

## TOLGA AYTUG (U.S. Citizen)

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### EDUCATION

Ph.D in Physics, University of Kansas, Lawrence, KS	2000
MS in Physics, Middle East Technical University, Ankara, Turkey	1994
BS in Physics, Middle East Technical University, Ankara, Turkey	1991

### APPOINTMENTS

(2007-Present) <b>Research Staff Member:</b> Oak Ridge National Laboratory, Oak Ridge, TN
(2007-Present) <b>Adjunct Professor:</b> University of Tennessee, Dept. of Phys., Knoxville, TN
(2003-2007) <b>Research Assistant Professor:</b> University of Tennessee, Dept. of Phys., Knoxville, TN
(2000-2003) <b>Post-doctoral Research Associate:</b> Oak Ridge National Laboratory, Oak Ridge, TN
(1999-2000) <b>Post-graduate Research Associate:</b> Oak Ridge National Laboratory, Oak Ridge, TN
(1997-1999) <b>Research/Teaching Assistant:</b> University of Kansas, Lawrence, KS

### PUBLICATIONS, PATENTS, & PRESENTATIONS (h-index=24)

- One book chapter and over 100 articles in refereed journals (a list is attached)
- 19 US patents, 10 issued and 9 pending
- Numerous invited and contributed presentations at professional conferences

### AWARDS, HONORS & GRANTS

- (2015) **R&D 100 Award** for Multifunctional Superhydrophobic Transparent Glass Coating.
- (2014) **Research Accomplishment Award (ORNL)**. This represents the highest individual technical award for outstanding scientific accomplishment at ORNL
- (2014) **R&D 100 Award** for The Super-hydro-tunable HiPAS Membranes
- (2014) **ORNL Significant Event Award** for licensing of the technology on optically transparent nanostructured superhydrophobic coatings to United Protective Technologies
- (2012) **R&D 100 Award** for Low-Cost Plasma Processing System for Research and Pilot Production
- (2011) **Southeast and National Federal Laboratory Consortia Award** for excellence in technology transfer for flexible thin-film solar photovoltaics on RABiTS
- (2010) **R&D 100 Award** for High-Performance, High-Tc Superconducting Wires Enabled via Self-Assembly of Non-Superconducting Columnar Defects
- (2009) **ORNL Significant Event Award** for establishment of MOCVD capabilities at ORNL to produce high-performance superconductor films
- (2008) **ORNL Significant Event Award** for development of IBAD based second generation superconducting wires
- (2007) **Southeast** and (2008) **National Federal Laboratory Consortia Award** for excellence in technology transfer of LaMnO<sub>3</sub> – buffers to fabricate high-performance, high-temperature superconducting tapes
- (2007) **R&D 100 Award** for High-Performance LaMnO<sub>3</sub>-Enabled, High Temperature Superconducting Tape
- (2006) **Excellence in Technology Transfer Award**, Oak Ridge National Laboratory. This is one of the highest technical awards given at ORNL
- (2004) **Exceptional Accomplishment**, U.S.D.O.E. Superconductivity Program Peer Review
- (1994-1998) **Turkish higher education council fellowship**. This is the highest level of fellowship awarded in Turkey for exceptional students to study abroad
- American Chemical Society, Petroleum Research Grant (FY 2006-2008)

### PROFESSIONAL ACTIVITIES/MEMBERSHIPS

- Editorial Board Member, Superconductor Science and Technology (2010-present)
- Associate Technical Editor, IEEE Transactions on Applied Superconductivity (2008-present)
- Organizer for symposium entitled “Advances in superconductivity: Heterostructures, Materials Functionalization, and Nanoscale Optimization” in the Materials Research Society, Spring 2008

- Co-organizer for symposium entitled “Nanostructured Materials: Synthesis, Characterization and Applications” in the Materials Science and Technology Conference 2006
- Reviewer of professional journal articles (e.g. J. Matter. Res., Physica C, Appl. Phys. A, IEEE Trans. on Appl. Supercond., Supercond. Sci. and Technol., J. Elec. Matter., Physical Review B, Appl. Surf. Sci., etc.)
- Session chairman at numerous symposia
- Member: Sigma Xi Scientific Research Society, Materials Research Society, American Chemical Society
- Ph.D. thesis advisor (University of Tennessee), Mentor for undergraduate interns, visiting high-school teachers and university faculty seeking research experience

## **RESEARCH INTEREST and EXPERTISE**

- Epitaxial growth of thin film heterostructures using various techniques including *dc* and *rf*-magnetron sputtering, pulsed laser ablation, electron beam evaporation, metal organic chemical vapor deposition (MOCVD) and chemical solution (Metal Organic Decomposition and Sol-Gel) approaches
- Epitaxial thin film multilayers of ferroelectric perovskites, magnetoresistive oxides, nitrides and metals on single crystals and textured metal substrates.
- Processing strategies for insulating and conducting oxide and nitride thin films as buffer layers on biaxially textured Cu, Ni and Ni-alloy tapes
- Synthesize and characterize properties of bulk and thin films of mercury-, thallium- and yttrium-based high temperature superconducting cuprates
- Ion and neutron irradiation effects on the physical/chemical and microstructural properties of nanoparticle doped yttrium-based high temperature superconductors
- Chemical synthesis approaches for the development of novel radiation resistant polymer-ceramic based nanocomposite dielectric materials for nuclear environments
- Effects of gamma radiation on the mechanical and electrical properties of the composite polymer systems
- Mechanisms of magnetic vortex phenomena in high-temperature superconducting films
- Thermodynamic and kinetic effects on phase nucleation, structure formation and stability of oxide and nitride thin films
- Relationships between film microstructure, defects, and diffusion properties on an atomic scale
- Physical, chemical, and electrical properties of superconducting materials, oxide, nitride, metal and CMR thin films including electrical transport and magnetic properties
- Synthesis of two-dimensional, self-organized arrays of various oxide and metal nanoparticles with controlled size, orientation, and concentration on technological substrates
- Effects of nanoparticle surface engineering on flux-pinning properties of superconducting films
- Synthesis and formation of chemically phase separated and structurally self-assembled composite structures in epitaxial thin films
- Processing strategies for the fabrication and electrical stabilization of high critical current density superconducting wires
- Metallization layers, die-attach materials and assembly concepts for high temperature power electronics packaging
- Design concepts and fabrication of integrated high temperature, high frequency thin film ceramic capacitors for power electronic modules
- Synthesis and design of window, absorber, and electrode layers for thin film based photovoltaics on glass and flexible materials
- Novel approaches for the development of transparent and non-transparent nanostructured superhydrophobic coatings
- Process development/optimization of conductive interconnects based on nanoparticle inks for printed flexible electronics

