University of Vermont
Theoretical and Applied Physics

Fall 2009

Artificially Layered Ferroelectric Superlattices

Professor Matthew Dawber
Department of Physics and Astronomy
SUNY Stony Brook University, NY

Ferroelectric materials possess highly exploitable functional properties, making them useful in applications ranging from non-volatile computer memories to micro-electro-mechanical devices. In paraelectric/ferroelectric heterostructures, precise tailoring of materials to particular applications [1] can be achieved by modifying the thickness of constituent layers in a superlattice while maintaining a strain constraint from the substrate through epitaxial growth. In many systems, strain and electrostatics are the dominant interaction between layers, and these provide handy "knobs" to turn when designing a tailored superlattice. However, looking beyond this, certain systems possess the potential to display phenomena that are driven by the interfaces and present markedly different behaviors from the parent compounds. An example of this kind of behavior is the interfacially driven improper ferroelectricity in $PbTiO_3/SrTiO_3$ superlattices [2]. In our research on this material system, we used a combination of experimental measurements and first principles calculations to reveal the manner in which oxygen rotations at the interfaces in the structure couple in such a way as to drive a macroscopic polarization that, apart from being larger [3], also has properties that differ substantially from those associated with conventional ferroelectricity. These observations suggest an approach, based on interface engineering, to produce artificial materials with unique properties. This talk will present an overview of the techniques we use, the materials we work with, and the technological advances that we hope to realize through this approach.

[1] M. Dawber, N. Stucki, C. Lichtensteiger, S. Gariglio, P. Ghosez and J.-M. Triscone, *Advanced Materials*, 19, 4153 (2007).
[2] E. Bousquet, M. Dawber, N. Stucki, C. Lichtensteiger, P. Hermet, S.Gariglio, J.-M. Triscone, and P. Ghosez, *Nature*, 452, 732 (2008).
[3] M. Dawber, C. Lichtensteiger, M. Cantoni, M. Veithen, P. Ghosez, K. Johnston, K.M. Rabe, J.-M. Triscone, *Physical Review Letters* 95, 177601 (2005).

Wednesday, November 18, 2009
4:00 p.m.
Waterman, Memorial Lounge 338

Refreshments will be provided at 3:30 p.m.