

## Supporting Information

# ITO-Free Tandem Polymer Solar Cells on Opaque Substrates with Top Illumination

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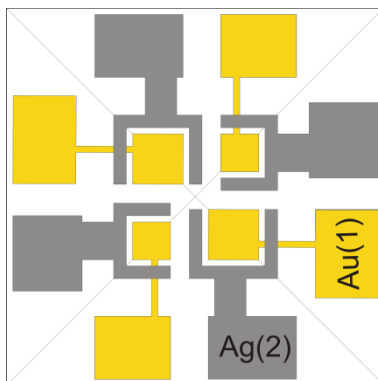
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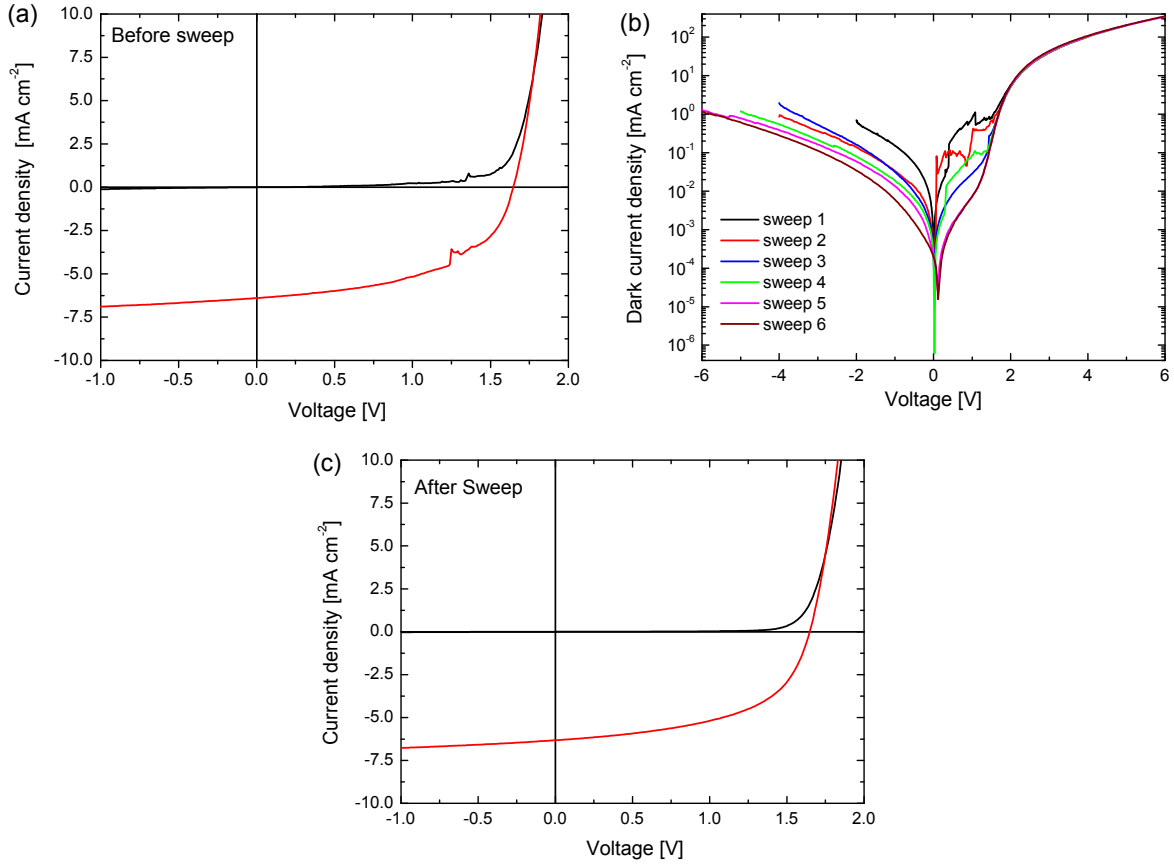
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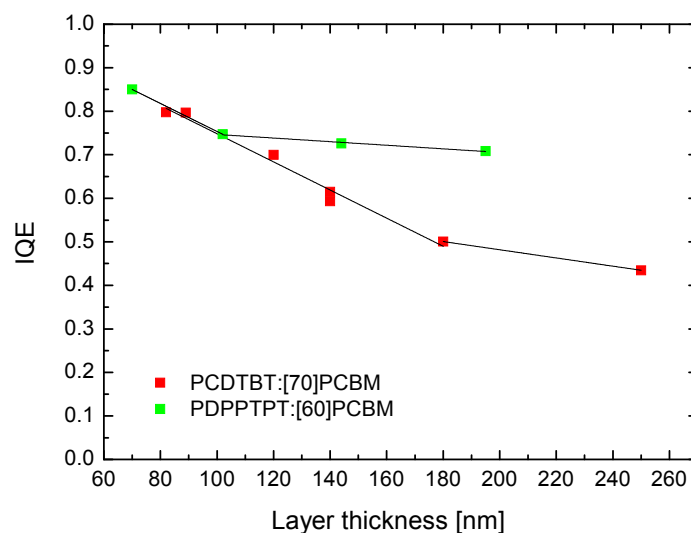
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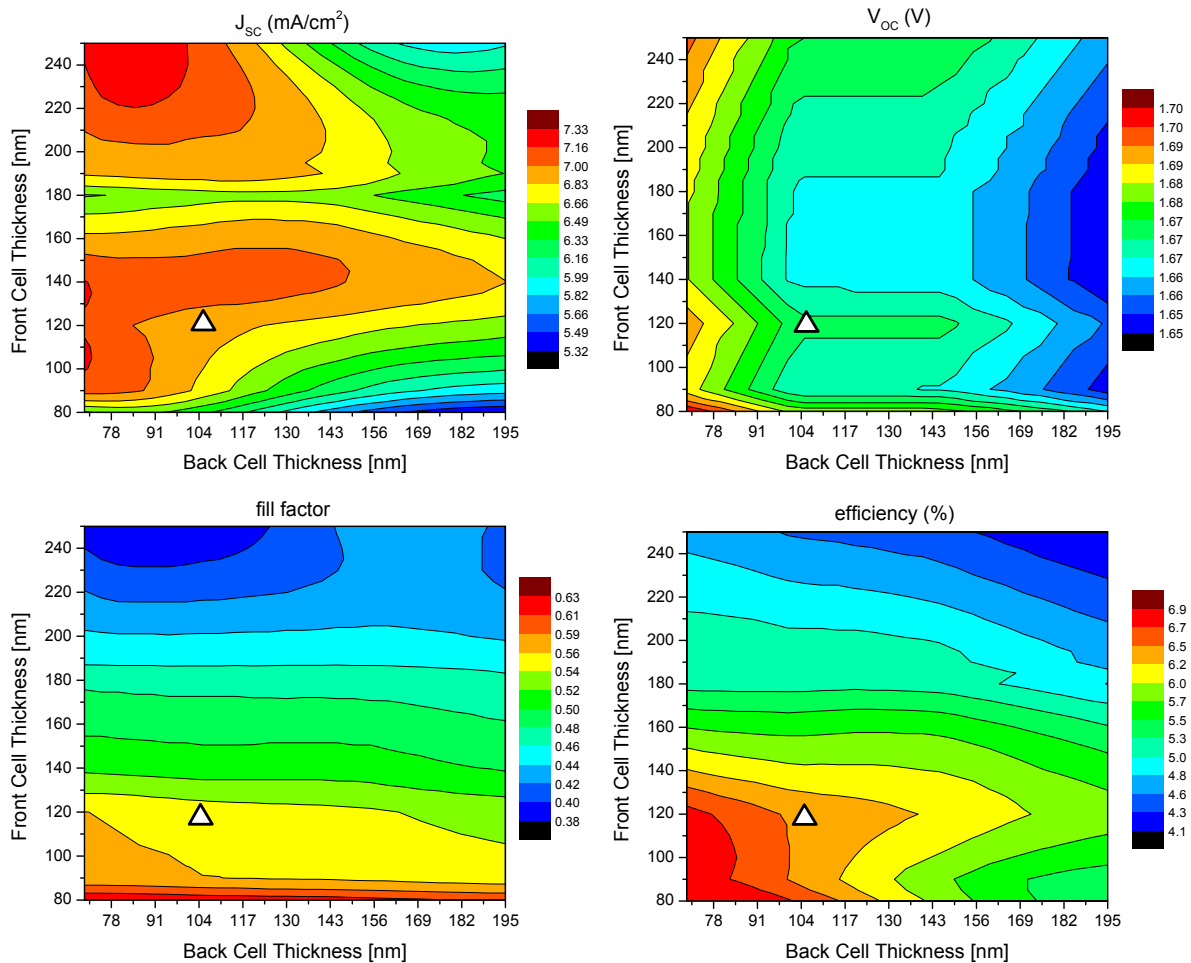