## **SKILLS**

- X-ray diffraction: powder, texture and pole figure analysis
- Microscopy: SEM/EDAX, AFM, and Optical; Profilometry
- Spectroscopy: XAS, SAM, RBS, SIMS, and Optical (UV-Vis-NIR transmittance and reflectivity)
- Mechanical: Dynamic mechanical analysis, uniaxial tensile measurements

- Static and dynamic contact angle measurements
- Residual gas and thermal gravimetric analysis
- Electrical transport by four-point technique and Hall-effect measurements
- Vacuum techniques, deposition equipment, roll-to-roll equipment and processing
- *Rf*- and *dc*-magnetron sputtering, MOCVD, CVD, Screen-printing, Tape-casting, Spin- and dip-coating techniques
- Photonic curing techniques using pulsed thermal processing
- Air-sensitive techniques and equipment (e.g., Schlenk apparatus and dry box)
- Thin film patterning using photolithography

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## PATENTS

1. Inventor, "Superhydrophobic transparent glass (STG) thin film articles", U.S. Patent No. 8,741,158; June 3, 2014
2. Inventor, "Hetero-junction photovoltaic device and method of fabricating the device", U.S. Patent No. 8,647,915; Feb 11, 2014
3. Inventor, "Method for producing microstructured templates and their use in providing pinning enhancements in superconducting films deposited thereon", U.S. Patent No. 8,486,864; July 16, 2013
4. Inventor, "Phase separated, epitaxial composite cap layers for electronic device applications, and method of making the same", U.S. Patent No. 8,221,909, July 17, 2012
5. Co-inventor, "Chemical Solution Deposition Method of Fabricating Highly Aligned MgO Templates", U.S. Patent No. 8,088,503; Jan 3, 2012.
6. Co-inventor, "Chemical Solution Deposition Method of Fabricating Highly Aligned MgO Templates", U.S. Patent No. 7,553,799 B2; June 30, 2009.
7. Co-inventor, "Superconductors on Iridium Substrates and Buffer Layers", U.S. Patent No. 7,432,229 B2; October 7, 2008.
8. Co-inventor, "Method of Depositing an Electrically Conductive Oxide Buffer Layer on a Textured Substrate and Articles Formed There from," U.S. Patent No. 6,956,012; October 18, 2005.
9. Co-inventor, "Buffer Layers and Articles for Electronic Devices," U.S. Patent No. 6,764,770; July 20, 2004.
10. Co-inventor, "Method of Depositing an Electrically Conductive Oxide Buffer layer on a Textured Substrate and Articles Formed There from," U.S. Patent No. 6,617,283 B2; September 9, 2003.

## BOOK CHAPTERS

1. **T. Aytug** in: "Applied Superconductivity, Handbook on Devices and Applications (2015), Wiley-VCH" ISBN: 978-3-527-41209-9
2. **T. Aytug** in: "*Flux Pinning and AC Loss Studies on YBCO Coated Conductors* (2007), Nova Science Publishers" ISBN: 1-60021-692-7

## PUBLICATIONS

1. M.S. Rager, **T. Aytug**, G.M. Veith, and J.C. Pooran, "Low Thermal Budget Photonic Processing of Highly Conductive Cu Interconnects Based on CuO Nanoinks: Potential for Flexible Printed Electronics," ACS Appl. Mater. Interfaces, **8**, 2441 (2016).
2. B. Yang, O. Dyck, J. Poplawsky, J. Keum, S. Das, A. Puretzky, **T. Aytug**, P. C. Joshi, C. Rouleau, G. Duscher, D. B. Geohegan, and K. Xiao, "Controllable Growth of Perovskite Films by Room-Temperature-Air-Exposure for Efficient Planar Heterojunction Photovoltaic Cells," Angew. Chem. Int. Ed. **54**, 14862 (2015).
3. Y. Lu, J. Poole, **T. Aytug**, H. Meyer, and S. Ozcan, "Tunable Morphologies of Indium Tin Oxide Nanostructures Using Nanocellulose Templates," RCS Adv. **5**, 103680 (2015).

