# X-RAY DIFFRACTION INVESTIGATION OF FERROELECTRIC CONSTITUTIVE BEHAVIOR AT MULTIPLE LENGTH SCALES

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The complex response of ferroelectrics to electromechanical loading requires rigorous characterization of their internal stresses and texture to fully appreciate their constitutive behavior. This presentation will highlight recent developments in the use of advanced high-energy X-ray diffraction techniques to study ferroelectrics at multiple length scales.

Macroscale: Using transmission geometry and a two-dimensional detector, lattice strain and texture evolution (domain switching) in polycrystalline $BaTiO_3$ were measured in multiple sample directions simultaneously. Samples were subjected to electric field and/or mechanical loading via four-point bending. The results offer a unique coupled strain/domain switching dataset on the multiaxial constitutive behavior of ferroelectric ceramics. It is seen, for instance, the lattice strain data are highly anisotropic resulting in large differences between *hkl*-specific strains. In addition, texture analysis suggests that non-180° domain switching is tightly coupled with lattice strain evolution.

Mesoscale: A recent X-ray diffraction technique, "3-D XRD", was employed to probe the constitutive behavior of single, embedded grains of polycrystalline $BaTiO_3$ under electric field. In addition, domain variants of those grains were identified and their evolution was monitored as a function of applied field. 3-D XRD data correlate well with the macroscale results, but also yield valuable information about local variations at the mesoscale.