashville, Tennessee, Universidad Autonoma de Madrid, Madrid, Spain, Boston College, Boston Massachusetts, and University of Groningen, The Netherlands "Novel Silicon Surface Science"; Boston College, Boston Massachusetts, "Electron Correlations at Semiconductor Surfaces"

G. D. Wignall—The University of Tennessee, Knoxville, Tennessee, Florida State University, Tallahassee, Florida, and Dupont Central Research and Development Laboratories, Wilmington, Delaware, "Neutrons and Polymers: Why Do They Mix So Well?"; University of Cincinnati, Cincinnati, Ohio, and Laboratoire Leon Brillouin, Saclay, France, "Neutron Scattering Characterization of Polymerization Mechanisms in Supercritical Carbon Dioxide";

M. Yethiraj—University of Kentucky, Lexington, Kentucky, "Vortex Lattice Structures in YNi_2B_2C"

J. Zhang—Drexel University, Philadelphia, Pennsylvania, "Exotic Materials in Reduced Dimensionality"; Florida State University, Tallahassee, Florida, "The Surface of $La_{(1-x)}Ca_{(x)}MnO_{(3)}$"; Institute of Industrial Science, University of Tokyo, Tokyo, Japan, "Bulk and Surface Properties of Perovskite Manganites"; University of Florida, Gainesville, Florida, and Florida International University, Miami, Florida, "Exotic Properties of Complex Materials"; University of Miami, Miami, Florida, "Exotic Properties in Colossal Magnetoresistance Materials";

Z. Zhang—National Chongchen University, Taipei, Taiwan, "Atomistic Processes in the Early Stages of Thin-Film Growth"; National Central University, Taipei, Taiwan "Atomistic View of 2D Pattern Formation in Epitaxial Growth"; Institute of Physics, Academia Sinica, Taipei, Taiwan, "Kinetics and Thermodynamics of Thin-Film Growth," "Atomistic View of 2D Pattern Formation in Epitaxial Growth: Fractals, Dendrites, and Compact Islands," "Manipulation of Growth Kinetics in Thin-Film Epitaxy," "Dynamics of Ad-Dimers at Surfaces," "Monolayer Thermodynamics of Ge on Si(100)," and "Spontaneous Chiral Symmetry Breaking in Diffusion-Limited Aggregation"; National Tsinghua University, Taipei, Taiwan, "An Overview of Basic Concepts in Thin-Film Growth"; Hong Kong University of Science and Technology, Hong Kong, and the Swiss Federal Institute of Technology, Lausanne, Switzerland, "Spontaneous Chiral Symmetry Breaking in Diffusion-Limited Aggregation"; University of Minnesota, Minneapolis, Minnesota, "Electronic Growth of Metallic Overlayers on Semiconductor Substrates"; University of Minnesota, Minneapolis, Minnesota, "Kinetics and Thermodynamics of Thin-Film Growth"; Ames Laboratory, Ames, Iowa, and Iowa State University, Ames, Iowa, "Kinetics and Thermodynamics of Thin-Film Growth"; Rutgers University, Piscataway, New Jersey, and Bell Laboratories/Lucent Technologies, Murray Hill, New Jersey, "Quantum Theory of Metal Overlayer Growth on Semiconductor Substrates"; Rice University, Houston, Texas, and University of Houston, Houston, Texas, "What's Magic About Metallic Thin-Film Growth?"

Scientific Activities, Awards, and Honors

J. B. Bates	Lockheed Martin Energy Research Corporation Development Accomplishment Award, 1999
A. P. Baddorf	Executive Board, Complex Materials Consortium Collaborative Access Team
L. A. Boatner	Recipient, Committee Award, American Conference on Crystal Growth and Epitaxy, 1999 Recipient, First-in-Class Award, American Ceramic Society Ceramographic Competition, Optical Microscopy Category, 1999 Recipient, First-in-Class Award, American Ceramic Society Ceramographic Competition, Scanning Electron Microscopy Category, 1998 Recipient, First-in-Class Award, ASM International/ International Metallographic Society Competition, Color Microscopy Category, 1998 Lockheed Martin Energy Research, Significant Research Accomplishment Award, New Structural Transformations, 1998 Lockheed Martin Energy Research, Significant Research Accomplishment Award, Ferroelectricity at Small Length Scales, 1998 Lockheed Martin Energy Research Technical Achievement Patent Award, 1997 Fellow, The Institute of Materials of the United Kingdom, 1998 Fellow, The American Ceramic Society, 1998 Corresponding Member of the Academia Mexicana de Ciencias (Academy of Sciences of Mexico), 1997 Chair, Committee on International Scientific Affairs, The American Physical Society, 1999 Review Editor, *The Journal of Materials Research*, 1995–present Associate Editor, *Journal of Optical Materials* Chairman, "ORNL Alvin M. Weinberg Lecturer" Selection Committee, 1995–present Member, Executive Committee, American Association for Crystal Growth, 1987–present Chairman, ORNL Corporate Fellows Council, 1996–1998 Member, External Affairs Committee, Materials Research Society, 1995–1999 Member, Awards Committee, Materials Research Society, 1995–1999 Member, John Jeppson Award Committee, The American Ceramic Society, 1999–present Member, Awards Committee, American Association for Crystal Growth, 1999

