Supporting Information

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

Lei Zheng, #a Jinfeng Li, #a Yu Wang, #a Xiong Gao, #a Kuo Yuan, #a Xixia Yu, #a
Xiaochen Ren, #a Xiaotao Zhang *a and Wenping Hu *a,b,c

#Tianjin Key Laboratory of Molecular Optoelectronic Sciences, Department of Chemistry, School of Science, Tianjin University, Tianjin 300072, China

bBeijing National Laboratory for Molecular Sciences, Key Laboratory of Organic Solids, Institute of Chemistry, Chinese Academy of Sciences, Beijing 100190, China

cCollaborative Innovation Center of Chemical Science and Engineering, Tianjin 300072, China

* Correspondence and requests for materials should be addressed.
E-mail: zhangxt@tju.edu.cn; huwp@tju.edu.cn

Experiments section

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

Figure S2 UV−vis absorption spectra and photoluminescence 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(PPh₃)₄ were added into a 250 mL flask under argon. Then 50mL toluene and 15 mL 2M K₂CO₃ 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 C₃₈H₂₄ (%): 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) SiO₂/Si wafers containing a 300 nm-thick SiO₂ layer were successively cleaned with deionized water, isopropanol, de-ionized water, piranha solution (70/30vol./vol. H₂SO₄/H₂O₂), deionized water, isopropanol and oxygen plasma (10 min, 80 W). (2) Surface modification of SiO₂/Si wafer with OTS was then carried out by vapor deposition method at a vacuum chamber (0.1 Pa). The SiO₂/Si wafer was first dried at 90 °C (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 SiO₂/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 \(I_{DS} = \frac{W}{2L}C_i \mu (V_G - V_T)^2\).

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 °C substrate temperatures (OTS treated SiO$_2$/Si).
(a) Out-of-plane and (b) In-plane XRD