Electronic Supplementary Material (ESI) for Journal of Materials Chemistry

Supporting Information

Optically tunable arrayed structures for highly sensitive plasmonic detection via simplified holographic lithography

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***Prism Holographic Lithography*:** The optical setup used for holographic lithography (HL) included a He-Cd laser (CW, 325 nm, 50 mW, Kimmon) with a 10× beam expander as a coherent light source. The final spot size was 1 cm in diameter. An electronic beam shutter was used to control the exposure time. SU-8 photoresists (PR) with resin/solvent (γ-butyrolactone (GBL)) ratios of 2:8 and 4:6 (with PI 1 wt% to resin) were used with spin speeds of 2000 rpm or 3000 rpm over 30 s to fabricate 1-layered and 2-layered FCC structures, respectively. After soft-baking on a hotplate at 95°C for 15 min, the expanded laser beam was passed through a single top-cut prism. Three beams, designated by the wavevectors $\mathbf{k}_1$, $\mathbf{k}_2$, and $\mathbf{k}_3$, were generated by refraction from the three side surfaces of the prism, and a central beam of wave vector $\mathbf{k}_0$ traveled through the top truncated surface of the prism. $\mathbf{k}_i = 2\pi/\lambda\ (\cos\beta_i\sin\alpha, \sin\beta_i\sin\alpha, \cos\alpha)$, derived from Snell's law for a prism of cutting angle of 54.7°. Here, λ is the wavelength of the laser, and α and β_i are the polar and azimuthal angles of $\mathbf{k}_i$, as shown in Fig. S1b. The laser exposure time ranged from 0.4 to 0.7 sec and 0.21 to 0.27 sec for the 1-layered and 2-layered cases, respectively. Post-exposure baking was achieved at 55°C for 20 min. Finally, unexposed regions were removed by propylene glycol methyl ether acetate (PGMEA) and rinsed with isopropyl alcohol.

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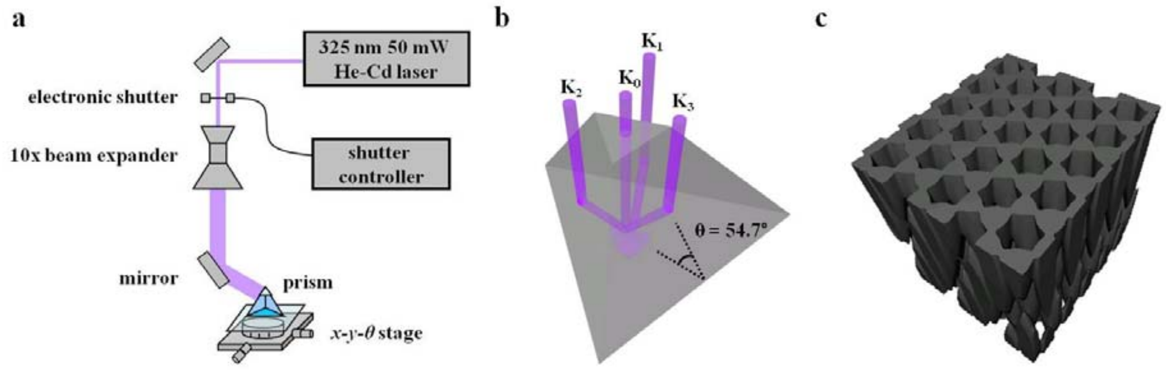

Figure S1. (a) Optical setup for prism HL. (b) Geometry of the single prism (top-cut surface is an equilateral triangle with 0.4 cm on each side, which would be the area of resulting FCC structures) and resulting beam configuration which is the central beam ($\mathbf{k}_0$) and three side beams ($\mathbf{k}_1$-$\mathbf{k}_3$) refracted from side planes with a $\theta = 54.7°$ corner angle. (c) Theoretical 3D simulation image of FCC structure using given wave vectors.

