

Organic crystalline monolayers for ideal-behaviours in organic field-effect transistors

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Experimental

Materials and method: IDTBT was purchased from Derthon Optoelectronic Materials Co. Ltd (China). NDI and CMUT was synthesized as reported in literatures. The mixture of IDTBT and NDI was dissolved in chlorobenzene with a constant concentration of IDTBT (4 mg/mL). The IDTBT-NDI blend films were prepared by spin-coating the compound of IDTBT and NDI solution on the OTS modified $\text{SiO}_2/\text{Si}^{++}$ substrates at 2000 rpm for 60 s. Then, the films were annealed at 90 °C for 20 min.

Measurements: The optical and fluorescent images of IDTBT-NDI films were carried out by DM4M fluorescent microscope. The atomic force microscopy (AFM) and high-resolution atomic force microscopy images (HR-AFM) images were carried out by Cypher ES Enviromental AFM. The Grazing-Incidence Wide-Angle X-ray Scattering (GIWAXS) were carried out at the 8ID-E beamline at the Advanced Photon Source (APS), Argonne National Laboratory, using X-rays with a wavelength of $\lambda = 1.136 \text{ \AA}$ and a beam size of B200 mm (h) and 20 mm (v). The electrical characteristics of the OFETs were measured by Keithley 4200-SCS and Agilent B1500A semiconductor parameter analyzer.

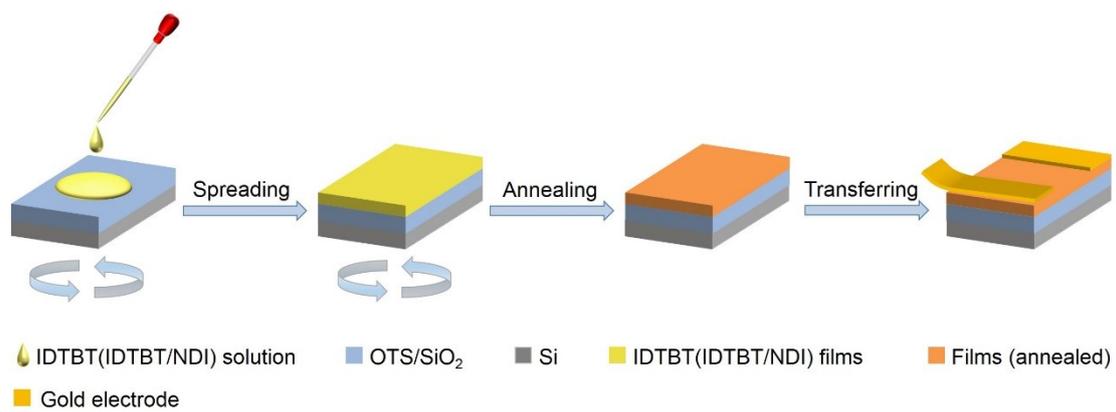


Fig. S1. Schematic diagram of devices fabricated by IDTBT or IDTBT/NDI films on OTS.

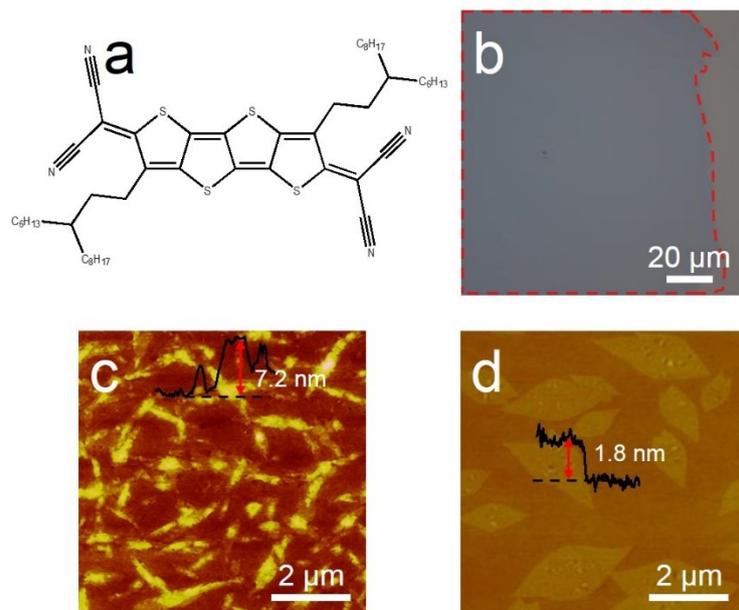


Fig. S2. (a) Molecular structure of CMUT. (b) Optical image of CMUT monolayer by drop casting. (c-d) AFM image of CMUT and NDI films by phase separation method.

