Supporting Information

Resonant Optical Transmission through Topologically Continuous Films

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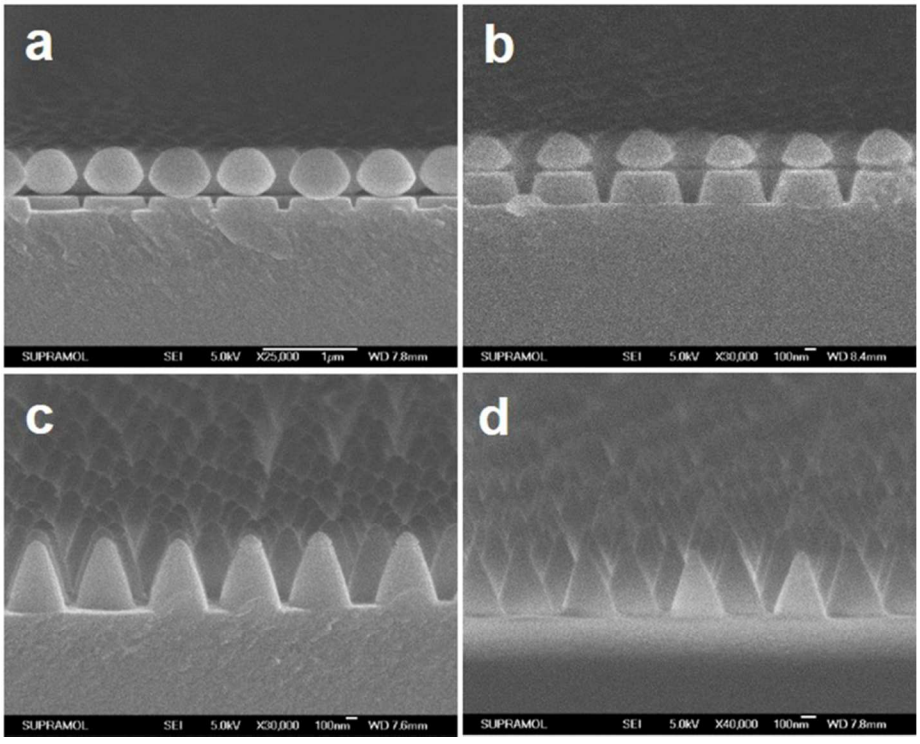

Figure S1. SEM images of PS spheres and photoresin films etched for (a) 30 s, (b) 90 s, (c) 150 s and (d) 210 s.

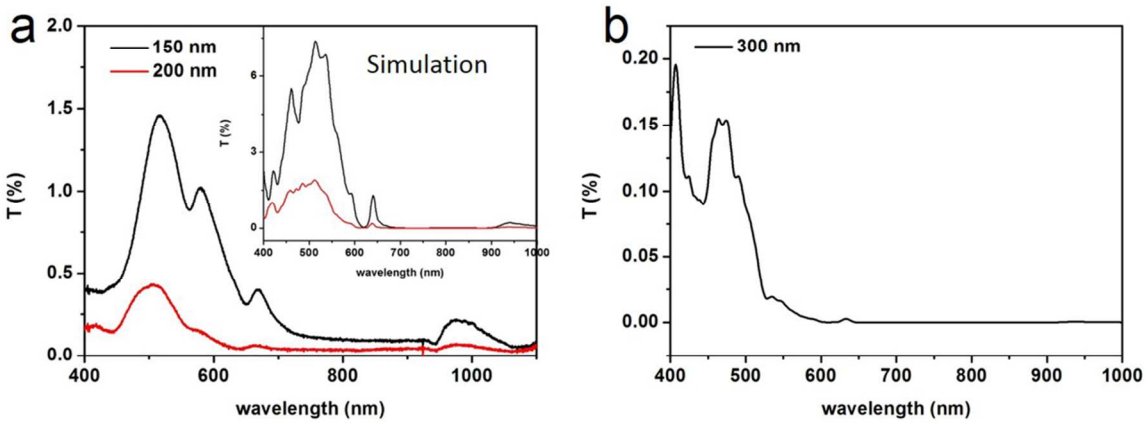

Figure S2. (a) Experimental transmission spectra of 150 nm and 200 nm hollow nanocone array films (HNAFs). The inset image shows the corresponding simulated results. (b) Simulated spectrum of a 300 nm hollow nanocone array film.

