Observation of the Semiconductor–Semimetal and Semimetal–Semiconductor Transitions in Bi Quantum Wires Induced by Anisotropic Deformation and Magnetic Field

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The semimetal–semiconductor transition is observed in glass–coated quantum single–crystal bismuth wires[1] with diameters less than 70 nm due to the quantum size effect. It is shown that, using magnetic field, owning to the effect of motion of band boundaries and elastic deformation (due to Lifshits electron topological transitions), it is possible to control the overlapping of L and T bands. It is found that elastic deformation of Bi nanowires $(10\bar{1}1)$ oriented along the wire axis with the semiconductor dependence R(T) leads to the approaching of L and T bands and to the semiconductor–semimetal transition; as a result, Shubnikov–de Haas oscillations appear on the magnetoresistance dependences R(H). The influence of the stretch–induced variation in the Fermi surface topology on the thermoelectric properties of bismuth nanowires in the temperature range 4.2–300 K is disscused.
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