Highly Sensitive SERS Active Substrates using Engineered Plasmonic Nanostructures and its Application to Bimolecular Sensing

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Surface enhanced Raman scattering (SERS) is an important analytical sensing method because it significantly increases of the Raman scattering cross section for molecules adsorbed on surfaces. This Raman enhancement is mainly attributed to the local enhancement of the incident electromagnetic (EM) field that occurs when a surface plasmon mode is excited at a metallic nanostructure. Here we demonstrated the SERS-active nanostructures to highly sensitive detect SERS signals. By controlling the evaporation incident angle, rotation of the substrate, and the deposition rate, controllable and reproducible SERS-active nanostructures can be achieved using commercially available anodized alumina nanoporous membranes. Four different types of nanostructures are obtained (pillar, nib, ellipsoidal cylinder, and triangular tip) using different combinations of the above deposition parameters. In addition, we present experimental and numerical results showing how a hybrid structure comprising of gold nanospheres embedded in a silver nano-pillar structure can be used to obtain a further 50x SERS enhancement.