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Quantum Transport of Surface State Dirac Fermions of a 3D Topological Insulator YANG XU, IRENEUSZ MIOTKOWSKI, Department of Physics, Purdue University, JIUNING HU, School of Electrical and Computer Engineering, Purdue University, TAI-LUNG WU, YONG P. CHEN, Department of Physics, Purdue University — A three-dimentional (3D) strong topological insulator (TI) has a fully insulating gap in the bulk and topological surface states of gapless Dirac fermions. However it is a great challenge to eliminate bulk conduction and reveal the transport signatures of the Dirac fermion from surface states in real 3D TI materials. By Bridgman method, we have successfully grown high-quality single crystal of 3D TI $BiSbTeSe_2$ with very low bulk carrier density (p type, less than 1.5×10^{15} cm^{-3}) and high surface mobility (above 1000 cm^2/Vs at low temperature). The insulating bulk and dominated surface conduction are confirmed by transport measurements of samples with various thicknesses (20 nm to 52 μm). In high magnetic fields (up to 31 T), we studied quantum oscillations and quantum Hall transport from topological surface states in exfoliated flake devices on SiO_2/Si substrates, where the density of the bottom surface can be tuned by a back gate voltage. Our experiements reveal an intrinsic 3D TI material and paves the way for further application of topological quantum electronics.

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