Poster PS-10

Magnetic and Electronic Transport Properties of Large Crystallite Disorientation Angle Interfaces of a Bi–Sb 3d Topological Insulator

Fiodor M. Muntyanu[1], Elena P. Condrea[1], and Vitalie G. Chistol[2]

[1] *Institute of Electronic Engineering and Nanotechnologies, Chisinau, Rep. of Moldova*
[2] *Technical University of Moldova, Chisinau, Rep. of Moldova*

We present results of a study of the magnetic and galvanomagnetic properties of $Bi_{1-x}Sb_x$ ($0.07 < x < 0.2$) bicrystals in a temperature range of 1.6–100 K using a Quantum Design SQUID magnetometer and a Physical Property Measuring System (PPMS) with a 140-kOe induction magnet. The quantum oscillations of galvanomagnetic effects were registered in stationary (up to 180 kOe) and pulse magnetic fields (up to 400 kOe) directed along the C_3 axis of the crystallites. The studied bicrystals consisting of two single crystalline blocks (crystallites) and the perfect superconducting nano-width crystallite interfaces with a solitary central part (thickness of about 60 nm) and two similar adjacent layers (~20 nm) on both sides of it were prepared by the horizontal zone recrystallization method.

It was found that the large crystallite disorientation angle (LDA) interfaces show ferromagnetic hysteresis loops and specific characteristics of a single superconducting layer with critical temperature T_c ~ 3.7–4.6 K and a thickness comparable with the entire interface. In addition, our investigations highlighted that the simultaneous manifestations of superconductivity and weak ferromagnetism at LDA interfaces are due to spin reorientation of charge carriers after interaction with disorder in component layers. High sensitivity of the charge carriers to a slight increase in disorder indicates close energies of weak ferromagnetic and superconducting ground states and invokes the possibility of coexistence of these two different states in a single phase. LDA bicrystals, being located in strong magnetic fields, exhibit quantum oscillations of the magnetoresistance and the Hall effect, thus indicating that the density of states is higher and charge carriers are heavier in the layers of the interfaces than in the crystallites. In addition, our results show that twisting bicrystals contain regions with different densities of quantum electronic states, which are determined by the crystallite disorientation angle and magnetic-field strength. According to the obtained data, bicrystals of $Bi_{1-x}Sb_x$ ($0.07 < x < 0.2$) 3D topological insulators can be used to study a number of important problems of modern physics, such as the problems of superconducting systems with Dirac nodes and the Majorana mode, issues related to the quantum spin Hall phase, etc.