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Surface state transport in MBE-grown topological insulator $(Bi_{1-x}Sb_x)_2Te_3$ thin films and field effect transistors JIFA TIAN, Department of Physics, Purdue University, CUIZU CHANG, Department of Physics, Tsinghua University, HELIN CAO, Department of Physics, Purdue University, JIUNING HU, Electrical Engineering, Purdue University, TAI-LUNG WU, Department of Physics, Purdue University, KE HE, XUCUN MA, IOP, CAS, QIKUN XUE, Department of Physics, Tsinghua University, YONG CHEN, Department of Physics, Purdue University — Topological insulators feature spin-helical, Dirac fermion surface states, promising potential applications in both nanoelectronics and spintronics. However, experimental identification of a clear transport signal of the surface state conduction is still challenging. Here, we report a systematical study of the gate tunable magneto-transport in MBE grown $(Bi_{1-x}Sb_x)_2Te_3$ (x=0.96) thin film on $SrTiO_3$ substrate. We observed an ambipolar field effect and a sign change in the Hall resistance as the gate voltage (V_g) crosses the Dirac point (V_D). Temperature (T) dependence of the resistance at different V_g shows a transition from a metallic to an insulating bulk with 100% surface conduction at low T. Weak antilocalization measurements indicate a π Berry phase near V_D. We also performed spin valve measurements and observed a resistance asymmetry (which reverses with reversing current direction) between the positive and negative in-plane magnetic fields, demonstrating the predicted locking between spin and momentum for the surface state. We also studied the thermal-electric transport, demonstrating a sign change of the thermoelectric power across the V_D as the carrier type switches from electron to hole.

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