MSP 11 P QUANTUM TRANSPORT AND MAGNETIC PHENOMENA IN NANO-WIDTH CRYSTALLITE INTERFACES OF TOPOLOGICAL INSULATORS Bi_{1-x} - Sb_x (0,07≤x ≤ 0.2)

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According to recent studies [1-3], the Bi_{1-x} Sb_x alloys in the semiconducting regime ($0.07 < x < 0.22$) are three- dimensional 3D topological insulator (TI) that belongs to a non-trivial Z_2 topological class. The 3D TI is a novel quantum state of matter and is insulating in the bulk but have gapless edge/surface states. The results of angle-resolved photoemission spectroscopy shows that the surface states of Bi_{1-x} Sb_x ($0.07 < x < 0.22$) alloys are metallic. Since the surface states surround the sample, the quantum transport phenomena in magnetic fields becomes very attractive to study the metallic surface states in the Bi_{1-x} Sb_x ($0.07 < x < 0.22$) topological insulators. In bicrystals of these alloys, consisting of two single crystalline blocks (3D TI) and the superconducting nano-width crystallite interface (CI), one of the external surfaces is replaced with the CI which is a comlex systems composed of a solitary central part (the thickness about 60nm) and two similar adjacent layers (~ 20nm) on both sides of it. Dispate its small size the CIs play a significant role in electronic transport and may change qualitatively the distinctive behavior of topological insulators.

In this report, we present the investigation of the magnetic and transport phenomena at low temperatures and in high magnetic fields, having as objective the elucidation of the role played by nano-width CI in the interaction between Dirac fermions in a 3D TI.

We have experimentally proved that nano-width CI of bicrystals and tricrystals of bismuth-antimony alloys exhibit superconductivity, whereas the single crystalline samples, are diamagnetic and they are not superconducting. The observed display of superconductivity appears to be a consequence of increasing of carrier density at the nano-width crystallite interfaces and changes of the carrier pockets topology. We suggest that the unpaired electron spins responsible for ferromagnetic-like hysteresis loops in tricrystals and in some bicrystals have their origin in topological defects and structural disorder. It was also found that the semiconductor-semimetal transition is induced in crystallites and CI of bicrystals at different values of magnetic field.

[1] L. Fu and C. L. Kane, *Phys. Rev*. B **76**, 045302 (2007).
[2] J. C. Y. Teo, Liang Fu, and C. L. Kane, *Phys. Rev. B*. **78**, 045426 (2008)