

Center for Nanoscale Materials

presented at

DOE

Nanoscale Science Research Center

Workshop

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Washington, DC

by

Sam Bader

Argonne National Laboratory

<http://nano.anl.gov>

ARGONNE
NATIONAL LABORATORY



United States
Department of Energy

The University of Chicago

ENTRANCE

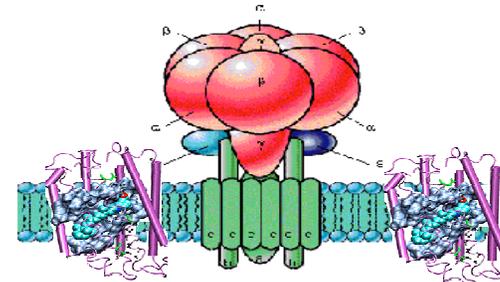


The Compelling Vision...

...present day materials and processes are reaching their limits...

Grand Challenges: Transcendencies...

- Beyond silicon electronics
- Beyond microlithography
- Beyond fixed architectures
- Beyond diffraction-limited optics
- Beyond binary computing



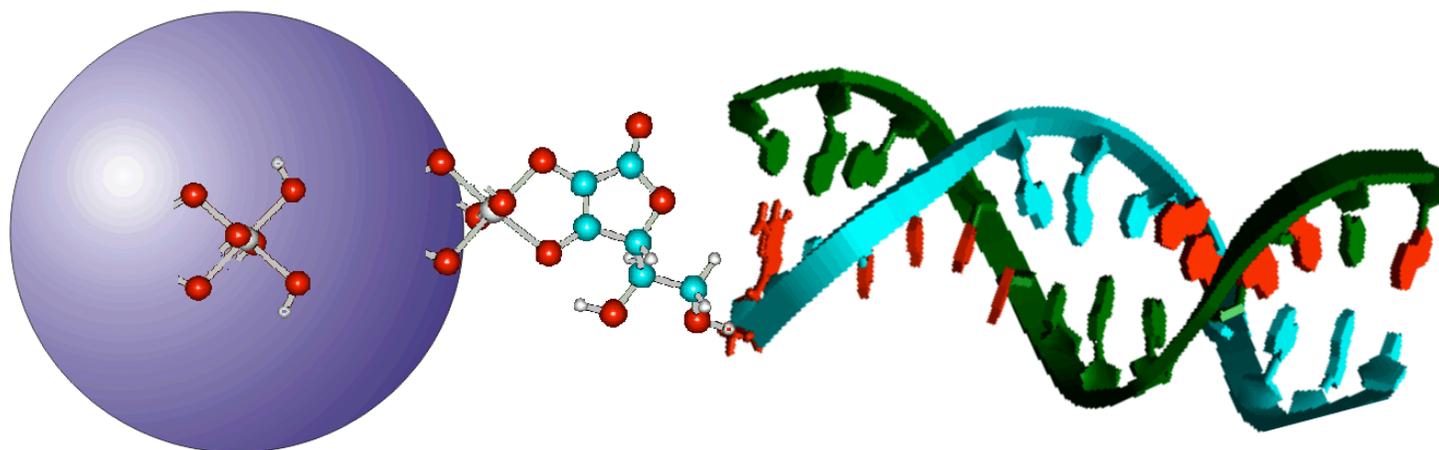
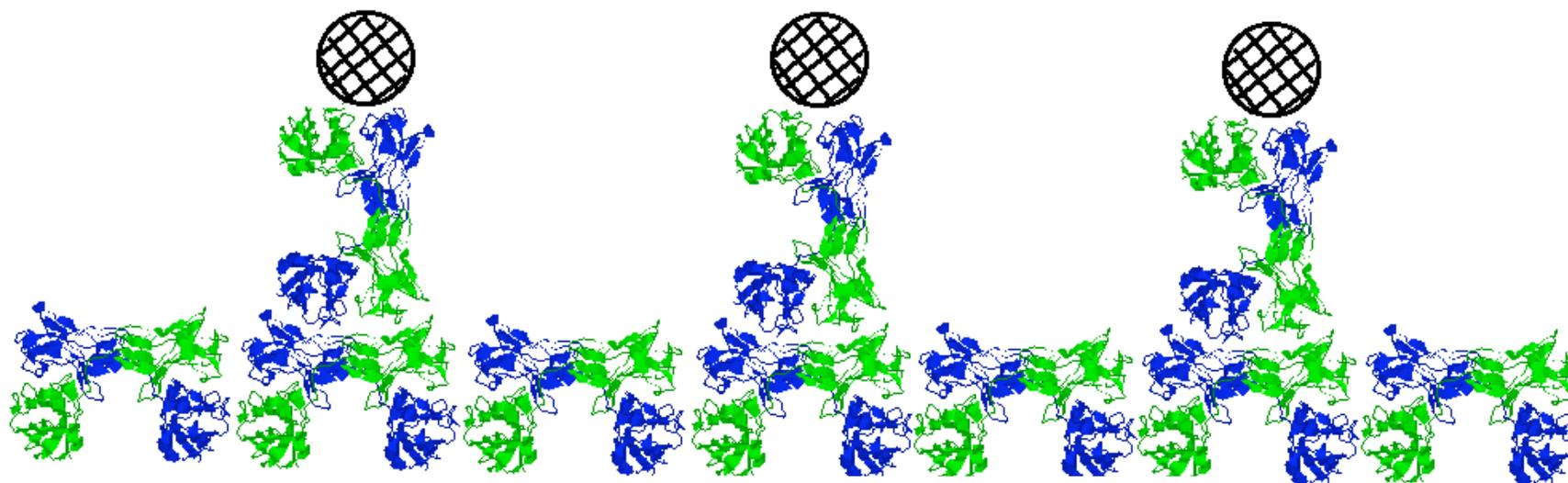
Center for Nanoscale Materials at Argonne