4. G.E. Jellison, **T. Aytug**, A.R. Lupini, M.P. Paranthaman, and J.C. Pooran, "Optical properties of a nanostructured glass-based film using spectroscopic ellipsometry," *Thin Solid Films* (submitted, 2015)
5. J.T. Simpson, S.R. Hunter, and **T. Aytug**, "Superhydrophobic materials and coatings: a review," *Rep. Prog. Phys.* **78**, 086501 (2015)
6. D. Sanjib, Y. Bin, G. Gong, J. C. Pooran, I.N. Ivanov, C.M. Rouleau, Christopher, **T. Aytug**, D.B. Geohegan, and K. Xiao, "High-Performance flexible perovskite solar cells by using a combination of ultrasonic spray-coating and low thermal budget photonic curing," *ACS Photonics* **2**, 680 (2015)
7. G.A. Malek, **T. Aytug**, Q.F. Liu, and J.Z. Wu, "Plasmonic three-dimensional transparent conductor based on Al-doped zinc oxide-coated nanostructured glass using atomic layer deposition," *ACS Appl. Mater. Interfaces* **7**, 8556 (2015)
8. **T. Aytug**, A.R. Lupini, G.E. Jellison, J.C. Pooran, I.N. Ivanov, L. Tao, P. Weng, R. Menon, R.M. Trejo, E. Lara-Curzio, S.R. Hunter, J.T. Simpson, M.P. Paranthaman, and D.K. Christen, "Monolithic graded-refractive-index glass-based antireflective coatings: broadband/omnidirectional light harvesting and self-cleaning characteristics," *J. Mater. Chem. C* **3**, 5440 (2015)
9. A.A. Gapud, N.T. Greenwood, J.A. Alexander, A. Khan, K.J. Leonard, **T. Aytug**, F.A. List III, M. Rupich, and Y. Zhang, "Irradiation of commercial, high- $T_c$  superconducting tape for potential fusion applications: electromagnetic transport properties," *J. Nucl. Mater.* **462**, 108 (2015)
10. R. C. Duckworth, G. Polyzos, P. Paranthaman, **T. Aytug**, K. Leonard, and I. Sauers, "Radiation resistance of XLPE nano-dielectrics for advanced reactor application," *Trans. Am. Nuc. Soc.* **110**, 937 (2014)
11. **T. Aytug**, D.F. Bogorin, M. Paranthaman, J.E. Mathis, J.T. Simpson, and D.K. Christen, " Superhydrophobic ceramic coatings enabled by phase-separated nanostructured composite  $TiO_2-Cu_2O$  thin films," *Nanotechnology* **25**, 245601 (2014)
12. K. J. Leonard, **T. Aytug**, A. A. Gapud, F. A. List III, N. T. Greenwood, Y. Zhang, A. G. Perez-Bergquist and W. J. Weber, "Irradiation response of next generation high temperature superconductors for fusion energy applications," *Fusion Sci. Technol.* **66**, 57 (2014)
13. M. Paranthaman, **T. Aytug**, L. Stan, Q. Jia, C. Cantoni, and S.H. Wee, "Chemical solution derived planarization layers for highly aligned IBAD-MgO templates," *Supercond. Sci. Technol.* **27**, 022002 (2014)
14. **T. Aytug**, J.T. Simpson, A.R. Lupini, R.M. Trejo, G.E. Jellison, I.N. Ivanov, S.J. Pennycook, D.A. Hillesheim, K.O. Winter, D.K. Christen, S.R. Hunter, and J.A. Haynes, "Optically transparent, mechanically durable, nanostructured superhydrophobic surfaces enable by spinodally phase-separated glass thin films," *Nanotechnology* **24**, 315602 (2013)
15. O. Polat, **T. Aytug**, A. R. Lupini, P. M. Paranthaman, M. Ertugrul, D. F. Bogorin, H. M. Meyer, W. Wang, S. J. Pennycook, and D. K. Christen, "Nanostructured columnar heterostructures of  $TiO_2$  and  $Cu_2O$  enabled by a thin-film self-assembly approach: Potential for photovoltaics," *Mater. Res. Bull.* **48**, 352 (2013)
16. **T. Aytug**, V. A. Maroni, D. J. Miller, Z. Chen, A. J. Kropf, N. J. Zaluzec, Y. Zuev, E. D. Specht, and M. Paranthaman, "Novel tri-modal defect structure in Nb-doped MOCVD  $YBa_2Cu_3O_7$ : A paradigm for pinning landscape control," *Supercond. Sci. Technol.* **25**, 095013 (2012)
17. O. Polat, M. Ertugrul, J.R. Thompson, K.J. Leonard, J.W. Sinclair, M.P. Paranthaman, S.H. Wee, Y.L. Zuev, X. Xiong, V. Selvamanickam, D.K. Christen, and **T. Aytug**, "Superconducting properties of  $YBa_2Cu_3O_{6+\delta}$  films deposited on commercial tape substrates, decorated with Pd or Ta nano-islands," *Supercond. Sci. Technol.* **25**, 025018 (2012)
18. G. Polyzos, E. Tuncer, X.F. Qui, **T. Aytug**, M.K. Kidder, J.M. Messman, and I. Sauers, "Nonfunctionalized Polydimethyl Siloxane Superhydrophobic Surfaces Based on Hydrophobic-Hydrophilic Interactions," *Langmuir* **27**, 2953 (2011)
19. **T. Aytug**, Z. Chen, V.A. Maroni, D.J. Miller, C. Cantoni, E.D. Specht, A.J. Kropf, N. Zaluzec, Y. Zhang, Y. Zuev, and M. Paranthaman, "Nano-engineered defect structures in Ce- and Ho-doped metal-organic chemical vapor deposited  $YBa_2Cu_3O_{6+\delta}$  films: Correlation of structure and chemistry with flux pinning performance," *J. Appl. Phys.* **109**, 113923 (2011)

