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**Symmetry of Epitaxial $BiFeO_3$ Films in the Ultrathin Regime**[1]
YONGSOO YANG, University of Michigan, CHRISTIAN SCHLEPÜTZ, Argonne National Laboratory, CAROLINA ADAMO, DARRELL SCHLOM, Cornell University, ROY CLARKE, University of Michigan — $BiFeO_3$ (BFO) films grown on $SrTiO_3$ (STO) with a $SrRuO_3$ buffer layer exhibit a monoclinic structure at thicknesses greater than 40 nm, but higher structural symmetry can be observed for thinner films [Phys. Rev. B 81, 144115 (2010)]. We report a structural phase transition from monoclinic to tetragonal in ultra-thin BFO films grown directly on (100)-oriented STO. X-ray diffraction measurements of 3-dimensional reciprocal space maps reveal half-integer order peaks due to oxygen octahedral tilting. When the film thickness is decreased below 20 unit cells, the integer-order Bragg peak splitting associated with the presence of multiple domains of the monoclinic phase disappears. Instead, a single peak that is commensurate with the STO substrate lattice appears. The diffraction pattern has four-fold symmetry, ruling out the presence of a single monoclinic domain in favor of a tetragonal film structure. The evolution of the oxygen octahedra tilt pattern inferred from the intensities of half-order peaks suggests that this transition originates from the corner-connectivity of oxygen atoms at the interface between BFO and STO, and also strongly supports this monoclinic to tetragonal transition.

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