

Magnetic phase transition of BiFeO₃ film on (111) SrTiO₃ substrate observed by optical second harmonic generation

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We have investigated optical second harmonic generation (SHG) signals from multiferroic BiFeO₃ (BFO) thin films. Epitaxial (111) BFO films with 40-nm thickness have been grown on (111) SrTiO₃ substrates by on-axis sputtering technique. From the rotational anisotropy measurement of the SHG signals, 3-fold crystal symmetry of BFO film is confirmed. Investigation of nonvanishing components of nonlinear optical susceptibility tensor reveals that s-s polarization components of SHG signals correspond to the homogeneous antiferromagnetic ordering of BFO film. With changing magnetic annealing field of the films from 0 to 5 kOe, s-s components of SHG signals are gradually increased. This phenomena can be understood as magnetic phase transition occurs during magnetic annealing process from spatially modulated spin structure to perpendicular homogeneous antiferromagnetic state.