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NEBRASKA CENTER FOR MATERIALS AND NANOSCIENCE
2013 SEMINAR SERIES PRESENTS

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Visualization and Manipulation of Polarization and Screen Charges

Ferroelectric materials possess spontaneous polarization – net electric dipole moment per unit volume, of which magnitude and direction determine the surface charge density, and of which direction can be switched by electric field larger than a threshold called coercive field. As polycrystalline materials have grains with different crystallographic orientations and various grain boundaries dividing those grains, ferroelectric materials usually form domains with different polarizations and various domain boundaries dividing those domains. As such, ferroelectric domain structure and its dynamic behavior determine their macroscopic electric and piezoelectric properties. Furthermore, electric charges in various forms such as charged defects, electrons and ions interact with ferroelectric domains and their boundaries to influence the stability of domains and mobility of each domain boundary. Here I will present our efforts to develop angle-resolved piezoresponse force microscopy (AR-PFM) to visualize ferroelectric domains with polarization variants in 3D and scanning resistive probe microscopy (SRPM) to map the surface charge density (~0.8 μC/cm^2) with spatial resolution of 25 nm and temporal resolution of 125 μs, both of which are based on the system of atomic force microscopy (AFM). Furthermore, I will demonstrate how we could address the origin of domain structure showing polarization variants deviating from ferroelectric easy axes and electrostatically unstable charged domain boundaries in conjunction with the crystal nucleation and growth model. Lastly, the impacts of such domain structures on the local polarization switching behaviors will be discussed with the future implications for energy harvesting and memory devices.

Friday, April 19—3:30 pm
Room 136 Jorgensen Hall

Refreshments at 3:00 pm

Host:
Dr. Alexei Gruverman
Department of
Physics & Astronomy

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