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# Intrinsic uniaxial stress induced by co-doping and its influence on piezoelectric performance of $\text{PbZr}_{0.45}\text{Ti}_{0.55}\text{O}_3$ ferroelectric

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## Abstract

Intrinsic uniaxial stress along the  $[001]_{\text{pc}}$  (pseudo-cubic  $[001]$ ) direction in tetragonal  $\text{PbZr}_{0.45}\text{Ti}_{0.55}\text{O}_3$  polycrystal is obtained via A-site acceptor-donor ( $\text{Li}^+ - \text{Al}^{3+}$ ) co-doping. In-situ X-ray diffraction results demonstrate that local A-site cations ordering of donor-acceptor (along the  $[001]_{\text{pc}}$  direction) should be responsible for the intrinsic uniaxial stress. The diffuse tetragonal-cubic phase transition and enhanced piezoelectricity are achieved in the doped ferroelectric. Based on the phenomenological theory, enhanced piezoelectricity is related to local low symmetry and stress-driven flattening of free-energy profile. The present study provides a promising method to obtain intrinsic uniaxial stress in  $\text{Pb}(\text{TiZr})\text{O}_3$  polycrystal via donor-acceptor co-doping, and reveal the relationship between this doping route, chemical stress and corresponding properties.

**Keywords:** piezoelectric; codoping; intrinsic uniaxial stress; phenomenological theory

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