Pulsed Field Magnetotransport Quantum Oscillations in Topological Insulators

Z. Zhang, Y. Wang (Tsinghua U, Physics); Z. Zhu (NHFML-PFF, LANL); J. Lau (UC-Riverside); R.D McDonald (NHFML-PFF, LANL)

Introduction

Topological insulators [1] (TIs) are quantum materials with bulk insulating and topologically protected metallic surfaces. Understanding and controlling the surface Dirac electrons transport in the presence of non-trivial bulk states is essential to both realizing future applications and exploring the proposed exotic topological effects. Transport measurements of TI surface states is challenging due to the dominated bulk transport. To minimize the bulk contribution and let the surface dominate transport, chemical doping is introduced to tune the band filling, which we probe via the surface and bulk quantum oscillation signatures in the pulsed magnetic fields. We report Hall effect and magnetoresistance measurements in our single crystal in pulsed magnetic fields up to 60 T.

Experimental

$Bi_2(Te,S)_3$ single crystal were grown in China. The bulk contribution can be significantly reduced by tuning the ratio of Te:S. Transport measurements were carried out in the 65T short pulse magnet of NHMFL-PFF, LANL.

Results and Discussion

We investigate the transport properties of a series of TI single crystal in the 60 T pulsed magnet. A systematic evolution of quantum oscillation is observed when the Fermi level is tuned by varying the ratio of Te/S.

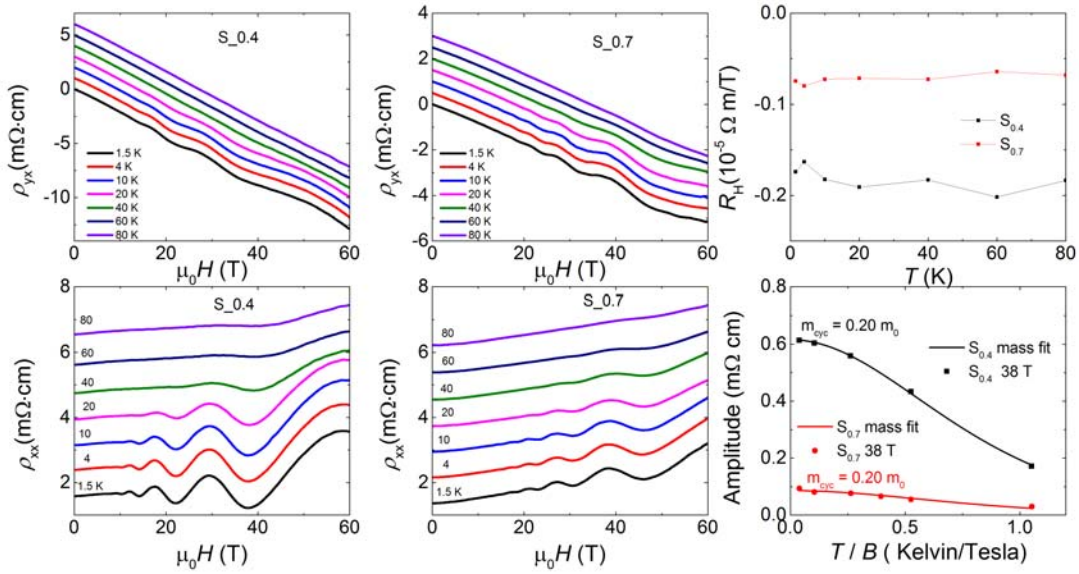

Fig.1 Hall effect (upper panel) and magneto resistance (lower panel) in two different doping single crystals.

Conclusions

Angle and temperature dependence of the quantum oscillation spectrum reveal distinct surface and bulk contributions whose relative intensity can be tuned via sulfur composition

Acknowledgements

We acknowledge funding support from NSF of China, MOST of China. RMcD acknowledges support from BES-`Science of 100 tesla'. RMcD and JL acknowledge the LANL-UC Fees grant `Topological insulators'. The work at the National High Magnetic Field Laboratory is supported via NSF/DMR 1157490

References

[1] Hasan, M.Z., *et al*., Review of Modern Physics, **82**, 3045-3067 (2010).