DSCM P62 SUPERCONDUCTING AND WEAK FERROMAGNETIC FEATURES AT INTERFACES OF BICRYSTALS OF 3D TOPOLOGICAL INSULATOR $BI_{1-X}SB_X$.

F. M. Muntyanu[1,*], A.J. Zaleski[2], K.Rogacki[2], V. Chistol[3]
[1] *Institute of Electronic Engineering and Nanotechnologies, Chisinau, Moldova;* [2]*Institute of Low Temperatures and Structural Research, Wroclaw, Poland;* [3]*Technical University of Moldova, Chisinau, Moldova*
*E-mail: muntean_teodor@yahoo.com

In this report we present the results of study of the magnetic and superconducting properties of bicrystals of 3D topological insulator (TI) $Bi_{1-x}Sb_x$ ($0 \leq x \leq 0.2$) in temperature range 1.8-100K using Quantum Design SQUID magnetometer and a Physical Property Measuring System (PPMS) with a 140 kOe magnet. Two types of bicrystals were investigated: inclination type (crystallographic axes of the crystallites are revolved in a single plane) and twisting type (crystallographic axes of crystallites are revolved in two planes). Two/one superconducting phases [1] with the onset of transition ≤ 36 K are observed at CIs of bicrystals, while the rhombohedral 3D topological insulator BiSb is diamagnetic and do not exhibit superconductivity. To that (see Fig. 1(a,b)) in large crystallite disorientation angle BiSb interfaces both superconductivity and weak ferromagnetism were revealed simultaneously, which is completely surprising for these materials.

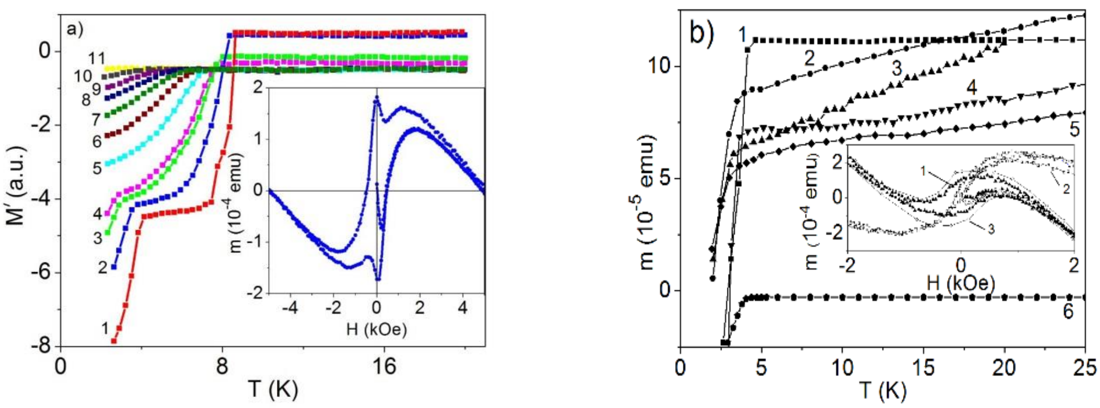

Fig.1. Temperature and magnetic field dependences of both magnetic moment *m* and the real (*M'*) part of ac-magnetic moment, as well as magnetic hysteresis loops in BiSb bicrystal interfaces. **(a)** bicrystals of inclination type: $Bi_{0.85}Sb_{0.15}Sn$, $\theta = 19^{\circ}$; 1 – 0; 2 – 0.4 kOe; 3 – 1.5 kOe; 4 - 2 kOe; 5 - 4 kOe; 6 - 6 kOe; 7 - 8 kOe; 8 - 10 kOe; 9 - 12 kOe; 10 - 15 kOe; 11 - 20 kOe, Inset: Magnetic hysteresis loops at 1.8K. (**b**) bicrystals of twisting type: (1) $Bi_{0.93}Sb_{0.07}Sn$, $\theta_1 = 75^{\circ}$, $\theta_2 = 4^{o}$, scale for *m*(*T*) 1:4 (2) $Bi_{0.93}Sb_{0.07}Sn$, $\theta_1 = 68^{\circ}$, $\theta_2 = 2^{o}$, scale for *m*(*T*) 1: 10, (3) $Bi_{0.85}Sb_{0.15}Te$, $\theta_1 = 19^{\circ}$, $\theta_2 = 3^{o}$, scale for *m*(*T*) 20:1, (4) $Bi_{0.94}Sb_{0.06}Te$, $\theta_1 = 69^{\circ}$, $\theta_2 = 2^{o}$, (5) $Bi_{0.82}Sb_{0.18}Sn$, $\theta_1 = 18^{\circ}$, $\theta_2 = 5^{o}$, scale for *m*(*T*) 300:1, (6) $Bi_{0.85}Sb_{0.15}$, $\theta_1 = 12^{\circ}$, $\theta_2 = 5^{o}$; Inset: $Bi_{0.85}Sb_{0.15}$, $\theta_1 = 12^{o}$, $\theta_2 = 5^{o}$, (1) 10K, (2) 300K, (3) 1.8K;

Due to relatively high structural disorder in such interfaces, the temperature of superconducting transition T_c is considerably reduced, the shape of the magnetic hysteresis loops undergoes significant changes (dependent on the type of disorientation angles of the crystallites), the hysteresis curves on twisting bicrystals are only typical ferromagnetic, while in inclination bicrystals the loops evidently are formed from overlapping of superconducting and ferromagnetic components (see Fig.1a), standing out against paramagnetic background *m*(*T*).

[1] Muntyanu F M, Gilewski A, Zaleski A J, Chistol V and Rogacki K., Physics Letters A. (2017); **381:** 2040