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Second-harmonic rotational anisotropy and circular dichroism of a Sb_2Te_3 topological insulator nanoplate YONG AN, ROBIN JACOBS-GEDRIM, AVERY GREEN, SAMUEL O'MULLANE, ALAIN DIEBOLD, SUNY College of Nanoscale Science and Engineering — Topological insulators are an exotic class of materials that are electrically insulating in the bulk but conductive at the surface due to the presence of topological surface states. Spin-momentum locking of the surface states makes topological insulators potential candidates for spintronic applications. Experimental detection of the surface states and their spin polarization due to spin-momentum locking remains difficult because of the lack of surface-specific analytical techniques. Optical second-harmonic generation (SHG) is a surface-specific probe and thus it should probe the topological surface states preferentially over the bulk states. Here we present an experimental study of SHG from a Sb_2Te_3 topological insulator nanoplate, which is a 30-μm wide, hexagonal-shaped, and (0001)-faced single crystal grown via chemical vapor deposition on an oxidized Si(001) substrate. We show that SHG rotational anisotropy can identify the crystalline symmetry of the nanoplate and also probe spin-polarized currents excited by circularly polarized light. Furthermore, by measuring SHG circular dichroism (the differential SHG of left- and right-handed circularly polarized excitation), we show that a non-zero SHG circular dichroism signal when the incident plane lies in the mirror symmetry plane of the nanoplate corresponds to time reversal symmetry breaking due to photo-induced spin polarization.

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