Member, Program Committee, Eleventh American Conference on Crystal Growth, Tucson, Arizona, 1999
Member, Advisory Committee, DOE-EPSCoR Program for Research in Puerto Rico, 1998
Editor, *Company Profiles*, the American Association for Crystal Growth Newsletter, 1998–present
Adjunct Professor, The Department of Materials Science and Engineering, The University of Tennessee, Knoxville, Tennessee, 1998–present
Member, Commission on International Networks, The International Union of Materials Research Societies, 1998
Member, William Hunt Eisenman Rare Book Committee of ASM International, 1997
Member, NASA Science Working Group for the Space Station Furnace Facility, International Space Station Alpha, 1995–1997

J. D. Budai

Session Organizer, American Physical Society, Los Angeles, California, 1998
Lockheed Martin Energy Research Corporation Technical Achievement Award, 1997
Lockheed Martin Corporation NOVA Award, 1997
Research and Development Magazine R&D 100 Award, 1999
American Museum of Science and Energy Technical Achievement Award, 1999

B. C. Chakoumakos

Associate Editor, *American Mineralogist*, 1999–present
Correspondent, *Neutron News*
Guest Editor, *Neutron News* **10**, Issue 2, special issue on the neutron scattering facilities at the High-Flux Isotope Reactor at the Oak Ridge National Laboratory, 1998–1999
Member, Program Advisory Committee, Intense Pulsed Neutron Source/Manual Lujan Neutron Scattering Center, 1996–present
Member, Research Committee, Japan Atomic Energy Research Institute-U.S. Department of Energy Cooperative Program on Neutron Scattering, 1995–present
Member, Research Committee, Institute for Solid State Physics (University of Tokyo)-U.S. Department of Energy Cooperative Program on Neutron Scattering, 1995–present

D. K. Christen

Lockheed Martin Corporation NOVA Award for Teamwork, 1997
Lockheed Martin Energy Research Corporation Scientist of the Year Award, 1997
Lockheed Martin Awards Night, Technical Achievement, 1997
1999 American Museum of Science and Energy Awards-Tribute to Tennessee Technology for "RABiTS Low-Cost, Single-Crystal, Flexible Substrates for Energy/Electronic Applications," 1999
R&D 100 Award for "RABiTS Low-Cost, Single-Crystal, Flexible Substrates for Energy/ Electronic Applications," 1999
ORNL Value Award for Technical Contributions, 1999
Committee Member, Review Panel for DOE Proposal SZ718-19, Superconductivity for Electric Power Systems
Invited Contributor, *Nature*, "News and Views," April 1998
Co-Organizer, Focused Session on Materials Physics Issues in High-T_c Superconductivity: Intragranular Defects, Grain Boundaries, and

Interfaces, American Physical Society, Los Angeles, California, March 16–20, 1998
Judge, 1997 MRS Graduate Student Awards, Boston, Massachusetts, December 1, 1997

P. Dai

Lockheed Martin Energy Research Corporation Technical Achievement Award, 1998
Winner, U.S. Department of Energy Outstanding Scientific Accomplishment Award in Condensed Matter Physics, 1999

N. J. Dudney

Associate Editor, *Journal of the American Ceramic Society*

R. Feenstra

Lockheed Martin Awards Night, Technical Achievement, 1997
1999 American Museum of Science and Energy Awards-Tribute to Tennessee Technology for "RABiTS Low-Cost, Single-Crystal, Flexible Substrates for Energy/Electronic Applications," 1999
R&D 100 Award for "RABiTS Low-Cost, Single-Crystal, Flexible Substrates for Energy/ Electronic Applications," 1999
Lockheed Martin Awards Night, Development Accomplishment, 1999
Co-Organizer, Symposium of Superconducting Materials Properties, Crystal Chemistry, and Processing, Materials Research Society Fall Meeting, Boston, Massachusetts (to be held in FY 2000)
Program Committee, 2000 Applied Superconductivity Conference, Virginia Beach, Virginia (to be held in FY 2000)

L. C. Feldman

Vice Chair (Chair Elect), Division of Materials Physics, American Physical Society, 1999
Member, Executive Committee, Applied Surface Science Division, American Vacuum Society, 1999
Member, Advisory Panel, Physics Division, Lawrence Livermore National Laboratory, 1999
Member, Scientific Advisory Council, Institute for Semiconductor Physics, Frankfurt, Germany, 1996–present
Member, Executive Committee, Applied Surface Science Division, American Vacuum Society, 1998–present
Member, International Conference Committee, Ion Beam Analysis Conference, 1978–present
Member, International Conference Committee, Shanghai Conference on Advanced Silicon Materials, 1999
Member, International Conference Committee, Ion Beam Modification of Materials Conference, 1999–present
Associate Editor, *Journal of Vacuum Science and Technology A*
Editorial Board, *Radiation Effects*

J. A. Fernandez-Baca

Member, Research Committee, Japan Atomic Energy Research Institute-U.S. Department of Energy Cooperative Program on Neutron Scattering, 1995–present
Member, Research Committee, Institute for Solid State Physics (University of Tokyo)-U.S. Department of Energy Cooperative Program on Neutron Scattering, 1995–present