- Create and Characterize Novel Functional Nanoscale Materials
- Access Advanced Photon Source, Neutron Source & Microscopy Center



- **IL** **\$36 M** **Building Construction: FY03-05**
- **DOE** **\$36 M** **Major Instrumentation: FY04-07**

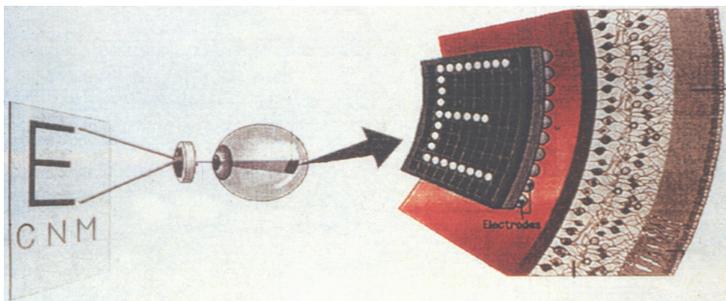
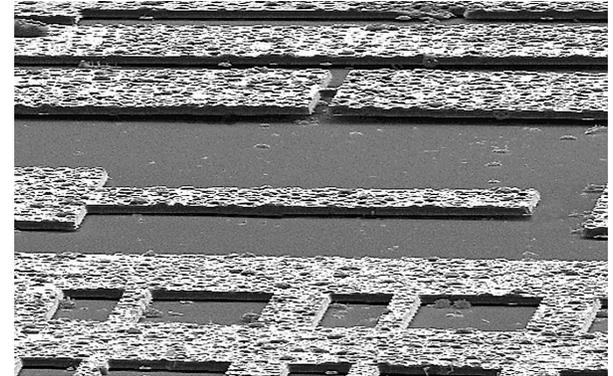
Bio-Inorganic Theme: Biological Templates



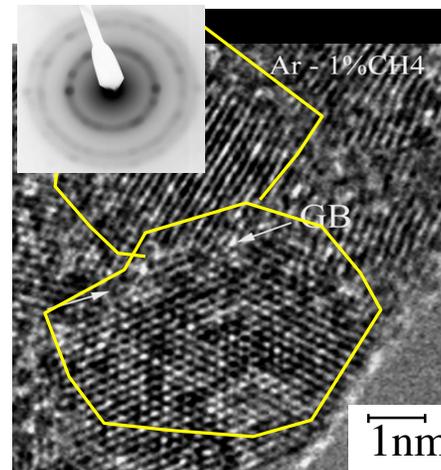
Nanocarbon Theme

Nanocrystalline diamond and beyond...

