Facile Fabrication of Plasmonic Mirror Substrate with High-density Metallic Nanogaps for Surface-enhanced Raman Spectroscopy

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Small nanogaps between metal nanostructures enable to strongly concentrate an incoming light into such tiny space, resulting in a strong near-field enhancement. This outstanding optical property has been applied to enhance weak molecular signals such as Raman and fluorescence. However, most of previous methods to fabricating plasmonic substrates with high-density nanogaps rely on lithographic techniques, and it has been considered as challenging task to achieve high-density nanogaps by using colloidal nanoparticles. Herein we propose facile synthesis for large-scale plasmonic substrate of high-density metal nanoparticles on metal thin film. Our proposed method consists of two steps; (1) sequential depositions of gold thin film and spacer on various substrates (e.g., glass, PDMS) and (2) monolayer transfer of interfacial colloidal nanoparticles onto the substrates. The resulting substrate shows multiple nanogaps that are originated between (1) neighboring nanoparticles and (2) nanoparticle and metal thin film, respectively. The morphology of the substrate is characterized by scanning electron microscope (SEM), transmission electron microscope (TEM) and UV-vis spectrometer.