

Supporting Information

**Efficient as-cast semitransparent organic solar cells with efficiency over 9% and  
a high average visible transmittance of 27.6%**

Wenyan Su,<sup>a</sup> Qunping Fan,<sup>a</sup> Xia Guo,<sup>a</sup> Jingnan Wu,<sup>a</sup> Maojie Zhang\*<sup>a</sup> and Yongfang

Li<sup>ab</sup>

<sup>a</sup>Laboratory of Advanced Optoelectronic Materials, College of Chemistry, Chemical  
Engineering and Materials Science, Soochow University, Suzhou 215123, China

E-mail: mjzhang@suda.edu.cn

<sup>b</sup>CAS Research/Education Center for Excellence in Molecular Sciences, CAS Key  
Laboratory of Organic Solids, Institute of Chemistry, Chinese Academy of Sciences,  
Beijing 100190, China

**Materials**

Commercially available chemicals were used without further purification. Solvents were dried and distilled from appropriate drying agents prior to use. PBFTT<sup>1</sup> and IT-4Cl<sup>2</sup> was synthesized according to the procedure reported in the literature.

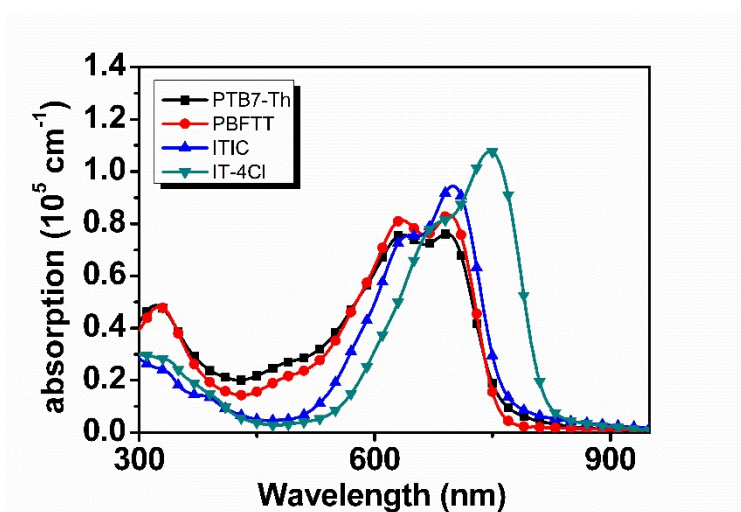
**Experimental Section**

*Measurements:* UV-vis absorption spectrum was recorded on a UV-Vis-NIR Spectrophotometer of Agilent Technologies Cary Series. Atomic force microscopy (AFM) measurements were performed on a Dimension 3100 (Veeco) Atomic Force Microscope in the tapping mode. Transmission electron microscopy (TEM) was performed using a Tecnai G2 F20 S-TWIN instrument at 200 kV accelerating voltage.

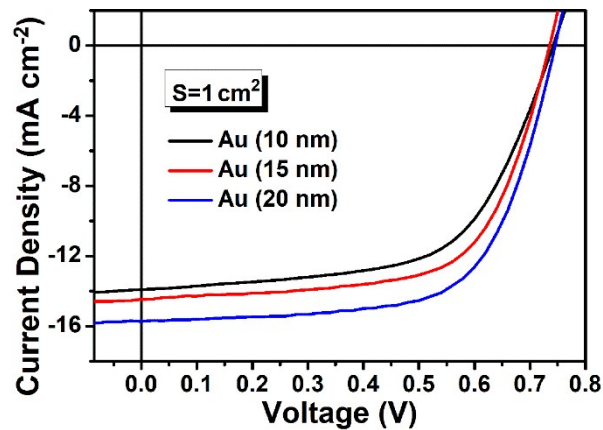
TEM was performed using a Tecnai G2 F20 S-TWIN instrument at 200 kV accelerating voltage, in which the blend films were prepared using a processing technique, as following: first, the blend films were spin-cast on the PEDOT:PSS/ITO substrates; second, the resulting blend film/PEDOT:PSS/ITO substrates were submerged in deionized water to make these blend films float onto the air-water interface; finally, the floated blend films were taken up on unsupported 200 mesh copper grids for a TEM measurement.

