Synthesis and heat treatment of semiconducting InSb nanowires with different diameters

Dominika Gilek[1*], Katarzyna E. Hnida[2], Grzegorz D. Sulka[1]

[1] Department of Physical Chemistry & Electrochemistry, Faculty of Chemistry, Jagiellonian University in Krakow, Ingardena 3, 30-060 Krakow, Poland
[2] AGH University of Science and Technology, Academic Centre for Materials and Nanotechnology, A. Mickiewicza 30, 30-059 Krakow, Poland
**gilek@chemia.uj.edu.pl*

Indium antimonide is semiconductor widely used as a material for many applications including thermoelectric generators [1], infrared detectors [2], sensors [3], and others. Materials based on InSb with a stoichiometric composition were prepared mainly in the form of nanowires [4], and thin films [5]. Especially, interesting are InSb nanowires due to their large specific surface area, narrow band gap (0.195 eV at 300 K) and smaller grain sizes than thin layers. The above mentioned material is characterized also by a high mobility of charge carriers (exceptionally electrons due to anion vacancies), and a high length-to-diameter ratio. Furthermore, recent studies demonstrated that an appropriate heat treatment creates opportunity to change charge transport from holes (p-type) to electron (n-type) in InSb nanowires [4]. The aim of this research was to investigate the effects of nanowire diameter and annealing temperature on properties of synthesized InSb nanowires. For this purpose, InSb nanowires were synthesized by pulsed electrodeposition in anodic aluminum oxide (AAO) templates with various pore diameters. Subsequently, received InSb nanowires were annealed at different temperatures. The morphology, chemical composition, optical and electrical transport properties of deposited nanowires were examined in detail.

References:

[1] H. A. Nilsson, P. Caroff, C. Thelander, M. Larsson, J. B. Wagner, L. E. Wernersson, L.Samuelson, H. Q. Xu, *Nano Lett*., 3151 (2009).
[2] A. Rogalski, *J. Appl. Phys.* **93**, 4355 (2003).
[3] R. K. Paul, S. Badhulika, A. Mulchandani, *Appl. Phys.Lett*., **99**, 033103 (2011).
[4] K.E. Hnida, S. Bäβler, L. Akinsinde, J. Gooth, K. Nielsch, R.P. Socha, A. Łaszcz, A. Czerwinski, G.D. Sulka, *Nanotechnology* **26**, 285701 (2015).
[5] K. E. Hnida, S. Bäβler, J. Mech,c K. Szaciłowski, R. P. Socha, M. Gajewska,a K. Nielsch, M. Przybylski, G. D. Sulka, *J. Mater. Chem. C* **4**, 1345 (2016)

Acknowledgments

This research was partially supported by the National Science Centre, Poland (grant no. 2015/17/D/ST5/021332).