Dynamic piezoresponse force microscopy: Spatially resolved probing of polarization dynamics in time and voltage domains

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Abstract: An approach for probing dynamic phenomena during hysteresis loop measurements in piezoresponse force microscopy (PFM) is developed. Dynamic PFM (D-PFM) necessitates development of 5-dimensional (5D) data acquisition protocols and associated methods for analysis and visualization of multidimensional data. Using a combination of multivariate statistical analysis and phenomenological fitting, we explore dynamic behavior during polarization switching in model ferroelectric films with dense ferroelastic domain structures and in ferroelectric capacitors. In polydomain films, multivariate analysis of the switching data suggests that ferroelectric and ferroelastic components can be decoupled and time dynamics can be explored. In capacitors, a strong correlation between polarization dynamics and microstructure is observed. The future potential of D-PFM for probing time-dependent hysteretic phenomena in ferroelectrics and ionic systems is discussed. (C) 2012 American Institute of Physics.

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