D. B. Geohegan	Chair, 2000 Gordon Conference on Laser Interactions with Materials (to be held in FY 2000) Editorial Board, *Applied Physics Letters* Editorial Board, *Journal of Applied Physics*
W. A. Hamilton	Member, Working Group for Large-Scale Structures, SNS/NSF Neutron Science Workshop Committee Member, Large-Scale Structures Subcommittee, Manuel Lujan Jr. Neutron Scattering Center Materials Advisory Committee, 1998–present
T. E. Haynes	Lockheed Martin Energy Research Corporation Technical Achievement Award, 1998 Symposium Organizer, "Silicon Front-End Processing: Physics and Technology of Dopant-Defect Interactions," Spring Meeting of the Materials Research Society, San Francisco, California, April 1999 Editor, *Si Front-End Processing—Physics and Technology of Dopant-Defect Interactions*, Materials Research Society, Warrendale, Pennsylvania, 1999 Guest Editor, *Materials Research Bulletin* (June 2000) Member, Local Committee, "Tenth International Conference on Surface Modification of Metals by Ion Beams," September 1997 Research Visitor, Silicon Processing Research Department, Bell Laboratories, Lucent Technologies, Murray Hill, New Jersey, 1994–present Adjunct Professor, Department of Physics, University of North Texas, Denton, Texas, 1996–present Adjunct Professor, Department of Chemical, Bio, and Materials Engineering, Arizona State University, Tempe, Arizona, 1995–1998
D. K. Hensley	Lockheed Martin Energy Research Corporation Technical Achievement Award, 1998 Co-Organizer, 1998 Symposium of North Eastern Accelerator Personnel, Knoxville, Tennessee, October 1999
G. E. Jellison Jr.	Lockheed Martin Energy Research Corporation Technical Achievement Award, 1997 Program Committee, Second International Conference on Spectroscopic Ellipsometry, Charleston, South Carolina, May 6, 1997 Panelist, Workshop on Thin-Film Metrology, NIFT, October 1997, Gaithersburg, Maryland
D. E. Jesson	Editorial Board, *Micron* Session Chairman, "Defect Formation, Strain Relaxation, and Growth Issues," Spring Meeting of the Materials Research Society, San Francisco, California, April 1997 Session Chairman, "Quantum Domain Structures," Royal Microscopy Society Meeting, April 1997 Principal Organizer, "Nanometer Scale Morphology of Surfaces and Interfaces, American Physical Society March Meeting, Los Angeles, California, March 1998 Member, Thin Films and Interfaces Committee of TMS

B. C. Larson	Chairman, Policy and Advisory Board, Cornell High Energy Synchrotron Source Organizing Committee, M. A. Krivoglaz Memorial Symposium on New Diagnostic Techniques Based on the Synchrotron Radiation Beams, Crimea, Ukraine, September 6–12, 1999
J. S. Lin	Session Chairman, Eleventh International Conference on Small-Angle Scattering (SAS'99), Upton, New York, May 1999 Adjunct Professor, Department of Materials and Engineering, The University of Tennessee, Knoxville, Tenn.
D. H. Lowndes	Lockheed Martin Energy Research Corporation Technical Achievement Award, 1999 Professor, Department of Materials Science and Engineering, The University of Tennessee, Knoxville, Tennessee Member, Ph.D. Thesis Committees, The University of Tennessee Chair, Nanoscience/Nanotechnology Group, Basic Energy Sciences Program, United States Department of Energy, 1999 Editor, *Nanoscale Science, Engineering and Technology Research Directions*, a report of the Nanoscience/Nanotechnology Group, Basic Energy Sciences Program, U. S. Dept. of Energy, for the FY2001 National Nanotechnology Initiative Co-Chair, "Focused Session on Nanoparticles and Nanoparticle Systems," March Meeting of The American Physical Society, Minneapolis, Minnesota, 2000 Member, International Committee, Fifth International Conference on Laser Ablation (COLA-99), Goettingen, Germany, July 1999 Co-Organizer, "Symposium on Film Growth and Processing Using Hyperthermal Beams," 1998 Fall Meeting of the Materials Research Society, November 30–December 4, 1998, Boston, Massachusetts Co-Organizer, Symposium Y, "Advances in Laser Ablation of Materials," Spring Meeting of the Materials Research Society, San Francisco, California, April 1998 Program Committee, Laser Applications in Microelectronic and Optoelectronic Manufacturing III, SPIE, San Jose, California, January 1998
G. D. Mahan	Co-Organizer, Symposium on Thermoelectric Materials 2000: The Next Generation Materials for Small-Scale Refrigeration and Power Generation Applications, Materials Research Society Spring Meeting, San Francisco, California (to be held in FY 2000) Chairman, Section 13 (Applied Physical Science), National Academy of Science Editor, *Thermoelectric Materials 1998—The Next Generation Materials for Small-Scale Refrigeration and Power Generation Applications*, Materials Research Society, Warrendale, Pennsylvania, 1999 Editor, *The Physics of Liquids and Solids*, Plenum Press Editorial Board, *International Journal of Modern Physics* Editorial Board, *Modern Physics Letters*

