MS40-01 | Nanoscale In-Situ 3D Imaging of Defect Dynamics in Oxide Ferroelectrics

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Lattice defects create long-ranging strain fields that lower local crystal symmetry. For systems with strong lattice coupling, such as functional oxides, this results in unpredictable and potentially debilitating functionality and device performance. Here, we used dark-field X-ray microscopy to nondestructively map lattice distortions around deeply embedded lattice defects in a range of ferroelectric and multiferroic materials. We show that individual dislocations, domain walls, and grain boundaries create weak, long-ranging strain fields that extend up to several µm – orders of magnitude more than generally assumed. Capturing real-time movies of these defects during phase transformations and electrical poling then reveals how heterogeneous structural distortions affect functionality over multiple length and time scales. Such extrinsic strains are pivotal in defining the local properties and self-organization of defects, and must be accounted for in the design of new materials and devices.