Nanoplasmonics and surface enhanced spectroscopy

SERS-activity of porous silicon coated with nanostructures of noble metals

H. Bandarenka, K. Girel, S. Zavadski, N. Khinevich, V. Bondarenko

Materials and Structures of Nanoelectronics, Belarusian State University of Informatics and Radioelectronics. Browka st., 6, Minsk-220013, Belarus.
E-mail: h/bandarenka@gmail.com

Plasmonic structures with controllable properties can be synthesized by deposition of highly ordered arrays of metallic nanoparticles or nanovoids onto porous silicon. Such nanostructured substrates show great activity in surface enhanced Raman scattering (SERS) that allows to detect and study organic molecules in a number of sensing applications ranging from medical diagnostics to forensic science. In this work the potential for using porous silicon as a template to improve detection limit, reproducibility and shelf life of the SERS substrates is highlighted. Reported data on SERS substrates formed on porous silicon implies that the morphology and the dopant type of the porous template as well as combination of different metals allow to manage a spectral position of the surface plasmon resonance of metallic nanostructured substrates from near UV to near IR. In addition, there an evidence is shown that metallic nanovoids fabricated in porous silicon with pore sizes varying between 500 and 2000 nm significantly improve SERS signal intensity, through a combined effect of strong electromagnetic field around the pore entrances and multiple light bounces inside the pores. The detection limit of the SERS substrates based on the metallized porous silicon is found to reach pico- and femtomolar concentrations depending on the types of the active structure and analyte molecule. The deviation of the SERS signal in the range of a single substrate or a batch of substrates does not exceed 7 %. The shelf life of the SERS substrate proved up to date is one year. Finally, the utility of plasmonic structures based on metallized porous silicon in the SERS spectroscopy shows much promise and is worthy of further intensive study.

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