20. O. Polat, **T. Aytug**, M. Paranthaman, K. Kim, A.R. Lupini, H.M. Meyer, X.F. Qui, J.R. Thompson, D.K. Christen, and V. Selvamanickam, "Pinning enhancements in YBCO films via nanoengineered LaMnO<sub>3</sub>:MgO composite cap layer," *IEEE Trans. Appl. Supercond.*, **21**, 3171 (2011)
21. O. Polat, **T. Aytug**, M. Paranthaman, K.J. Leonard, A.R. Lupini, S.J. Pennycook, H.M. Meyer, K. Kim, X.F. Qui, S. Cook, J.R. Thompson, D.K. Christen, A. Goyal, X.M. Xiong, and V. Selvamanickam, "An evaluation of phase separated, self-assembled LaMnO<sub>3</sub>-MgO nanocomposite films directly on IBAD-MgO as buffer layers for flux pinning enhancements in YBa<sub>2</sub>Cu<sub>3</sub>O<sub>7-δ</sub> coated conductors," *J. Mater. Res.*, **25**, 437 (2010)
22. E. Tuncer, G. Polizos, I. Sauers, D.R. James, A.R. Ellis, J.M. Messman, and **T. Aytug**, "Polyamide 66 as a cryogenic dielectric," *Cryogenics* **49**, 463 (2010)
23. V.A. Maroni, A.J. Kropf, **T. Aytug**, and M. Paranthaman, "Raman and x-ray absorption spectroscopy characterization of Zr-doped MOCVD YBa<sub>2</sub>Cu<sub>3</sub>O<sub>6+δ</sub>," *Supercond. Sci. Technol.* **23**, 014020 (2010)
24. **T. Aytug**, M. Paranthaman, E.D. Specht, Y. Zhang, K. Kim, Y.L. Zuev, C. Cantoni, A. Goyal, D.K. Christen, V.A. Maroni, Y. Chen, and V. Selvamanickam, "Enhanced flux pinning in MOCVD-YBCO films through Zr additions: systematic feasibility studies," *Supercond. Sci. Technol.* **23**, 014005 (2010)
25. Y. Zhang, E.D. Specht, C. Cantoni, D.K. Christen, J.R. Thompson, J.W. Sinclair, A. Goyal, Y.L. Zuev, **T. Aytug**, M. Paranthaman, Y. Chen, and V. Selvamanickam, "Magnetic field orientation dependence of flux pinning in (Gd,Y)Ba<sub>2</sub>Cu<sub>3</sub>O<sub>7-x</sub> coated conductor with tilted lattice and nanostructures," *Physica C* **469**, 2044 (2009)
26. **T. Aytug**, M. Paranthaman, L. Heatherly, Y. Zuev, Y. Zhang, K. Kim, A. Goyal, V.A. Maroni, Y. Chen, and V. Selvamanickam, "Deposition studies and coordinated characterization of MOCVD YBCO films on IBAD-MgO templates," *Supercond. Sci. Technol.* **22**, 015008 (2009)
27. M. Paranthaman, **T. Aytug**, K. Kim, E.D. Specht, and L. Heatherly, "Strategic buffer layer development for YBCO conductors," *IEEE Trans. Appl. Supercond.*, **19**, 3303 (2009)
28. Y.M. Chen, V. Selvamanickam, Y. Zhang, Y.L. Zuev, C. Cantoni, E.D. Specht, M. Paranthaman, **T. Aytug**, A. Goyal, and, D. Lee, "Enhanced flux pinning by BaZrO<sub>3</sub> and (Gd,Y)<sub>2</sub>O<sub>3</sub> nanostructures in metal organic chemical vapor deposited GdYBCO high temperature superconductor tapes," *Appl. Phys. Lett.*, **94**, 062513 (2009)
29. K. Kim, D.P. Norton, D.K. Christen, C. Cantoni, M. Paranthaman, and **T. Aytug**, "Epitaxial growth of MgO/TiN multilayers on Cu," *Vacuum* **83**, 897 (2009)
30. O. Polat, **T. Aytug**, M. Paranthaman, K. Kim, Y. Zhang, C. Cantoni, Y.L. Zuev, A. Goyal, J.R. Thompson, D.K. Christen, X. Xiong, and V. Selvamanickam, "Properties of YBCO on LaMnO<sub>3</sub>-capped IBAD MgO-templates without homo-epitaxial MgO layer," *IEEE Trans. Appl. Supercond.*, **19**, 3315 (2009)
31. O. Polat, **T. Aytug**, M. Paranthaman, K. Kim, Y. Zhang, J.R. Thompson, D.K. Christen, X. Xiong, and V. Selvamanickam, "Direct growth of LaMnO<sub>3</sub> cap buffer layers on IBAD-MgO for simplified template-based YBCO coated conductors," *J. Mater. Res.*, **23**, 3021 (2008)
32. **T. Aytug**, M. Paranthaman, K.J. Leonard, K. Kim, A.O. Ijaluola, E. Tuncer, J.R. Thompson, and D.K. Christen, "Enhanced flux pinning and critical currents in YBa<sub>2</sub>Cu<sub>3</sub>O<sub>7-δ</sub> films by nanoparticle surface decoration: Extension to coated conductor templates," *J. Appl. Phys.* **104**, 043906 (2008)
33. K. Kim, D.P. Norton, D.K. Christen, C. Cantoni, **T. Aytug**, and A. Goyal, "Epitaxial (La,Sr)TiO<sub>3</sub> on textured Ni-W as a conductive buffer architecture for high temperature superconducting coated conductor," *Physica C* **468**, 961 (2008)
34. S. H. Wee, A. Goyal, H. Hsu, S. Sathyamurthy, M. Paranthaman, J. Li, L. Heatherly, K. H. Kim, and **T. Aytug**, "Formation of high-quality, epitaxial La<sub>2</sub>Zr<sub>2</sub>O<sub>7</sub> films on biaxially textured substrates by slot-die coating of chemical solution precursors followed by atmospheric crystallization," *J. Am. Ceram. Soc.* **90**, 3529 (2007)
35. S. Sathyamurthy, K.J. Leonard, M.S. Bhuiyan, **T. Aytug**, S. Kang, R.D. Hunt, P.M. Martin, and M. Paranthaman, "Low-cost approaches for flux-pinning enhancements in YBCO films using solution processing," *IEEE Trans. on Appl. Supercond.* **17**, 3668 (2007)

