

Supporting Information

Figure S1. Transmission electron microscope (TEM) cross-sectional images and energy dispersive X-ray spectroscopic (EDX) data of the Au nano-gap structures. Au nano-gap structures were successfully fabricated in a period of 500 nm with 20 nm thickness (a - c). The trenched area only shows the Si peak, whereas the non-trenched area shows strong Au peaks and a small Si peak which was estimated as a background peak (d).



Figure S2. Optical transparency of a metal embedded stamp. Plot of transmittance versus wavelength from 400 nm to 800 nm (a). Photo images with white background (b - c).

Metal embedded stamp that consists of optically clear polymer, particularly PDMS, and Pt line patterns with 500 nm period, 10 nm scale resolution and high aspect ratio (approximately 15). We recently revealed that Au patterns fabricated by SSL with a 1000 nm period were completely transparent, having a transmittance of 93 % at 550 nm. The optical properties of PDMS are also transparent for a 230 to 700 nm wavelength within a range of 190 to 700 nm As a result, the metal embedded stamp showed a transmittance of 81.75 % at 550 nm. Therefore, the metal embedded stamp is perfectly suitable to form complex and elaborate patterns.



Figure S3. Comparison of the height of prominent Pt line patterns in a stamp. (a) AFM height image of the first imprinted metal embedded stamp maintained at 50 to 60 nm with 500 nm center-to-center spacing (a). AFM height image of the second imprinted metal embedded stamp also maintained at 50 to 60 nm with 500 nm center-to-center spacing (b). Scale bars: $(a - b) 2 \mu m$.



Figure S4. A SEM image of a large area of line gap patterns with a width of approximately 90 width and a period of 500 nm. Scale bar: $2 \mu m$.



Figure S5. FDTD simulations on different shapes of nano-gap structures about the polarization angle of 45 $^{\circ}$ and 90 $^{\circ}$: (a) line, (b) squared grid, and (c) diamond grid.



Figure S6. Scheme for fabrication of 10nm scale nano pattern by secondary sputtering lithography (SSL).