Abstract Submitted
for the MAR09 Meeting of
The American Physical Society

Understanding and Controlling Photovoltaic Effects in Complex Oxide Thin Films STEVEN BYRNES, THOMAS CONRY, SOURAV ROGER BASU, LANE MARTIN, DREW PARAN, VARADA BAL, JOEL W. AGER, R. RAMESH, UC Berkeley and Lawrence Berkeley National Laboratory — Thin-film oxide heterostructures are a promising material system for large-scale photovoltaic energy conversion, as oxides can be cheap, abundant, stable, and highly light-absorbing. As a model system, we have investigated the room-temperature ferroelectric $BiFeO_3$ (BFO). Heteroepitaxial BFO films are grown by both metal-organic chemical vapor deposition (MOCVD) and pulsed laser deposition (PLD), allowing for a wide range of control over thickness, composition, and ferroelectric domain structure. BFO has been measured to have a direct bandgap at 2.6 eV; moreover its bandgap and other material properties can be controlled by alloying and by modification of stoichiometry. In this work, we will demonstrate the photovoltaic properties of BFO thin films (100–1000 nm) grown heteroepitaxially on oxide bottom electrodes with transparent ITO top contacts. Electrical and external quantum efficiency measurements prove that the photovoltaic effect comes from a Schottky barrier between ITO and p-type BFO, but time-dependent and capacitance-voltage measurements show that ferroelectricity, ion motion, and/or trap states also play an important role in the electrostatics of the device.

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Date submitted: 21 Nov 2008 Electronic form version 1.4