PhD Viva-Voce

Photo-Seebeck effect, magnetotransport and Ultrafast THz photocurrent studies on Bi₂Te₃ and Bi₂Se₃ topological insulators

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Abstract

Three-dimensional topological insulators (3dTIs) can be found in binary, ternary and quaternary material forms. For example, Bi₂Te₃ family of compounds among the binary systems, Bi₂Te₂Se from the ternary, and BiSbTeSe from among the quaternary systems are the most commonly studied 3dTIs. In the current thesis, the focus has been kept on two exemplary systems, viz, Bi₂Te₃ and Bi₂Se₃. Initially, magneto-transport measurements were carried out to realize nontrivial topological characteristics of the surface states in magnetoresistance at low temperatures and low magnetic fields in single crystalline Bi₂Te₃. Also, the influence of magnetic fields on temperature-dependent resistivity was studied to capture the response of surface and bulk states in this system. These studies helped set the foundation for achieving the subsequent objectives in the thesis which have been achieved by optical probing. Bi₂Te₃ is a very good thermoelectric material with very high value of Seebeck coefficient. Therefore, it is imperative to investigate photo-induced thermoelectric response of this material along with its pure optical response. We have studied photo-Seebeck effect induced photocurrent response of surface and bulk states in single crystalline Bi₂Te₃. Finally, femtosecond optical pulse-induced ultrafast photocurrents on the surface as well as in the bulk of single crystalline Bi₂Te₃ and Bi₂Se₃ systems were investigated using THz emission time-domain spectroscopy. Such an advanced methodology helped to resolve some of the challenges that limit the efficiency of 3dTIs as potential sources of THz radiation.

References:

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