SUPERCONDUCTIVITY UP TO 36 K IN NANO-WIDTH CRYSTALLITE INTERFACES OF Bi_{1-x} - Sb_x ($x \leq 0.2$) ALLOYS

F. M. Muntyanu, V. Chistol

Institute of Electronic Engineering and Industrial Technologies, Academy of Sciences of Moldova, MD-2028 Chisinau, Moldova, International Laboratory of High Magnetic Fields and Low Temperatures, PL-53421 Wroclaw, Poland

Magnetic properties of high quality bicrystals (in some samples the Dingle temperature of charge carriers was even less than 1 K) and tricrystals of Bi_{1-x} - Sb_x ($x \leq 0.2$) alloys were studied in the temperature range (1.8 -100) K using the superconducting quantum interference device magnetometer (Quantum Design SQUID magnetometer) and the physical property measurement system (Quantum Design PPMS). The samples for measurements were obtained by the zone recrystallization method and showed a clearly pronounced large-block structure with blocks (crystallites) being disoriented relative to each other. The crystallite interfaces (CI) of bicrystals and tricrystals represents a single crystalline platelets (share of CI volume from overall volume of a bicrystal ~ 10^{-4}). The compositions of the samples were controlled by scanning electron probe microanalyzer Camebax, by SEM equipped with energy-dispersive X-ray (EDX) analyzers Oxford and PV 9800, by spectrographic analysis. We found that the nano-width crystallite interfaces [consisting of a solitary central part (width ~ 60 nm) and two similar adjacent layers on both its sides (width ~ 20 nm)] reveal superconducting behavior up to 36 K, whereas the single crystalline samples are not superconducting. The temperature of the superconducting transition in some of these interfaces surpassing considerably values of other semimetal nanoobjects. The superconductivity of nano-width crystallite interfaces of bicrystals and tricrystals of Bi1-x - Sbx (x ≤ 0.2) alloys appears to be [1,2] a consequence of substantial growth of carrier density and changes of the carrier pockets topology, but is not an intrinsic property of VB semimetals. Characteristics of crystallite interfaces in such complex structures have an eminent influence in controlling the macroscopic superconducting properties.

References

[1] F.M.Muntyanu, A.Gilewski, K.Nenkov, J.Warchulska, A.Zaleski, Phys.Rev.B **73,** 132507 (2006)
[2] F.M.Muntyanu, A.Gilewski, K.Nenkov, A.Zaleski, V.Chistol, Phys.Rev.B **76,** 014532 (2007)