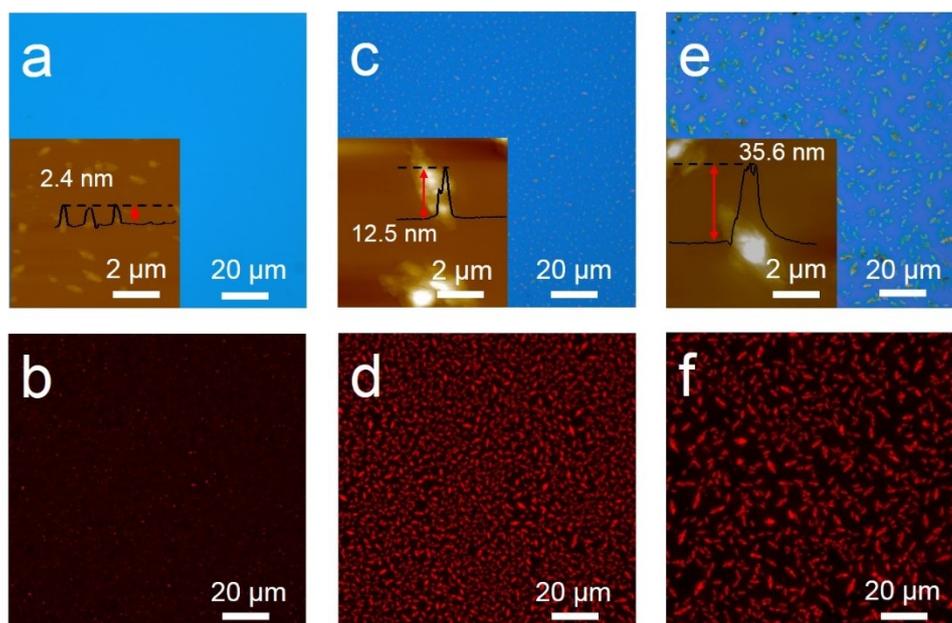


Fig. S3. (a-b) Optical image and fluorescence image of the surface morphology of IDTBT/NDI films with mass ratio at 4:0.2. In fluorescence image, the excitation wavelength is at 530 nm (the red region and dark region are NDI and IDTBT films, respectively). (c-d) and (e-f) are the surface morphology of IDTBT/NDI films with mass ratio at 4:0.5 and 4:1. The insert pictures are corresponding AFM images.

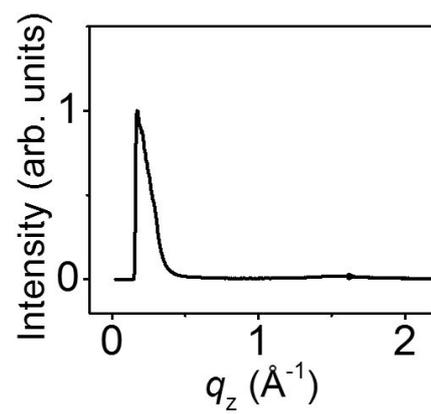


Fig. S4. The 1D GIWAXS plots of IDTBT films along out-of-plane directions.

