Electronic Supplementary Information for:

Ambient roll-to-roll fabrication of flexible solar cells based on small molecules

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Materials. Unless stated otherwise, solvents and chemicals were obtained commercially and were used without further purification. Coating was performed on poly(ethyleneterephthalate) (PET) substrate that comprise a highly conducting metal grid, semi-transparent conductor and hole blocking layer (freely available for academics from www.plasticphotovoltaics.com). The PET/Ag grid substrates were prepared according to the literature procedures.[1] The metal grid had a hexagonal pattern with a line width of 150 mm and a spacing of 2 mm. The height of the lines was 200 nm. The silver grid had a honeycomb structure with 13 mm wide stripes. Two types of highly conductive poly(3,4-ethylenedioxythiophene):poly(styrenesulfonate) (PEDOT:PSS) were employed. For the front electrode (the firstly printed PEDOT:PSS electrode) we employed Clevios PH1000 from Heraeus diluted with isopropyl alcohol in the ratio 10:3 (w/w). The front PEDOT:PSS electrode had a sheet resistivity of 60–90 $\Omega\ \square^{-1}$, and the substrate with metal grid had a sheet resistivity of 10 $\Omega\ \square^{-1}$. For the back electrode we employed a thicker PEDOT:PSS (Clevios SV3 from Heraeus) also diluted with isopropyl alcohol to a viscosity of 300 mPa s. ZnO nanoparticles in acetone with a concentration of 55 mg ml^{-1} was employed for the electron transport layer. The active layer was composed of S(TPA-DPP) (synthesized according to the literature procedure[2]) and PCBM (technical grade from Solenne BV). The PET substrate was Melinex ST506 obtained from Dupont–Teijin. The silver electrodes were printed using a flexographic printing silver paste (PV410 from Dupont). The sheet resistivity of the back PEDOT:PSS electrode was 60 $\Omega\ \square^{-1}$ on its own and the sheet resistivity of the top silver electrode was 0.1 $\Omega\ \square^{-1}$. The dry thickness of the top silver electrode was 6 mm. The PET substrate with Ag grid, PEDOT:PSS layer and ZnO layer has the maximum transmittance of 63.4% at 424 nm, and the transmittance at 550 nm is 60.3%.

Fabrication and characterization of flexible solar cells. For the fabrication of solar cell

devices, we used the technique of slot-die coating. The dissolved material to be coated (the ink) was transferred from an external container via a pump to the slot-die head, where the coating width was defined by the width of the head's bottom slot through which the ink flowed onto the moving substrate, while the coating thickness was dictated by the ink flow rate and the substrate move speed. We prepared active-material inks using different solvents, comprising a blend of the small molecule electron donor S(TPA-DPP) and the electron acceptor PCBM. The ink was deposited as multiple stripes (typically two or three) on a flexible PET substrate, precoated with ZnO-on-high conductive PEDOT:PSS cathodic stripes. The back PEDOT:PSS layer was slot-die coated on the active layer with a further offset of 1 mm (to prevent shorting of the device). The coating was conducted at 80 ^{o}C with a web speed of 0.5 m min^{-1} affording a wet thickness in the range of 200–250 mm. The ink formulation and coating took place in ambient air, with the roller kept at 80 °C to facilitate the drying of the films. The layer was dried on the roll for about 20 min. The silver electrodes were applied by flexographic printing of a heat curing silver paste PV410 (Dupont). The silver paste was added to the flexographic roll and further transferred to the substrate with a web speed of 1.2 m min^{-1} and roll temperature of 80 ^{o}C. The completed solar cells were then divided the substrates into *ca.* 150 individual cells each with an active area of 1 cm^{2}. Solar cells were measured with a Keithley 2400 sourcemeter under a KHS 575 solar simulator with an AM1.5G 100 mW cm^{-2} intensity.

Light beam induced current (LBIC) mapping. The LBIC experiments were carried out using a custom made setup with 410 nm laser diode (5 mW output power, 100 μm spot size ≈65 W cm^{-2}, ThorLabs) mounted on a computer controlled XY-stage and focused to a spot size of <100 μm. The short circuit current from the device under study was measured using a computer controlled source measure unit (SMU, a Keithley 2400 instrument). A custom written computer program was used to

scan the solar cell devices in a raster pattern in 200 μm steps in the *X* and the *Y* directions, logging the coordinates and measured current. The results were then converted to yellow/blue colored bitmaps in 255 different hues with another custom written program. Bright yellow represents the highest absolute current extracted while blue represents the lowest current. Current profiles along selected directions were taken from these maps to visualize the relative differences in different regions.

Morphology measurement. The nanoscale morphology of blend film was observed by using a Veeco Nanoscopy V atomic force microscopy (AFM) in tapping mode.

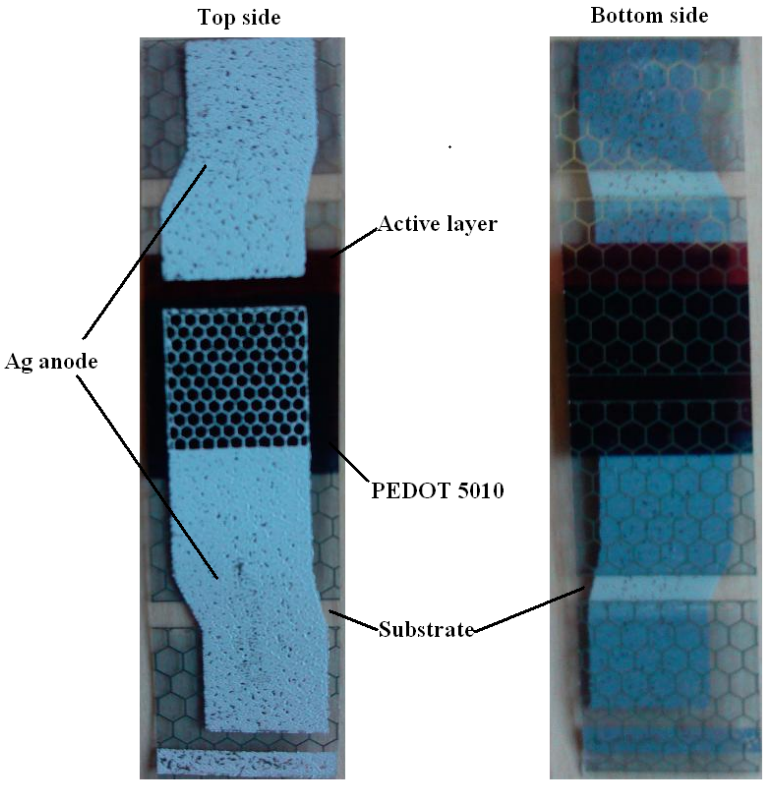

Fig. S1 The optical images of an individual solar cell fabricated by mini roll coater.

References

S1. M. Hösel, R. R. Søndergaard, M. Jørgensen and F. C. Krebs, *Energy Technol.*, 2013, **1**, 102-107.

S2. Y. Lin, P. Cheng, Y. Li and X. Zhan, *Chem. Commun.*, 2012, **48**, 4773-4775.