PSU

Exploring New Physical Regimes and Emergent Properties of Materials Through Design on the Nanometer Length Scale

Pennsylvania State University

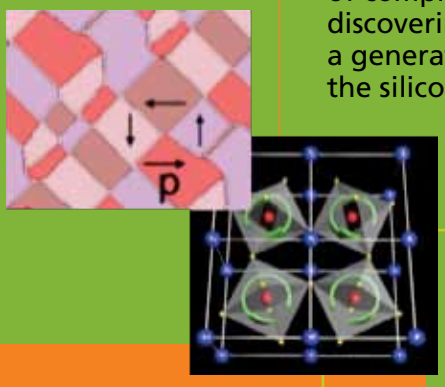
NANOSCIENCE

The Center for Nanoscale Science (CNS) explores the new physical properties and functions of materials that emerge on the nanometer length scale.

Many of the fundamental properties of solid materials, such as their electrical conductivity, magnetism and interaction with light, change dramatically when their dimensions are in the nanoscale regime. Studying these phenomena provides an opportunity not only to discover and understand the physics of "old" materials in new forms, but also to design materials with wholly new properties and functions.

By learning about electron and spin transport in quasi-one-dimensional nanowires, and by studying thin films of complex oxides, CNS teams are discovering materials that may enable a generation of computers beyond the silicon roadmap. These computing devices would perform logic using the spin of the electron and use electrical pulses to read and write magnetic memory.

Composite materials made from nanoscale components can have unusual optical properties, such as zero or negative refractive index. These materials could improve the technology of imaging, lithography, microsurgery, telecommunications, and solar energy conversion. CNS scientists are also studying the behavior of nano- and micro-scale motors that are powered by chemical reactions. Teams of scientists and engineers bring together expertise in theory, nanofabrication, and physical property measurements to solve these interdisciplinary problems.



HIGHLIGHTS . . .

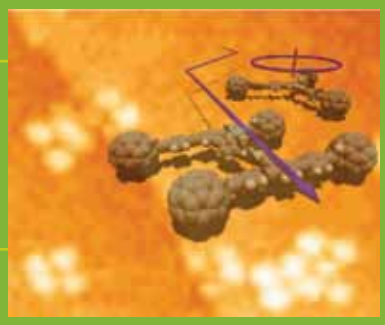
Strain-induced ferroelectricity (top) and multiferroicity (bottom) in Strontium titanate ($SrTiO_3$).

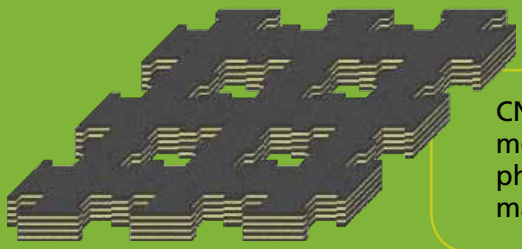
Catalytically generated proton gradients drive nanorod motors.

DIRECTOR: Thomas E. Mallouk
http://mrsec.psu.edu

RESEARCH FUNDAMENTALS . . .

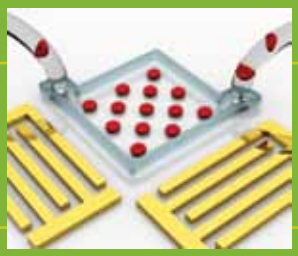
A unique aspect of the Center is the capability to synthesize or fabricate a broad range of materials with nanoscale- or even atomic-level precision.





CNS combines theory and measurement to discover new physical properties in composite materials.

Physical properties are exploited at the device level in a number of interdisciplinary applications.



"We are combining the predictive power of theory with advanced fabrication techniques to make new materials with really unprecedented physical properties. These materials are fundamentally exciting as well as technologically relevant."

Thomas E. Mallouk, Director
CNS

CNS OUTREACH INCLUDES EDUCATION, RESEARCH EXPERIENCES, AND PARTNERSHIPS...

- **Science Museum Shows:** CNS partners with the Franklin Institute in Philadelphia to develop cart-based shows for distribution to 21 partner science museums in the U.S. and Canada.
- **Summer Science Camps:** CNS develops content for K-12 summer science camps at Penn State.
- **REU – Research Experiences for Undergraduates:** brings students from other institutions to perform summer research with CNS faculty.
- **RET - Research Experience for Teachers:** Brings high school teachers to Penn State in the summer to work in CNS laboratories, developing classroom experiments and interfacing with outreach activities.
- **The CNS Industrial Affiliates Program:** Connects research in the Center with R&D in partner companies, jointly supporting graduate student research.
- **Materials Research Facility Network (MRFN) partnership:** CNS partners with the Penn State node of the NNIN and with the Penn State Materials Characterization Laboratory as part of the Materials Research Facility Network (MRFN).

OUTREACH

More information about the workshops, internships, partnerships, and educational opportunities are available at: http://www.mrsec.psu.edu/education/

CENTER FOR nanoscale science

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