Thickness Dependent Response of Domain Wall Motion in Declamped {001} $Pb(Zr_{0.3}Ti_{0.7})O(3)$ Thin Films

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Scaling effects were investigated in tetragonal [001) textured Pb(Zr0.3Ti0.7)O-3 thin films doped with 2 mol% Nb over a thickness range of 0.27 mu m 1.11 mu m. Scaling effects refer to the size-induced degradation of properties at length scales exceeding those associated with the ferroelectric stability limit. The irreversible Rayleigh coefficient was found to be thickness-dependent, indicating suppression of the extrinsic contributions to the relative permittivity for all clamped films. Both defects in the seed layer and substrate clamping contributed to the observed thickness dependence. The influence of the seed layer on dielectric properties was accounted for using a capacitor in series model. After the films were partially declamped from the substrate, the irreversible contributions increased up to 23% in Nb-doped films and became more frequency dependent (by up to 29%). The suppressed frequency dependence in the clamped films was attributed to the pinning of irreversible domain walls active at lower frequencies. Both the seed layer and substrate clamping contributed to the pinning of irreversible domain walls.