NNN 24P SEMICONDUCTOR – SEMIMETAL TRANSITION INDUCED BY ANISOTROPIC DEFORMATION IN BI QUANTUM WIRES

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In this paper the temperature dependences of resistance R(T) in bismuth nanowires in the field of the transition semimetal-semiconductor which predicted in paper [1] at diameters of wires d <100 nm in the range of temperatures 4,2 – 300 K were investigated.

The single-crystal bismuth wires in glass insulation were obtained by casting from liquid phase method [2]. X – Ray diffraction investigation and rotation angle diagram transverse magnitoresistance at 300 K have shown that the axis of wires the ΓL direction located in the Brillowin zone in the bisector-trigonal plane and making an angle 19,5º with the bisector.

It is established that temperature dependences of resistance R(T) of Bi wires essentially depend on diameter of wires d and at diameters of wires d < 80 nm have "semiconductor" character [3].It is shown that by means of anisotropic elastic deformation of a stretching at the expense of effect of movement of borders of bands and realization of electronic topological transitions of Lifshits it is possible to operate by overlapping L and T bands.

On figure 1 present temperature dependences of the resistance R(T) for a 55 nm Bi nanowire at different values of the elastic tension.

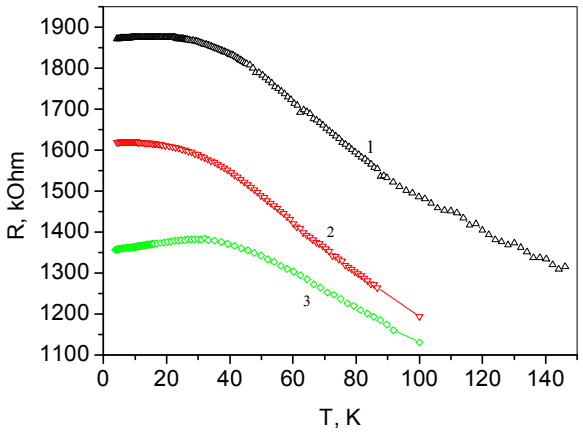

Fig. 1 Temperature dependence of the resistance R(T) Bi- wires, d= 55 nm at different values of the tension: 1. ξ=0, 2. ξ= 0.7%, 3. ξ= 1.9%.

It is established that elastic deformation of Bi nanowires orientation (10$\underline{1}$1) along the wire axis with semiconductor dependence R(T) leads to approach of L and T bands and semiconductor-semimetal transition. Temperature dependences R(T) becomes character "metal", and on magnetofields dependences R(H) appears ShdH oscillations from L - electrons.

Present results are in qualitative agreement with the predictions of the theory [1, 4] about transition semimetal-semiconductor in quantum B- wires and in the paper shown that it is possible to carry out return of semiconductor-semimetal transition on the same sample – Bi quantum wires with the help of elastic stretching.

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References

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