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Spin helical transport from topological surface states and Rashba 2DEG in topological insulators JIFA TIAN, Department of Physics, Purdue University, JIUNING HU, School of Electrical and Computer Engineering, Purdue University, HELIN CAO, ISAAC CHILDRES, IRENEUSZ MIOTKOWSKI, YONG P. CHEN, Department of Physics, Purdue University — Topological insulators are an unusual phase of quantum matter with nontrivial spin-momentum-locked gapless topological surface states (TSS) and strong spin-orbit coupled bulk states. Coexistence of parallel conduction channels makes revealing transport signatures of the spin-momentum helical locked TSS difficult. Here, we report the fabrication of spin valve devices from exfoliated topological insulator thin flakes, with two outside nonmagnetic contacts for injecting a DC current together with a middle ferromagnetic (FM) contact for spin detection. By applying an in-plane magnetic field along the easy axis of FM contact, we observe a striking asymmetric magnetoresistance (MR) with a clear hysteresis. Furthermore, the trend of the asymmetric MR can be reversed by reversing the direction of the DC current. Our result is consistent with the current induced spin polarization from TSS, giving the direct transport evidence of spin-momentum-locking of TSS. Furthermore, from more metallic samples due to bulk conduction, we observe a current induced spin polarization opposite to that of TSS but consistent with Rashba 2D electron gas (2DEG) coming from band bending near surface. Our demonstration of spin helical transport opens ways for novel TI-based spintronc devices.

Jifa Tian
Department of Physics, Purdue University

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