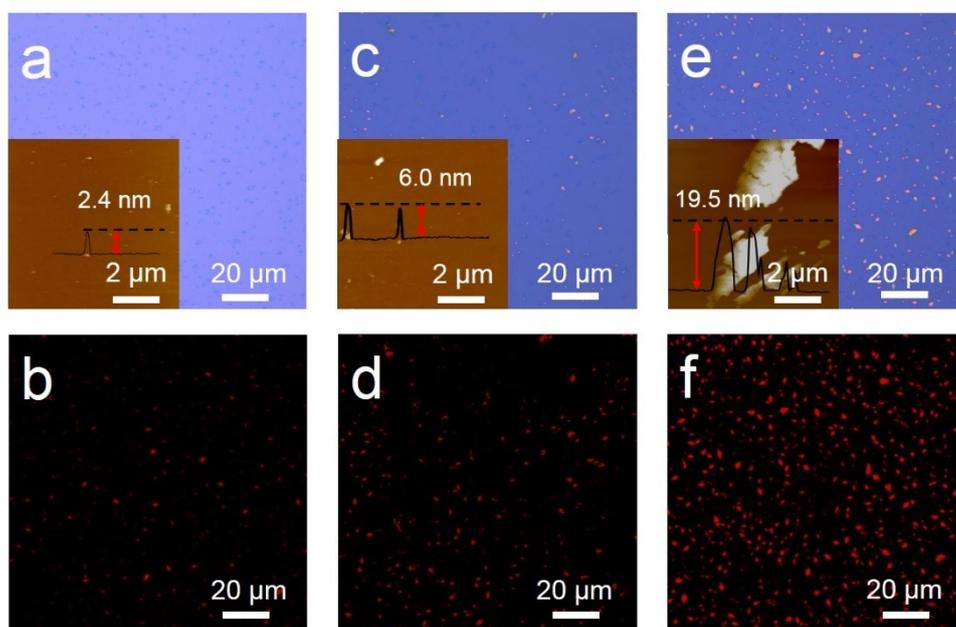


Fig. S5. (a-b) Optical image and fluorescence image of the bottom interface morphology of IDTBT/NDI films with mass ratio at 4:0.2. In fluorescence image, the excitation wavelength is at 530 nm (the red region and dark region are NDI and IDTBT films, respectively). (c-d) and (e-f) are the interface morphology of IDTBT/NDI films with mass ratio at 4:0.5 and 4:1. The insert pictures are corresponding AFM images.

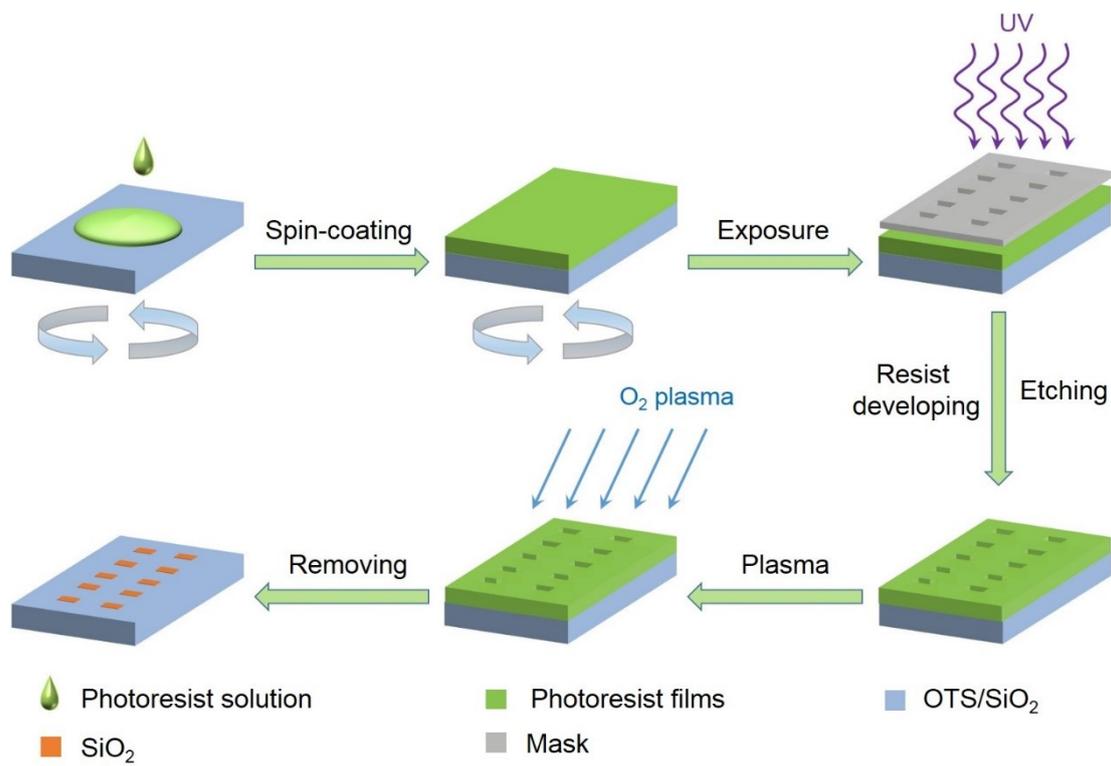


Fig. S6. Schematic diagram of lithography for pattern OTS substrate.

