ENHANCEMENT OF THE THERMOPOWER IN BI WIRES UNDER ANISOTROPIC DEFORMATION

Elena Condrea

Technical University of Moldova, Institute of Electronic Engineering and Nanotechnologies, Academiei str., 3/3, Chisinau, Moldova

The prospect of the thermoelectric application of Bi based materials will require the ability to control their parameters. Investigations of Bi wires in a wide range of temperatures, magnetic fields and anisotropic deformation have revealed an effective way to control the magnitude of the thermopower under the influence of uniaxial deformation.

Measurements of the thermopower of submicron Bi wires in the temperature range of 4.2 - 77 K, revealed the possibility of changing not only the magnitude and sign of the thermopower coefficient but also the overall nature of the thermopower mechanism under the influence of uniaxial deformation or magnetic field.

Submicron Bi wire exhibits positive thermopower being generated in the diffusion transport mechanism of carriers at low temperatures. The diffusion transport mechanism can be transformed into phonon-dominated transport through a smooth manipulation with the phonon spectrum and Fermi surface by applying a uniaxial strain. The phonon mechanism becomes a dominant in the total thermopower above deformation value of 1.1 %, that is indicative of a change in the Fermi surface topology under strain known as Lifshitz transition. It seems that strain value of 1.1 % is as an "inflexion point" in the trend of the thermopower from diffusive to phonon drag mechanism, where the required condition $q \leq 2k_F$ for the interacting of the electrons with phonons is satisfied (q is the phonon momentum, $2k_F$ is the maximum dimension of Fermi surface changed after topological transition). The application of a magnetic field at a given point can enhance or diminish this effect depending on the field direction relative to the crystallographic axis of Bi wire.

The study was supported by the Project « Nanostructures and advanced materials for implementation in spintronics, thermoelectricity and optoelectronics » no. 020201.

Corresponding author:
Dr. Condrea Elena
e-mail: elcondrea@gmail.com
ORCID: 0000-0003-1773-7319