The Influence of Sample Preparation on Raman Spectrometry Spectrum with the Application of SERS Effect

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Raman Spectroscopy and Surface Enhanced Raman Spectroscopy are important methods for both chemical and biochemical scientific research. The main purpose of my investigation was to increase the sensitivity of those methods by solidifying sample on improved and activated substrates. To achieve this purpose the following actions were performed: 1) formation of SERS substrates by galvanic replacement and electrochemical plating; 2) investigation of these substrates; 3) obtaining Raman spectra of rhodamine 6G solution and bacterial lysate with different substrates. Spectra of those samples were collected from liquid solutions and microscope slides as control samples. Substrates were prepared by galvanic replacement on aluminium foil with NaF method (for silver, copper and palladium) and from Tollens' reagent (for silver). Substrates with silver microstructures were also prepared by galvanic replacement and plating on a copper strip. All substrates were investigated with SEM, AFM and EDX analysis. SEM images have shown that palladium and copper form microdendrites with spheroid representative particles, while silver "tree like" dendrites are very branched with sharp tips and much higher specific surface. As a result, Raman signals intensity increases: on silver structure - more than 10 times, on the copper – about 150%, on the palladium – about 20%. Conclusions: 1) methods of SERS substrate improvement with dendrite coating by galvanic replacement and plating has been proposed; 2) dependence of Raman signals intensity increasing from type and geometric parameters of dendrite and specific surface was shown; 3) the best SERS substrate is Al foil coated with silver dendrites foamed with either fluoride-based or Tollens' reagent method with increase of signal more than 1000%.

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