D. G. Mandrus	Lockheed Martin Energy Research Corporation Technical Achievement Award, 1997 Session Chairman, Spring Meeting of the Materials Research Society, San Francisco, California, 1997 Adjunct Professor, The University of Tennessee, Knoxville, Tennessee, April 1999 Co-Organizer, Symposium on Thermoelectric Materials 2000: The Next Generation Materials for Small-Scale Refrigeration and Power Generation Applications, Spring Meeting of the Materials Research Society, San Francisco, California (to be held in FY 2000)
F. A. Modine	First Prize for Optical Microscopy, awarded by the American Ceramic Society, with Hsin Wang and Ralph Dinwiddie, May 4, 1997
H. A. Mook	Winner, U.S. Department of Energy Outstanding Scientific Accomplishment Award in Condensed Matter Physics, 1999 Fellow, American Physical Society, 1973–present Lockheed Martin Senior Corporate Fellow, 1995–present Member, American Physical Society Fellow, 1973–present Member Organizing Committee, Second International Conference on Stripes and High-T_c Superconductivity, Rome, Italy, 1998 Member, LANSCE Proposal Evaluation Committee, 1999 Member, Board of Trustees, Institute of Complex Adaptive Matter, 1999 Member, Scientific Advisory Committee, Spallation Neutron Source, 1998–present Member, Steering Committee, National School on X-Ray and Neutron Scattering, 1999 Member, Organizing Committee, Users Workshop for Spallation Neutron Source and HFIR Reactor, 1998–present Member, Steering Committee for HFIR Upgrades, 1998–1999 Advisor to Research Committee, Institute for Solid State Physics (University of Tokyo)-U.S. Department of Energy Cooperative Program on Neutron Scattering, 1995–present Advisor to Research Committee, Japan Atomic Energy Research Institute-U.S. Department of Energy Cooperative Program on Neutron Scattering, 1995–present Member, Program Committee, Workshop on Scientific and Industrial Opportunities for the Spallation Neutron Source, Washington, D.C., 1998
S. E. Nagler	Lockheed Martin Energy Research Corporation, ORNL Scientist of the Year, 1998 Lockheed Martin Energy Research Corporation Technical Achievement Award, 1998 Chairman, IPNS Program Advisory Committee, Excitations Section, 1998–1999 Member, International Advisory Committee, NOBUGS 2000, 1999 Member, SNS Target Interface Advisory Committee, 1998 Member, Program Committee, National School on X-Ray and Neutron Scattering, 1998 Member, LANSCE Program Advisory Committee, 1997 Member, NOBUGS'97 International Advisory Committee Member, SDT for HELIOS, 1997 Member, Organizing Committee, ORAU Neutron Workshop, 1997

	Member, Program Committee, International Conference on Neutron Scattering, 1997 Member LANSCE Users Group Executive Committee, 1996–1999 Member, NSERC Allocations Committee on Interdisciplinary Science, 1996–1999
B. J. Neudecker	Lockheed Martin Energy Research Corporation Development Accomplishment Award, 1999
D. P. Norton	R&D 100 Award for Coated Superconducting Tape, 1999 Lockheed Martin Energy Research Corporation Technical Achievement Award, 1999 American Museum of Science and Energy Technological Achievement Award, 1999 Lockheed Martin Corporation Nova Award, 1997 Lockheed Martin Energy Research Technical Achievement Award, 1997
S. T. Pantelides	Chairman, Workshop on the Si-SiO_2 and SiC-SiO_2 Interfaces—Similarities and Differences, Nashville, Tennessee, November 4–5, 1999 Co-Organizer, Symposium on Molecular Electronics, Materials Research Society Fall Meeting, Boston, Massachusetts (to be held in FY 2000) Co-Chair, Workshop on 15 Years of the Car-Parrinello Method, Minneapolis, Minnesota (to be held in FY 2000) Co-Organizer, Focused Session on Novel Dielectric-Semiconductor Systems, American Physical Society, Atlanta, Georgia, March 22–26, 1999 Editorial Board, *Applied Physics Reviews* Editorial Board, *Defect and Diffusion Data* Editorial Advisory Board, *Computational Materials Science*
S. J. Pennycook	Councilor, Materials Research Society, 1998–present Editor, *Electron Microscopy of High-T_c Superconductors*, Cambridge University Press, Cambridge, United Kingdom, 1999 Editorial Board, *Journal of Electron Microscopy* Editorial Board, *Journal of Microscopy*
D. B. Poker	Co-Chair, Program Committee, "Tenth International Conference on Surface Modification of Metals by Ion Beams, September 1997 Editorial Board, *Nuclear Instruments and Methods in Physics Research* Editor, *Surface and Coatings Technology*, Vol. 104, Elsevier Science SA, Lausanne, Switzerland, 1998 Chair, Program Committee, Materials Research Society Chair, Bound Volumes Subcommittee, Materials Research Society Member, Electronic Services Committee, Materials Research Society Member, Electronic Publication Task Force, Materials Research Society
J. J. Quinn	Divisional Associate Editor, *Physical Review B* Member, External Advisory Committee for QUEST, University of California–Santa Barbara

J. B. Roberto

Chair, Division of Materials Physics, American Physical Society, 1997

Past Chair, Division of Materials Physics, American Physical Society, 1998–1999.

Vice-Chair, Solid State Sciences Committee, National Research Council, 1995–1997

Vice-Chair, Committee on Condensed Matter and Materials Physics, National Research Council, 1996–present

Editor, *Condensed-Matter and Materials Physics: Basic Research for Tomorrow's Technology,* National Research Council, National Academy Press, 1999

Board of Visitors, Department of Physics and Astronomy, The University of Tennessee, Knoxville, Tennessee, 1999–present

DOE Review Committee for Landlord Activities, Argonne National Laboratory, Argonne, Illinois

Member, Council on Materials Science and Engineering, Southeastern Universities Research Associate, 1994–present

Member, Organizing Committee, "Condensed Matter and Materials Physics: Into the Next Century," National Research Council Workshop, Washington, D. C., September 1997

Member, Organizing Committee, March Meeting of the American Physical Society, Los Angeles, California, March 1998

Member, Organizing Committee, Forum of the Solid State Sciences Committee, Washington, D. C., February 1998

Focus Area Coordinator, DOE Center of Excellence in Synthesis and Processing, 1993–1999

Chair, Advisory Review Board, *Journal of Materials Research,* 1993–present

Chair, Nominating, Fellowship, and Adler Award Committees, Division of Materials Physics, American Physical Society, 1997

Member, Committee on Public Affairs, Materials Research Society, 1995–present

Focus Area Coordinator, BES Center of Excellence in Synthesis and Processing, 1993–present

Chair, High Flux Isotope Reactor Upgrades Steering Committee, ORNL, 1997–present.

