

Ferroelectric Domains — Formation, Engineering and Dynamics

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Domains and domain walls are critically important in determining functional properties of ferroelectric materials. Because the strain mismatch between different domains in a 3D space, crystal structure in the domain wall region must be deformed. This deformation introduced some degree of instability into the system, making it more responsive to external stimuli such as electric field and stresses. The enhanced functional properties due to domain walls are called extrinsic properties and they are associated with larger losses.

In recent years, PMN-PT single crystals and other relaxor-PT ferroelectric single crystals have revolutionized medical ultrasound and some electromechanical devices, their giant piezoelectric properties come from engineered ferroelectric domains, utilizing the easy rotation nature of polarization under an external field applied off the polarization direction.

This talk will use a Landau-Devonshire type phenomenological theory to provide a systematic interpretation of the formation, engineering and dynamics of ferroelectric domains. Co-existing multiphase domains and the formation of monoclinic phases in the morphotropic phase boundary composition of solid solution systems will also be explained.