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
colorization 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 BaTiO3 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 BaTiO3 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.