

Nanoscale physics

Quantum oscillations in thickness dependences of transport properties of topological insulator Bi_2Se_3 thin films

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For thin film applications, it is necessary to take into account the quantum size effects, which can drastically change properties under change in the film thickness (d). One of the possible manifestations of the quantum size effects in 2D-structures is an oscillatory behavior of d - dependences of the transport and thermodynamic properties due to the quantization of the energy spectrum.

Bi_2Se_3 semiconducting compound and solid solutions based on it are known as promising thermoelectric materials for refrigerating devices. Recently, interest in investigating the transport properties of Bi_2Se_3 has grown sharply due to the prediction and experimental observation of the special properties characteristic of topological insulators in Bi_2Se_3 [1]. In [2] we revealed size oscillations in transport properties of the Bi_2Te_3 compound. The objects of the present study were thin Bi_2Se_3 films with d in the range of $d = 25 - 420$ nm, grown by thermal evaporation in vacuum of n - Bi_2Se_3 crystals on glass substrates. The room-temperature d -dependences of the Seebeck coefficient, Hall coefficient, electrical conductivity were measured. The obtained dependences exhibited an oscillatory behavior, thus providing the first experimental evidence for the existence of quantum oscillations in d - dependences of the transport properties of Bi_2Se_3 thin films. A convincing argument in favor of the interpretation of the data in terms of size quantization is a good correspondence between experimentally determined and theoretically calculated values of the oscillation period. The observed oscillatory character of the d - dependences of the thermoelectric properties should be taken into account for 2D- structures applications in thermoelectricity and other fields of science and technology.

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3. Rogacheva E.I., Budnik A.V., Sipatov A.Yu., et.al. Thickness dependent quantum oscillations of transport properties in topological insulator Bi_2Te_3 thin films // Appl. Phys. Lett. – 2015. –**106**. – P. 053103-107.