Abstract Submitted
for the MAR09 Meeting of
The American Physical Society

Ferroelectric Size-effect on $BiFeO_3$ Films in Ultra-high Vacuum PETER MAKSYMOVYCH, STEPHEN JESSE, Oak Ridge National Laboratory, TN, 37831, SERGEY LISENKOV, LAURENT BELLAICHE, University of Arkansas, AK, 72701, NINA BALKE, MARK HUIJBEN, RAMAMOORTHY RAMESH, University of California, Berkeley, CA, 94720, ARTHUR P. BADDORF, Oak Ridge National Laboratory, TN, 37831, SERGEI V. KALININ, Oak Ridge National Laboratory, TN 37831 — The ferroelectric size effect is a highly pursued and controversial topic encompassing the scaling of polar distortion, domain structure and switchable polarization. We have studied epitaxial $BiFeO_3$ films using ultrahigh vacuum piezoresponse force microscopy. The films in vacuum develop out-of-plane polarization domains which, based on their lateral dimensions, drastically violate the Kittel law. From the analysis of the piezoresponse amplitude, we have established that the presence of a topographic island induces in-plane rotation of the polarization vector by 90^o. These findings are analyzed using a first-principles based model Hamiltonian approach. We have also obtained stable and reproducible piezoresponse hysteresis loops on the 2 nm films. Experiments conducted at the Center for Nanophase Materials Sciences, Oak Ridge National Laboratory, sponsored by the Division of Scientific User Facilities, U.S. Department of Energy.

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Date submitted: 30 Nov 2008 Electronic form version 1.4