In-situ X-ray diffraction on switchable low energy geometric multiferroic single crystal

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Geometric ferroelectrics are called as improper ferroelectrics where geometric structural constraints, rather than typical cation-anion pairing, induce proper ferroelectric polarization. Among the geometric structural distortion, trimerization of MnO5 bipyramids in hexagonal manganites induces most intriguing multiferroicity such as topological vortex-antivortex, angle dependent conducting domain walls, enhanced magnetoelectric coupling at domain walls, etc. The ferroelectric transition induced by incorporation of trimerization and ferroelectricity in hexagonal *R*MnO3 (R=Ho, Er, Yb, Lu, Y) occurs at very high temperature 1120 - 1435 C. Because of the high transition temperature, it has been unavailable to study thermodynamic behavior of trimerization and polarization. Here, we present in-situ x-ray diffraction in structural and polarization evolution near the transition temperature of the improper ferroelectric in order to clearly understand the fundamental thermodynamics of improper ferroelectric correlated with trimerization and polarization.