Influence elastic deformation, effect size quantization, magnetic field on energy spectrum and thermoelectric properties semimetal $Bi_{1-x}Sb_x$ nanowires

A.A. Nikolaeva[1*], L.A. Konopko[1], T.E. Huber[2], I.A. Popov[1], P.P. Bodiul[1]

[1]*Ghitu Institute of Electronic Engineering and Nanotechnologies, Chisinau, Moldova, email:* A.Nikolaeva@nano.asm.md

[2]*Howard University, Washington, USA*

The paper describes an experimental study of single-crystal semimetal $Bi_{1-x}Sb_x$ nanowires with a diameter of 100–1000 nm, which are prepared by liquid-phase casting in a glass capillary using the Ulitovsky technique.

According to Shubnikov–de Haas oscillations in longitudinal and transverse magnetic fields, it is found that the overlap of the L and T bands in semimetal $Bi_{0,98}Sb_{0,02}$ wires is two times less than the overlap in pure Bi. Accordingly, the semimetal–semiconductor transition (SMSC) due to the quantum size effect in $Bi_{0,98}Sb_{0,02}$ wires is observed for a critical diameter that is five times larger ($d \approx 350$nm) than the critical diameter of pure Bi wires [1].

It is shown that the SMSC transition can be controlled using a magnetic field and elastic deformation (up to 1.8% relative elongation).

The reverse semiconductor–semimetal transition is observed in a strong magnetic field (10 T). A weak magnetic field leads to an increase in the contribution of holes to positive thermopower α at 4.2- 150 K.

The effect of the diameter of $Bi_{0,98}Sb_{0,02}$ wires, elastic deformation, magnetic field, and temperature on magnetothermoelectric properties is discussed.

[1] A. Nikolaeva, T. E. Huber, D. Gitsu, and L. Konopko. Phys. Rev. B **77**, 035422 (2008).

Acknowledgements: This work was supported by Moldova State Project # 20.80009.50007.02, NSF through STC CIQM 1231319, the Boeing Company and the KeckFoundation.