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The Hunt for a Snark: Spatially Resolved Imaging of Nucleation Centers in Ferroelectrics SERGEI KALININ, STEPHEN JESSE, BRIAN RODRIGUEZ, ARTHUR BADDORF, Oak Ridge National Laboratory — Ferroelectric polarization switching in non-volatile memory and high density data storage devices is governed by a number of nucleation centers that are necessary to account for experimentally observed low values of coercive fields. Despite 50 years of extensive research addressing the role of conductivity, surface dead layers, charge injection, and other factors, the microstructural origins of the Landauer paradox (switching fields correspond to implausibly large nucleation activation energies) are still a mystery. Here, Switching Spectroscopy Piezoresponse Force Microscopy (SS-PFM) is developed as a quantitative tool for real-space mapping of imprint, coercive bias, remanent and saturation responses, work of switching, and nucleation biases in ferroelectrics. Several examples of switching behavior in low dimensional ferroelectrics are presented, including (a) pinning at grain boundaries in polycrystalline PZT, (b) non-uniform work of switching in ferroelectric nanodots and (c) switching in the vicinity of topographic defects. The "abnormal" hysteresis loops were observed in the vicinity of topographic defects in multiferroic thin films and PZT ceramics and attributed to the interaction of nascent domain with the strain field of the defect. The mapping of the spatial and energy distribution of Landauer switching centers is demonstrated.

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