Observation of a weak topological insulator phase in thin films of R3MR Bi2Te3

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We report the electrical transport in thin films of R3MR phase of Bi2Te3 and for the first time to our knowledge, quantum transport investigations is done on this phase. We see the emergence of a weak topological insulator phase in this material as probed by quantum oscillations in magnetoconductivity.3-D Weak topological insulators can be viewed as adiabatic stacking of 2-D quantum spin Hall insulators, and hence have topologically protected surface states only in the side surfaces. High quality oriented thin films were grown by pulsed laser deposition and standard Hall bars were fabricated by electron beam lithography.
In the standard measurement configuration where magnetic field is perpendicular to the sample, magnetoresistance showed weak antilocalization like cusp and the Hall measurements showed bulk carrier concentration of 5E20/cm3 and a small mobility.
But in the specific configuration where the magnetic field is parallel to the sample and perpendicular to the current (ie, the magnetic field is aligned perpendicular to the side surface), we observed strong Shubiknov de Haas quantum oscillations from 9T to 14T. These quantum oscillations is a signature of the existence of Dirac cone like side surface states with large electron mobility. The quantum oscillations are analysed by 2D Lifshitz -Kosevich(LK) equations. From the LK fit, electron mobility of 3400cm2/Vs was obtained corresponding to an effective mass of 0.15me. The absence of oscillations in the perpendicular magnetic field, whereas its prominence when the field is aligned perpendicular to side surface of the device can possibly explain that the R3MR phase of Bi2Te3 is a weak topological insulator, unlike its usually counterpart, which is a strong topological insulator.