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Title:	Probing the Non-Trivial States of Low Dimensional Topological Materials by Magnetotransport
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Abstract:	The discovery of topological materials such as topological insulators, topological semimetals, topological superconductors, etc., has led to a surge in condensed matter physics owing to their non-trivial band structure. Topological insulators (TI) are insulating materials with conducting edge/surface states protected by time-reversal symmetry. These edge/surface states are immune to non-magnetic impurities. Due to spin-orbit coupling, the conducting edge/surface states have a spin momentum locking property. The spin momentum locking results in the helical nature of surface states. Topological semimetals (Dirac/Weyl) are the three-dimensional phases of matter with gapless electronic excitations. The degeneracy of band crossings gives rise to distinct topological semimetal phases such as Dirac or Weyl semimetals, and beyond these. 3D Dirac semimetals (DSM) can be seen analogous to 2D Graphene, with the Dirac bands dispersing linearly in all three momentum directions. In DSMs, conduction and valence bands touch each other at discrete points in the Brillouin zone, called Dirac Points. These Dirac points are degenerate, protected by time-reversal (TRS) and inversion (IS) symmetry. The DSMs can be converted into other topological phases such as Weyl semimetal (WSM) by breaking either time-reversal symmetry (TRS) or inversion symmetry (IR), which leads to the splitting of Dirac point into two non-degenerate Weyl points. Unlike Dirac and Weyl fermions with four-fold and two-fold band degeneracy, many other new fermions have been predicted in materials with higher-fold band degeneracy. Due to their distinctive bulk band structure, the TSMs have been shown to exhibit exotic physical properties such as giant magneto-resistance, Fermi arc surface states, high mobility, non-trivial Berry phase, chiral anomaly induced negative magneto- resistance, etc. In topological materials, bulk conductivity often overwhelms the surface state's contribution, complicating the explicit interpretation of the observed effects electronically. Increasing the surface to volume ratio thus offers the possibility to enhance the contribution of the topological surface states to the conductivity. Therefore, the fabrication of thin films is an effective technique to reduce the bulk contribution by increasing the surface-to-volume ratio. This thesis presents the growth and magneto-transport investigation of non- trivial states of some low-dimensional topological materials. These materials include the topological semimetal candidates $Pd_3Bi_2S_2$, $Pd_3Bi_2Se_2$, $PdSb_2$ and topological semimetal $Co_3Sn_2S_2$. Our work on these materials reveals severalexciting results: (i) observation of 2D weak anti-localization in thin films of topological semimetal $Pd_3Bi_2S_2$, indicating for the first time the contributions from two dimensional (2D) topological surface states,(ii) observation of two dimensional Dirac fermions in thin films of topological candidate $Pd_3Bi_2Se_2$, (iii) Comparative study of weak anti-localization and electron-electron interaction effect in thin films of topological semimetal candidate $PdSb_2$, giving an alternate way to gain information about the coupling between the topological surface states and bulk states, (iv) observation of planar Hall effect below the ferromagnetic ordering temperature in $Co_3Sn_2S_2$, indicating that planar Hall effect can't be connected with the topological character of $Co_3Sn_2S_2$.
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