

**Subject:** MSD Colloquium, Evans, Thurs, 8/09, 11am, 212, A-157  
**From:** Suzanne Kokosz <kokosz@anl.gov>  
**Date:** Thu, 26 Jul 2007 07:58:19 -0500  
**To:** Materials Science Division <msd@anl.gov>

MATERIALS SCIENCE COLLOQUIUM

**SPEAKER:** DR. PAUL G. EVANS  
University of Wisconsin, Madison

**TITLE:** <sup>3</sup>Non-linear Piezoelectricity in Ferroelectric Thin Films in Extreme Electric Fields<sup>2</sup>

**DATE:** Thursday, August 09, 2007

**TIME:** 11:00 a.m.

**PLACE:** Building 212, Room A-157

**HOST:** Michael Pierce

Refreshments will be available at 10:45 a.m.

**Abstract:**

Non-linear effects in the coupling of polarization with elastic strain have been predicted to occur in ferroelectric materials subjected to high electric fields. We have tested these predictions for a Pb(Zr<sub>0.2</sub>Ti<sub>0.8</sub>)O<sub>3</sub> ferroelectric thin film (grown by H.-N. Lee of Oak Ridge National Laboratory) at electric fields in the range of several MV/cm. Thermal runaway and subsequent low-frequency dielectric breakdown are overcome by using nanosecond electrical pulses to apply high electric fields, which made the probing of the film's structure possible at piezoelectric strains reaching up to 2.7%. The piezoelectric strain exceeds predictions based on constant piezoelectric coefficients at electric fields from 2 to 4 MV/cm, which is consistent with a non-linear effect predicted to occur at concomitant piezoelectric distortions. At higher fields, the piezoelectric response decreases, suggesting that elastic interactions between atoms enter a new regime.

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