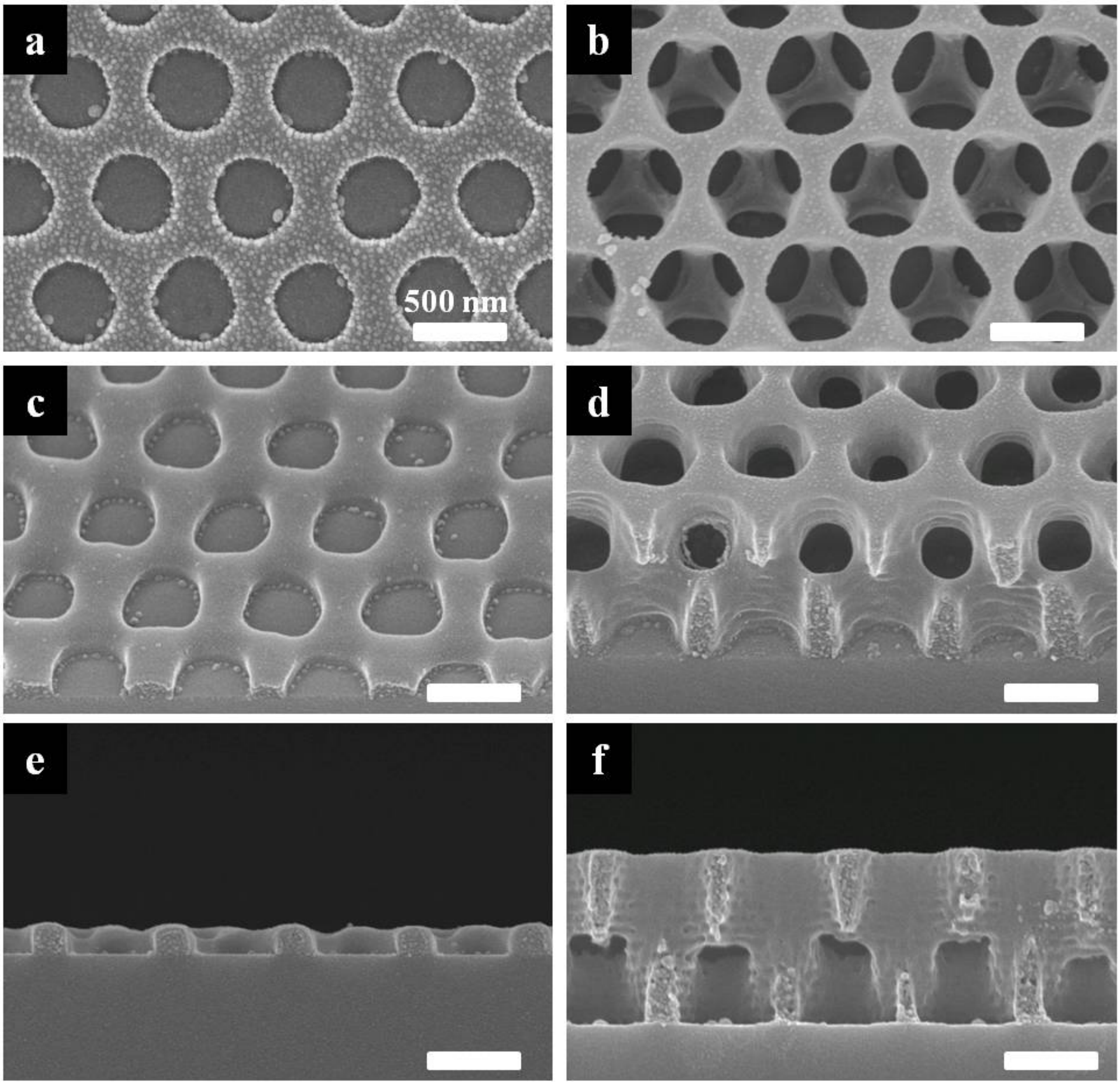

Figure S2. (a, b) Top, (c, d) 40° tilted, and (e, f) cross-sectional views of the scanning electron microscope (SEM) images of the fabricated SU-8 FCC structures for 1-layer and 2-layer cases, respectively.

