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**Effect of dielectric spacer layers and substrate on SERS with Au nanoparticle arrays** XIN ZHANG, ROBERT M. BRIBER, ODED RABIN[1], Department of Materials Science and Engineering, University of Maryland, College Park, MD 20742 — The optical response of a plasmonic nanostructure is often highly dependent on the nature of the underlying substrate. To study the effect of the substrate on surface enhanced Raman scattering (SERS), a series of SERS substrates were fabricated consisting of a hexagonal array of Au nanoparticles self assembled on block copolymer films, a silicon oxide (dielectric) layer and a silicon substrate or an Au substrate. The inter-particle distance and the dielectric layer thickness were controlled. The SERS Enhancement Factors (EF) were calculated by comparing the Raman spectra of 4-aminothiophenol adsorbed on the surface of the Au nanoparticles and in a standard solution. The SERS EF were found to be strongly affected by the inter-particle distance and silicon oxide thickness. Changing the inter-particle spacing induced a $10^2$ variation in the EF, changing the oxide thickness increased EF values by an factor of 10, and changing substrate from Si to Au increased EF by a factor of 10. Maximal enhancement factors were found with oxide layer thicknesses between 30 nm and 50 nm beneath the 30 nm polymer film with Au substrates. This geometry both improved the resonance condition with the probe laser and reduced the absorption by the substrate. This work illustrates that optimization of plasmonic-based sensors should consider both the metallic and the surrounding structures.

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