MAR11-2010-000741

Abstract for an Invited Paper
for the MAR11 Meeting of
the American Physical Society

Quantum oscillations and Hall anomaly of surface electrons on Topological Insulators[1]

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 Bi_2Se_3, and proceeding to Bi_2Te_3 and to Bi_2SeTe_2. Using Ca dopants in Bi_2Se_3, 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 Bi_2Te_3 can be tuned into the gap by heat treatment. The non-metallic samples display a bulk resistivity ρ = 4-12 mΩcm 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 $\times 10^5$ m/s, and a high surface mobility μ = 10,000 cm^2/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 Bi_2Se_3, 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 Ωcm). The interesting pattern of SdH oscillations in this new system will be reported.

Collaborators: D.X. Qu, J. M. Checkelsky, Y. S. Hor, J. Xiong, R. J. Cava

[1]Supported by NSF-MRSEC DMR 0819860. High-field experiments were performed in the National High Magnetic Field Lab., Tallahassee.