rf-Measurements of Topological Insulators in Pulsed Magnetic Fields

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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.

Experimental

We report tunnel diode oscillator measurements of the topological insulator $Bi_2(Te,S)_3$, single crystals of which were grown in China. The bulk contribution can be significantly reduced by tuning the ratio of Te/S. Angle dependent measurements of the skin depth were carried out in the 60T short pulse magnet of NHMFL-PFF, LANL.

Results and Discussion

TDO measurement is applied on the $Bi_2Te_{2.3}S_{0.4}$ single crystal. Quantum oscillations are observed in the $Bi_2Te_{2.3}S_{0.4}$ single crystal, which are consistent with previous magnetotransport measurement. Cos(θ) dependence can be traced up to 70 degrees, indicating the oscillation is originated from surface state.

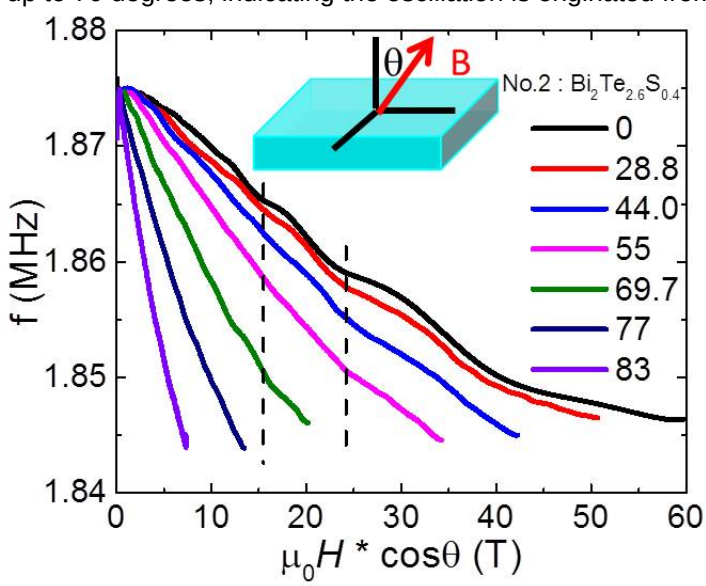

Fig 1. Angle dependence of TDO measurement on $Bi_2Te_{2.3}S_{0.4}$ single crystal.

Conclusions

Combining the transport, torque and TDO measurement on the $Bi_2Te_{2.3}S_{0.4}$ single crystal, we can confirm that the transport in this particular doping is dominated by the surface state.

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References

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