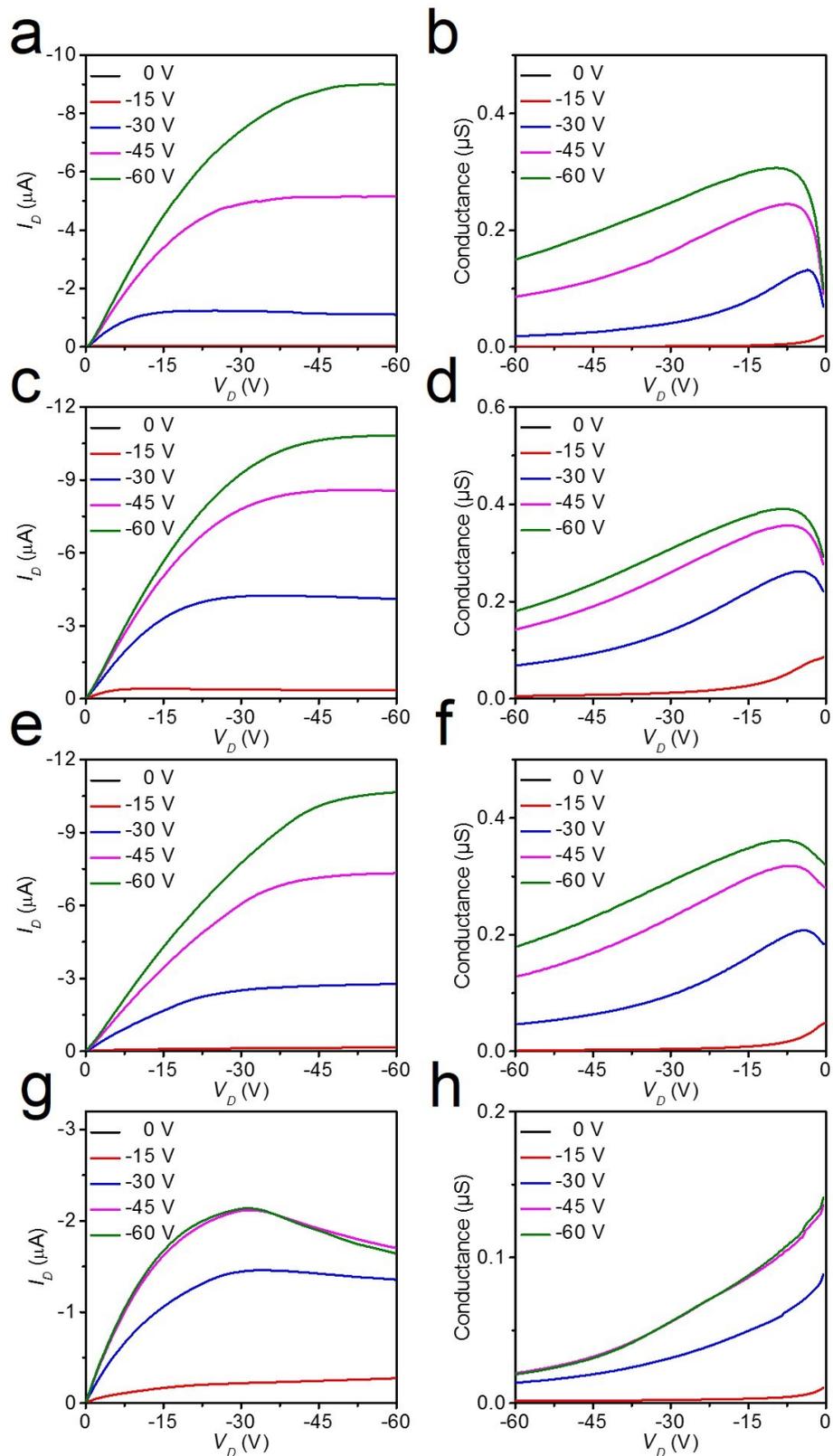


Fig. S7. (a-b) Electrical properties of the devices based on IDTBT films: (a) Output characteristics; (b) conductance. (c-h) Electrical properties of the devices based on IDTBT/NDI films with various mass ratio: (c-d) mass ratio at 4:0.2; (e-f) mass ratio at 4:0.5; (g-h) mass ratio at 4:1.

