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Electronic Supplementary Information for

All-solution-processed, flexible thin-film transistor based on PANI/PETA as gate/gate insulator

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1. Experimental Section

Formation of CSA-doped PANI Gate Electrodes. All chemicals were purchased from Sigma-Aldrich and used as received. Water (30 mL) and $CHCl_3$ (60 mL) were mixed at a volumetric ratio of 1 to 2, followed by the addition of HCl (96 mmol). Aniline monomer (22 mmol) was added dropwise into the solution followed by vigorous stirring. An ammonium persulfate (APS) solution, prepared by adding APS powder (11 mmol) to 5.76 M HCl solution (15 mL), was introduced into the monomer solution at −30 °C. The obtained PANI was washed consecutively with distilled water, ethanol, and acetone. After drying, the PANI was deprotonated in a 1 M aqueous solution of NH_4OH. The dedoped PANI was washed again and dried. For secondary doping, PANI and CSA were mixed in a mortar and dissolved in *m*-cresol. The CSA-doped PANI gate electrodes were spin-coated onto a flexible PES substrate. The film was dried on a hot-plate at 100 °C for 12 h.

Fabrication of Organic TFTs with Ag Source/Drain Electrodes. The gate insulator layer was formed by spin-coating acrylate resin onto the PANI-coated substrate. The acrylate resin was prepared by dissolving 1 wt% of diphenyl(2,4,6-trimethylbenzoyl)phosphine oxide, a photoinitiator, into PETA followed by stirring for 48 h. Then, the acrylate resin was spin coated onto the substrate at 6000 rpm for 40 sec, and the spin-coated acrylate resin was photo-cured by irradiation of UV light using mercury lamp (300 W). All experiments were performed at room temperature in a glove box that provided oxygen-free conditions, and the samples have the UV-curing time of 60 sec in order to give a sufficient time for crosslinking. Highly doped Si substrates with a 300 nm layer of thermally grown oxide were used for Si-gated control devices without any treatment. Ag source and drain electrodes for the TFTs

were constructed on gate insulator of both PETA and SiO_2 by inkjet printing of a silver nanoparticle dispersion (20 wt% Ag) containing 10 wt% propylene glycol and 0.05% of BYK®-348 as wetting agents. The printing was performed with an Omnijet 200 printer (Unijet Co., LTD, Korea) with 30 pL-jetting piezoelectric printheads (Samsung Electro-Mechanics). Uniform droplet effluence was achieved by applying 50 V pulse (5 s long) at a frequency of 500 Hz. The printed pattern was sintered under N_2 atmosphere in a glove box at 150 °C for 30 min. Thin films of active semiconductor were formed by drop-casting a 2 wt% solution of TIPS-pentacene in chlorobenzene, onto the channel between the Ag source-drain electrodes.

Characterization of Thin Films and Organic TFTs. Electrical resistance of the CSA-doped PANI gate electrodes was measured by using a four-point probe method with a Keithley 2400 sourcemeter (Keithley, Cleveland, OH, USA) at 25 °C. Optical micrographs were acquired by using an Eclipse LV100POL microscope (Nikon Instruments Inc., Japan). Atomic force microscopy (AFM; XE-70, Park Systems, Korea) was used to examine the surface morphology of the CSA-doped PANI gate electrodes and TIPS-pentacene crystals. Field-emission scanning electron microscopy (FE-SEM) and focused ion beam (FIB; Carl Zeiss, Auriga, Germany) were used to investigate the interface between the PANI gate electrodes and the PES substrate. The transistors were tested by using an Agilent HP4155C semiconductor parameter analyzer. Capacitance-voltage characteristics of the metal–insulator–metal (MIM) capacitors were measured by using an HP 4284 precision LCR meter. The measured capacitance values were 10.6 nF/cm^2 for SiO_2 and 1.2 nF/cm^2 for PETA. Water contact angles were measured on the surfaces of both PANI/PETA and Si/SiO_2

substrates with a Phoenix 300 (Surface Electro Optics, Korea), and the results were analyzed with ImagePro 300 software.

