Ferroelectric and Ferroelastic Domain Wall Motion in Unconstrained $Pb(Zr,Ti)O_3$ Microtubes and Thin Films

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Abstract: Ferroelectric polarization switching of high aspect ratio (>80:1) $PbZr_{0.52}Ti_{0.48}O_3$ (PZT) microtubes with a wall thickness of ~200 nm was investigated. A charge-based technique was used to assess the dielectric and ferroelectric properties of individual mechanically-unconstrained PZT microtubes with interdigitated electrodes. An enhancement in the degree of ferroelastic (non-180°) domain wall motion was observed in the tubes relative to films of similar thickness on rigid substrates. The dielectric response of the tubes showed a Rayleigh-like ac field dependence over a wide temperature range; the extent of the extrinsic contribution to the dielectric response dropped as the temperature approached 10K, but remained finite. This work demonstrates a general methodology for directly electrically addressing small, unconstrained ferroelectric devices, extending the range of driving fields and temperatures over which these materials can be probed.