Influence of Doping and Thickness on Domain Avalanches in Lead Zirconate Titanate Thin Films

T. Peters. W. Zhu, M. Checa, L. Collins, S. Trolier-McKisntry

In undoped lead zirconate titanate films of 1-2 lm thick, domain walls move in clusters with a correlation length of approximately 0.5-2 mu m. Band excitation piezoresponse force microscopy mapping of the piezoelectric nonlinearity revealed that niobium (Nb) doping increases the average concentration or mobility of domain walls without changing the cluster area of correlated domain wall motion. In contrast, manganese (Mn) doping reduces the contribution of mobile domain walls to the dielectric and piezoelectric responses without changing the cluster area for correlated motion. In both Nb and Mn doped films, the cluster area increases and the cluster density drops as the film thickness increases from 250 to 1250 nm. This is evident in spatial maps generated from the analysis of irreversible to reversible ratios of the Rayleigh coefficients.