36. M. Paranthaman, S. Sathyamurthy, M.S. Bhuiyan, P.M. Martin, **T. Aytug**, K. Kim, M. Fayek, K.J. Leonard, J. Li, A. Goyal, T. Kodenkandath, X. Li, W. Zhang, and M.W. Rupich, "MOD buffer/YBCO approach to fabricate low-cost second generation HTS wires," *IEEE Trans. on Appl. Supercond.* **17**, 3332 (2007)
37. **T. Aytug**, M. Paranthaman, A.A. Gapud, S. Kang, M. Varela, P.M. Martin, J.M. Raitano, S.-W. Chan, J.R. Thompson and D.K. Christen, "Substrate surface decoration with CeO<sub>2</sub> nanoparticles: An effective method for improving flux pinning in YBa<sub>2</sub>Cu<sub>3</sub>O<sub>7-δ</sub>," *IEEE Trans. on Appl. Supercond.* **17**, 3720 (2007)
38. E. Tuncer, I. Sauers, D.R. James, A.R. Ellis, **T. Aytug**, M. Paranthaman, J. Li, A. Goyal, and K.L. More, "Electrical properties of resin based composites," *Nanotechnology* **18**, 025703 (2007)
39. S. Sathyamurthy, M. Paranthaman, K. Kim, and **T. Aytug**, "Effect of relative humidity during coating on the crystallization behavior of sol-gel lanthanum zirconium oxide thin films," *Chemistry of Materials* **18**, 5829 (2006)
40. **T. Aytug**, M. Paranthaman, K.J. Leonard, S. Kang, P.M. Martin, L. Heatherly, A. Goyal, A.O. Ijaduola, J.R. Thompson, D.K. Christen, R. Meng, I. Rusakova, and C.W. Chu, "Analysis of Flux Pinning in YBa<sub>2</sub>Cu<sub>3</sub>O<sub>7-δ</sub> films by nanoparticle-modified substrate surfaces," *Phys. Rev. B.* **74**, 184505 (2006)
41. K. Kim, M. Paranthaman, D.P. Norton, **T. Aytug**, C. Cantoni, A.A. Gapud, A. Goyal, and D.K. Christen, "A perspective on conducting oxide buffers for Cu-based YBCO-coated conductors," *Supercond. Sci. Technol.* **19**, R23 (2006)
42. **T. Aytug**, M. Paranthaman, A.A. Gapud, S. Kang, H.M. Christen, K.J. Leonard, P.M. Martin, J.R. Thompson, D.K. Christen, R. Meng, I. Rusakova, C.W. Chu, and T.H. Johansen, "Enhancement of flux pinning and critical currents in YBa<sub>2</sub>Cu<sub>3</sub>O<sub>7-δ</sub> films by nano-scale Iridium pre-treatment of substrate surfaces," *J. Appl. Phys.* **98**, 114309 (2005)
43. A. Polyanskii, R.L.S. Emergo, J.Z. Wu, **T. Aytug**, D.K. Christen, G.K. Perkins, and D. Larbalestier, "Magneto-optical imaging and electromagnetic study of YBa<sub>2</sub>Cu<sub>3</sub>O<sub>7</sub> vicinal films of variable thickness," *Phys. Rev. B* **72**, 174509 (2005)
44. **T. Aytug**, M. Paranthaman, K.J. Leonard, H.Y. Zhai, M.S. Bhuiyan, E.A. Payzant, A. Goyal, S. Sathyamurthy, D.B. Beach, P.M. Martin, D.K. Christen, X. Li, T. Kodenkandath, U. Schoop, M.W. Rupich, H. E. Smith, T. Haugan, and P.N. Barnes, "Assessment of chemical solution synthesis and properties of Gd<sub>2</sub>Zr<sub>2</sub>O<sub>7</sub> thin films as buffer layers for second generation high-temperature superconductor wires," *J. Mater. Res.* **20**, 2988 (2005)
45. Y.F. Zhang, M. Paranthaman, R. Feenstra, **T. Aytug**, and D. K. Christen, "Comparison of YBa<sub>2</sub>Cu<sub>3</sub>O<sub>7-δ</sub> precursors made using TFA-MOD and BaF<sub>2</sub> ex-situ processes and their post-deposition processing under low pressure conditions," *IEEE Trans. on Appl. Supercond.* **15**, 2659 (2005)
46. **T. Aytug**, M. Paranthaman, H. Y. Zhai, K. J. Leonard, A. A. Gapud, J. R. Thompson, A. Goyal, and D. K. Christen, "Iridium: An oxygen diffusion barrier and a conductive seed layer for RABiTS-based coated conductors," *IEEE Trans. on Appl. Supercond.* **15**, 2977 (2005)
47. C. Cantoni, A. Goyal, U. Schoop, X. Li, M. W. Rupich, C. Thieme, A.A. Gapud, T. Kodenkandath, **T. Aytug**, M. Paranthaman, K. Kim, J.D. Budai, and D. K. Christen, "Investigation of TiN seed layers for RABiTS architectures with a single-crystal-like out-of-plane texture," *IEEE Trans. on Appl. Supercond.* **15**, 2981 (2005)
48. K. Kim, D.P. Norton, C. Cantoni, **T. Aytug**, A. Gapud, M. Paranthaman, A. Goyal, and D.K. Christen, "(La; Sr)TiO<sub>3</sub> as a conductive buffer for high-temperature superconducting coated conductors," *IEEE Trans. on Appl. Supercond.* **15**, 2997 (2005)
49. Y. Zhang, R. Feenstra, J.R. Thompson, A.A. Gapud, **T. Aytug**, P.M. Martin, and D.K. Christen, "High critical current density YBa<sub>2</sub>Cu<sub>3</sub>O<sub>7-δ</sub> thin films fabricated by ex situ processing at low pressures," *Supercond. Sci. Technol.* **17**, 1154 (2005)
50. M. Paranthaman, **T. Aytug**, H.Y. Zhai, L. Heatherly, A. Goyal, and D.K. Christen, "Growth of YBCO films on MgO-based rolling-assisted biaxially textured substrates templates," *Supercond. Sci. Technol.* **18**, 223 (2005)
51. **T. Aytug**, M. Paranthaman, H.Y. Zhai, A.A. Gapud, K.J. Leonard, P.M. Martin, A. Goyal, J.R. Thompson, and D.K. Christen, "An approach for electrical self-stabilization of high-temperature superconducting wires for power applications," *Appl. Phys. Lett.* **85**, 2887 (2004)

