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Experimental studies on epitaxial films of three-dimensional (Bi_2Te_3) and crystalline ($Pb_{1-x}Sn_xTe$) topological insulators

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Abstract

Bismuth telluride (Bi_2Te_3) is an archetype of a three-dimensional topological insulator, which presents topological surface sates (TSS) with a linear dispersion like in a Dirac cone positioned between the valence and conduction bands. The Dirac fermions on the surface are protected against scattering by the time inversion symmetry [1]. On the other hand, $Pb_{1-x}Sn_xTe$ is a topological crystalline insulator, in which the topological nature of the electronic structure arises from the crystalline symmetry. In this case, the TSS appear only for samples with Sn compositions where the band inversion occurs [2]. Details about the molecular beam epitaxial growth of Bi_2Te_3 and $Pb_{1-x}Sn_xTe$ thin films on (111) BaF_2 substrates and their structural characterization will be presented here. Angle resolved photoemission spectroscopy (ARPES) revealed metallic surface states in the form of a Dirac cone within the energy gap of the Bi_2Te_3 films with the Fermi level crossing only the TSS, demonstrating a bulk insulating behavior [3]. We will also show results on the investigation of our Bi_2Te_3 epitaxial films doped with europium [4]. Experiments on the electronic transport of our $Pb_{1-x}Sn_xTe$ films at intense magnetic fields up to 30 T and temperatures varying from 4.2 to 300 K will be presented in detail. Pronounced Shubnikov - de Haas oscillations were detected on SnTe film up to 80 K. Our analysis showed that the observed beating pattern on these quantum oscillations originates from the Rashba splitting of the bulk longitudinal ellipsoid in SnTe [5]. Preliminary results on extrinsic n-type doping of $Pb_{1-x}Sn_xTe$ with bismuth will be also exhibited here [6].

References

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