SERS-ACTIVE MATERIALS BASED ON METALLIZED POROUS SILICON: FROM AN IDEA TO PRACTICAL APPLICATION

Since the discovery of porous silicon (PS), its unique physical and chemical properties, which are significantly different from those of bulk silicon, have been actively studied, providing development of novel optoelectronic, sensing, energy conversion and biomedical devices and materials. However, the importance of PS extends beyond areas of direct using its own peculiarities. Highly ordered structure has motivated scientists to utilize PS as a template for deposition of other materials. Under this approach, PS plays a role of supporting substrate for accurate shape/size definition of the depositing structures. Such method of nanostructuring can stick out or facilitate to manage specific features of well-known materials and provide their emerging as principally new materials for spintronics, plasmonics, biomedicine, etc. The present review is devoted to fabrication, properties and application of plasmonic metallic nanostructures formed by deposition on PS, which demonstrate activity in surface enhanced Raman scattering (SERS), for analysis of chemical and biological species at extremely low concentrations. Some technological tricks meeting the most important requirements to SERS-active materials (intensive Raman signal, its reproducibility and storage stability) are discussed. It is shown that PS acts not only as the template for nanostructuring but also as an agent promoting improvement of metallic nanostructures stability to oxidation in environment. Principal attention is focused on the electromagnetic field distribution depending on geometry of the SERS-active materials including metallic dendrites on nanoPS, metallic nanoparticles on mesoPS and arrays of metallic nanovoids (antinanoparticles) in macroPS. In addition, prospects of bimetallic nanostructures on PS for SERS-based analysis are observed. Finally, new results on graphene protection of organic molecules adsorbed on the surface of metallized PS from distraction under laser excitation are presented. Concluding, advantages of SERS-active materials fabrication using PS compared to traditional nanoengineering methods including simplicity, cost-effectiveness and compatibility with existing Si technology are considered in details.

Short CV

Dr. Bandarenka received her Ph.D. in Engineering Sciences from Belarusian State University of Informatics and Radioelectronics (BSUIR) in 2014. Currently, she holds a position of senior research scientist in the R&D Laboratory “Materials and Structures for Nanoelectronics” at her Alma Mater.

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