52. R.L.S. Emergo, J.Z. Wu, **T. Aytug**, and D.K. Christen, "Thickness dependence of superconducting critical current density in vicinal  $\text{YBa}_2\text{Cu}_3\text{O}_{7-\delta}$  thick films," *Appl. Phys. Lett.* **85**, 618 (2004)
53. S. Sathyamurth, M. Paranthaman, H.Y. Zhai, S. Kang, **T. Aytug**, C. Cantoni, K.J. Leonard, E.A. Payzant, H.M. Christen, A.Goyal, X.Li, U. Schoop, A. Kodenkandath and M.W. Rupich, "Chemical solution deposition of lanthanum zirconate barrier layers applied to low-cost coated-conductor fabrication," *J. Mater Res.* **19**, 2117 (2004)
54. M.S. Bhuiyan, M. Paranthaman, S. Sathyamurthy, **T. Aytug**, S. Kang, D.F. Lee, A. Goyal, E.A. Payzant, and K. Salama, "MOD approach for the growth of epitaxial  $\text{CeO}_2$  buffer layers on biaxially textured Ni-W substrates for YBCO coated conductors," *Supercond. Sci. and Technol* **16**, 1305 (2003)
55. **T. Aytug**, M. Paranthaman, J.R. Thompson, A. Goyal, N. Rutter, H.Y. Zhai, A.A. Gapud, A.O. Ijaluola and D. K. Christen, "Electrical and magnetic properties of conductive Cu-based coated conductors," *Appl. Phys. Lett.* **83**, 3963 (2003)
56. M.Paranthaman, **T. Aytug**, D.K. Christen, P.N. Arendt, S.R. Foltyn, J.R. Groves, L. Stan, R.F. DePaula, H. Wang, "Growth of thick  $\text{YBa}_2\text{Cu}_3\text{O}_{7-\delta}$  films carrying a critical current of over 230 A/cm on single  $\text{LaMnO}_3$ - buffered ion-beam assisted deposition  $\text{MgO}$  substrates," *J. Mater. Res.* **18**, 2055 (2003)
57. M.Paranthaman, **T. Aytug**, S. Kang, R. Feenstra, J.D. Budai, D.K. Christen, P.N. Arendt, L. Stan, J.R. Groves, R.F. DePaula, S.R. Foltyn, and T.G. Holesinger, "Fabrication of high- $J_c$   $\text{YBa}_2\text{Cu}_3\text{O}_{7-\delta}$  tapes using the newly developed lanthanum manganate single buffer layers," *IEEE Trans. on Appl. Supercond.* **13**, 2481 (2003)
58. **T. Aytug**, M. Paranthaman, S.Kang, H.Y. Zhai, H.M. Christen, C.E. Vallet, S. Sathyamurthy, and D.K Christen, " $\text{LaMnO}_3$ : A single oxide buffer layer for high- $J_c$   $\text{YBa}_2\text{Cu}_3\text{O}_{7-\delta}$  coated conductors," *IEEE Trans. on Appl. Supercond.*, **13**, 2661 (2003)
59. X. Li, M.W. Rupich, W. Zhang, N. Nguyen, T. Kodenkandath, U. Schoop, D.T. Verebelyi, C. Thieme, M. Teplitsky, P.N. Arendt, S.R. Foltyn, T.G. Holesinger, **T. Aytug**, D.K. Christen, and M.P. Paranthaman, "High critical current MOD ex-situ YBCO films on RABiTS™ and  $\text{MgO}$ -IBAD Templates," *Physica C* **390**, 249 (2003)
60. **T. Aytug**, A. Goyal, M. Paranthaman, J.R. Thompson, N. Rutter, H.Y. Zhai, and D. K. Christen, "High critical current density  $\text{YBa}_2\text{Cu}_3\text{O}_{7-\delta}$  on  $\text{LaMnO}_3$ -buffered biaxially textured Cu tapes for coated conductor applications," *J. Mater. Res.* **18**, 872 (2003)
61. **T. Aytug**, M. Paranthaman, S. Sathyamurthy, B.W. Kang, D.F. Lee, R. Feenstra, A. Goyal, P.M. Martin, and D.K. Christen, "Continuous reel-to-reel chemical solution deposition of epitaxial  $\text{Gd}_2\text{O}_3$  buffer layers on biaxially textured Ni-3at.% W-1.7at.% Fe alloy and Ni substrates for the fabrication of high  $J_c$   $\text{YBa}_2\text{Cu}_3\text{O}_{7-d}$  coated conductors," *J. Am. Ceram. Soc.* **86**, 257 (2003)
62. S.L. Yan, L. Fang, **T. Aytug**, Y.Y. Xie, and J.Z. Wu, "Microstructural evolutions in converting epitaxial  $\text{Tl}_2\text{Ba}_2\text{CaCu}_2\text{O}_x$  thin films to epitaxial  $\text{HgBa}_2\text{CaCu}_2\text{O}_{6+\delta}$  thin films," *J. Appl. Phys.* **93**, 1666 (2002)
63. M. Paranthaman, **T. Aytug**, S. Sathyamurthy, D.B. Beach, A. Goyal, D.F. Lee, B.W. Kang, L. Heatherley, E.D. Specht, K.J. Leonard, D.K. Christen, and D.M. Kroeger, "Bulk solution techniques to fabricate high  $J_c$  YBCO coated conductors," *Physica C* **378**, 1009 (2002)
64. Y.Y. Xie, J.Z. Wu, **T. Aytug**, D.K. Christen, and A.H. Cardona, "Diffusion mechanism of cation-exchange process for fabrication of  $\text{HgBa}_2\text{CaCu}_2\text{O}_{6+\delta}$  superconducting films," *Appl. Phys. Lett.* **81**, 4002 (2002)
65. A. Goyal, R. Feenstra, M. Paranthaman, J.R. Thompson, B.W. Kang, C. Cantoni, D.F. Lee, F.A. List, P.M. Martin, E. Lara-Curzio, C. Stevens, D.M. Kroeger, M. Kowalewski, E.D. Specht, **T. Aytug**, S. Sathyamurthy, R.K Williams, and R.E. Ericson, "Strengthened, biaxially textured Ni substrate with small alloying additions for coated conductor applications," *Physica C* **382**, 251 (2002)
66. S. Sathyamurthy, B.W. Kang, **T. Aytug**, M. Paranthaman, P.M. Martin, A. Goyal, D.M. Kroeger, and D.K. Christen, "Chemical solution deposition of lanthanum zirconate buffer layers on biaxially textured Ni-W alloy substrates for coated-conductor fabrication," *J. Mater. Res.* **17**, 1543 (2002)