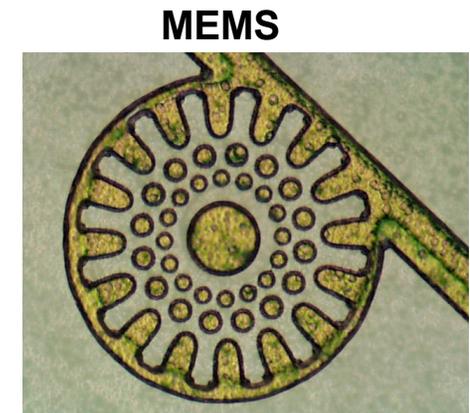
- **Mechanical**: Hardness and fracture strength
- **Tribological**: Low friction and thermal conductance
- **Transport**: Electronic, thermal
- **Electrochemical**
- **Biocompatible**



Artificial retina with
nanocrystalline diamond



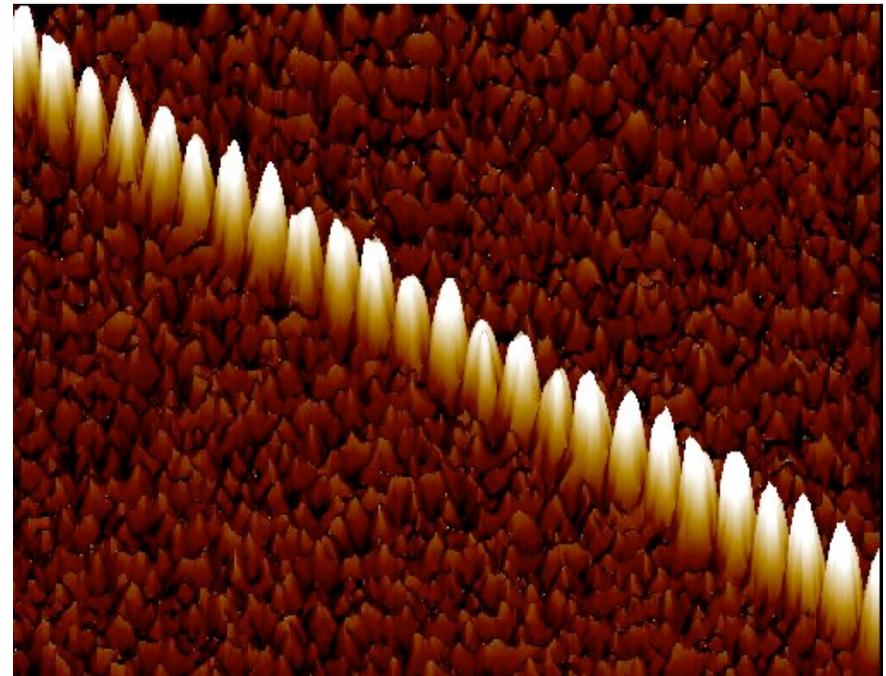
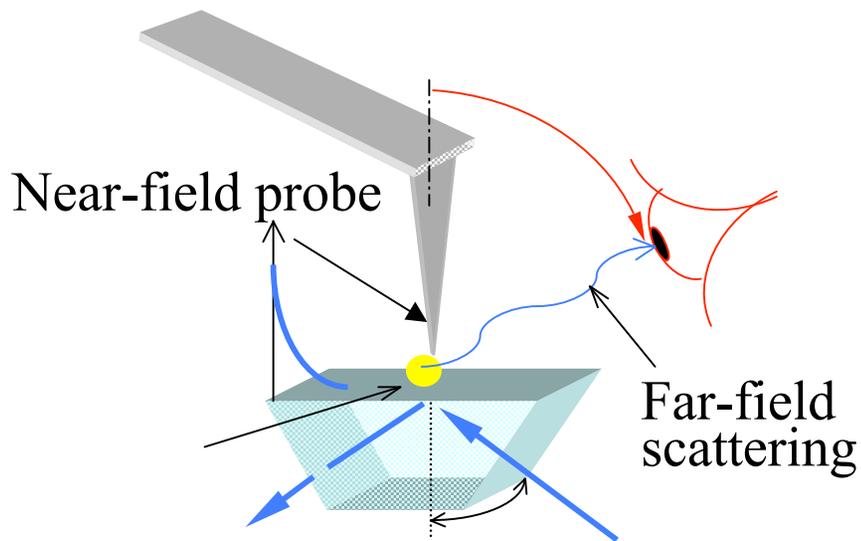
HRTEM



