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Quantum oscillations and Hall anomaly of surface electrons on Topological Insulators¹ N. PHUAN ONG, Princeton University

The investigation of Topological Insulators (TI) by transport experiments is a challenge, because the surface currents cannot be well-resolved when the bulk conductance is dominant, as in most crystals. I will review the progress starting from Ca-doped Bi₂Se₃, and proceeding to Bi₂Te₃ and to Bi₂SeTe₂. Using Ca dopants in Bi₂Se₃, we succeeded in lowering the Fermi energy E_F into the bulk gap. However, in non-metallic crystals, the substantial dopant-induced disorder precluded observation of Shubnikov-de Haas (SdH) oscillations. Fortunately, E_F in undoped Bi₂Te₃ can be tuned into the gap by heat treatment. The non-metallic samples display a bulk resistivity $\rho = 4.12 \text{ m}\Omega \text{cm}$ at 4 K. In these crystals, weak SdH oscillations are observed below 10 K. We confirmed that these oscillations arise from a 2D Fermi Surface by tilting the magnetic field **H**. From the behavior of the SdH amplitude versus temperature T and H, we infer a surface Fermi velocity $v_F = 3.7-4.2 \times 10^5 \text{ m/s}$, and a high surface mobility $\mu = 10,000 \text{ cm}^2/\text{Vs}$. The high mobility of the surface electrons is confirmed by the appearance of an unusual weak-field anomaly in the Hall conductance G_{xy} . I will discuss recent progress in further lowering the bulk conductance in the new TI Bi₂Se₃, in which a Se layer is sandwiched between two Te layers in each quintuplet unit cell. In these crystals, ρ at 4 K is a factor of 1000 larger (6 Ω cm). The interesting pattern of SdH oscillations in this new system will be reported.

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