Direct deposition of two nanomaterials with the same surface

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charge using a liquid-liquid interface

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Supplementary Information

Experimental section

Nanocrystals of poly[1,6-di(N-carbazolyl)-2,4-hexadiyne] (pDCHD) with square-shape (~30 nm in width and length) was fabricated by reprecipitation method as reported previously^{S1}. The concentration of dispersion was 5 mM based on the repeating unit. SWCNTs that had been synthesized by HiPco method were purchased from Unidym Inc. and used as received. Sodium dodecyl sulfate was obtained from Wako Pure Chemicals Ltd. and used as received. Ten milligrams of SWCNTs and 100 mg of SDS were dissolved in 10 mL of water sonicated for 2 h at 38 kHz (As One Corp.) at 5 °C. Then the dispersion was centrifuged at 5×10^4 g for 4 h (GS100GXII; Hitachi Koki.). The supernatant was collected and used as a water phase to fabricate the liquid-liquid interface. The initial concentration of the dispersion was calculated as 86 µg/mL using the extinction coefficient of 0.0286 L/mg cm at 500 nm.^{S2} The absorption spectra were measured using a UV-vis-NIR spectrophotometer (U-3500; Hitachi Ltd.). Prior to use, a silicon and glass substrate (Polished Wafers; SUMCO Corp.) was washed with alkali detergent, acetone, and methanol. Then treated with O_3 and immersed into 1 mM of 3-aminopropyltriethoxysilane (APTS) in toluene for 40 min at 80 °C to form an amino-terminated surface. The surface morphology of the deposited films was observed

by environmental scanning electron microscope (ESEM, XL30; Nikon Corp). Gold was sputtered on the surface before the SEM observation. Photoconductivity of the bi-layer film was measured using a semiconductor parameter analyzer (4155c; Agilent Technologies, Inc.). Xenon lamps (500 W) equipped with IR cutoff filter (IRA-2S; Toshiba Corp.) and interference filters (400-600 nm wavelength, 10 nm fwhm, Vacuum Optics Corporation of Japan) were used to obtain monochromatic lights. The photoconductivity measurements were carried out in vacuum (below 10⁻³ Pa) using vacuum prober (MJ-8; Measure Jig Co.). Interdigitated array (IDA) electrodes were fabricated using thermal deposition of Cr/Au with a metal mask at the glass substrate. The IDA electrode has two sets of comb-type Au arrays; each array has nine electrode elements, which are 0.5 mm wide and 8.5 mm long and which are separated by 0.2 mm from adjacent elements.

ζ-potential measurement of SDS-coated SWCNT

The exact ζ -potential measurement of SDS-coated SWCNT with addition of ethanol is difficult because the free SDS (desorbed from SWCNT) remained in the measurement cell. ^{S3} However, it is safe to assume that SWCNT assembled at the interface shows a negative surface potential because not all the SDS was desorbed from the SWCNT surface. ^{S4}



Figure S1 Values of ζ -potential for the aqueous dispersion of SDS-coated SWCNT at the different ethanol concentration.

Dependence of photocurrent on the excitation wavelength



Figure S2 Dependence of photocurrent on the excitation wavelength.

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