**Fabrication and characterization of polymer solar cells.** Polymer solar cell devices with a inverted device structure of ITO/ZnO/PBFTT:IT-4Cl/MoO<sub>3</sub>/Al (or Au) were fabricated under conditions as follows: patterned indium tin oxide (ITO)-coated glass with a sheet resistance of 10-15 ohm/square was cleaned by a surfactant scrub and then underwent a wet-cleaning process inside an ultrasonic bath, beginning with deionized water followed by acetone and isopropanol. After oxygen plasma cleaning for 10 min, then the ZnO layer with a thickness of 30 nm was deposited by spin-coating under 2000 rpm for 60 s on top of the ITO substrate. ZnO nanoparticles were synthesized followed the literature.<sup>3</sup> The active layer was then deposited on top of the ZnO layer by spin-coating a solution of chlorobenzene (CB) (10 mg mL<sup>-1</sup> of PBFTT in the solution of PBFTT:IT-4Cl, dissolved 8 h under 80 °C) of PBFTT:IT-4Cl. Finally, MoO<sub>3</sub> (10 nm), and Al (80 nm) or Au (10 or 15 or 20 nm) were successively deposited on the photosensitive layer under vacuum at a pressure of ca.  $\sim 10^{-5}$  Pa, and through a shadow mask to determine the active area of the devices (0.0665 cm<sup>2</sup>). The PCE values of the PSCs were measured under a illumination of AM 1.5G (100

mW/cm<sup>2</sup>) using a SS-F5-3A solar simulator (AAA grade, 50 × 50 mm<sup>2</sup> photobeam size) of Enli Technology CO., Ltd.. A 2 × 2 cm<sup>2</sup> monocrystalline silicon reference cell (SRC-00019) was purchased from Enli Technology CO., Ltd. PCE statistics were obtained using 20 individual devices fabricated under the same conditions. The EQE was measured by Solar Cell Spectral Response Measurement System QE-R3011 of Enli Technology CO., Ltd. The light intensity at each wavelength was calibrated with a standard single crystal Si photovoltaic cell. To study the charge generation and dissociation processes of the PBFTT:IT-4Cl-based PSCs, plots of the photocurrent ( $J_{\text{ph}}$ ) versus effective voltage ( $V_{\text{eff}}$ ) of the PSCs were measured. Here,  $J_{\text{ph}}$  and  $V_{\text{eff}}$  are defined as  $J_{\text{ph}} = J_{\text{L}} - J_{\text{D}}$  and  $V_{\text{eff}} = V_0 - V_{\text{appl}}$ , respectively, where  $J_{\text{D}}$  and  $J_{\text{L}}$  are the photocurrent densities in the dark and under the illumination, and  $V_{\text{appl}}$  is the applied bias voltage and  $V_0$  is the voltage at which  $J_{\text{ph}} = 0$ , respectively.<sup>4</sup> The  $J_{\text{ph}}$  reaches the saturation current density ( $J_{\text{sat}}$ ) at high  $V_{\text{eff}}$  ( $\geq 2$  V in this case).



**Fig. S1** The absorption spectra of the PTB7-Th, PBFTT, ITIC, and IT-4Cl in pure films.



**Fig. S2** The  $J$ - $V$  curves of the ST-OSCs with a large device area of  $1.00 \text{ cm}^2$  and different thickness Au layers.

**Table S1** Photovoltaic data of the ST-OSCs with a large device area of  $1.00 \text{ cm}^2$  and different thickness Au layers.

Electrode	$V_{oc}$ [V]	$J_{sc}$ [ $\text{mA cm}^{-2}$ ]	FF [%]	PCE <sup>a</sup> [%]
Au (10 nm)	0.74	13.9	60.7	6.3 (6.0)
Au (15 nm)	0.74	14.5	65.0	6.9 (6.7)
Au (20 nm)	0.74	15.7	66.1	7.7 (7.5)

<sup>a</sup>The average PCEs in parentheses from 5 devices

## References

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