2. Device configurations

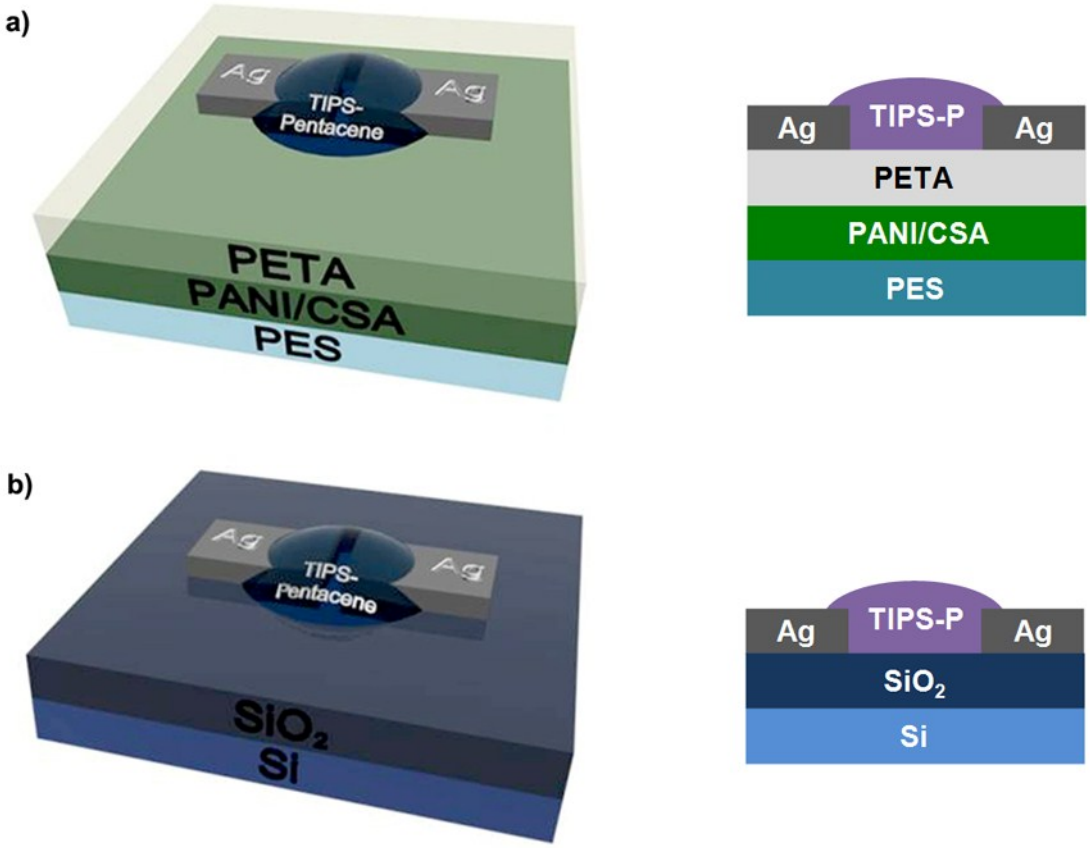

Fig. S1 Schematic diagrams of (a) PANI/PETA- and (b) Si/SiO_2 TIPS-pentacene TFTs.

3. AFM image for PANI-based gate electrode

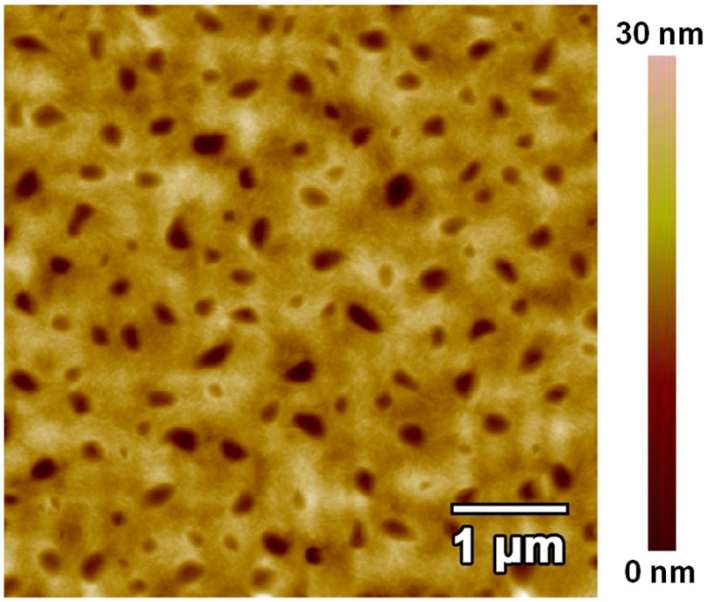

Fig. S2 AFM height image of a CSA-doped PANI gate electrode.