Great enhancement in SP efficiency enables light propagation through optically thick (100 nm, 150 nm, 200 nm and 300 nm) continuous Ag films. As the film becomes thicker, the blocking effect gets stronger resulting in reduced transmission intensity, yet with similar spectral shape. In addition, the spectrum of 300 nm HNAF can't be recognized by the device because of the small intensity. However, FDTD simulation presents that there is still a little light with a similar spectral feature passing through a film whose actual thickness on the side of the nanocones is higher than 100 nm. This result proves that much more effective SPR excitation induced by light is generated by the unique structure, enabling light to pass though opaque metal films.

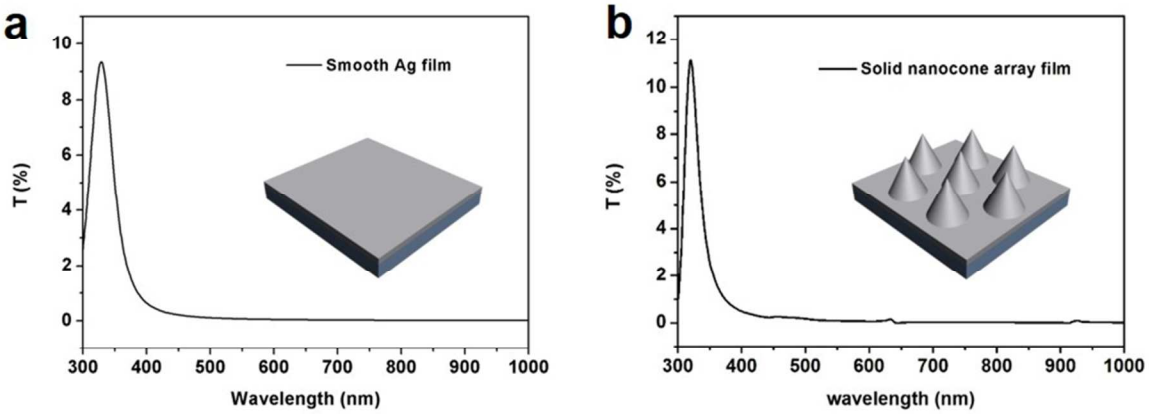

Figure S3. Simulated transmission spectra of (a) a smooth Ag film (100 nm) and (b) a solid nanocone array film with the same main structural parameters to the hollow nanocone array film.