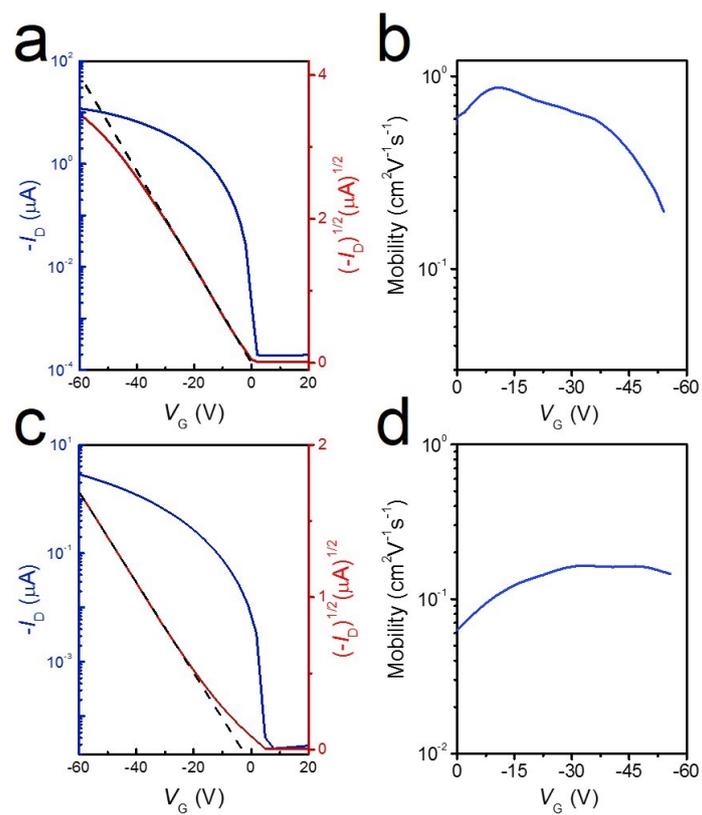


Fig. S8. (a, b) Electrical characteristics of DPP films. (a) Transfer characteristics of DPP based devices under ambient conditions. (b) Mobility versus gate voltage. (c, d) electrical characteristics of DPP-NDI based devices.

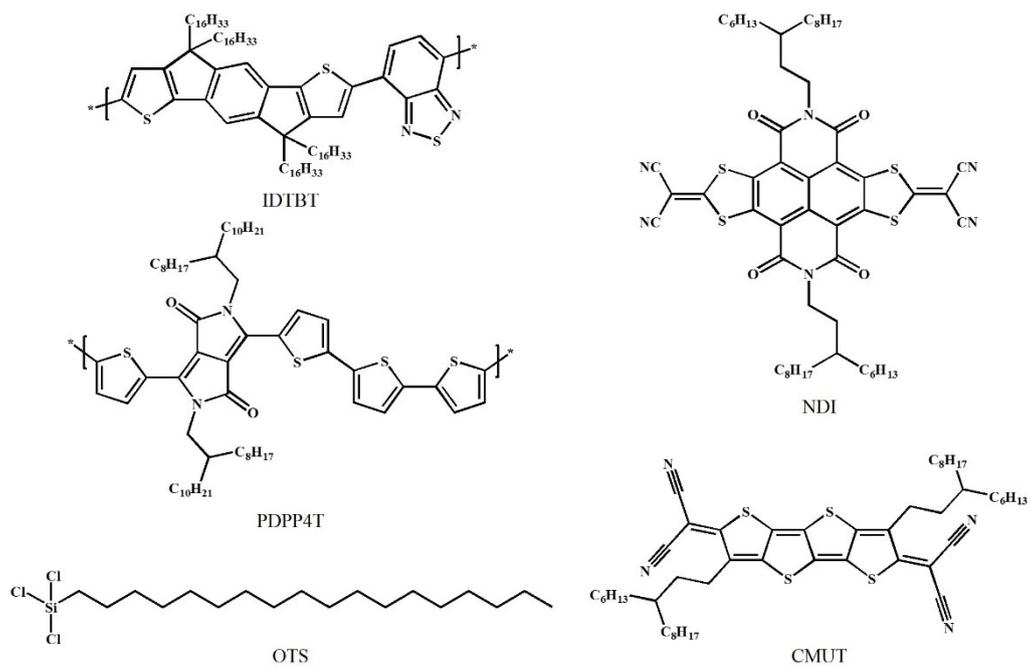


Fig. S9. Chemical structures of the compounds used in this study.