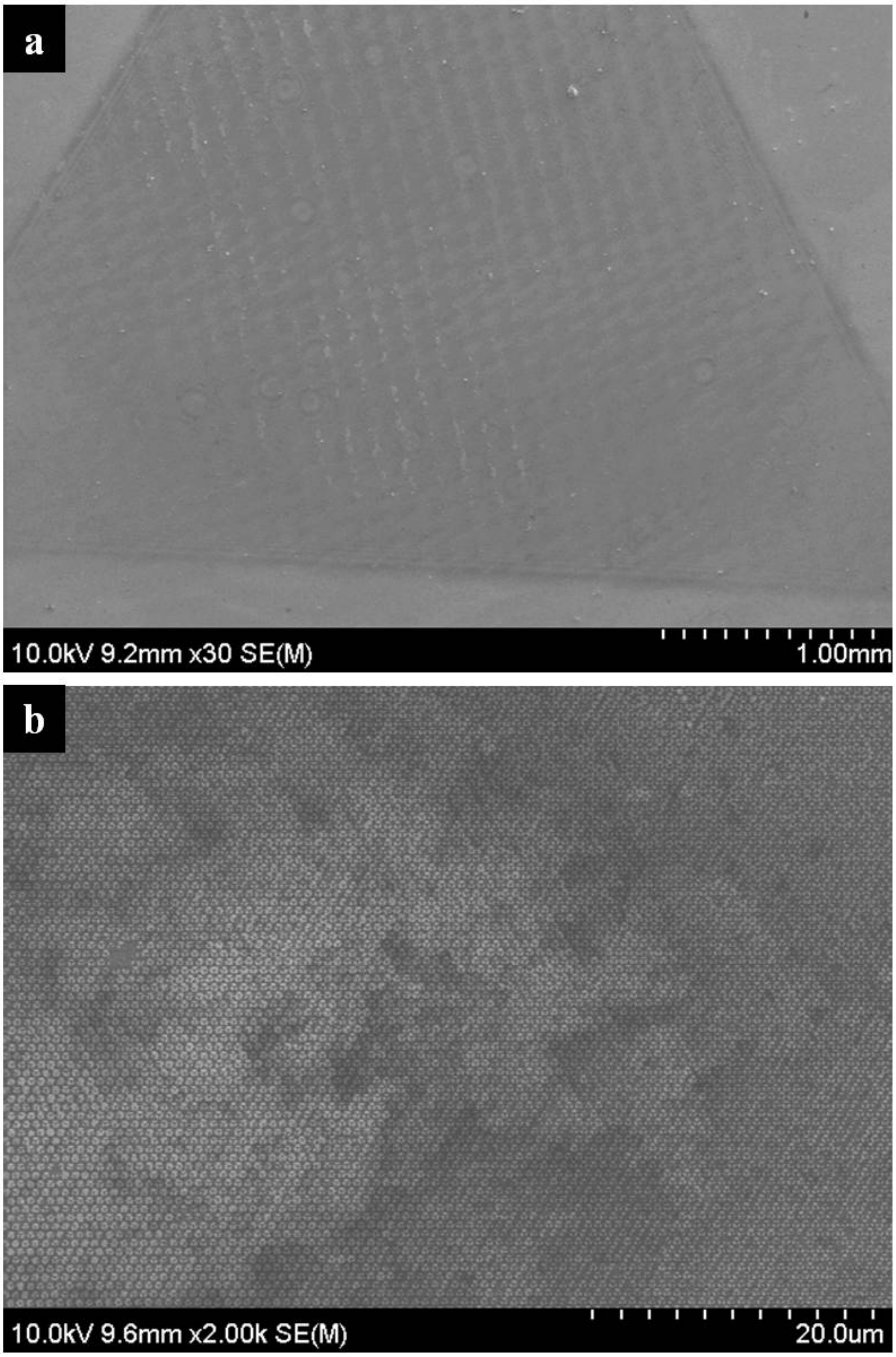

Figure S3. (a) An SEM image of the fabricated hexagonal arrays consisting of 3 elliptical dots, which were prepared by using 2-layered FCC structures, over the whole triangular area. (b) A large area SEM image of 3 elliptical dot array.