MEMS

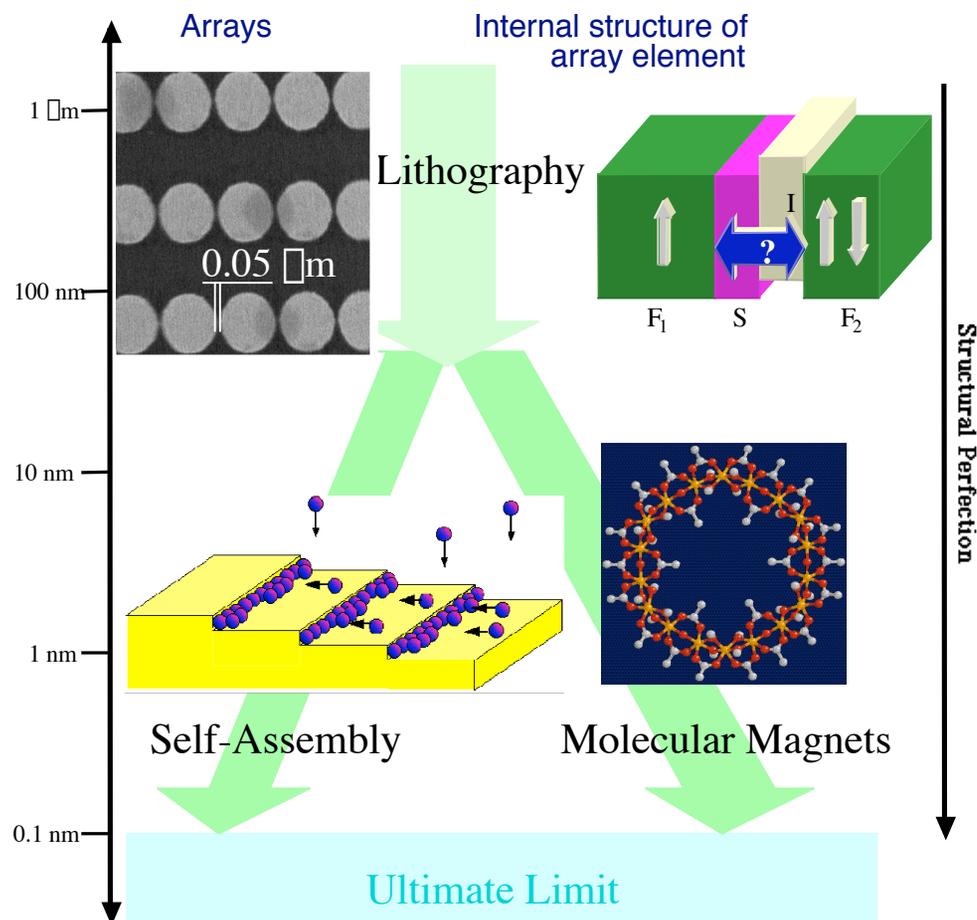
Nanophotonics Theme: Transcending Diffraction-Limited Optics

What new principles can we discover to control light propagation in nanostructures?



