Supporting Information

Semi-transparent polymer solar cells with 6% PCE, 25% average visible transmittance and color rendering index close to 100 for power generating window applications

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Material preparation, device fabrication, and characterizations

PBDTTT-C-T is synthesized according to the procedure reported earlier.[1] PBDTTT-C-T (10 mg ml^{-1}) and PC$_{71}$BM (American Dye Source, 15 mg ml^{-1}) were dissolved in 1,2-dichlorobenzene with 3 vol% of 1,8-diiodooctaneas the processing additive. 1,2-dichlorobenzene (Aldrich) and 1,8-diiodooctane (Aldrich) were used without further purification. The PBDTTT-C-T:PC$_{71}$BM blend solution was heatedfor homogenous mixing but was cooled and filtered with 0.45 μm PTFE filter before use. The ZnO precursor was prepared following the procedure reported by Sun et al.[2]Zinc acetate dihydrate (Aldrich, 99.9%, 1 g) is dissolved in and ethanolamine (Aldrich, 99.5%, 0.28 g) are dissolved in 2-methoxyethanol (Aldrich, 99.8%, 10 mL) under vigorous stirring for a least 12 h and filtered (0.45 μm PTFE) before use. C$_{60}$-SAM molecules were dissolved in chlorobenzene (Aldrich, 50 vol%) and tetrahydrofuran (THF, Aldrich, 50 vol%) co-solvent at the concentration of 1 wt%.

ITO-coated glass substrates were cleaned sequentially by sonication in detergent, de-ionized water, acetone, and isopropyl alcohol, and dried in a nitrogen stream, followed by 30 s of oxygen plasma treatment. The deposition of each layer is described as followed. ZnO precursor solution was first spin-coated on the ITO-coated glass substrates to deposit a thin ZnO layer (ca. 33 nm) and baked at 200°C for 1 h under ambient condition. The substrates were then transferred into a nitrogen-filled glovebox for the following processing. The self-assembly of the C$_{60}$-SAM was performed by spin-coating of the C$_{60}$-SAM solution on top of the ZnO surface. The substrates were washed with THF to remove unbound C$_{60}$-SAM molecules. Subsequently, the PBDTTT-C-T:PC$_{71}$BM active layer (ca. 90 nm) was spin-coated on the ZnO layer from filtered solution. No further post-treatments such as thermal annealing were performed on the devices.The substrates pumped down to high vacuum ($< 2\times10^{-6}$Torr) in the evaporator chamber, and then MoO$_3$ (5 nm) and silver (6 nm - 60 nm) weresequentially evaporated onto the active layer through shadow masks to define the active area of the devices.

The current density-voltage (*J*-*V*) characteristics of photovoltaic devices were measured in an inert environment using a Keithley 2400 source-measurement unit under simulated AM 1.5 global illumination from an 300 Watt Solar Lightsolar simulator. A Hamamatsu silicon solar cell with a KG5 color filter, which is traced to the National Renewable Energy Laboratory (NREL), was used as the reference cell to calibrate the light intensity to 1 sun (100 mW/cm^2). The spectral external quantum efficiency was recorded under chopped illumination in ambient atmosphere. The photocurrent was recorded with a lock-in-amplifier (Stanford Research Systems SR830).

Table S1. Special color rendering indices (CRIs) of the transmitted light of the STOPV devices under AM1.5G illumination.

	0 nm	6 nm	12 nm	18 nm	30 nm	60 nm
Special CRI - TCS01	97.7	95.0	96.3	97.5	97.9	97.6
Special CRI - TCS02	98.7	96.9	97.6	97.8	96.8	94.8
Special CRI - TCS03	99.5	99.3	98.9	98.3	96.0	91.2
Special CRI - TCS04	98.2	96.1	97.1	97.7	96.6	93.0
Special CRI - TCS05	98.1	95.6	96.9	98.0	98.4	98.2
Special CRI - TCS06	98.8	96.6	97.5	97.6	96.5	94.5
Special CRI - TCS07	98.1	97.8	97.2	97.2	96.2	93.7
Special CRI - TCS08	95.1	92.8	93.1	94.6	95.5	95.6