Member, Organizing Committee, SNS Instrumentation Workshop and SNS/HFIR Users Group Meeting, Knoxville, TN, November 9–11, 1998.

Member, High Flux Isotope Reactor Management Assessment Committee, ORNL, 1998–1999.

Member, Organizing Committee, Solid State Sciences Committee Forum on "Materials in a New Era," National Academy of Sciences, Washington, D.C., February 16–17, 1999.

B. C. Sales

Lockheed Martin Energy Research Technical Achievement Award, *Science* article, 1997

Lockheed Martin Energy Research Technical Achievement Award, High-J_c Superconductors on Rolled Metals, 1997

NOVA Award, 1997

Fellow, American Physical Society, 1998

Member, Editorial Advisory Board, *Journal of Physics and Chemistry of Solids*

	Co-Organizer, Focused Session on Thermoelectric Materials: Low-Dimensional Effects and Novel Phenomena, American Physical Society, Atlanta, Georgia, March 22–26, 1999
J. R. Thompson	Oak Ridge Centers for Manufacturing Technology Exceptional Service Award, April 1997 Program Committee, Workshop on Flux, Quantum, and Mesoscopic Effects in Superconducting Materials and Devices, Santa Fe, New Mexico, August 1997 Chair, Vortex Imaging Session, Vortex Matter Workshop, Hachimantai, Japan, June 1998 Session Chair, Vortices in Superconductors, Twenty-Second International Conference on Low-Temperature Physics, Espoo-Helsinki, Finland, August 1999 Professor of Physics, University of Tennessee, Knoxville, Tennessee
J. Z. Tischler	Chair, Ninth Advanced Photon Source Users Organization Meeting, Argonne, Illinois, October 13–15, 1998
H. Weitering	Co-Chair, Focused Session on Surfaces and Ultrathin Films, American Physical Society Meeting, Atlanta, Georgia, March 22–26, 1999
J. F. Wendelken	Member, Board of Directors, Nanometer Science and Technology Division of the American Vacuum Society
C. W. White	Member, Program Committee, "Eleventh International Conference on Ion Beam Modification of Materials," September 1998 Member, IBMM International Committee Advisory Board, *Journal of Materials Chemistry and Physics* Member, Program Committee, "SPIE Symposium on Ion Beam Processing of Materials," Montreal, Canada, October 1998 Co-Organizer, Focused Session on Semiconducting and Metallic Nanocrystals: Fabrication, Characterization, and Modeling, American Physical Society Meeting, Atlanta, Georgia, March 22–26, 1999 Member, Program Committee, International Conference on Ion Beam Processing of Materials, Porte Alegre, Brazil (to be held in FY 2000) Member, External Affairs Committee and Publications Committee, Materials Research Society
G. D. Wignall	Paul W. Schmidt Memorial Award for Significant Technical Contributions to the Eleventh International Conference on Small-Angle Scattering (SAS'99) and for Major Contributions to the SANS Field, 1999 1999 International Society for Measurement and Control, Arnold O. Beckman Founder Award Member, International Advisory Board, Eleventh International Conference on Small-Angle Scattering (SAS'99), Upton, New York, May 1999 Guest Editor, *Proceedings of the Eleventh International Conference on Small-Angle Scattering (SAS'99)*, 1999

S. P. Withrow	Co-Chair, Program Committee, "Tenth International Conference on Surface Modification of Metals by Ion Beams, September 1997 Editor, *Surface and Coatings Technology*, Vol. 104, Elsevier Science SA, Lausanne, Switzerland, 1998
M. Yethiraj	Member, JINS Building Committee Member, Search Committee, UT Physics Faculty in Neutron Sciences
Z. Zhang	Co-Organizer, Focused Session on Surfaces, Interfaces, and the Growth of Thin Films, American Physical Society, Minneapolis, Minnesota (to be held in FY 2000) Co-Organizer, Topical Program on Formation and Physical Properties of Nanostructures, Tsinchu, Taiwan, December 1998–March 1999 Visiting Professor, Hong Kong University of Science and Technology, Hong Kong, China, May–June, 1999 Assessor, Overseas Experts Review Committee, Chinese Academy of Sciences, 1999–2000 Member, Scientific Adversary Committee, Beijing Laboratory of Vacuum Physics, Chinese Academy of Sciences, Beijing, China, 1997–present Editorial Board, *Acta Physica Sinica*
R. A. Zuhr	Lockheed Martin Energy Research Corporation Development Accomplishment Award, 1999

Personnel Changes

New Staff Members

A. *Scientific Staff*

M. Bartkowiak, Mickiewicz University (Poland) (9/25/00)
P. D. Butler, The University of Tennessee (5/8/00)
E. Furman, Pennsylvania State University
Y. I. Jang, Massachusetts Institute of Technology (5/1/00)
Y. B. Melnichenko, Institute of Macromolecular Chemistry (Russia) (1/10/00)
B. J. Neudecker, University of Stuttgart (Germany)
L. Petersen, University of Aarhus (Denmark) (4/19/00)
J. Shen, Zhejiang University (China)
Y. Tang, University of Missouri–Columbia

