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Silver Grating for Strong and Reproducible SERS Response

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Abstract : One of the most significant obstacles for the application of surface enhanced Raman spectroscopy (SERS) is the poor reproducibility of SERS active substrates: SERS intensity can be varied from one substrate to another and moreover along the one substrate surface. High enhancement of the near-field intensity is the key factor for ultrasensitive SERS realization. SERS substrate can be prepared through introduction of highly ordered metal array, where light focusing is achieved through excitation of surface plasmon-polaritons (SPPs). In this work, we report the preparation of silver nanostructures with plasmon absorption peaks tuned by the metal arrangement. Excimer laser modification of poly(methyl methacrylate) followed by silver evaporation is proposed as an effective way for the creation of reproducible and effective surface plasmon-polaritons (SPP)-based SERS substrate. Theoretical and experimental studies were performed to optimize structure parameter for effective SPP excitation. It was found that the narrow range of grating periodicity and metal thickness exist, where SPPs can be most efficiently excited. In spite of the fact, that SERS response was almost always achieved, the enhancement factor was found to vary more with the effectivity of SPP excitation. When the real structure parameters were set to optimal for SPP excitation, a SERS enhancement factor was achieved up to four times. Theoretical and experimental investigation of SPP excitation on the two-dimensional periodical silver array was performed with the aim to make SERS response as high as possible.

Keywords : grating, nanostructures, plasmon-polaritons, SERS
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