67. **T. Aytug**, M. Paranthaman, H-Y. Zhai, H.M. Christen, S. Sathyamurthy, D.K. Christen, and R.E. Ericson, "Single buffer layers of  $\text{LaMnO}_3$  or  $\text{La}_{0.7}\text{Sr}_{0.3}\text{MnO}_3$  for the development of  $\text{YBa}_2\text{Cu}_3\text{O}_{7-d}$  coated conductors. A comparative study," *J. Mater. Res.* **17**, 2193 (2002)
68. **T. Aytug**, M. Paranthaman, S. Sathyamurthy, B.W. Kang, D.B. Beach, C.E. Vallet, E.D. Specht, D.F. Lee, R. Feenstra, A. Goyal, D.M. Kroeger, K.J. Leonard, P.M. Martin, and D.K. Christen, "High  $J_c$  YBCO coatings on reel-to-reel dip coated  $\text{Gd}_2\text{O}_3$  seed buffer layers epitaxially fabricated on biaxially textured Ni and Ni-alloy tapes," *MRS Symposium Proceedings*, **689**, 211 (2001)
69. M. Paranthaman, **T. Aytug**, H-Y. Zhai, S. Sathyamurthy, H.M. Christen, P.M. Martin, D.K. Christen, R.E. Ericson, and C.L. Thomas, "Single buffer layer technology for YBCO coated conductors," *MRS Symposium Proceedings*, **689**, 323 (2001)
70. S. Sathyamurthy, M. Paranthaman, B.W. Kang, H-Y. Zhai, **T. Aytug**, H.M. Christen, E.D. Specht, M.M. Kowalewski, A. Goyal, and P.M. Martin, "Fabrication of high  $J_c$   $\text{YBa}_2\text{Cu}_3\text{O}_{7-d}$  coated conductors using sol-gel buffer layers on nickel and nickel alloy substrates," *MRS Symposium Proceedings* **689**, 357 (2001)
71. Y.Y. Xie, J.Z. Wu, **T. Aytug**, D.K. Christen "Diffusion mechanism of cations and anions in cation-exchange process for fabrication of High- $T_c$  superconducting  $\text{HgBa}_2\text{CaCu}_2\text{O}_{6+\delta}$  films," *MRS Symposium Proceedings*, **689**, 357 (2001)
72. A. Goyal, D.F. Lee, F.A. List, E.D. Specht, R. Feenstra, M Paranthaman, X. Cui, S.W. Lu, P.M. Martin, D.M. Kroeger, D.K. Christen, B.W. Kang, D.P. Norton, C. Park, D.T. Verebelyi, J.R. Thompson, R.K. Williams, **T. Aytug**, and C. Cantoni, "Recent progress in the fabrication of high- $J_c$  tapes by epitaxial deposition of YBCO on RABiTS," *Physica C* **357**, 903 (2001)
73. **T. Aytug**, M. Paranthaman, B.W. Kang, S. Sathyamurthy, A. Goyal, and D.K. Christen, " $\text{La}_{0.7}\text{Sr}_{0.3}\text{MnO}_3$ : a single, conductive-oxide buffer layer for the development of  $\text{YBa}_2\text{Cu}_3\text{O}_{7-\delta}$  coated conductors," *Appl. Phys. Lett.*, **79**, 2205 (2001)
74. M. Paranthaman, C. Cantoni, H.Y. Zhai, H.M. Christen, **T. Aytug**, S. Sathyamurthy, E.D. Specht, J.R. Thompson, D.H. Lowndes, H.R. Kerchner, and D.K. Christen, "Superconducting  $\text{MgB}_2$  films via precursor post processing approach," *Appl. Phys. Lett.*, **78**, 3669 (2001)
75. **T. Aytug**, B.W. Kang, C. Cantoni, E.D. Specht, M. Paranthaman, A. Goyal, D.K. Christen, D.T. Verebelyi, J.Z. Wu, R.E. Ericson, C.L. Thomas, C.-Y. Yang, and S.E. Babcock, "Growth and characterization of conductive  $\text{SrRuO}_3$  and  $\text{LaNiO}_3$  multilayers on textured Ni tapes for high- $J_c$   $\text{YBa}_2\text{Cu}_3\text{O}_{7-\delta}$  coated conductors," *J. Mater. Res.* **16**, 2661 (2001)
76. C. Cantoni, **T. Aytug**, D.T. Verebelyi, M. Paranthaman, E.D. Specht, D.P. Norton, and D.K. Christen, "Conductive buffer layers and overlayers for the electrical stability of coated conductors", *IEEE Trans. on Appl. Supercond.* **11**, 3309 (2001)
77. **T. Aytug**, Y.Y. Xie, J.Z. Wu, and D.K. Christen, "Growth characteristics of  $\text{HgBa}_2\text{CaCu}_2\text{O}_6$  superconducting films on  $\text{CeO}_2$ -buffered YSZ single crystals: an assessment for coated conductors," *Physica C* **363**, 107 (2001)
78. Y.Y. Xie, **T. Aytug**, J.Z. Wu, D.T. Verebelyi, M. Paranthaman, A. Goyal, and D.K. Christen, "High critical current density  $\text{HgBa}_2\text{CaCu}_2\text{O}_6$  superconducting films on textured Ni substrates," *Appl. Phys. Lett.* **77**, 4193 (2000)
79. **T. Aytug**, J.Z. Wu, B.W. kang, D.T. Verebelyi, C. Cantoni, E.D. Specht, A. Goyal, and M. Paranthaman, "An all-sputtered buffer layer architecture for high- $J_c$   $\text{YBa}_2\text{Cu}_3\text{O}_{7-\delta}$  coated conductors", *Physica C* **340**, 33 (2000)
80. Y.Y. Xie, **T. Aytug**, J.Z. Wu, and D.K. Christen, "Growth and physical properties of Hg-1212 HTSC tapes on buffered metal substrates," *Physica C* **341**, 2505 (2000)
81. J.Y. Lao, J.H. Wang, D.Z. Wang, Y. Tu, S.X. Yang, H.L. Wu, Z.F. Ren, D.T. verebelyi, M. Paranthaman, **T. Aytug**, D.K. Christen, R.N. Bhattacharya, and R.D. Blaugher, "Synthesis and characterization of chromium-containing, thallium-based 1212 film," *Physica C* **333**, 221 (2000)



