# Influence of Compressive Stress on the Piezoelectric and Dielectric Behavior of Lead-Free Ferroelectrics: Shifting Phase Boundaries

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Previous investigations have revealed that the origin of the large strain response in $(Na_{1/2}Bi_{1/2})TiO_3$-based lead-free ferroelectrics is the electric field-induced transformation from a relaxor state to a long range ferroelectric order, which is accompanied by a large jump in polarization and strain. Through thermal, chemical, or microstructural destabilization, this transformation can become reversible, resulting in large unipolar strains during each electrical loading cycle. Recently, however, we have found that a uniaxial compressive stress is capable of inducing a long-range ferroelectric order as well.[1] This can be clearly observed as the formation of a dielectric anomaly at $T_{F\text{-}R}$ in the field cooling-zero field heating response of mechanically 'textured' samples, analogous to the behavior found in electrically poled samples (Figure 1).

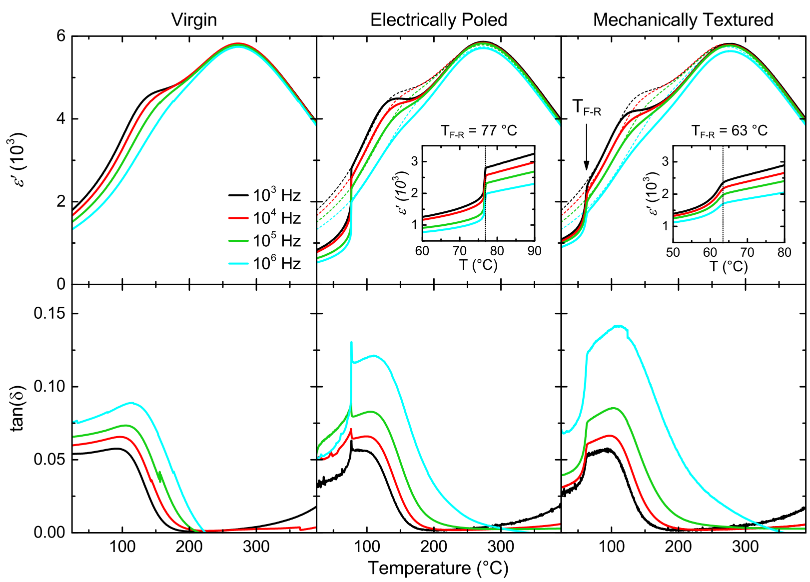


Figure 1. Temperature-dependent relative permittivity and loss tangent of virgin, electrically poled, and mechanically textured polycrystalline NBT-6BT samples.

In this presentation, the uniaxial compressive stress-induced transformation from relaxor to long range ferroelectric order in polycrystalline $(Na_{1/2}Bi_{1/2})TiO_3$–$BaTiO_3$ ferroelectrics will be discussed. Specifically, the temperature- and stress-dependent piezoelectric and dielectric response of various $(Na_{1/2}Bi_{1/2})TiO_3$–$BaTiO_3$ compositions across the morphotropic phase boundary will be contrasted with temperature-dependent macroscopic mechanical and electrical constitutive behavior. These data show a clear influence of uniaxial compressive stress on the stable state in lead-free relaxor ferroelectrics; the resulting stress-temperature phase diagram is analogous to the electrical case. Macroscopic measurements will be contrasted with room temperature *in situ* stress-dependent high-energy x-ray diffraction experiments that reveal an apparent phase transformation during mechanical loading, consistent with previous macroscopic electrical measurements.

References

1. Schader FH, Wang Z, Hinterstein M, Daniels JE, Webber KG, Stress Modulated Relaxor-to-Ferroelectric Transition in Lead-Free $(Na_{1/2}Bi_{1/2})TiO_3$-$BaTiO_3$ Ferroelectrics, Phys. Rev. B 93 (2016) 134111.