Title:	Probing Topological Character and Fermi Surface of Topological Materials by Magnetotransport Measurements
Authors:	Vashist, A.
Keywords:	Topological Fermi surface Magnetotransport
Issue Date:	28-Jul-2021
Publisher:	IISERM
Abstract:	Condensed matter physics has taken an exciting turn after the theoretical prediction and experimental realization of two and three dimensional (2D/3D) topological quantum materials, possessing a nontrivial bulk band structure characterized by topological invari- ants. The discovery of these quantum materials has been inspired by the fundamental concept of bulk boundary correspondence in quantum Hall effect, which is considered as first topological state of matter. This new state of matter includes many variants such as, topological insulators (TIs), Weyl and Dirac semimetals (DSMs/WSMs) and topological superconductors (TSCs). Topological insulators(TI) exhibit insulating behaviour in the bulk having conducting edge/surface states. The 2D dispersion of these Dirac states in the bulk gap forms a cone on the surface and is known as surface Dirac cone. These edge/surface states expected to be immune against scattering from non magnetic disorder and hence could be useful for spintronics devices. Topological (Dirac or Weyl) semi- metals (DSM, WSM), which possess bulk bands with linear electronic dispersions in all three momentum directions, have attracted immense research interest, recently. In DSMs, doubly degenerate Dirac cones (of opposite chirality) exist and they are protected by time reversal (TRS) and inversion (IS) symmetry. If any of the above symmetries breaks that will leads to a splitting of the Dirac cones into a pair of Weyl cones with opposite chi- rality, thus transforming a DSM into a WSM. Topological semimetals (TSMs) are further categorized as type-I and type-II TSMs. Type-I TSMw have linear and isotropic disper- sion in momentum space, while dispersion relation in type-II semimetals is tilted in a perticular momentum direction. These topological materials have been shown to exhibit exotic physical properties like extremely large magnetoresistance (MR), high mobility, small effective mass, small carrier density, negative magnetoresistance, a large value of the anomalous Hall/thermal conductivity and a Berry phase of π . In addition to TSMs, topological superconductors (TSCs) have been the focus of intense recent research due to the possibility that these materials may host Majorana fermion excitations. These Ma- jorana excitations are of fundamental as well as technological interest and can also be utilized in fault-tolerant Quantum computation. In this thesis, we present magnetotransport, high pressure and thermal property inves- tigation of some topological materials. These materials include the topological insulator Bi 1−x Sb x , topological semimetals ATe 2 (A = Pt, Pd), XBi (X = La, Pr) and a topological superconductor candidate Pd:Bi 2 Te 3 . Our work on these materials uncovers several in- teresting results: (i) observation of a strong Weyl state in the TI regime in Bi 1−x Sb x , (ii) experimental evidence for DSM nature of ATe 2 , additionally, the planar Hall effect (PHE), observed for PtTe 2 even though the Dirac node is 0.8 eV away from the Fermi level, (iii) first experimental realization of the topologically nontrivial state in PrBi, (iv) our heatii capacity measurements strongly indicate that the superconductivity in PdTe 2 is conven- tional in nature despite the presence of topologically nontrivial electrons contributing to the transport, (v) evidence for unconventional superconductivity in topological supercon- ductor candidate Pd:Bi 2 Te 3
URI:	http://hdl.handle.net/123456789/3726
Appears in Collections:	PhD-2014

Files in This Item:

File	Description	Size	Format	
Thesis_Amit PH14042.pdf		13.46 MB	Adobe PDF	View/Open