Dual Length-Scale Nanotip Arrays with Controllable Morphological Features for Highly Sensitive SERS Applications

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Here, we demonstrate a facile method for the fabrication of hexagonally ordered, dual length-scale, large-area nanotip arrays with controllable morphological features for highly sensitive surface enhanced Raman scattering (SERS) applications; this method uses prism holographic lithographically (HL)-derived 3D periodic structures as sharpened or roughened templates for directional or isotropic metal deposition. The sharpness and overall geometrical shape of the polymeric nanotip arrays could be controlled from triangular pyramidal tips to more sharpened, conical tips via adjusting the reactive ion etching (RIE) time, using SF6 gas as the etchant. After directional silver (Ag) deposition, the resulting metallic nanotip arrays showed high SERS activities, with tunability depending on the morphological features. Furthermore, additional O2 RIE formed the smaller-scale surface-roughness of resulting nanotip arrays, which could function as 'hot-spots' after isotropic deposition of the thin Ag film. Finally, such nanotip arrays showed a potential as a fluorescence-based sensing platform.