4. FT-IR/ATR spectroscopy

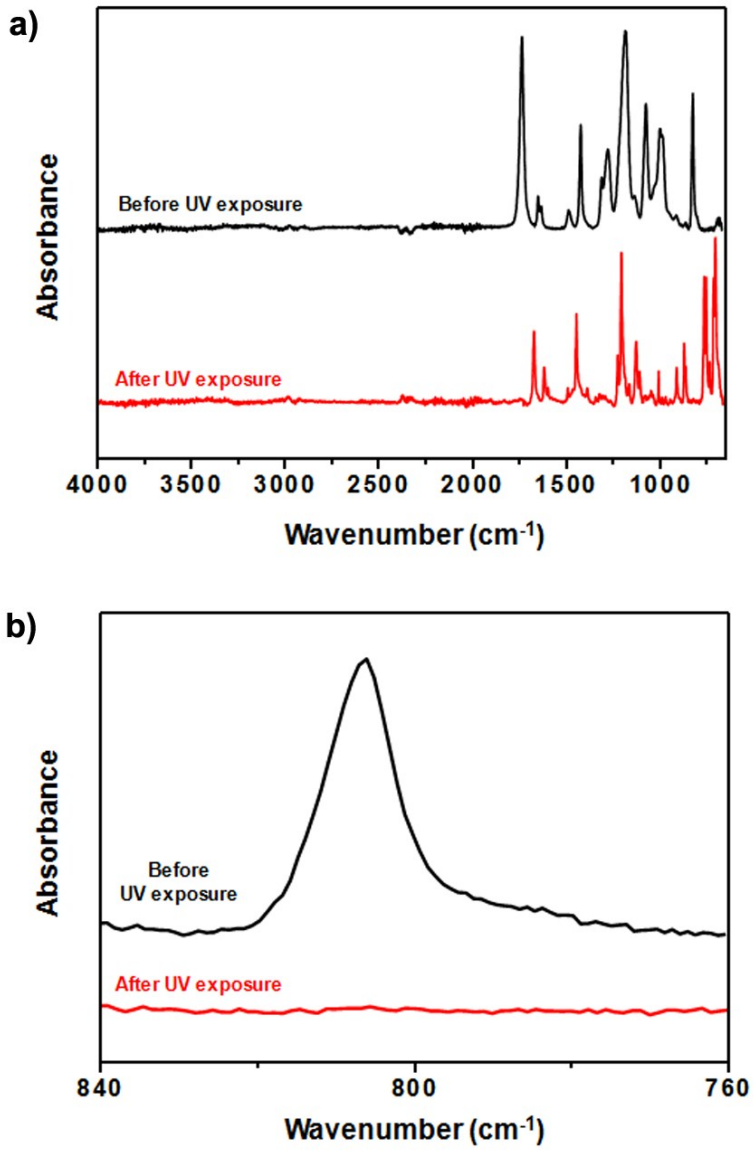

Fig. S3 (a-b) FT-IR/ATR spectra of the PETA films before (black) and after (red) UV exposure. The UV (300 W) irradiation time is 60 sec.

5. Film thickness analysis

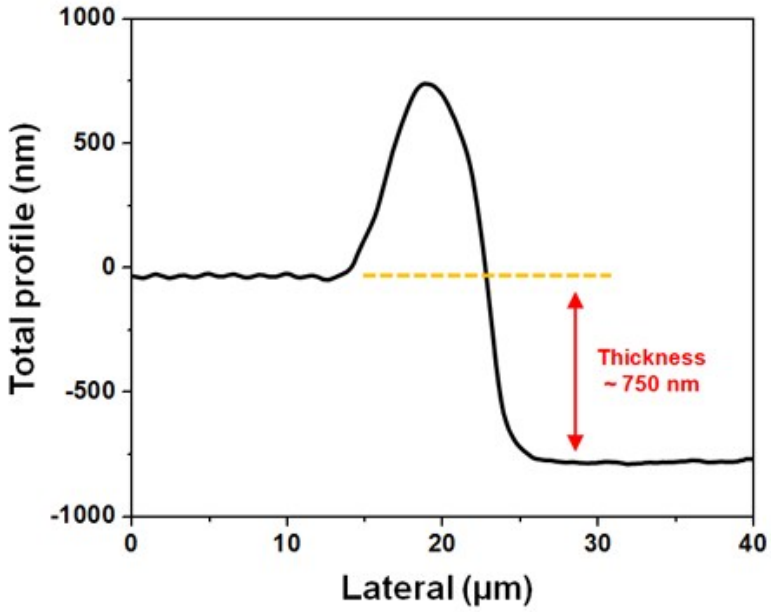

Fig. S4 Height profile along an edge for PETA film.

