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Ultrafast transient-photocarrier relaxation through the topological surface state of $Bi_{1.5}Sb_{0.5}Te_{1.7}Se_{1.3}$ YOUNGGWAN CHOI, CHANJUNE ZHUNG, SOON HEE PARK, Gwangju Inst of Sci Tech, JOONBUM PARK, JUN SUNG KIM, Pohang University of Science and Technology, SEONGHEUN KIM, JAEHUN PARK, Pohang Accelerator Laboratory, POSTECH, JONGSEOK LEE, Gwangju Inst of Sci Tech — Using optical-pump terahertz-probe spectroscopy, we investigated an ultrafast photocarrier relaxation behavior in a $Bi_{1.5}Sb_{0.5}Te_{1.7}Se_{1.3}$ (BSTS) single crystal which is one of the most bulk-insulating topological insulators. Compared to n-type bulk-metallic Bi_2Se_3, we found that BSTS endows distinct behaviors in its photocarrier dynamics; (i) the relaxation time turns out to be several times longer, and (ii) the photoconductance exhibits a nonlinear increase as a function of the pumping power. We discuss these intriguing experimental observations based on a bulk-to-surface carrier injection assisted by the built-in electric field near the surface and electron-phonon scattering.

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