B. *Administrative and Technical Support Staff*

J. K. Carter, Training and User Coordinator (4/19/00)
C. R. Humphrey, Secretary (7/24/00)
S. Lowe, Secretary
C. M. Redmon, Technician
W. H. Sides, Jr., Engineer (11/15/99)
D. M. Valentine, Technician (1/10/00)
N. W. Ward, Secretary

C. *Leased Personnel*

P. F. Cox, Secretary
C. D. Evans, Research Scientist
V. G. Hendrix, Secretary
S. E. Jesson, Technician
J. L. Moody, Secretary

Staff Transfers and Terminations

A. *Scientific Staff*

J. B. Bates (retirement)
E. Furman (completion of temporary employment) (2/4/00)
J. B. Hayter (medical retirement)
D. E. Jesson (voluntary resignation) (10/4/00)
D. C. Lubben (voluntary resignation)
D. G. Marinescu (completion of temporary employment)
F. A. Modine (retirement) (9/30/00)
J. B. Roberto (transfer to Central Management Offices)
A. K. Swan (voluntary resignation)

Y. Tang (completion of temporary employment) (9/29/00)
M. Yoon (completion of temporary employment)
J. Zhang (completion of temporary employment)

B. *Administrative and Technical Support Staff*

E. R. Dubose (transfer to Spallation Neutron Source Project) (3/1/00)
L. W. Hinton (transfer to Human Resources and Diversity Program Directorate)
B. J. Shoopman (retirement)

Guest Assignments

A. *Scientific Staff*

L. Beckers, Forschungszentrum Jülich, Jülich, Germany
J. W. Cable, Oak Ridge National Laboratory Retiree
G. S. Canright, The University of Tennessee, Knoxville, Tennessee
H. R. Child, Oak Ridge National Laboratory Retiree
A. Eguiluz,* The University of Tennessee, Knoxville, Tennessee
L. C. Feldman, † Vanderbilt University, Nashville, Tennessee
L. J. Gillespie, Medtronics, Inc., Brooklyn Center, Minnesota
F. X. Hart, University of the South, Sewanee, Tennessee
C. Hwang, Korean Research Institute of Standards and Science, Taejon, Korea
W. Klooster, University of Florida, Gainesville, Florida
M. N. Kunchur, University of South Carolina, Columbia, South Carolina
W.-M. Liu, University of Texas at Austin, Austin, Texas
G. D. Mahan,†† The University of Tennessee, Knoxville, Tennessee
P. Maheswaranathan, Winthrop University, Rock Hill, South Carolina
P. Miranovic, University of Tokyo, Tokyo, Japan
R. M. Moon, Oak Ridge National Laboratory Retiree
P. D. Nellist, University of Birmingham, Birmingham, United Kingdom
S. T. Pantelides, † Vanderbilt University, Nashville, Tennessee
B. N. J. Persson, Forschungszentrum Jülich, Jülich, Germany
E. W. Plummer,† The University of Tennessee, Knoxville, Tennessee
A. A. Puretzky, The University of Tennessee, Knoxville, Tennessee
J. J. Quinn, The University of Tennessee, Knoxville, Tennessee
F. J. Rodriquez, The University of Tennessee, Knoxville, Tennessee
H. G. Smith, Oak Ridge National Laboratory Retiree
M. Strobel, University of Wurzburg, Wurzburg, Germany
R. Triolo, University of Palermo, Palermo, Italy
H. H. Weitering, The University of Tennessee, Knoxville, Tennessee
R. T. Westfall, Insyte Corporation, Tampa, Florida
M. K. Wilkinson, Oak Ridge National Laboratory Retiree
J. L. Zarestky, Ames Laboratory/Iowa State University, Ames, Iowa
J. Zhang, Florida International University, Miami, Florida
Z.-K. Zuo, Southwest Missouri State University, Springfield, Missouri

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* ORNL/UT Collaborating Scientist
†ORNL Distinguished Visiting Scientist
††ORNL/UT Distinguished Scientist

