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SERS-substrates with controllable localization of analyte in the plasmonic "hot-spots"

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Surface-Enhanced Raman Spectroscopy (SERS) has been increasingly gaining popularity as a promising spectroscopic tool for detection and identification of trace amounts of various molecular species [1]. The level of sensitivity claimed by many groups various types of substrates and analytes in the impressive pico- to femto-molar concentration range. However, the no wide commercialization of the SERS-based sensing technologies took place so far. The major reason is that a good performance of the sensing substrate should come at affordable fabrication costs. At the same time, the best performance is usually reported for SERS substrates fabricated by rather sophisticated routes. In addition, one of the important issues is reproducibility of the enhancement produced by the substrate. One of the conditions of achieving reproducible results is homogeneous distribution of the analyte over the substrate surface. On the other hand, the condition of obtaining high enhancement is localization of as much as possible analyte in the so-called "hot spots" – nanometer-scale space regions of high concentration of electric field between metal nanostructures.
In this work we reported an original type of very affordable substrates developed to enable self-localization of the analyte (deposited from solution) in the hot spots that are regularly arranged over the substrate surface. The basis of the substrate are self-assembled layers of highly monodisperse SiO2 nanospheres, synthesized via facile and scalable route in aqueous solution. The coverage of this nanosphere layer with thin layer of gold or silver by thermal evaporation or some other methods creates numerous hot-spots in the places between silica particles. The efficiency of the developed substrates is demonstrated for several different types of analytes, in particular common dye molecules, small biomolecules such as aminoacids, as well as large biomolecules such as proteins and antibodies.
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[1] P. Dey. Aiming for Maximized and Reproducible Enhancements in the Obstacle Race of SERS. ACS Measurement Science. 10.1021/acsmeasuresciau.3c00037

Topics

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