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<u>PROCEEDINGS</u>

# Emergent Behaviors in Ferroelectric Materials Due to Phase Coexistence

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**ABSTRACT**

Ferroelectric materials usually experience various phase under external temperature, electric and stress fields. Unique properties such as piezoelectricity, dielectricity, polarization reversal, and phase transitions are widely used in various electronic devices. Particularly, the phase and domain structures, ferroelastic switching behaviors often play a crucial role in determining their dielectric and piezoelectric properties. Here, we report some abnormal behaviors in ferroelectric thin films and single crystals, from which, we build the Landau theoretical model for relaxor ferroelectric single crystals. Using this model, we studied the phase coexistence and the corresponding physical properties. Using the results, we design a ferroelectric film under a phase boundary and a large-area, collective ferroelastic domain switching in $PbTiO_3$ epitaxial thin films was observed. Based on the collective ferroelastic switching behaviors, we design a rotation path to introduce structural instabilities and arrange the domain structure efficiently. The operation of free energy provides an powerful way to tune the ferroelectric domain structures and physical properties.

**KEYWORDS**

Ferroelectric; phase coexistence; nanodomains; collective switching

**Conflicts of Interest:** The authors declare that they have no conflicts of interest to report regarding the present study.