6. Electrical output and transfer characteristics

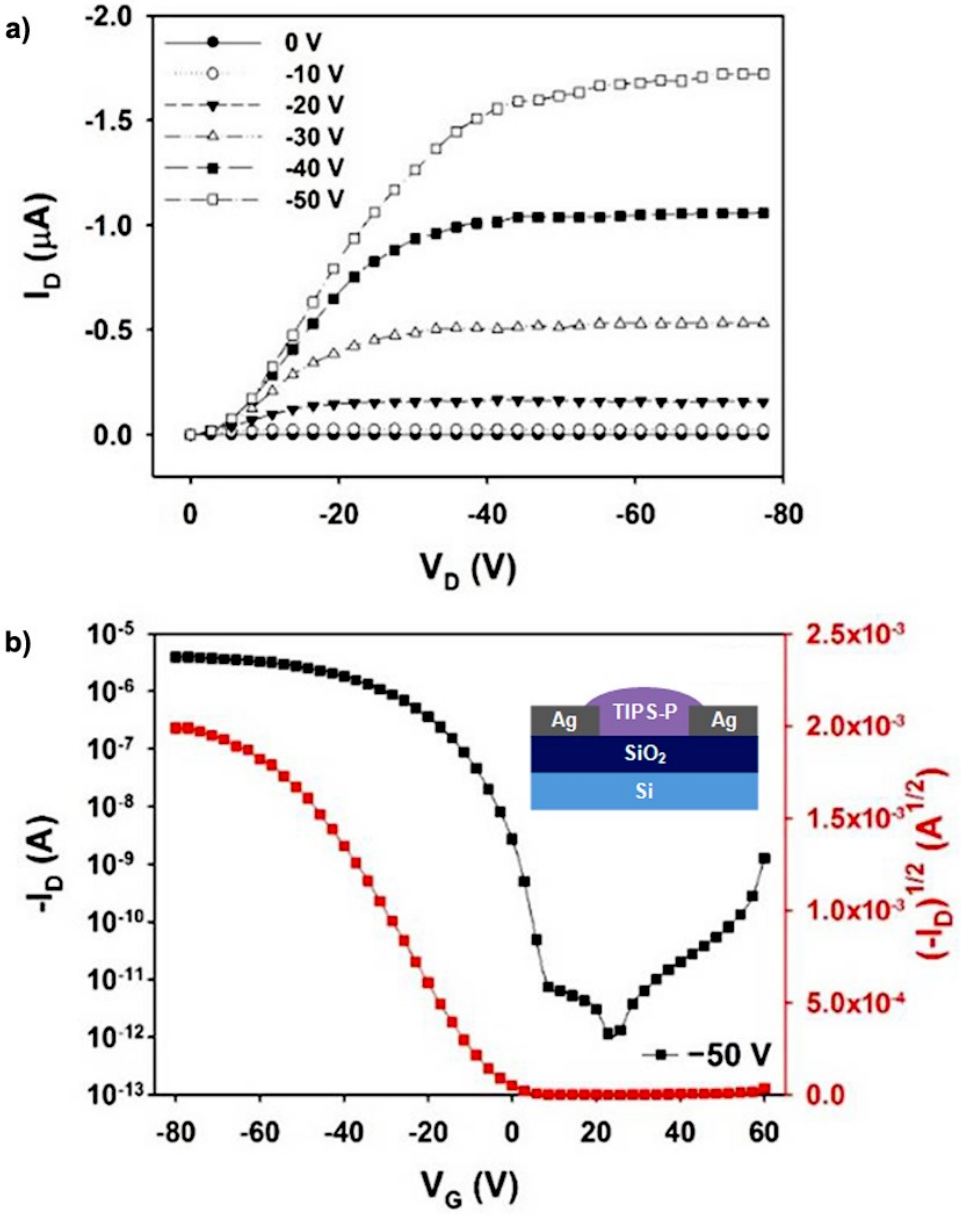

Fig. S5 Current-voltage characteristics of TIPS-pentacene OTFTs with (a),(b) Si/SiO_2 as gate electrode/gate insulator.

