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Anisotropic photo-control of spontaneous polarization in $BiFeO_3$ thin films: Indications of photo-assisted magnetoelectric effect D.S. RANA, I. KAWAYAMA, H. MURAKAMI, M. TONOUCHI, Institute of Laser Engineering, Osaka University, Japan, INSTITUTE OF LASER ENGINEERING, OSAKA UNIVERSITY, JAPAN TEAM — The terahertz (THz) emission from multiferroic $BiFeO_3$(BFO) due to ultra-fast depolarization of electric order helps in evaluating its ferroelectric behavior [1]. In this work, we investigate THz-emission in BFO films on $(LaAlO_3)_{0.3}(Sr_2AlTaO_6)_{0.7}$ (LSAT) substrates along (100), (110) and (111)directions. THz emission amplitude (E_{THz}) and its electric field dependence are similar in BFO (100) and BFO (110); E_{THz} as function of electric field translates to ferroelectric-like hysteresis loop, and sign and amplitude of THz-emission are commensurate with the applied electric field. On the contrary, in BFO (111) the hysteretic loop is absent, E_{THz} varies linearly with electric field and the polarity of THz-emission is opposite to that of the electric field. These results suggest that THz-emission is mainly a result of ultrafast depolarization but with a superimposed character of ultrafast reorientation or demagnetization of antiferromagnetic (AFM) order. Though AFM order in BFO makes the determination of magnetoelectric (ME) coupling rather difficult, the photo-assisted electric field control of AFM order shown in the present work is suggestive of photo-assisted ME effect. 1. K. Takahashi *et al.*, Phys. Rev. Lett. 96, 117402 (2006).

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