Domain Wall Motion Across Microstructural Features in Polycrystalline Ferroelectric Films

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This paper describes the effect of microstructural features such as grain boundaries and triple points on the pinning of domain wall motion in perovskite $Pb(Zr_{0.52}Ti0.48)O_3$ (PZT) films on polycrystalline $SrRuO_3/SrTiO_3$ substrates. Spatial variability in the collective domain wall dynamics was assessed using non-linearity mapping via Band Excitation Piezoresponse Force Microscopy (BE-PFM). Collocating the non-linearity maps with triple point locations (as visualized by EBSD) allowed for exploration of the effects that local microstructure (e.g., grain boundary) have on domain wall motion. It was found that the extrinsic behavior varied with both the misorientation angle and the proximity to the grain boundary. The width of influence of individual grain boundaries on the motion of domain walls was a function of the character of the grain boundary; random grain boundaries exhibit deeper minima in alpha d/d33,initial and larger widths of influence (up to 905 nm) compared to coincident site lattice (CSL) boundaries (up to 572 nm). Additionally, triple points containing larger numbers of random boundaries exhibited non-Rayleigh behavior to greater distances, suggesting that the triple point provides either a deep potential minimum or a region where domain wall motion is unfavorable.