Thermoelectric Properties of Topological Surface States in Tetradymite 3D TI

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Topological insulators are a new phase of materials with intriguing properties. The topological states emerging on the surface are gapless, spin-polarized, and with a linear dispersion. At room temperature, evaluating and separating the contribution of topological surface state (TSS) and trivial bulk states to thermoelectricity is challenging. In this work, the Seebeck coefficient of very thin 3D TI films is extracted from photothermoelectricity measurement. The analyses of dimensionality and dispersion effects using Landauer approaching showed the TSS is the dominant carrier in thermoelectric effect. The dependence of carrier concentration is also determined by electrostatic doping over the entire film thickness. In addition, deep tuning of photothermoelectricity under optical spin injection is achieved, which is originated from the TSS spin-momentum locking. The Seebeck coefficient can be altered by more than five times compared to the case without spin injection. The helicity-selected topological surface state has a large effect on thermoelectric properties, demonstrating great opportunities in optoelectronic and thermal devices.