Electronic Supplementary Information (ESI)

A Novel Method to Prepare Photolithographic Polymer Shadow Masking: Toward High-Resolution High-Performance Top-Contact Organic Field Effect Transistors†

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Experimental Section

Poly (4-styrene sulfonate) (PSS), Polystyrene (PS), polymethyl methacrylate (PMMA) and polyacrylonitrile (PAN) were purchased from Aldrich. Polyimide (PI) was synthesized from the lab. Pentacene was purchased from Aldrich and used in this work after being purified. The positive photoresist (RZJ-304) and the developer were purchased from Ruihong in China.

Substrates used in the present study were successively cleaned with pure water, hot acetone, pure ethanol, piranha solution (H_2SO_4:H_2O_2=7:3), pure water, hot ammonia-hydrogen peroxide solution (ammonia: hydrogenperoxide: water=1:1:5), pure water and pure ethanol. BCB (Dow Chemicals) thin layers were spin coated from a mesitylene (Fluka) solution (V_{BCB}: $V_{mesitylene}$ = 1: 30) and thermally cross-linked on a hot plate in an N2 glovebox. Treatment of Si/SiO_2 wafer and polymer mask after plasma treatment with OTS was carried out by vapor deposition method. The clean wafers were dried under vacuum at 100 °C for 0.5 h in order to eliminate the influence of the moisture. After cooling to room temperature, one drop of OTS was placed on the wafers. Subsequently, this system

was heated to 120 °C and maintained for 2 h under vacuum. Treatment of polymer mask after plasma treatment with OTS was also carried out by vapor deposition method. After plasma treatment, one drop of OTS was placed on the wafers. Subsequently, this system was heated to 120 °C and maintained for 2 h under vacuum.

I–V characteristics of the transistors were recorded with a Keithley 4200-SCS semiconductor parameter analyzer and a Micromanipulator 6150 probe station in a clean and shielded box in ambient laboratory environment at room temperature. Atomic force microscopy (AFM) was performed using a Nanoscopy IIIa instrument (USA). Plasma treatment was carried out using Gala Instrument Prep2.

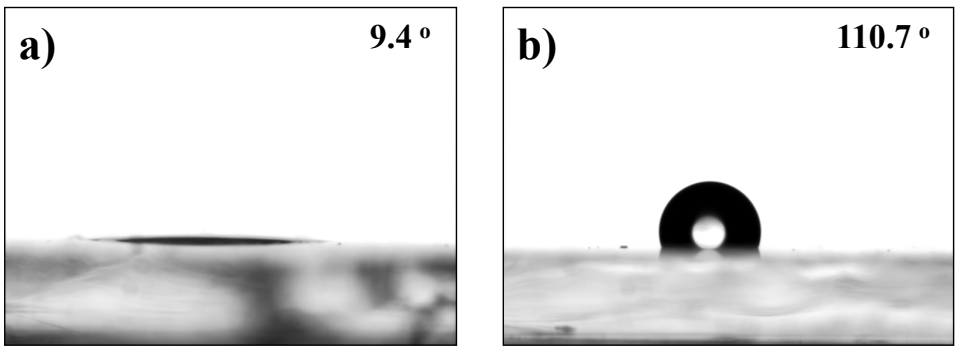

Fig. S1. (a) The water drops floated on polymer mask surface after plasma treatment with a contact angle of around 9.4°. (b) The water drops floated on polymer mask surface after modifying OTS with a contact angle of around 110.7°.

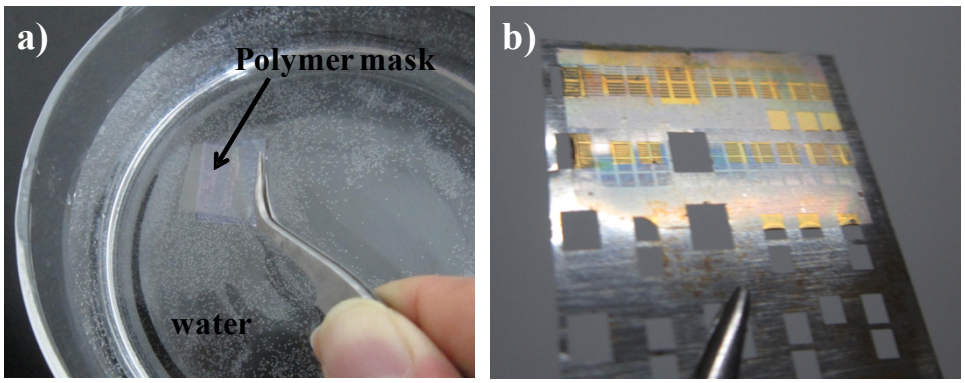

Fig. S2. a) The demonstration of the polymer mask to lift off. (b) The polymer mask on the metal supporting plate.

