Electronic Supplementary Material (ESI) for Nanoscale.

Subwavelength imaging in the visible range using metal coated carbon nanotube forest (Supplement)

Jong-Ho Choe, [a] **Muhan Choi,** [ab] **Won Jun Lee,** [c] **Byungsoo Kang,** [d] **Jinhyung Kim,** [e] **Min-Kyo Seo,** [e] **Bumki Min,** [d] **Sang Ouk Kim,** [c] **and Choon-Gi Choi*** [a]

Supplement 1: The fabrication of metal coated CNT forest

We prepared nanopatterned catalyst particles. Before spin coating block copolymers on a silicon wafer, the surface of the silicon was treated with a random brush copolymer. The block copolymer was formed 60 nm thin film by spin coating and was annealed at 190°C. Subsequent UV treatment and rinsing with acetic acid and water removed the PMMA cylinder cores and crosslinked the PS matrix. After rinsing, the substrate was exposed to oxygen plasma (10 seconds), and the iron catalyst film was deposited. The remnant PS nanoporous template was removed by ultrasonication in toluene.

The catalyst-deposited substrate was heated up to 750°C under a 100 sccm flow of ammonia gas (chamber pressure: 1.3 torr). After reaching 750°C, we kept the annealing state for a short while (less than 3 min) for reduction of the size of catalyst particles. Subsequently we increased the chamber pressure to 4 torr and applied 650V dc voltage. Under this condition with the flow of acetylene gas (flow rate of 25 sccm for 1 min), a dense CNT array was grown on the substrate.

Prior to platinum encapsulation, the vertical CNT forest was dipped in ethanol for 1 min. The platinum encapsulation was performed by dipping the vertical CNT forest in a K_2PtCl_4 aqueous solution (5ml, 25mM) for 10min at 60°C with magnetic stirring. After platinum encapsulation, the product was washed several times with deionized water, and dipped in deionized water again. For maintenance of the vertical structure, the product was transferred to acetone, rapidly injected into a high vacuum chamber, and heated up to 300°C for removal of residues.

The platinum encapsulated vertical CNT film was infiltrated with PDMS. The thickness of the PDMS infiltration was precisely controlled by spin coating speed and observing the top ends of the CNT forest with SEM. PDMS-infiltrated product was readily detached from the underlying silicon substrate by weak HF etching.

We purchased the asymmetric block copolymers (PS-b-PMMA forming cylindrical nanostructures, molecular weights, PS/PMMA of 140 k/60 k, D for PMMA=43 nm, L=72 nm), the iron catalyst source (for electron-beam evaporation, purity: 99.95%), the pure ammonia gas, the acetylene gases, and the platinum source (K_2PtCl_4, Potassium Tetrachloroplatinate) from Polymer Source, Thifine, Showa Denko K.K., Kyungin Chemical Industrial, and Sigma-Aldrich respectively.

Supplement 2: Thin PDMS layer coating on the slits

For the contrast experiment, we fabricated a thin PDMS layer on slit samples. Since PDMS is highly viscous, it is hard to make a PDMS layer thinner than one micrometer using spin coating. However when hexane is used to dilute PDMS, then making a thinner PDMS layer is possible.[1] We mixed PDMS and hexane in a 1:19 ratio and applied by spin coating at 3000 rpm for 3 minutes to acquire about a 400 nm thick PDMS layer on the slits. Figures S1(a), (b), and (c) show the optical image of the PDMS coated layer, AFM image of the corresponding optical image, and the vertical cross cut of the AFM image, respectively. By comparing the color near the slits (the inset) and the PDMS coated area in Fig. S1(a), we deduced that the thickness of the PDMS coated on the slits was about 400-420 nm.

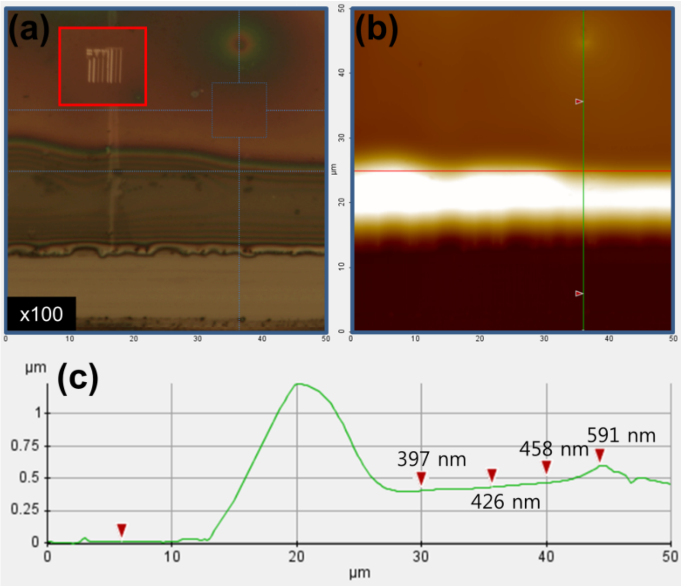

Figure. S1. (a) An optical image of part of the sample surface. Slits are shown in the inset. (b) AFM image corresponding to Fig. S1(a). (c) Cross cut of the vertical line in the AFM image (b).

Reference

1. Thangawng A. L.; Swartz M. A.; Glucksberg M. R.; Ruoff R. S. *Small*, **2007**, 3, 132-138.