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Binding of p-mercaptobenzoic acid and adenine to gold coated electroless etched silicon nanowires studied by surface-enhanced Raman scattering

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Abstract

Modern diagnostic tools ever aim to reduce the amount of analyte and the time needed for obtaining the result. Surface-enhanced Raman spectroscopy is a method that could satisfy both of these requirements, provided that for each analyte an adequate substrate is found. Here we demonstrate the ability of gold-sputtered silicon nanowires (SiNW) to bind p-mercaptobenzoic acid in 10^{-3}, 10^{-4} and 10^{-5} M and adenine in 30 and 100 μM concentrations. Based on the normal mode analysis, presented here for the first time, the binding of p-mercaptobenzoic acid is deduced. The intensity enhancement of the 1106 cm^{-1} band is explained by involvement of the C-S stretching deformation, and the appearance of the broad 300 cm^{-1} band attributed to S-Au stretching mode. Adenine SERS spectra demonstrate the existence of the 7H tautomer since the strongest band observed is at 736 cm^{-1}. The adenine binding is likely to occur in several ways, because the number of observed bands in the 1200 – 1600 cm^{-1} interval exceeds the number of observed bands in the normal Raman spectrum of the free molecule.

keywords: silicon nanowires, normal mode analysis, substrate binding, biosensors, SERS, mercaptobenzoic acid, hot spots mapping

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