82. Y.T. Xie, J.Z. Wu, **T. Aytug**, A.A. Gapud, D.K. Christen, D.T. Verebelyi, and K. Song, "Fabrication and physical properties of large-area  $\text{HgBa}_2\text{CaCu}_2\text{O}_6$  superconducting films," *Supercond. Sci. Technol.* **13**, 225 (2000)
83. J.Y. Lao, J.H. Wang, D.Z. Wang, S.X. Yang, Y. Tu, J.G. Wen, H.L. Wu, Z.F. Ren, D.T. Verebelyi, M. Paranthaman, **T. Aytug**, D.K. Christen, R.N. Bhattacharya, and R.D. Blaugher, "Synthesis and characterization of thallium-based 1212 films with high critical current density on  $\text{LaAlO}_3$  substrates," *Supercond. Sci. Technol.* **13**, 173 (2000)
84. L. Fang, S.L. Yan, A.A. Gapud, **T. Aytug**, B.W. kang, Y.Y. Xie, J.Z. Wu, S.C. Tidrow, M.H. Ervins, and K.W. Kirchner, "Fabrication and physical properties of very thin  $\text{HgBa}_2\text{CaCu}_2\text{O}_{6+\delta}$  films," *Physica C* **339**, 253 (2000)
85. **T. Aytug**, J.Z. Wu, C. Cantoni, D.T. Verebelyi, E.D. Specht, M. Paranthaman, D.P. Norton, D.K. Christen, R.E. Ericson, and C.L. Thomas, "Growth and superconducting properties of  $\text{YBa}_2\text{Cu}_3\text{O}_{7.8}$  films on conductive  $\text{SrRuO}_3$  and  $\text{LaNiO}_3$  multilayers for coated conductor applications," *Appl. Phys. Lett.* **76**, 760 (2000)
86. Y.Y. Xie, J.Z. Wu, S. Yan, Y. Yu, **T. Aytug**, L. Fang, and S.C. Tidrow, "Elimination of air detrimental effect using Tl-stabilized precursor for epitaxial  $\text{HgBa}_2\text{CaCu}_2\text{O}_6$  thin films," *Physica C* **328**, 241 (1999)
87. **T. Aytug**, Y. Yu, S. Yan, Y.Y. Xie, and J.Z. Wu, "Response of superconducting characteristics of Hg-based high- $T_c$  thin films to photolithographic processes," *Physica C* **325**, 56 (1999)
88. L. Fang, S.L. Yan, **T. Aytug**, A.A. Gapud, B.W. Kang, Y.Y. Xie, and J.Z. Wu, "Growth of superconducting Hg-1212 very-thin films," *IEEE Trans. on Appl. Supercond.* **9**, 2387 (1999)
89. **T. Aytug**, A.A. Gapud, S.H. Yoo, B.W. Kang, S.D. Kang, S.D. Gapud, and J.Z. Wu, "Effect of sodium doping on the oxygen distribution of Hg-1223 superconductors," *Physica C* **313**, 121 (1999)
90. J.Z. Wu, Y.Y. Xie, S.L. Yan, L. Fang **T. Aytug**, A.A. Gapud, R. Aga, D.K. Christen, J.R. Thompson, D. Oats, S. Tidrow, and M. Ervins, "Fabrication of Hg-HTS films and devices using cation-exchange method," *Proceedings of 4<sup>th</sup> joint ISTE/MRS International Workshop on Superconductivity*, 98 (1999)
91. S.L. Yan, Y.Y. Xie, J.Z. Wu, **T. Aytug**, A.A. Gapud, B.W. Kang, L. Fang, M. He, J.R. Liu, and W.K. Chu, "High critical current density in epitaxial  $\text{HgBa}_2\text{CaCu}_2\text{O}_x$  thin films," *Appl. Phys. Lett.* **73**, 2989 (1998)
92. A.A. Gapud, **T. Aytug**, S.H. Yoo, Y.Y. Xie, B.W. Kang, S.D. Gapud, J.Z. Wu, S.W. Wu, W.Y. Liang, X.T. Cui, J.R. Liu, and W.K. Chu, "Lithium-doping-assisted growth of  $\text{HgBa}_2\text{Ca}_2\text{Cu}_3\text{O}_{8+\delta}$  superconducting phase in bulks and thin films," *Physica C* **308**, 264 (1998)
93. **T. Aytug**, B.W. Kang, S.L. Yan, Y.Y. Xie, and J.Z. Wu, "Stability of Hg-based high- $T_c$  superconducting thin films," *Physica C* **307**, 117 (1998)
94. B.W. Kang, A.A. Gapud, X. Fei, **T. Aytug**, and J.Z. Wu, "Minimization of detrimental effect of air in  $\text{HgBa}_2\text{CaCu}_2\text{O}_{6+\delta}$  thin film processing," *Appl. Phys. Lett.* **72**, 1766 (1998)
95. J.Z. Wu, S.H. Yoo, **T. Aytug**, A. Gapud, B.W. Kang, S. Wu, and W. Zhou, "Superconductivity in lithium- and sodium-doped mercury-based cuprates," *J. of Supercond.* **11**, 169 (1997)