CONTROLLED FABRICATION OF BISMUTH TELLURIDE NANOWIRES BY ELECTRODEPOSITION IN ION-TRACK BASED POLYMER TEMPLATES

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For more than 50 years, bulk bismuth telluride has been in the scope of thermoelectric research. Even today, bismuth telluride based compounds belong to the few materials with a figure of merit *ZT* in the vicinity of 1 and represent the most commonly used constituents for commercially available thermoelectric devices operating at room temperature. Enhancing the *ZT* is the key requirement for developing new devices with increased efficiencies. One promising route to achieve an improvement of the thermoelectric properties is offered by reducing the dimensionality of materials, herewith allowing for a separated adjustment of the different contributions to *ZT*, namely increasing the Seebeck coefficient S and the electrical conductivity σ, on the one hand, and decreasing the thermal conductivity κ, on the other hand. According to theoretical investigations, a significant enhancement of *ZT* for bismuth telluride nanowires is expected, but up to now research on this topic is scarce. In this context, we intend to present results of our investigations of controlled fabrication of nanowire arrays by electrodeposition. In contrast to other groups working with template-based synthesis of nanowires, we use polycarbonate templates with a thickness of approx. 30 µm. The templates are fabricated at GSI by irradiation of the polymer foils with energetic heavy ions and subsequent etching of the so-called latent tracks, i.e. trails of damaged material along the ion trajectories occurring due to transfer of kinetic energy from the projectiles to the polycarbonate. By varying the ion fluence, one can obtain from 1 up to 10^9 pores/cm^2 and by changing the etching parameters, pore diameters ranging from 30 nm up to several µm are reachable. This method enables us to prepare nanowire arrays as well as single nanowires with highly homogeneous diameter distributions and aspect ratios of up to 1:1000. After preparation of the membrane, a gold layer is sputtered on its backside to assure electrical contact to the working electrode during the electrodeposition of the wires. The dc-electrodeposition is performed in a thermostated 3-electrode cell with a Pt counter electrode and a saturated calomel reference electrode. The influence of the deposition parameters on the nanowire morphology and elemental composition will be demonstrated by results obtained with scanning electron microscopy and energy dispersive x-ray analysis.

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