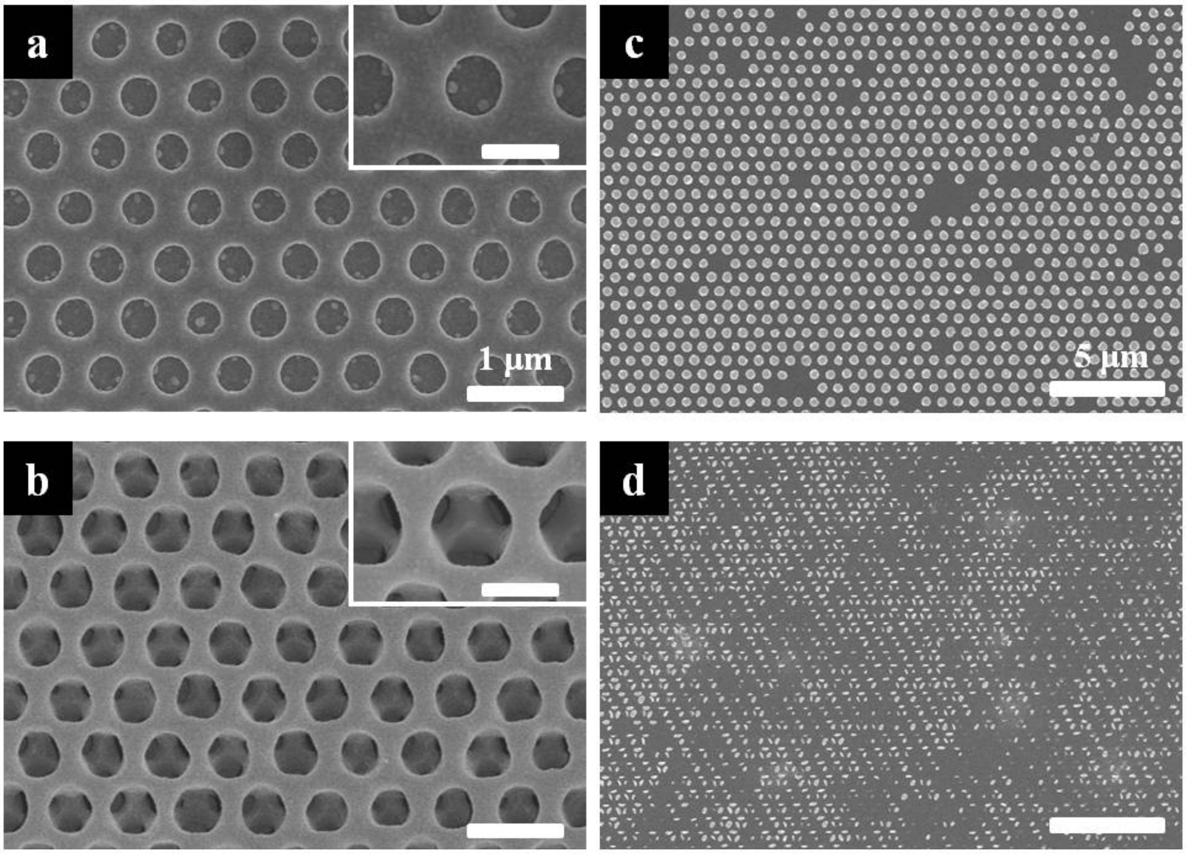

Figure S4. SEM images of the fabricated SU-8 FCC structures for 1-layer mask with (a) 0.7 sec, and 2-layer mask with (b) 0.27 sec of laser exposure time, and (c, d) the plasmonic arrays after metal deposition and lift-off processes using the structures shown in (a, b) as masks, respectively. The insets of (a, b) show the magnified views of the SEM images and scale bar represents 500 nm.

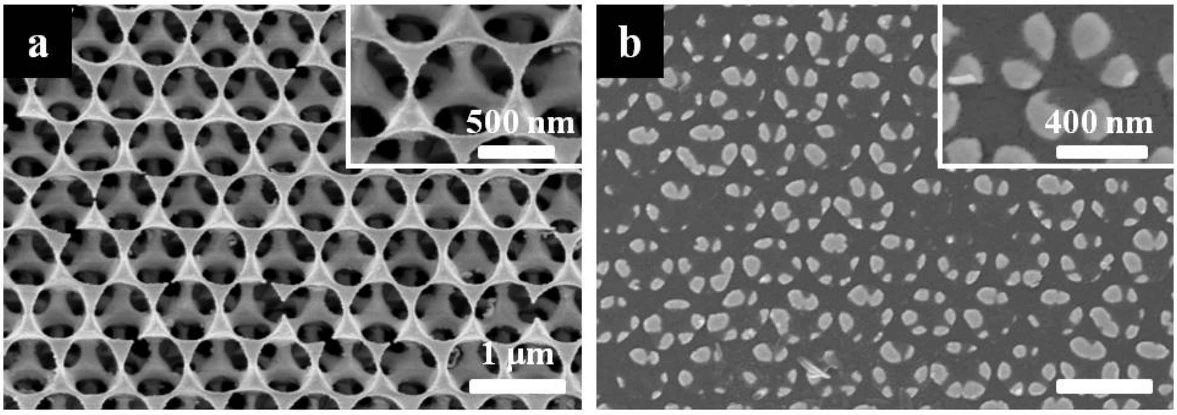

Figure S5. SEM images of the fabricated (a) 3-layer SU-8 FCC structures used as a mask and (b) the plasmonic arrays after the lift-off process. The insets of (a, b) show the magnified views.