SEMICONDUCTOR - SENIMETAL TRANSITION IN STRONG MAGNETIC FIELD IN $Bi_{0.92}Sb_{0.8}$ SINGLE CRISTAL WIRES

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The electron transport and transverse magnetoresistance of glass-insulated $Bi_{0.92}Sb_{0.08}$ single-crystal wires with diameters of 180 nm to 2.2 μm and the (1011) orientation along the wire axis have been studied. Thin wires can be varied as a function wire diameter, pressure, temperature and growth orientation. Glass-insulated $Bi_{0.92}Sb_{0.08}$ semiconductor single-crystal wires with various diameters (0.2–2.2 μm) were prepared by liquid phase casting (the Ulitovsky method) [1]. All samples had a strictly cylindrical shape with a circular cross section and are single-crystal had the (1011) orientation along the wire axis. It has been first found that the energy gap ΔE increases by a factor of 4 with a decrease in wire diameter d due to the manifestation of the quantum size effect, which can occur under conditions of a linear energy–momentum dispersion law characteristic of both the gapless state and the surface states in topological insulators (TIs) [2]. It has been revealed that, in strong magnetic fields at low temperatures, a semiconductor–semimetal transition occurs, which is evident as an anomalous decrease in the transverse MR anisotropy and the appearance of a metallic temperature dependence of resistance at $T < 100$ K. The features of the manifestation of the quantum size effect in $Bi_{0.92}Sb_{0.08}$ wires, semiconductor–semimetal electronic transitions induced by a magnetic field, and a decrease in the transverse MR anisotropy indicate the occurrence of new effects in low-dimensional structures based on semiconductor wire (TIs), which require new scientific approaches and applications.

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