Fabrication of large-scale nanogap-rich plasmonic SERS substrate

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Nanogaps between metal nanostructures which provide strong field localization by concentrating incident electromagnetic field have attracted considerable interest in surface-enhanced Raman spectroscopy (SERS). Recently many studies on the formation of nanogaps taking advantage from the coupling between nanoparticle and nanofilm have been conducted. However, these studies mainly focus on the analysis of single nanoparticle on nanofilm neglecting interparticle coupling effect. Here, we propose a large-scale plasmonic SERS substrate with high-density metal nanoparticles assembled on metal nanofilm. Localized surface plasmons (LSPs) of nanoparticles and surface plasmon polaritons (SPPs) of nanofilm form two types of nanogaps (1) between nanoparticles (LSP-LSP) and (2) between nanoparticle and nanofilm (LSP-SPP). The LSP-LSP and LSP-SPP interaction is observed through experiment and simulation by controlling the density of nanoparticles assembled on nanofilm and distance between the nanofilm and nanoparticle. The morphology of substrate is characterized by scanning electron microscope (SEM), transmission electron microscope (TEM) and atomic force microscope (AFM).