Fabrication of SbSI Photonic Crystals

Anna Starczewska [1], Piotr Szperlich [1,] Iwona Bednarczyk [2], Jerzy Bodzenta [1] and Marian Nowak [1]

[1] *Institute of Physics – Center for Science and Education, Silesian University of Technology, Krzywoustego 2, 44-100 Gliwice, Poland*
[2] *Department of Materials Science, Silesian University of Technology, Krasińskiego 8, 40-019 Katowice, Poland*

Photonic crystals (PCs) with periodically modulated dielectric constant have gathered great importance in recent years [1]. They posses a band gap for electromagnetic waves similar to that for valence electrons in crystalline semiconductors. Value of this gap strongly depends on geometrical parameters of the structure as well as on complex refractive indices of the applied materials. It is highly promising to use materials with refractive indices that can be tuned with external conditions, e.g. electric field or temperature. In this paper antimony sulfoiodide (SbSI) is using for the construction of photonic crystal. SbSI is a ferroelectric semiconductor with relatively high refractive index strongly dependent on temperature and external electric field, especially near its Curie point (T_C = 293(1) K). Therefore, SbSI is potentially very useful in fabrication of photonic crystals. In this work we present three-dimensional photonic crystals of air spheres in SbSI. The initial opal matrices with a closed-packed face centered cubic (fcc) lattice, were prepared from monodisperse silicon (SiO_2) spheres by gravity sedimentation. Composite opal - SbSI structures were obtained by infiltration the voids in opals with melted SbSI. To obtain the inverted SbSI opal consistent of air spheres in SbSI the original opal template was removed by etching in HF acid. Scanning electron microscopy (SEM), energy dispersive X-ray analysis (EDX) and atomic force microscopy (AFM) confirm the quality of the samples.

This work was partially supported by the NCN (Poland) under Contracts No. NN507250140.

[1] J. D. Joannnopoulos, S. G. Johnson, J. N. Winn, R. D. Meade, Photonic Crystals: Molding the flow of light, Princeton University Press (2008)