World Academy of Science, Engineering and Technology
International Journal of Chemical and Molecular Engineering
Vol:12, No:08, 2018

Repeatable Surface Enhanced Raman Spectroscopy Substrates from SERSitive for Wide Range of Chemical and Biological Substances

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Abstract : Surface Enhanced Raman Spectroscopy (SERS) is a technique used to analyze very low concentrations of substances in solutions, even in aqueous solutions - which is its advantage over IR. This technique can be used in the pharmacy (to check the purity of products); forensics (whether at a crime scene there were any illegal substances); or medicine (serving as a medical test) and lots more. Due to the high potential of this technique, its increasing popularity in analytical laboratories, and simultaneously - the absence of appropriate platforms enhancing the SERS signal (crucial to observe the Raman effect at low analyte concentration in solutions (1 ppm)), we decided to invent our own SERS platforms. As an enhancing layer, we have chosen gold and silver nanoparticles, because these two have the best SERS properties, and each has an affinity for the other kind of particles, which increases the range of research capabilities. The next step was to commercialize them, which resulted in the creation of the company 'SERSitive.eu' focusing on production of highly sensitive (Ef = 10^5 – 10^6), homogeneous and reproducible (70 - 80%) substrates. SERStive SERS substrates are made using the electrodeposition of silver or silver-gold nanoparticles technique. Thanks to a very detailed analysis of data based on studies optimizing such parameters as deposition time, temperature of the reaction solution, applied potential, used reducer, or reagent concentrations using a standardized compound - p-mercaptobenzoic acid (PMBA) at a concentration of 10^{-6} M, we have developed a high-performance process for depositing precious metal nanoparticles on the surface of ITO glass. In order to check a quality of the SERSitive platforms, we examined the wide range of the chemical compounds and the biological substances. Apart from analytes that have great affinity to the metal surfaces (e.g. PMBA) we obtained very good results for those fitting less the SERS measurements. Successfully we received intensive, and what's more important - very repetitive spectra for; amino acids (phenyloalanine, 10^{-3} M), drugs (amphetamine, 10^{-4} M), designer drugs (cathinone derivatives, 10^{-3} M), medicines and ending with bacteria (Listeria, Salmonella, Escherichia coli) and fungi.

Keywords : nanoparticles, Raman spectroscopy, SERS, SERS applications, SERS substrates, SERSitive
Conference Title : ICSSA 2018 : International Conference on Spectroscopy and Spectral Analysis
Conference Location : Vancouver, Canada
Conference Dates : August 09-10, 2018