Low-temperature oscillations of the thermopower in bismuth nanowires

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The emergence of the investigations concerned with various nanostructures is motivated partially by the very interesting thermoelectric and magnetotransport properties of bismuth nanowires that make them potentially useful for device applications. Under the quantum size effect (QSE), several fundamental macroscopic characteristic of solids exhibit an anomalous dependence on reduced size. Therefore, for subsequent applications, a precise determination of the size-dependent parameters of investigated nanostructures is required. If the decreased size of wires or films becomes comparable with the electron wavelength ($d \sim \lambda$), the transverse motion of carriers is quantized. Thus, the energy spectrum splits into subbands. When the discreteness of the energy subbands becomes significant, an oscillatory behavior of electron and hole density of states as a function of thickness is expected for metal films.
Measurements of the thermopower and resistance of bismuth nanowires with several diameters and different quality reveal oscillations on the dependence of thermopower under uniaxial strain at T = 4.2 K. Amplitude of oscillations is significant (30 %) at helium temperature with weak smearing at 20 K. Observed oscillations originate from QSE. A simple evaluation of period of oscillations allows us to identify the groups of carriers involved in transport.