Magneto-optical Study of Topological Crystalline Insulators

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Introduction

A new type of topological insulator, the so-called Topological Crystalline Insulator (TCI), has attracted great interest recently. In these materials, the metallic surface states are described by Dirac fermions and protected by the mirror symmetry of the crystal structure. TCIs widely exist in IV-VI semiconductors, for example, PbTe, PbSe and SnTe, as well as their solid solutions, $Pb_{1-x}Sn_xSe$ and $Pb_{1-x}Sn_xTe$. We carried out magneto-optical measurements on MBE grown thin films of TCIs in very high magnetic fields in NHMFL.

Experimental

In our experiments, TCI samples ($Pb_{1-x}Sn_xTe$) were grown by MBE on silicon substrates [1]. IR transmission spectra were measured using a Fourier transform infrared (IR) spectrometer at SCM3.

Results and Discussion

Figure 1 depicts the IR magneto-transmission ratio spectra T(B)/T(B=0) of $Pb_{1-x}Sn_xTe$ with two dopings in representative B fields up to 17.5T. In $Pb_{0.74}Sn_{0.26}Te$, several absorption peaks (dips in transmission) were observed, which evolve systematically with B field. It is very likely these features are due to Landau levels in this material. In $Pb_{0.7}Sn_{0.3}Te$, one absorption peak was observed and the magnitude of the feature changes with B field. Previous angle-resolved photoemission spectroscopy study on these MBE samples showed that the system undergoes a topological phase transition from a trivial insulator to TCI when the doping is changed [1]. Our results in figure 1 indeed show very interesting trend with doping, which suggests the great promise of the proposed magneto-optical measurements in elucidating the physics in these TCI systems.

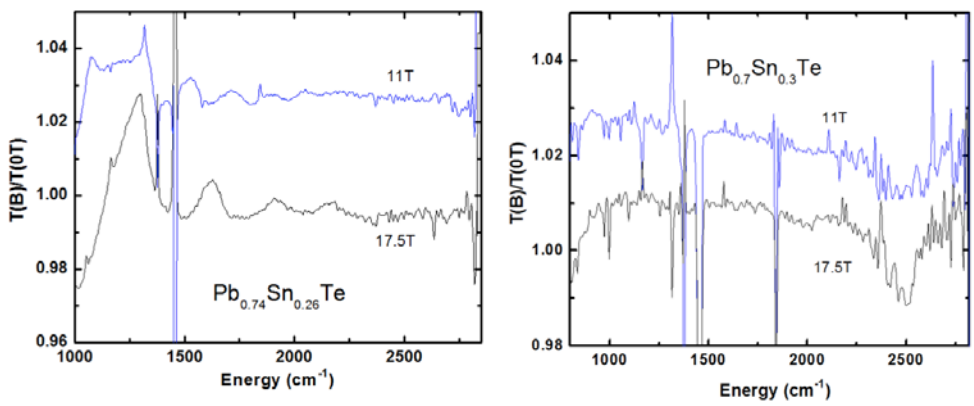

Figure 1: The IR magneto-transmission ratio spectra T(B)/T(B=0) of $Pb_{1-x}Sn_xTe$ with two dopings in representative B fields. Left panel: $Pb_{0.74}Sn_{0.26}Te$, the observed absorption peaks (dips in transmission) evolve systematically with B field. Right panel: $Pb_{0.7}Sn_{0.3}Te$, the magnitude of the dip feature changes with B field. Data are displaced vertically for clarity.

Conclusions

This work is in progress. Our studies will provide new insights in the fundamental physics of TCIs.

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References

[1] C. Yan et al, Phys. Rev. Lett. 112, 186801 (2014).