Nanomagnetism Theme

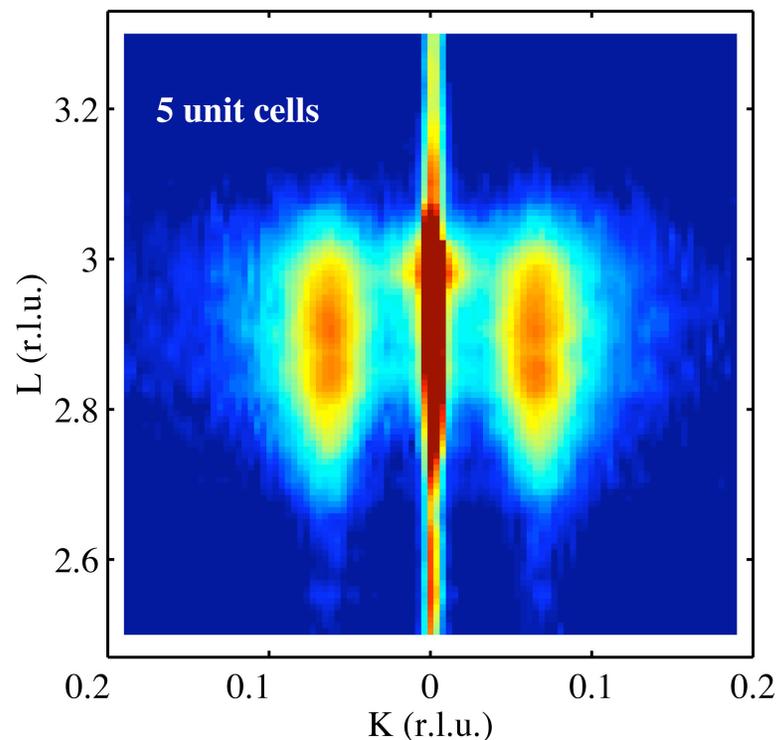
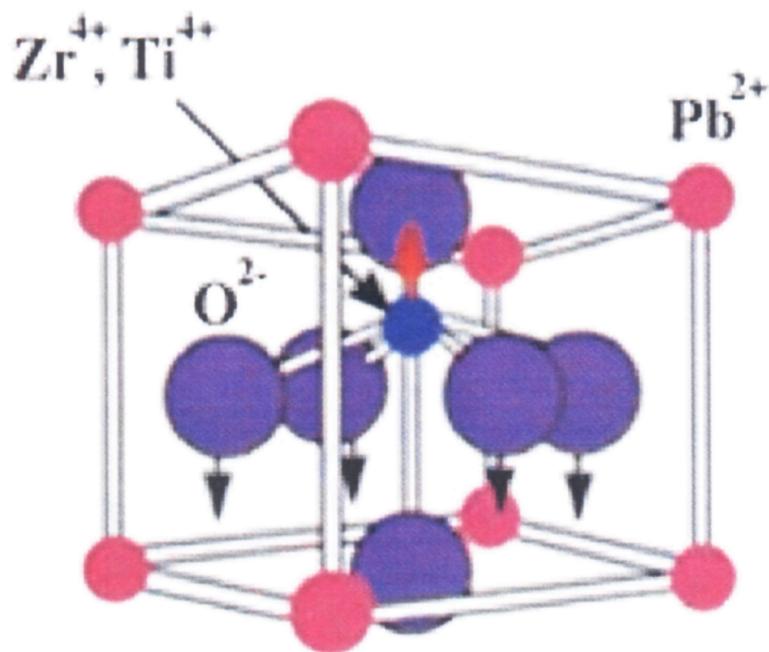
Will the next generation of electronics be spintronics?