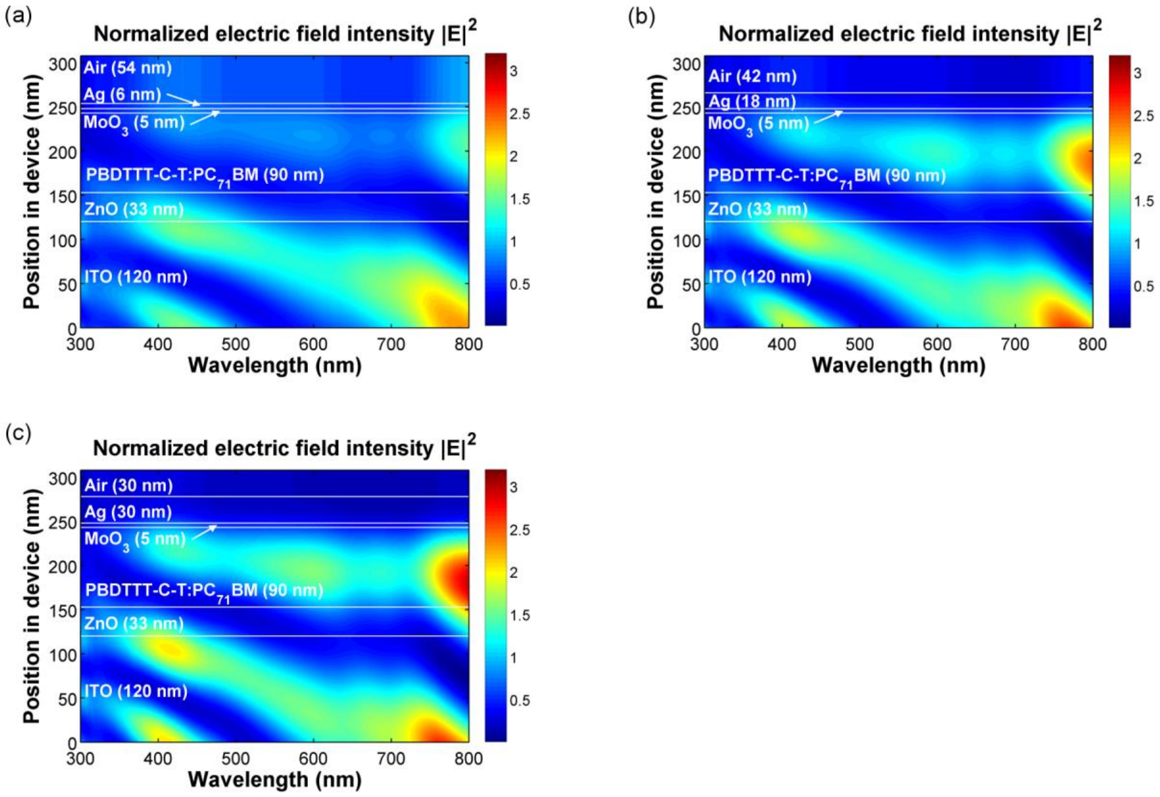

Figure S1. Simulations for the electric field intensity profile |E|^2 in the studied STOPV devices with (a) 6 nm, (b) 18 nm and (c) 30 nm of Ag electrode.

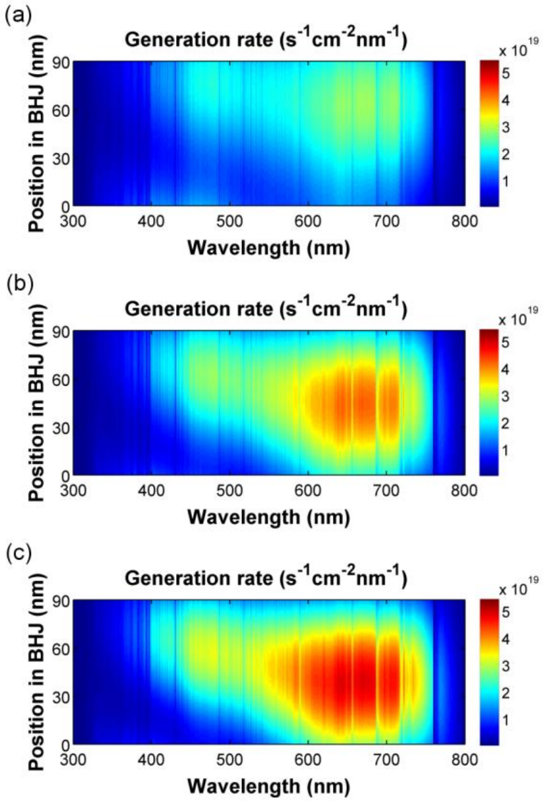

Figure S2. Simulations of exciton generation rate in the studied STOPV devices with (a) 6 nm, (b) 18 nm, and (c) 30 nm of Ag electrode.

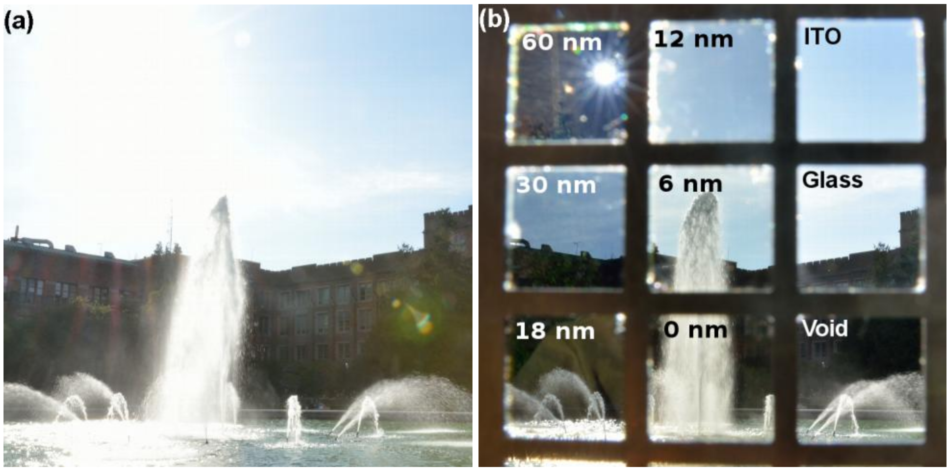

Figure S3. (a) Drumheller Fountain in the University of Washington in a sunny day. (b) Look of the fountain through the STOPV devices with different thickness of silver electrodes. Blank ITO and glass substrate are also compared.

1. L. Huo, S. Zhang, X. Guo, F. Xu, Y. Li and J. Hou, *Angew. Chem. Int. Ed.*, 2011, **50**, 9697-9702.
2. Y. Sun, J. Seo, C. Takacs, J. Seifter and A. Heeger, *Adv. Mater.*, 2011, **23**, 1679-1683.