Statistical Engineering Division Seminar

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CAML Conference Room, Technology Bldg., Room B111
NIST
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Microcracking in Ferroelectric Ceramics

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The ceramics of barium titanate ($BaTiO_3$), PZT ($Pb[Zr_xTi_{1-x}]O_3$) and PLZT ($Pb_{1-x}La_x[Zr_yTi_{1-y}]_{1-0.25x}V^B_{0.25x}O_3$) are widely used for manufacturing smart actuators owing to their strong electromechanical coupling effect and the prompt response to applied electric fields. The most commonly-encountered operational failure of these actuators is the so-called *electric fatigue* which refers to deterioration of material properties after a large number of cycles of applied electric field. Recent experimental investigations indicate that microcracking is one of themajor causes of electric fatigue. Our analysis suggests that intersections of ferroelectric domain walls (twinning planes) and grain boundaries are origins of microcracks because of the stress and electric field concentrations arising due to the incompatibility of lattice distortions with grain boundaries. Our asymptotic analysis shows that the stress and electric fields both exhibit the so-called power-law singularity at these intersections and that the interactions of ferroelectric domains with pre-existing microcracks substantially enhance the stress and electric fieldconcentrations at the crack tips.

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