Abstract Submitted
for the MAR13 Meeting of
The American Physical Society

Electrocaloric Properties of Epitaxial Strontium Titanate Films
JIALAN ZHANG, University of Connecticut, BURC MISIRLIOGLU, Sabanci University, PAMIR ALPAY, GEORGE ROSSETTI, University of Connecticut — The pyroelectric and electrocaloric effects in polar dielectric solids result from the coupling between the electrical and thermal properties. Although STO crystals or polycrystalline ceramics remain paraelectric down to 0 K, the ferroelectric phase can be induced by uniaxial stress, an external electrical field, or by doping. Here we develop a nonlinear thermodynamic theory to compute the electrocaloric response of strontium titanate thin films as a function of misfit strain, temperature, electric field strength, and electrode configuration. Our results show that the adiabatic temperature change ΔT of epitaxial (001) STO films can be controlled by the misfit strain and by varying the thermal and electrical boundary conditions. For films in a capacitor configuration on compressive substrates, the transition between paraelectric and strain-induced ferroelectric tetragonal phases produces a large adiabatic temperature change at room temperature. For films on tensile substrates, the transition between the paraelectric and strain-induced ferroelectric orthorhombic phases can also be accessed using inter-digitated electrodes, and the maximum EC response occurs with a [110] orientation.

Jialan Zhang
University of Connecticut

Date submitted: 07 Nov 2012 Electronic form version 1.4