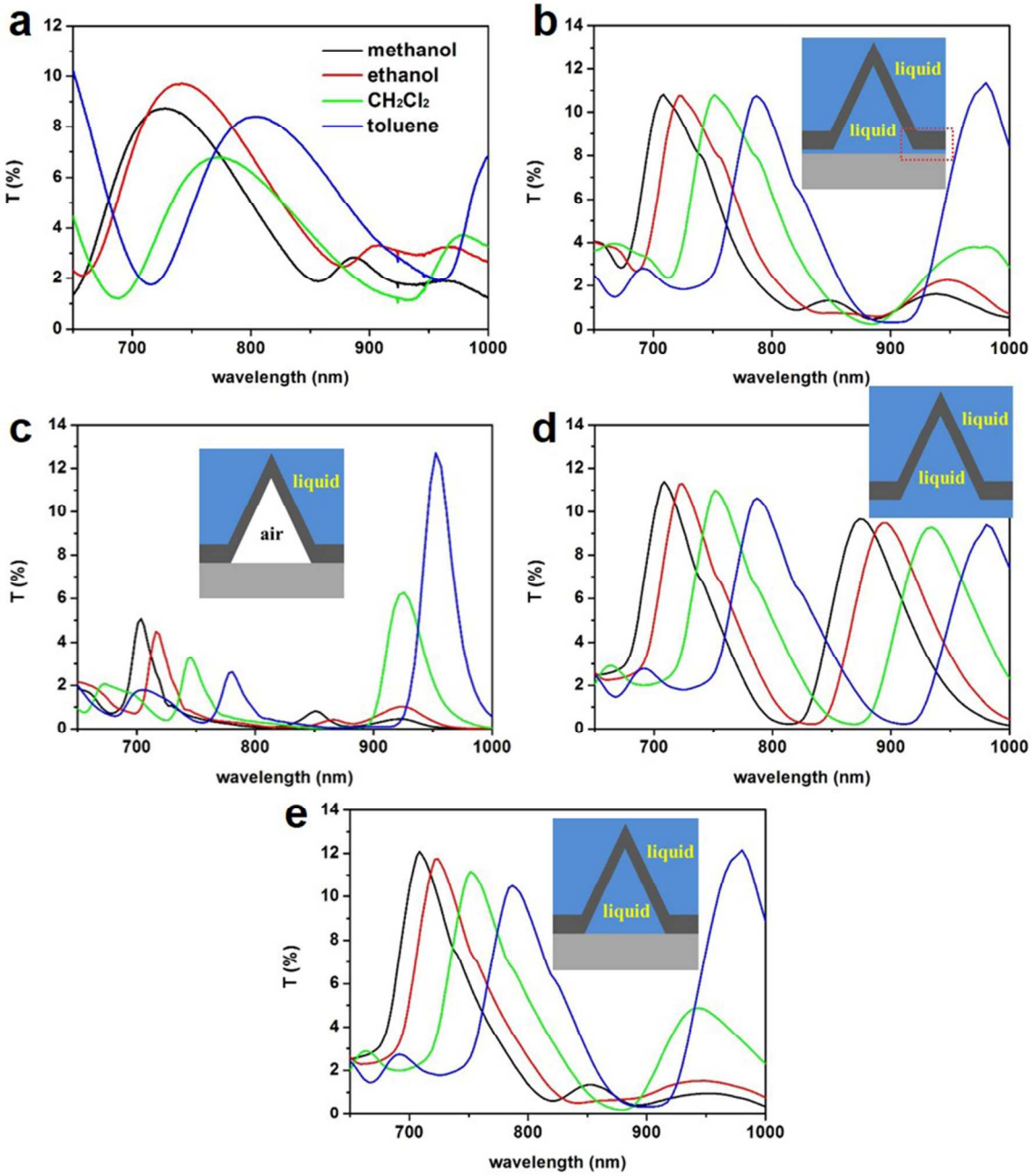

Figure S4. (a) Measured and (b-e) simulated transmission spectra of hollow nanocone arrays with the height of 600 nm immersed in a sequence of liquids with increasing RI: methanol (1.33), ethanol (1.36), dichloromethane (1.42) and toluene (1.49). (b) The liquids enter into the hollow core. The hollow nanocone array film has a distance of 50 nm from the substrate, which is indicated by the red dotted frame. (c) The liquids don't enter into the hollow core. (d) The film is free-standing and immersed in liquids. (e) The liquids enter into the hollow core, but the film has no distance from the substrate.

The simulated spectra of the sample with hollow core filled with liquids (Figure S4b) are in good agreement with the experimental result in Figure S4a. However, the simulated spectra of the condition that the liquids don't enter into the hollow core (Figure S4c) are very different from the experimental result. Then we consider that actual situation is that liquids could enter into the hollow core, which may happen due to the capillarity force. The generation of capillarity force may result from the fact that the film not directly deposits onto the substrate, because there is a photoresin film between the Ag film and the substrate before the dissolution procedure. Then a small gap would emerge between Ag film and substrate, which can be observed in the cross-sectional SEM images in Figure 2f and inset images in Figure 3. This would allow the liquids to enter into the hollow core because of capillarity forces. Furthermore comparing the results in Figure S4b, d and e, the spectra simulated for the condition indicated by the inset image in Figure S4b are almost the same as those of the condition in Figure S4e. However, the results in Figure S4b are very different from the results for the condition that the film is free-standing and immersed in liquids (Figure S4d). This indicates that the little liquid in the gap can hardly influence the SPR performance. Therefore we conclude that the sensing performance is the result of liquid on one side of the attached part but on both sides of the convex nanostructure (hollow nanocones).