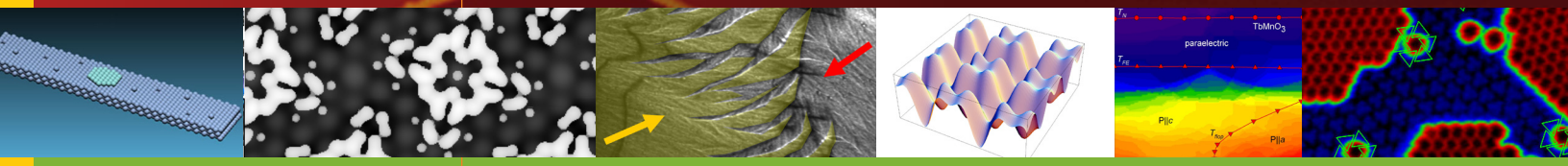
MATERIALS RESEARCH SCIENCE
AND ENGINEERING CENTER (MRSEC)

UNIVERSITY OF MARYLAND

Tuning Material Interfaces and Electromagnetic Boundaries for Efficient Energy Transport and New Device Concepts



University of Maryland

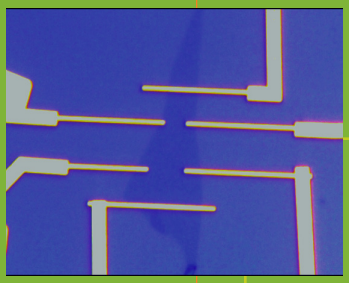
UMD MRSEC

Materials interfaces are the gateway to energy transport processes that drive technology.

From photovoltaic to memory devices, next-generation technologies call for nanostructured interfaces with controlled composition, geometries, and electromagnetic fields to match applications. The UMD MRSEC shows how atom-transport processes at interfaces and phase selection can be harnessed to create boundaries with unique electronic and magnetic features. Closely-coupled experiments and theory build a predictive framework for understanding formation, fluctuations and field-couplings of materials interfaces. Two interdisciplinary research groups (IRGs) develop materials systems for distinctive applications:

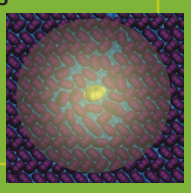
The **Low Dimensional Interfaces** IRG creates new materials structures from high-mobility graphene, inorganic semiconductors, and molecular materials. Fundamental limits on energy transport due to structural and temporal fluctuation are determined for emerging photovoltaic and nanoelectronic applications.

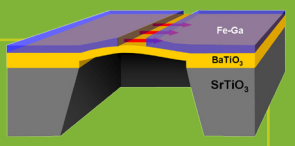
The **Multifunctional Magnetic Oxides** IRG focuses on transition metal oxides with coupled electric polarization and magnetic ordering. A tandem film and single crystal growth strategy provides combinatorial control of composition, phase and strain. Magneto-electric response mechanisms are developed and tested with new compositions.



HIGHLIGHTS . . .

Materials self organize into nanostructured interfaces. Theoretical models reveal mass-transfer processes along materials interfaces and predict structure evolution.



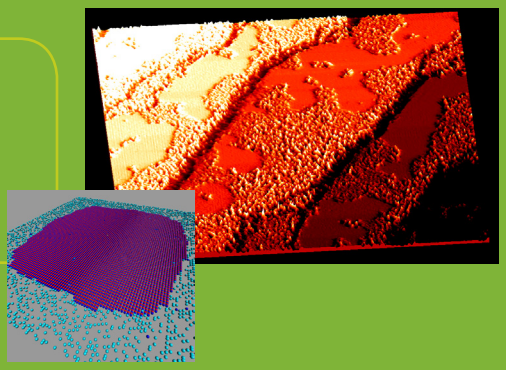


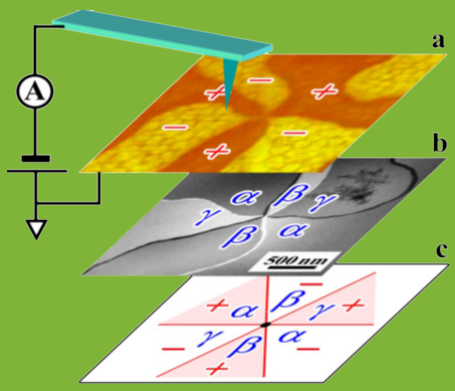
Mutiferroic vortices emerge in YMnO3 from the coupled ferroelectric - structural response. Spin-orbit coupling in transition metal oxides produces coexisting orders.

DIRECTOR: Janice Reutt-Robey
http://mrsec.umd.edu

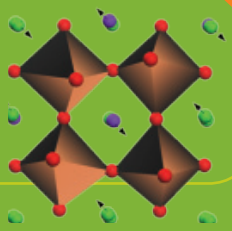
RESEARCH FUNDAMENTALS . . .

Nanostructured interfaces offer efficiencies of scale and unique electromagnetic features that enable technological innovation.





Fundamental knowledge of interfacial geometry, strain, and structure fluctuations are needed to channel energy flow and charge separation.



"Our successful efforts to guide the formation and dissipation of nanostructured interfaces with functional electromagnetic features provides a foundation for sustainable nanomaterials technologies to address our nation's critical needs in energy efficiency and security."

Janice Reutt-Robey,
Director MRSEC

MRSEC OFFERS DIVERSE EDUCATION AND PARTNERSHIPS...

- **Education program 1: Pre-engineering Program** prepares high school students to become college and career ready through project -based activities.
- **Education program 2: K-12 Summer Camps** provide students with STEM inquiry-based science learning in a high interest atmosphere.
- **Outreach program 1: REU** – Undergraduate students are challenged with exciting research internships and a series of research-based and professional development workshops.
- **Outreach program 2: Student Science Conference** provides middle school students with a transformative STEM experience through one-on-one mentoring, proven rubric, and professional meeting format.
- **Partnership 1: Partnership with International Spy Museum** in Research and Technology Education Programs for teachers and students.
- **Partnership 2: SEF-Shared Experimental Facilities** in a nation-wide partnership.

OUTREACH

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