B. *Postgraduate Research Participation Program*

M. M. Agamalian, State University of Tibilisi, Tibilisi, Russia
A. Agarwal, North Carolina State University, Raleigh, North Carolina
M. Bartkowiak, A. Mickiewicz University, Poznan, Poland
M. Bertolus, Université Paris, Paris, France
J. Braun, University of Gottingen, Gottingen, Germany
R. S. Buczko, Vanderbilt University, Nashville, Tennessee
P. D. Butler, The University of Tennessee, Knoxville, Tennessee
C. Cantoni, University of Naples, Naples, Italy
M.-C. Chang, University of Texas at Austin, Austin, Texas
J. H. Cho, Pohang University of Science and Technology, Pohang, Korea
R. Coldea, University of Oxford, Oxford, United Kingdom
G. Duscher, Max-Planck-Institut für Metallforschung, Stuttgart, Germany
X. Fan, University of Melbourne, Melbourne, Australia
H. Gao, Peking University, Peking, China
L. Gavioli, Universita de Modena, Modena, Italy
L. Gea, Universite Claude Bernard, Lyon, France
G. E. Granroth, University of Florida, Gainesville, Florida
G. Gvalani, Duke University, Durham, North Carolina
S. I. Honda, Osaka University, Osaka, Japan
Y. C. Hui, Ohio State University, Columbus, Ohio
V. Jahns, University of München, München, Germany
K.-J. Jin, Chinese Academy of Science, Beijing, China
A. Kadavanich, University of California–Berkeley, Berkeley, California
R. Kalyanaraman, North Carolina State University, Raleigh, North Carolina
H. Kawano, University of Tokyo, Tokyo, Japan
V. M. Keppens, Katholic Universitaet Leuven, Leuven, Belgium
J.-G. Kim, University of Florida, Gainesville, Florida
M. Kim, Arizona State University, Tempe, Arizona
T. Kostyrko, A. Mickiewicz University, Poznan, Poland
A. C. I. Lake, University of Oxford, Oxford, United Kingdom
W.-T. Lee, University of Missouri–Columbia, Columbia, Missouri
K. C. Lin, Michigan State University, East Lansing, Michigan
A. Maiti, North Carolina State University, Raleigh, North Carolina
R. E. Matzdorf, University of Kassel, Kassel, Germany
A. Meldrum, University of New Mexico, Albuquerque, New Mexico
A. G. Malchoukov, USSR Academy of Sciences, Moscow, Russia
Y. B. Melnichenko, Institute of Macromolecular Chemistry, Kiev, Ukraine
V. I. Merkulov, Pennsylvania State University, University Park, Pennsylvania
W. Montfrooij, Technical University of Delft, Delft, the Netherlands
B. J. Neudecker, University of Stuttgart, Stuttgart, Germany
M. Noh, University of Oregon, Eugene, Oregon
W. W. Pai, University of Maryland, College Park, Maryland
C. Park, Alfred University, Alfred, New York
L. Porcar, Université Montpellier II, Montpellier, France
C. S. Proteau, ISMRA–CRISMAT, Caen, France
A. A. Puretzky, Moscow Institute for Physics and Technology, Moscow, Russia
B. E. Rafferty, University of Cambridge, Cambridge, United Kingdom
W. D. Schöne, Technical University of Berlin, Berlin, Germany
K. W. Sohlberg, Johns Hopkins University, Baltimore, Maryland
T. Suwannasiri, Rutgers University, Piscataway, New Jersey

N. Tamura, Institut National Polytechnique, Grenoble, France
D. A. Tennant, University of Oxford, Oxford, United Kingdom
A. Ueda, Osaka City University, Osaka, Japan
D. T. Verebelyi, Clemson University, Clemson, South Carolina
V. S. Viswanath, University of Rhode Island, Kingston, Rhode Island
Y. Wei, Max-Planck-Institut FKF, Stuttgart, Germany
L. M. Woods, The University of Tennessee, Knoxville, Tennessee
Y. Xin, University of Cambridge, Cambridge, United Kingdom
Y. Yan, Wuhan University, Wuhan, China
G.-C. Yi, Northwestern University, Evanston, Illinois

C. *Graduate Students*

T. Aytug, University of Kansas, Lawrence, Kansas
Bagiyono, University of Kentucky, Lexington, Kentucky
M. Budde, Vanderbilt University, Nashville, Tennessee
D. P. Corrigan, Rensselaer Polytechnic Institute, Troy, New York
H. Dulli, The University of Tennessee, Knoxville, Tennessee
A. W. Garrett, University of Florida, Gainesville, Florida
D. T. Gillaspie, The University of Tennessee, Knoxville, Tennessee
T. M. Goon, The University of Tennessee, Knoxville, Tennessee
A. P. Graves, Vanderbilt University, Nashville, Tennessee
A. T. Hanbicki, The University of Tennessee, Knoxville, Tennessee
Q. He, The University of Tennessee, Knoxville, Tennessee
J. He, The University of Tennessee, Knoxville, Tennessee
T. W. Heitmann, Valparaiso University, Valparaiso, Indiana
M. J. Hicks, The University of Tennessee, Knoxville, Tennessee
Ismail, The University of Tennessee, Knoxville, Tennessee
S. Kang, The University of Tennessee, Knoxville, Tennessee
B. C. Kim, University of Pennsylvania, Philadelphia, Pennsylvania
H.-G. Kim, The University of Tennessee, Knoxville, Tennessee
J. P. Koster, University of Florida, Gainesville, Florida
W. Ku, The University of Tennessee, Knoxville, Tennessee
A. V. Meleshko, The University of Tennessee, Knoxville, Tennessee
K. S. Mrizig, The University of Tennessee, Knoxville, Tennessee
J. P. Pierce, The University of Tennessee, Knoxville, Tennessee
K. Pohl, The University of Tennessee, Knoxville, Tennessee
E. G. Roth, University of North Texas, Denton, Texas
I. M. Sandler, The University of Tennessee, Knoxville, Tennessee
J. G. Schulz, University of Sydney, Sydney, Australia
M. Simkin, The University of Tennessee, Knoxville, Tennessee
K.-J. Song, The University of Tennessee, Knoxville, Tennessee
J. M. Sullivan, The University of Tennessee, Knoxville, Tennessee
M. L. Sutherland, University of Toronto, Toronto, Canada
Y. Tu, State University of New York, Amherst, New York
V. C. Venezia, University of North Texas, Denton, Texas
C. Walters, University of Pennsylvania, Philadelphia, Pennsylvania
L. Xuan, The University of Tennessee, Knoxville, Tennessee
K. Yoo, The University of Tennessee, Knoxville, Tennessee
T. Zhang, The University of Tennessee, Knoxville, Tennessee
J.-X. Zhong, The University of Tennessee, Knoxville, Tennessee

