Supporting Information

Manuscript: Three-Dimensional Mapping of the Light Intensity Transmitted through Nanoapertures
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Pillar Fabrication. Corning glass coverslips (No. 1, 24 x 30 mm) were cleaned in aqua regia (3:1 stock solutions of HCl and HNO_3, respectively) for 1 h at room temperature. The coverslips were rinsed with ultrapure water (18 MΩ·cm, Millipore Super-Q), rinsed with acetone, and subsequently, sonicated (Branson 200 Ultrasonic cleaner) for 1.5 min in a 3:1 solution of acetone and methanol. After sonication, the coverslips were rinsed with methanol and dried in a stream of nitrogen. In order to promote the adsorption of the microspheres to the glass surface, the coverslips were hydrolyzed in a solution of 0.01 M NaOH for 20 min, followed by a water rinse and sonication in water for 5 min to help remove excess salts that remain on the surface. The coverslips were then rinsed with water and dried in a nitrogen stream. Various diameters of polystyrene microspheres (110, 200, 360, 480, and 770 nm, PolyScience Inc.) were placed on the coverslips by adding 200 μL of a solution of the suspended microspheres that had been diluted to 10^{-4}% (w/v) polystyrene in water. Afterwards, the samples were dried in low vacuum (1 torr) leaving the microspheres adsorbed to the surface of the coverslips.

The nanosphere samples were coated with ~10 nm of chromium as an adhesion layer followed by aluminum using thermal evaporation (CVE-20 filament evaporator). The thickness of the layers was monitored using a quartz microbalance (STM-100/MF, Sycon Instruments). In order to achieve well defined apertures, the total thickness of the Cr and Al films was maintained to be slightly less than the radius of the nanosphere used

for the given sample. This enables the easy removal of the nanospheres with sonication in methanol for 1.5 min. The nanoaperture samples were dried in a nitrogen flow and coated with a thin film (~15 μm) of the negative tone photoresist SU-8 2010 (MicroChem) by spinning at 1000 rpm ± 1% for 30 s with 30 s ramping (P6708, Speedline Technologies). The samples were prebaked for 1 min at 65°C and 3 min at 95°C (575 Digital hotplate, VWR), after which the SU-8 was exposed using a Hg arc lamp (0.5 mW/cm^2 at 365 nm, Spectroline 11SC-1 OP, Spectronics Corp) for times of 1, 3, 10, and 30 min. After exposure, the samples were post-baked by ramping at ~35°C /min and holding for 5 min at 95°C and, subsequently, immersed in SU-8 developer (MicroChem) for 3 min while slightly agitating to promote complete developing. The samples were then washed by immersing them in isopropyl alcohol and drying under low vacuum (1 torr). The resulting features, or pillars, (see Figure 1) were then sputter coated with ~10 nm of gold (E5100, Polaron Instruments) and analyzed in a scanning electron microscope (SEM, LEO 1430).

Finite-Difference Time-Domain Calculations. We assume a three layer system: glass, metal, and polymer with polymer also filling the cylindrical holes in the metal. The glass and polymer are described by a constant index of refraction, n=1.5 and 1.67, respectively. No allowance is made for possible changes in the polymer index during exposure; i.e., we assume that although a latent image is generated by the exposure, the changes in the resist (before the post exposure processing) do not significantly modify its optical properties. For the metal film only Al was taken into account, and its response was described by a Drude dielectric function with parameters fitted to optical data [1]. We calculated the steady state spatial distribution of $\left|\vec{E}\right|^2$ resulting from a linearly polarized plane wave with vacuum wavelength of 350 nm incident along the normal from

the glass side. The following combinations of aperture diameter/metal film thickness were calculated: 110/50, 200/100, 360/170, 480/230, and 770/380 nm. We used a uniform Yee mesh [2] with a lattice constant of 10 nm and a time step of $c\Delta t$ equal to 5 nm. Perfectly matched layers completely surround the region of physical interest, which extended 0.5 μm into the glass and 1-3 μm into the polymer. Note that propagating waves in the polymer have a wavelength of 350/1.67 = 210 nm. Hence only for the smallest diameter aperture (110 nm) does one approach the cut-off for all modes in the hole.

References

[1] E.D. Palik, *Handbook of Optical Constants of Solids* (Academic Press, New York, 1985).

[2] A. Taflove and S.C. Hagness, *Computational Electrodynamics: The Finite-Difference Time-Domain Method* (Artech House, Boston, 2000).