SSNN 6P SUPERCONDUCTIVITY AND FERROMAGNETISM IN TWISTING Bi-Sb INTERFACES

F. M. Muntyanu[1,2], A. Gilewski[2], A.J. Zaleski[3], V. Chistol[4], and K. Rogacki[2,3]
[1] *Institute of Electronic Engineering and Industrial Technologies, Chisinau, Moldova*
[2] *International Laboratory of High Magnetic Fields and Low Temperatures, Wroclaw, Poland*
[3] *Institute of Low Temperatures and Structural Research, Wroclaw, Poland*
[4] *Technical University of Moldova, Chisinau, Moldova*
E-mail: muntean_teodor @ yahoo.com

The hysteresis loops and temperature dependences of magnetic moment *m(T)* are studded in large disorientation angle (LDA) twisting interfaces of $Bi_{1-x}Sb_x$ ($0 < x < 0.\ 2$) alloys. They were found one superconducting transition with T_c ~ 3.7 - 4.6K (for various samples) and magnetic hysteresis loops typical for weak ferromagnetic materials. The values of upper critical $H_{c2}(T)$ and dH_{c2}/dT in LDA interfaces were somewhat lower than in small disorientation angle interfaces with two superconducting transition. For instance, $H_{c2}(T)$ and dH_{c2}/dT, depending on the sample composition, take values of ≈ 2.6–3.7kOe and - (0.9–1.5)kOe/K, respectively. They corresponds to the zero-temperature coherence length $\xi \approx 30$ - 35nm and superconducting layer thickness about 100-120nm.

The data on superconducting layer thickness are in good agreement with those obtained via scanning electron microscopy. On the other hand, the LDA interfaces bring out specific characteristics of superconducting layer with the thickness comparable to the total interface thickness, despite the fact that the quantum oscillations data clearly indicate the presence of several layers. The ferromagnetic hysteresis loops in LDA interfaces clearly stand out against the paramagnetic background of *m(T)* with a slightly temperature–dependent saturation moment $m_s \approx (0.7 – 1.2) \times 10^{-5}$ emu/g at H ≤ ±2 kOe.

The loops exhibit feromagnetic properties in the entire temperature interval studied; their form is slightly modified; their width decreases with increasing temperature, despite of diamagnetic response at $T_c < 5$ K. We believe [1] that manifestation of weak ferromagnetism in LDA Bi–Sb interfaces is result of the influence of strongly pronounced structural disorder (dislocations, local distortions, vacancies etc.), as evidenced by charge carriers mean-free path estimations from quantum oscillations. An increase in the structural disorder leads to breaking of electron pairs in interfaces different areas (apparently, some interface layer components) and to the formation of ferromagnetic underlying electronic structure, which are in constant competition or coupling with Cooper paired electrons. Comparison of the data for our different disorientation angle interfaces reveals that the most significant changes occur in the higher superconducting critical temperature phase, where structural disorder at SDA interfaces considerable reduce T_c and generate ferromagnetic regions. Thus, as a result of our investigations were highlighted: (i) simultaneous manifestations of superconductivity and weak ferromagnetism at LDA interfaces, due to spin reorientation of charge carriers after interaction with disorder in component layers; (ii) sensitivity of the charge carriers to a slight increase in disorder at LDA interfaces, indicates close energy of weak ferromagnetic and superconducting ground states, and suggesting the possibility of coexistence of these two different states in a single phase.

[1] F. M. Muntyanu, A. Gilewski, K. Nenkov, K. Rogacki, A. Zaleski, G. Fuks, V. Chistol, Physics Letters A **378**, 1213 (2014).