Title: SERS spectroscopy of model biomolecules for SERS biosensing

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Abstract: The main requirement for surface enhanced Raman scattering (SERS)-based biomolecular sensing is high sensitivity and spectral reproducibility. For this purpose, ordered silver and gold nanostructures fabricated by magnetron sputtering and lithography methods at cooperating institutes were tested in this work. Reproducible SERS spectra of employed model biomolecules (amino acids, lysozyme and albumin) were obtained on ordered silver surfaces at concentrations 10^{-4} M – 10^{-6} M and as low as ≈ 10^{-7} M in the case of porphyrins. SERS spectra of certain biomolecules were also compared to spectra measured on silver colloid. The limit of detection provided by hydroxylamine-reduced silver colloid, using KCl as an aggregating agent, is substantially lower (on the order of 10^{-8} M for cysteine), but with lower spectral reproducibility. The main drawback of SERS spectra measured on silver surfaces was the occurrence of spurious bands resulting from the preparation procedure. In the case of sputter-deposited silver surfaces, it was found that keeping the substrates several hours in vacuum significantly reduced this effect. Lithographically produced gold substrates exhibited generally lower enhancement, than silver, but reproducible SERS spectra of a monomolecular layer of oligonucleotides comprising 20 thymine units, attached to the gold surface via thiol groups, were obtained.

Keywords: SERS, biosensing, biomolecules, ordered metal nanostructures, GLAD