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Contrast in ultrathin film ferroelectric behavior between air and vacuum environments A. P. BADDORF, P. MAKSYMOVYCH, S. V. KALININ, Center for Nanophase Materials Sciences, Oak Ridge National Laboratory, R. RAMESH, Department of Materials Science, University of California, Berkeley —
At nanoscale dimensions, ferroelectric properties of oxide materials are dominated by depolarizing effects which depend strongly on the electrostatic screening at the interfaces and the environment. Oxide surfaces readily react with adsorbed molecules that may chemically or electronically alter the ferroelectric behavior. We have examined ultrathin (5-20 nm) $BiFeO_3$ thin films grown on $SrTiO_3(110)$ using ultra-high vacuum Piezoresponse Force Microscopy. All the films reveal a characteristic behavior trend that in air the films are uniformly polarized, while multiple domains are observed in vacuum. The monodomain to polydomain transition occurs via either annealing in oxygen or simple evacuation, which suggests that molecules may be weakly adsorbed on the surface. Local ferroelectric switching behavior has also been compared for vacuum and ambient environments on the same substrate. Measurements were made at the Center for Nanophase Materials Sciences, sponsored at Oak Ridge National Laboratory by the Division of Scientific User Facilities, U.S. DOE.

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