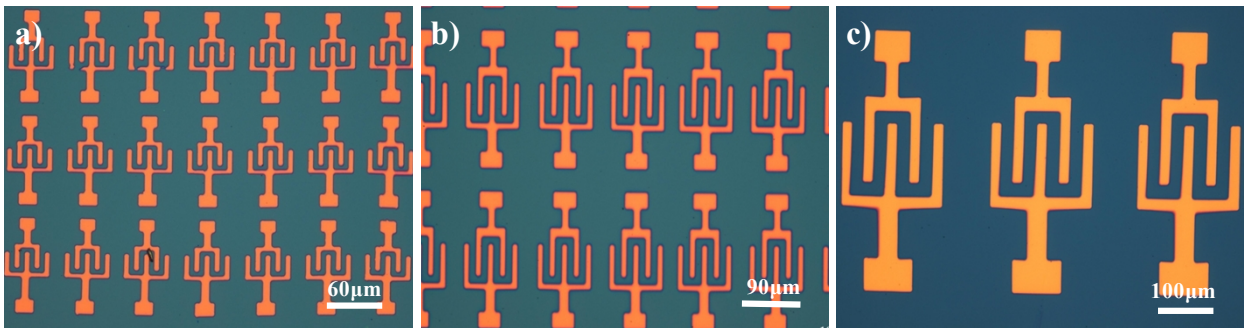

Fig. S3. Different channel size a) 5 µm, b) 10µm and c) 20 µm of electrode arrays on silicon dioxide.

Fig. S4. Polymer mask based on polymethyl methacrylate (PMMA), PAN and PI.

Fig. S5. Trapped holes in the grain boundary.

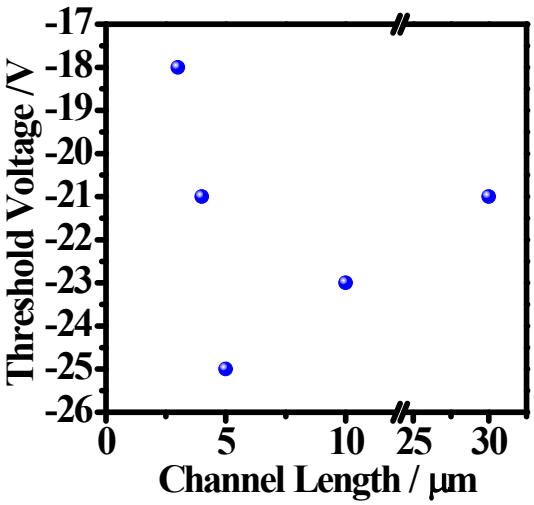

Fig. S6. Threshold voltage as a function of channel length.

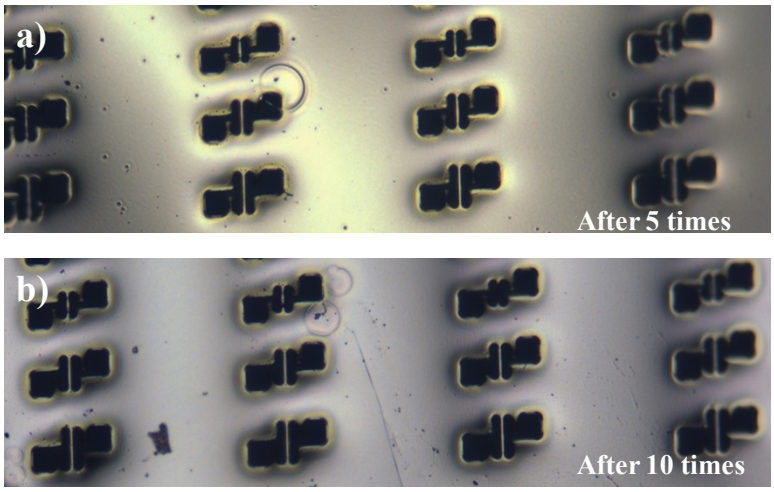

Fig. S7. (a) Polymer mask after 5 times use. (b) Polymer mask after 10 times use.