Abstract Submitted
for the MAR11 Meeting of
The American Physical Society

Harnessing competition in artificially layered ferroelectric superlattices to engineer enhanced piezoelectrics MATTHEW DAWBER, BENEDIKT ZIEGLER, SARA CALLORI, JOHN SINSHEIMER, Dept of Physics and Astronomy, Stony Brook University, VALENTINO COOPER, Materials Science and Technology Division, Oak Ridge National Laboratory, TAHIR YUSUFALY, KARIN M. RABE, PREMALA CHANDRA, Department of Physics and Astronomy, Rutgers University — First principles calculations by Cooper and Rabe (V. R. Cooper and K.M. Rabe, Phys. Rev. B 79, 180101 (R) (2009)), predicted that in $PbTiO_3/BaTiO_3$ superlattices an enhancement of the d_{33} piezoelectric coefficient could be achieved at a particular ratio of the thickness of the constituent layers. We have fabricated high quality artificially layered $PbTiO_3/BaTiO_3$ superlattices on $SrTiO_3$ substrates (with $SrRuO_3$ bottom electrodes) using an off-axis RF magnetron sputtering technique, allowing us to perform x-ray diffraction, electrical measurements and atomic force microscopy on this system. The experimental results confirm the prediction from first principles calculations, and we apply a Landau theory model as a useful bridge between the first principles predictions and experimental results at elevated temperature. In this work we have demonstrated that by finely balancing competing material properties in artificial heterostructures, desirable properties that exceed those of the parent compounds can be achieved.

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Date submitted: 19 Nov 2010 Electronic form version 1.4