Supporting Information

High-performance optical memory transistors based on a novel organic semiconductor with nanosprouts

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Experiments section

Figure S1 Thermal gravimetric analysis of 2, 7-DAN.

Figure S2 UV−vis absorption spectra andphotoluminescence spectra 2, 7-DAN in solid.

Figure S3 X-ray diffraction of 2, 7-DAN film. out-of-plane and in-plan XRD

Figure S4 UPS energy distribution curve of 2, 7-DAN.

Experiments section

Synthetic details. 2, 7-di (anthracen-2-yl) naphthalene (2, 7-DAN): 1 g (3.5 mmol) 2, 6-dibromonaphthalene, 1.71 g (7.69 mmol) anthracen-2-ylboronic acid and 202.05 mg (174.85 μmol) $Pd(PPh_3)_4$ were added into a 250 mL flask under argon. Then 50mL toluene and 15 mL 2M K_2CO_3 aqueous solution were added, and heated to 90 °C and kept stirring for 4 days. Then the system was filtered, washed with tri-ethylamine, dichloromethane, water and ethanol successively and purified by sublimation. 2, 7-DAN is obtained as a yellow solid in a yield of 83.5%. MS (EI) m/z: 480[M+]; Anal. calcd for $C_{38}H_{24}$ (%): C: 94.97, H: 5.03. Found: C: 94.98%, H: 4.97%.

Materials Characterization. UV-Vis spectra were obtained on SHIMADZU UV-3600 UV-Vis-NIR spectrophotometer. Photoluminescence (PL) spectra were recorded on a HITACHI F-7000 spectrofluorometer. Thermal gravimetric analysis (TGA) was carried out on a METTLER TOLEDO TGA2 apparatus with a scanning rate of 10 °C /min. X-Ray diffraction was measured in reflection mode at 45 kV and 200 mA with Cu Kα radiation using a RIGAKU SMARTLAB9KW diffractometer. UPS (KRATOS Axis Ultra DLD spectrometer) measurements were taken with a base pressure > 2×10^{-9} torr and He I (h = 21.22 eV) as the excitation source. AFM images were obtained by using a Dimension ICON-PT atomic force microscope in air.

Fabrication and measurement of 2, 7-DAN film OFETs. The devices fabrication of 2, 7-DAN film OFETs followed the following procedures. (1) SiO_2/Si wafers containing a 300 nm-thick SiO_2 layer were successively cleaned with deionized water, isopropanol, de-ionized water, piranha solution (70/30vol./vol. H_2SO_4/H_2O_2), deionized water, isopropanol and oxygen plasma (10 min, 80 W). (2) Surface modification of SiO_2/Si wafer with OTS was then carried out by vapor deposition method at a vacuum chamber (0.1 Pa). The SiO_2/Si wafer was first dried at 90℃ (1.5 h) to remove the moisture and then kept at 120 °C (2 h) to allow for the deposition of OTS. After cooling down to room temperature, the substrate was washed successively with n-hexane, trichloromethane and isopropanol for following device fabrications. (3)The thin-film devices were fabricated on OTS-modified SiO_2/Si

with bottom-gate and top-contact configuration by vacuum deposited patterned Au (30 nm) on 25-nm-thickness semiconductor layers of 2, 7-DAN as source and drain electrodes. Semiconductors were vacuum deposited at a deposition rate of 0.01 nm $s^{-1}$and substrate temperature of 23 °C， 50 °C, 60 °C, 80 °C, 100 °C, respectively. Au electrodes were vacuum deposited through a patterned shadow mask, with a deposition rates of 0.2 nm s^{-1} and without substrate heating. The field-effect transistor characteristics were measured at room temperature in air on a Keithley 4200 SCS and micromanipulator 6150 probe station and the mobility was extracted from the saturation region by using the equation of $I_{DS} = (W/2L)C_i\mu(V_G - V_T)^2$.