D. *Undergraduate Students*

D. A. Guild, Clarkson University, Potsdam, New York
G. J. Hurley, Thomas More College, Fort Mitchell, Kentucky
W. G. Kasch, Florida Institute of Technology, Melbourne, Florida
A. N. Kasule, Carnegie-Mellon University, Pittsburgh, Pennsylvania
M. J. Mitchell, Western Kentucky University, Bowling Green, Kentucky
C. A. Rodriquez, University of Puerto Rico, Mayaguez, Puerto Rico
J. P. Scott, Clinton High School, Clinton, Tennessee
L. M. Taylor, Roane State Community College, Oak Ridge, Tennessee

SOLID STATE DIVISION

November 1, 2000

J. F. COOKE,* DIRECTOR
L. S. THOMASON, SECRETARY

SPECIAL STAFF ASSIGNMENTS

C. R. HUMPHREY*, WORK FORCE DIVERSITY REP
A. P. BADDORF*, QUALITY ASSURANCE COORDINATOR
S. P. WITHROW*, ES&H AND EPO OFFICER
J. FERNANDEZ-BACA*, RADIATION CONTROL OFFICER
S. P. KING*, COMPUTER SECURITY OFFICER
J. K. CARTER, TRAINING COORDINATOR
G. E. JELLISON*, LASER SAFETY OFFICER
L. S. THOMASON*, EMPLOYMENT REPRESENTATIVE
J. O. RAMEY*, PRECIOUS METALS COORDINATOR

ADMINISTRATION, ENGINEERING, MAINTENANCE

P. H. GREEN*, ASSISTANT TO DIVISION DIRECTOR
J. K. CARTER, USER FACILITIES COORDINATOR
J. R. COOMBS[1], FIELD ENGINEER
S. E. WOOD[1], FIELD ENGINEER
M. LOWER[1], DESIGN ENGINEER
C. C. OVERBEY[2], FINANCE OFFICER

SOLID STATE THEORY

R. F. WOOD*, ACTING SECTION HEAD
B. J. WADDELL, SECRETARY

CONDENSED MATTER THEORY

R. F. WOOD*
A. CHERNYSHEV[9]
R. FISHMAN
S. P. KING*
S. T. PANTELIDES[11]
B. E. SERNELIUS[5]
K. VARGA[9]
Z. ZHANG
J.-X. ZHONG[6]

ORNL/UT THEORY PROGRAM

G. D. MAHAN[4]
M. BARTKOWIAK[3]
F. J. RODRIQUEZ[5]
L. M. WOODS[9]
G. T. WOODS[6]
J. J. QUINN[5]
G. S. CANRIGHT[5]
A. EGUILUZ[7]
W. KU[6]
J. M. SULLIVAN[6]

NEUTRON SCATTERING

H. A. MOOK*
T. H. RICHARDSON, SECRETARY
N. W. WARD, SECRETARY

NEUTRON DIFFRACTION

G. D. WIGNALL
R. COLDEA[9]
W. A. HAMILTON
W. T. LEE[9]
J. S. LIN
Y. MELNICHENKO
L. PORCAR[9]
S. SPOONER

NEUTRON SPECTROMETRY

S. E. NAGLER
G. AEPPLI[11]
P. D. BUTLER
B. C. CHAKOUMAKOS*
M. L. CROW, JR.[9]
P. DAI
J. A. FERNANDEZ-BACA*
S. P. KING*
W. T. MONTFROOIJ[9]
J. L. ROBERTSON
M. YETHIRAJ

NEUTRON SCATTERING USERS GROUP

B. C. CHAKOUMAKOS*

NEUTRON SCATTERING TECHNICAL SUPPORT

J. R. WEIR III
R. G. MAPLES
S. A. MOORE
C. M. REDMON
G. B. TAYLOR
D. W. VALENTINE

AMES LABORATORY NEUTRON SCATTERING

J. L. ZARESTKY[8]

CERAMICS AND INTERFACES

L. A. BOATNER*
N. F. DELENE,[3] SECRETARY
C. R. HUMPHREY,* SECRETARY

SYNTHESIS & PROPERTIES OF NOVEL MATERIALS

L. A. BOATNER*
B. C. SALES
J. M. FARMER[6]
R. JIN[9]
J. A. KOLOPUS
R. LOPEZ-NORIEGA*[6]
D. G. MANDRUS*
G. C. RAGGHIANTI[10]
J. O. RAMEY*[3]

CERAMIC THIN FILMS

N. J. DUDNEY
I. DUNBAR
Y.-I. JANG[12]
C. F. LUCK
B. J. NEUDECKER

SUPERCONDUCTIVITY

D. K. CHRISTEN
T. AYTUG[9]
C. CANTONI[9]
Y. R. CHOI[6]
R. FEENSTRA
H. R. KERCHNER
H.-J. KIM[6]
K. D. SORGE[6]
J. R. THOMPSON[3]
Y. ZHANG[5]

SPALLATION NEUTRON SOURCE PROJECT

T. E. MASON[13]
A. C. I. LAKE[9]
M. LUMSDEN[12,13]
X-L. WANG[13]
J. K. ZHAO[13]

U.S.-JAPAN NEUTRON SCATTERING PROGRAM

J. A. FERNANDEZ-BACA*

PARTICLE-SURFACE INTERACTIONS

D. M. ZEHNER*
V. E. BARNES, SECRETARY

ION-SOLID INTERACTIONS

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