7. Mobility distribution

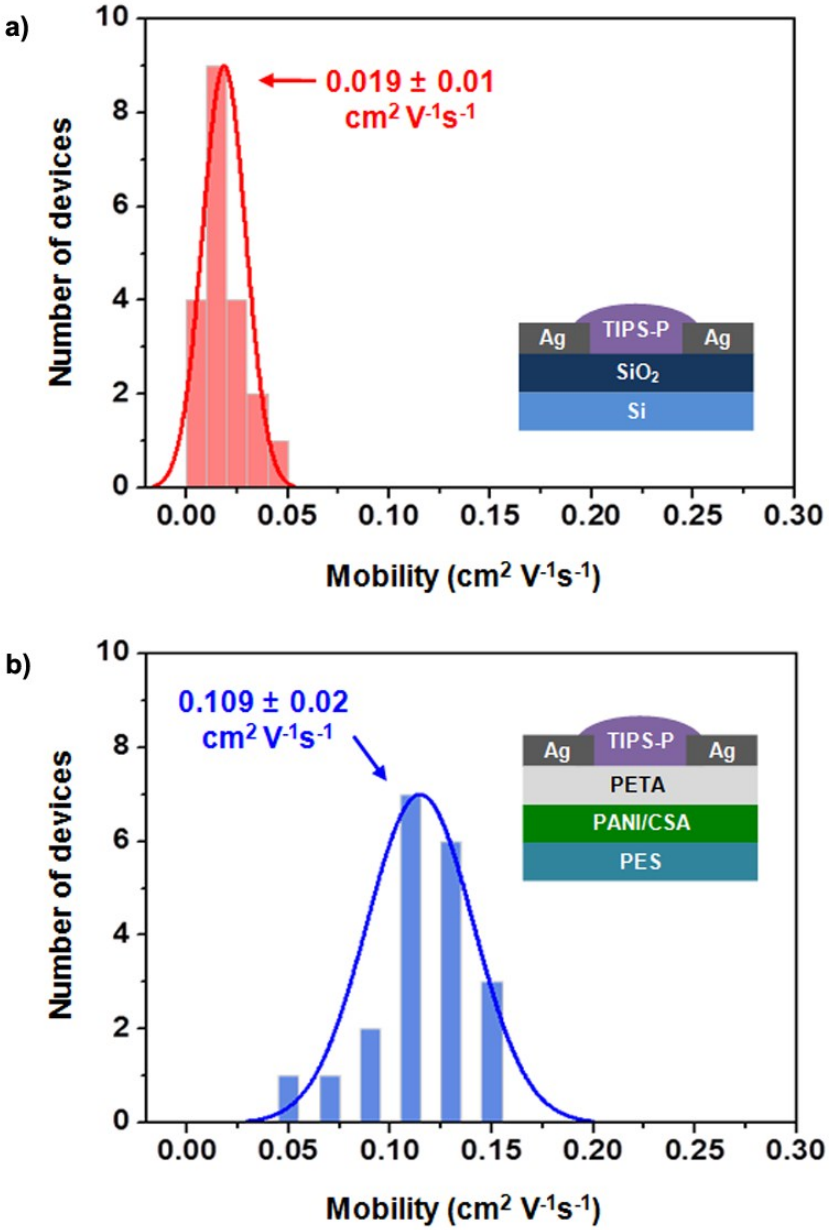

Fig. S6 Mobility distributions for 20 TFT devices prepared by the (a) Si/SiO_2 and (b) PANI/PETA.

