Abstract Submitted
for the MAR13 Meeting of
The American Physical Society

Phase coexistence, phase transitions, and piezoelectric switching in highly-strained $BiFeO_3$[1] HANS M. CHRISTEN, C. BEEKMAN, W. SIEMONS, M. CHI, J.Y. HOWE, M.D. BIEGALSKI, N. BALKE, P. MAKSYMOVYCH, T.Z. WARD, Oak Ridge National Laboratory, A.K. FARRAR, J.B. ROMERO, D. TENNE, Boise State University — Highly strained (T') BiFeO3 films are investigated as function of temperature by x-ray diffraction in combination with atomic-force, piezo-response force, and transmission electron microscopies. In these films on $LaAlO_3$ substrates, the coexistence of the T' majority phase (c/a $\sim$ 1.25) with an intermediary S' polymorph (c/a $\sim$ 1.09) leads to the formation of stripe patterns in samples where the bulk-like, nearly rhombohedral R' polymorph is absent. While T' films at 300K are monoclinic, our results reveal a true tetragonal high-temperature phase (at T$\geq$700K) for which Raman spectroscopy demonstrates a polar nature. However, piezoelectric switching of the T' phase is possible only in the presence of the S' polymorph. This polymorph, and the stripe patterns that result from its coexistence with the T' form appear after growth upon cooling below $\sim$570K. This shows that the S' polymorph is formed by additional stress resulting from the differences in thermal expansion between film and substrate. These results point to new approaches for tuning functional properties in materials exhibiting strain-induced polymorphic phase transitions.

[1]Sponsored by US-DOE, BES, MSED and supported at ORNL's CNMS and ShaRE user programs by US-DOE, BES. Raman studies supported by NSF grant DMR-1006136.

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Date submitted: 20 Dec 2012 Electronic form version 1.4