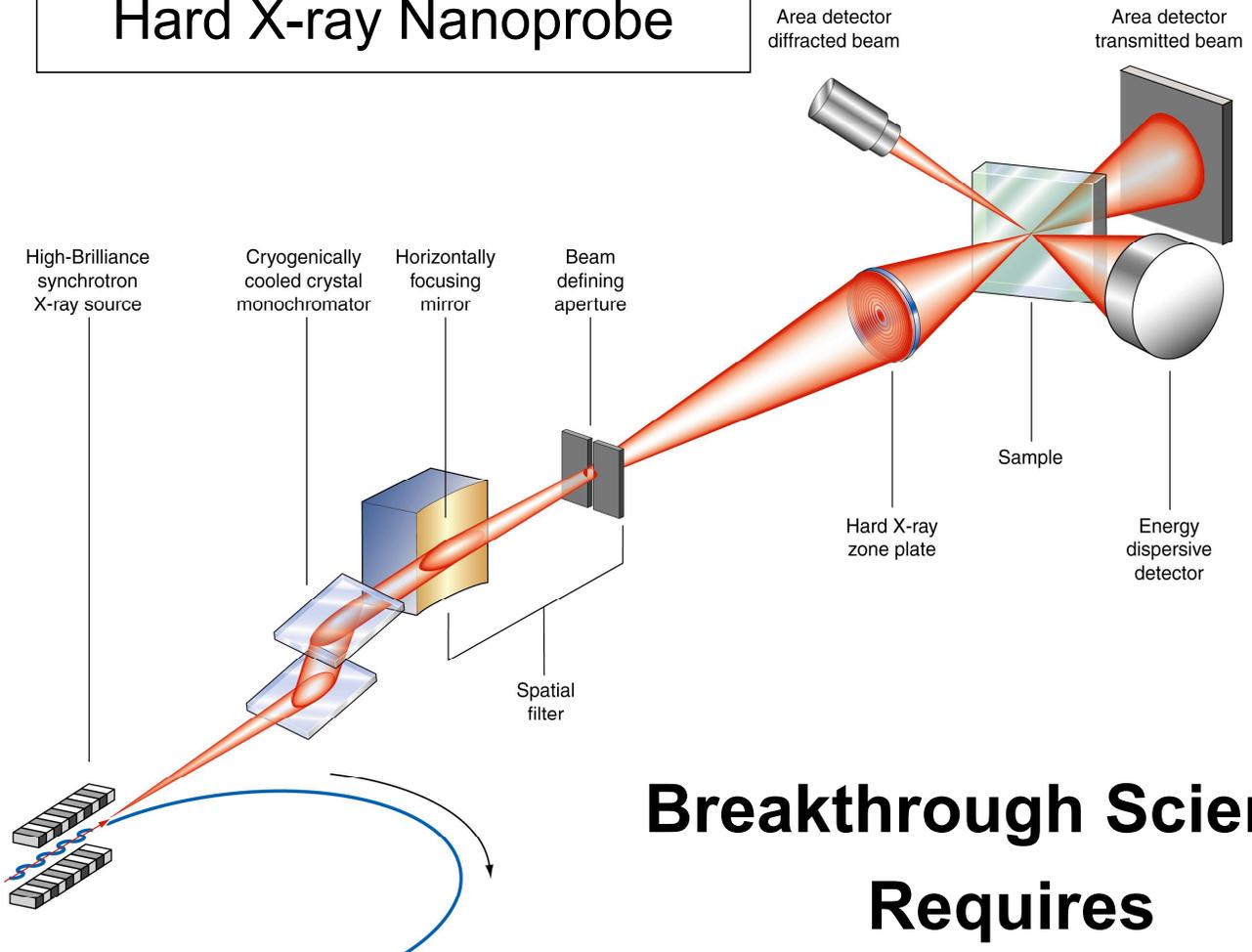
- Goal: The quest for magnetic electronics involves basic research to harness the spin as well as the charge of the electron to create new functionalities.
- Scope: Explore cutting-edge pathways to create and characterize novel magnetic nanostructures.

Complex Oxide Theme

- Complex oxides provide candidates for functional materials of the future:
 - Ferroelectrics, 100% Spin Polarized Oxides, ...
 - Challenge: Ferroelectrics degrade when confined.
 - Recent Argonne breakthrough: Ferroelectricity can be retained on the nanoscale.
 - Method: Strain-stabilized epitaxy optimized using *in-situ* x-ray scattering at the APS.



Hard X-ray Nanoprobe



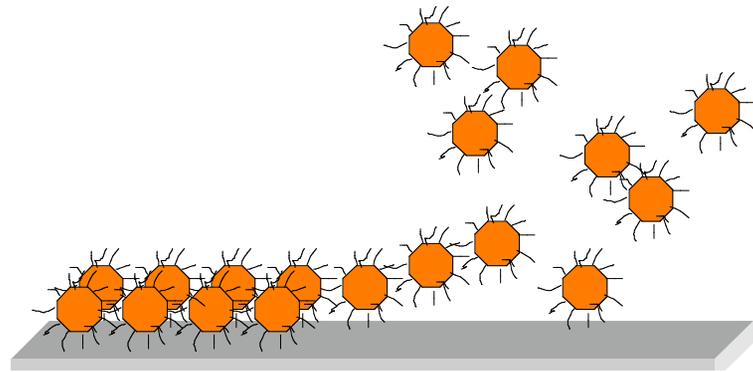
**Breakthrough Science
Requires
Breakthrough Tools**
- Coming to APS in 2007 -

Many APS beamlines are already available for nanoscience research.

Virtual Fab Lab

Theory and Simulation of Self-Assembly

- **Unlock rules for:**
 - Self Organization
 - Self Replication
 - Self Repair
 - Massive hierarchical simulational approaches
- **Workshop is being organized at Argonne on the Grand Challenges in Virtual Fab**



Jumpstart of User Outreach

- **Nanoscience Summer School:** Aug. 3-10, 2003
- **Upcoming CNM Workshops:** at the APS User Mtg.
 - April 29-May 1, 2003
- Sign-on as **CNM User:** <http://nano.anl.gov>
- **Common User Portal:** CNM, APS, IPNS, EMC
- **Proposals welcomed** from prospective General and Partner Users.

Nanoscience, Nanotechnology & National Benefits