8. AFM images of TIPS-pentacene in the channel area

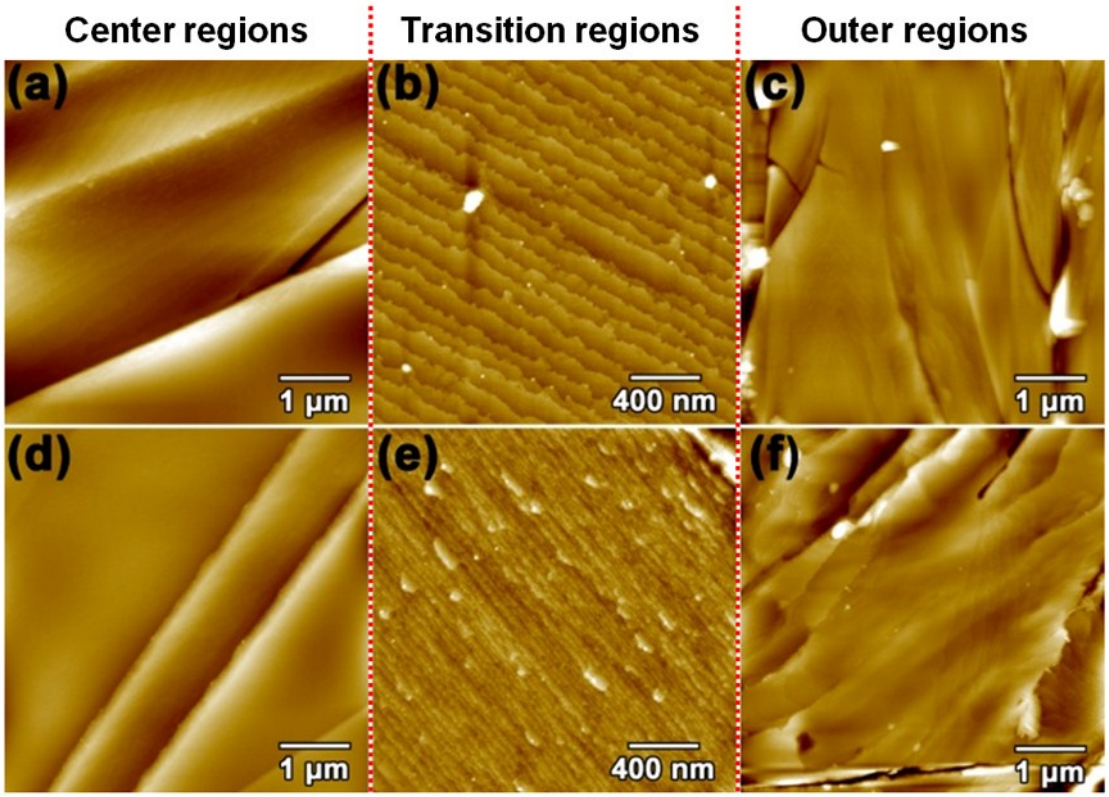

Fig. S7 AFM images of TIPS-pentacene in the channel area of TFTs with (a-c) PANI/PETA and (d-f) Si/SiO_2

9. Contact angle measurement

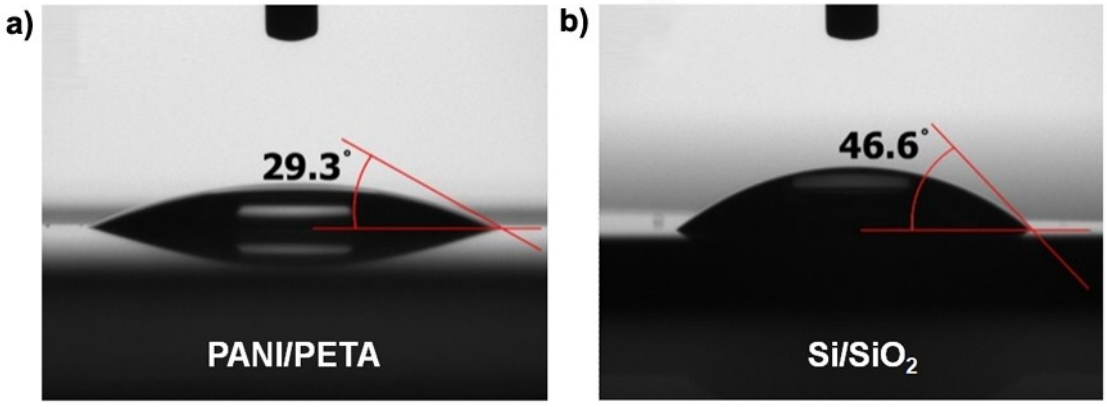

Fig. S8 Optical images of water droplet on the surface of the (a) PANI/PETA and (b) Si/SiO_2 substrate.