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Gold-capped silicon for ultrasensitive SERS-biosensing: towards human biofluids analysis

Agnieszka Kamińska^{a*}, Tomasz Szymborski^a, Tomasz Jaroch^a, Adam Zmysłowski^b and Arkadiusz Szterk^b

^a Institute of Physical Chemistry, Polish Academy of Sciences, Kasprzaka 44/52, 01-224 Warsaw, Poland

^b National Medicines Institute, Chełmska 30/34, 00-725 Warsaw, Poland

Abstract

Surface-enhanced Raman spectroscopy (SERS) has been widely used in a variety of biomedical, analytical, forensic and environmental investigations due to its chemical specificity, label-free nature combined with high sensitivity. Here, we report a simple, two steps method for the fabrication of reproducible and reliable, well-defined, stable SERS substrates with uniform and giant Raman cross-section of 'hot spots' suitable for routine trace chemical analysis and detection of biological compounds in complex biological fluids. We prepared porous silicon (PS) surface by a galvanostatic anodic etch of crystalline silicon wafers. The electrochemical process generates a specific layer of PS: the thickness and porosity of a given layer is controlled by the current density, the duration of the etch cycle, and the composition of the etchant solution. These substrates presented high sensitivity to *p*-mercaptobenzoic acid (*p*-MBA) at a low concentration of 10^{-6} M and the enhancement factor of over 10^8 was achieved. Such high enhancement is attributed to semiconducting silicon-induced and stabilized hot spots. The uniform density of SERS-active 'hot-spots' on the Au/Si surface results in high

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