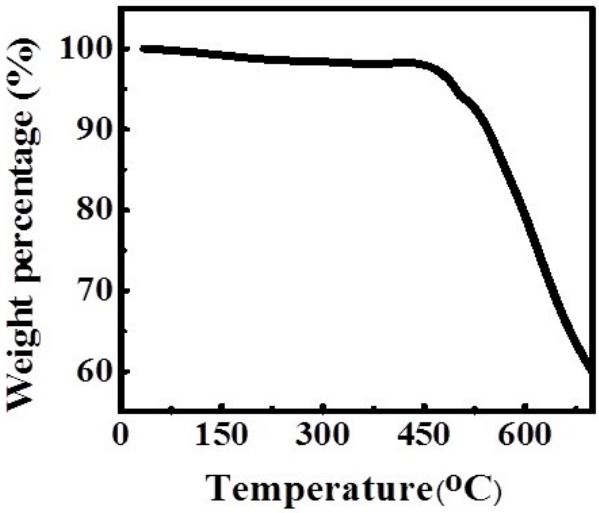

Fig. S1 Thermal gravimetric analysis of 2, 7-DAN.

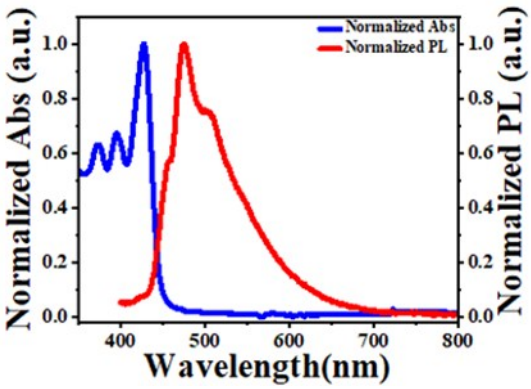

Fig. S2 UV−vis absorption spectra and photoluminescence spectra of 2, 7-DAN in solid

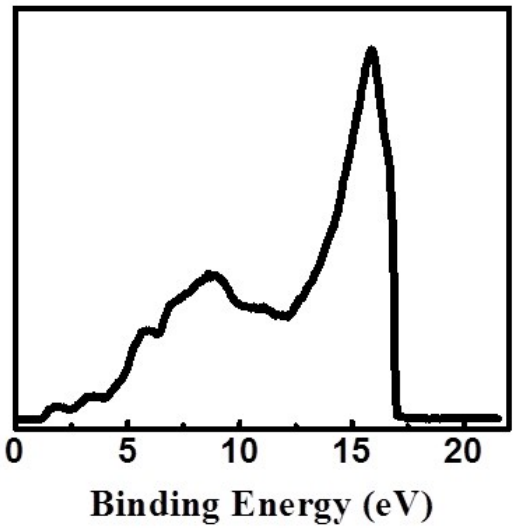

Fig. S3 UPS energy distribution curve of 2, 7-DAN.

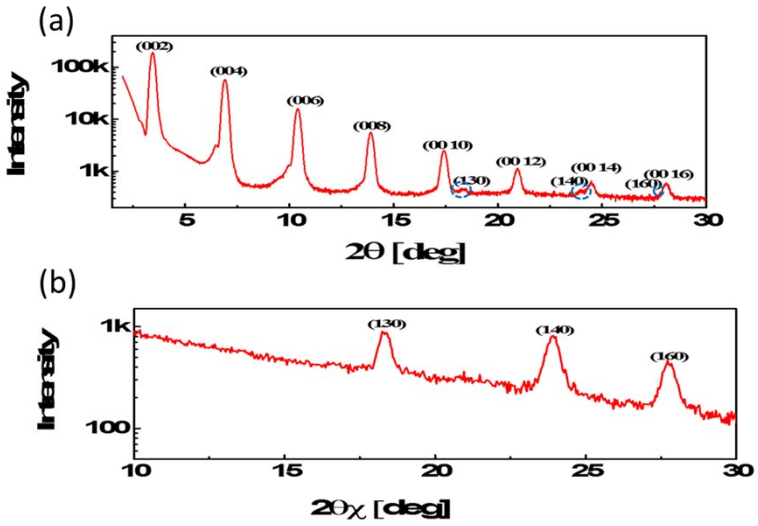

Fig. S4 X-ray diffraction of the 2, 7-DAN thin film deposited at 50 ℃ substrate temperatures (OTS treated SiO_2/Si). (a) Out-of-plane and (b) In-plane XRD