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Probing Polarization Dynamics and Energy Dissipation in Ferroelectric Polymers on the Nanoscale

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Ferroelectric polymers are emerging as prominent materials for ultrasonic actuators, gate materials for non-volatile ferroelectric memories, and energy storage. The nature of ferroelectricity in polymers is significantly different from that in inorganic perovskites, resulting in significant interest to elementary mechanism of switching and the role of local microstructure. In this talk, I briefly delineate Piezoresponse Force Microscopy and Spectroscopy as applied for characterization of Langmuir-Blodgett ferroelectric PVDF polymer films. The slow polarization switching in PVDF can be attributed to the grain-by grain switching mechanism. Recent advances in PFM probing of polarization dynamics and electromechanical energy dissipation are discussed. In particular, switching spectroscopy PFM is used to probe the spatial variability of switching behavior and role of grain boundaries on switching. Local energy dissipation imaging through the changes of the Q-factor of electrically driven cantilever in contact with the surface is developed to study energy losses in the ferroelectric switching processes. In collaboration with Brian J. Rodriguez and Stephen Jesse, Materials Sciences and Technology Division and The Center for Nanophase Materials Sciences, Oak Ridge National Laboratory; Jihee Kim and Steven Ducharme, Department of Physics and Astronomy, Nebraska Center for Materials and Nanoscience University of Nebraska, Lincoln.

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