

## Polarization rotation transitions in anisotropically strained SrTiO<sub>3</sub> thin films

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Abstract: Commensurately strained epitaxial SrTiO<sub>3</sub> thin films on a GdScO<sub>3</sub> substrate with anisotropic in-plane tensile strains of 1.46% and 1.59% were grown. By using optical second harmonic generation and polarization measurements, a ferroelectric transition from a tetragonal 4/mmm phase to a ferroelectric mm2 phase at ~ 400 K and an antiferrodistortive transition to a multiferroic phase at 150-175 K are observed, which are in agreement with thermodynamic calculations. In addition, a series of polarization rotation transitions between  $\langle 100 \rangle_p$  to  $\langle 100 \rangle_p$  ( $0 < \lambda < 1$ ) is observed in the 4–400 K temperature range. (c) 2008 American Institute of Physics.