**Figure S1.** Drawing of device contact pad layout. Bottom Au(1) electrodes (yellow) located around the center of the substrate have square shape with two different areas  $0.09 \text{ cm}^2$  and  $0.16 \text{ cm}^2$ . These metal patches are connected to larger contact pads via a thin metal line. The shape is chosen as such to reduce the relative area of the contacting patch vs. the actual cell area. To collect current from the PH1000 layer we used the fork-shaped Ag(2) electrodes (grey) “surrounding” the square-shaped Au electrodes.



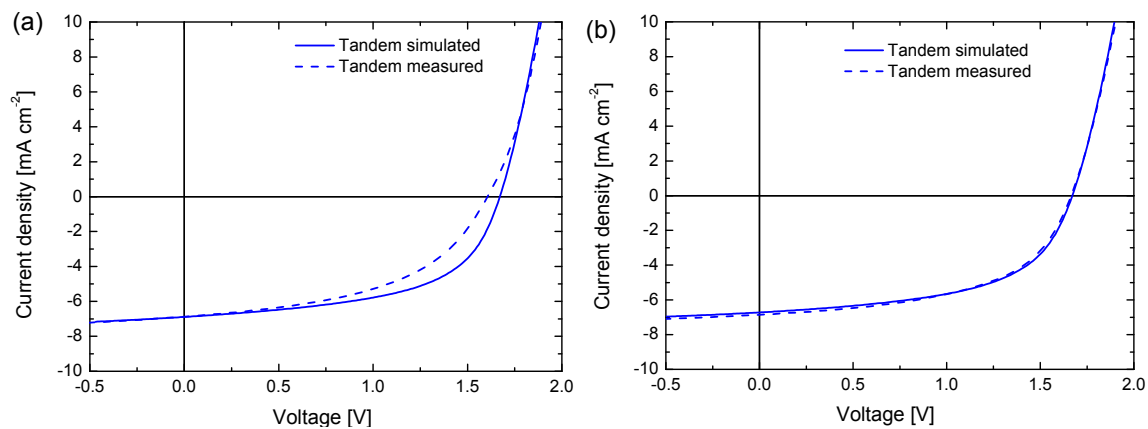
**Figure S2.** (a)  $J$ - $V$  characteristics of the tandem device on an opaque substrate as measured for first time under low voltage sweep ( $-2$  to  $+2$  V). Both the dark and the light  $J$ - $V$  show kink like features in the fourth quadrant where the bias is low. (b) Dark  $J$ - $V$  characteristics under high voltage sweep ( $-6$  to  $6$  V). The fluctuations in the current density disappear after few sweeps. (c) The  $J$ - $V$  characteristics measured after the high voltage sweep.



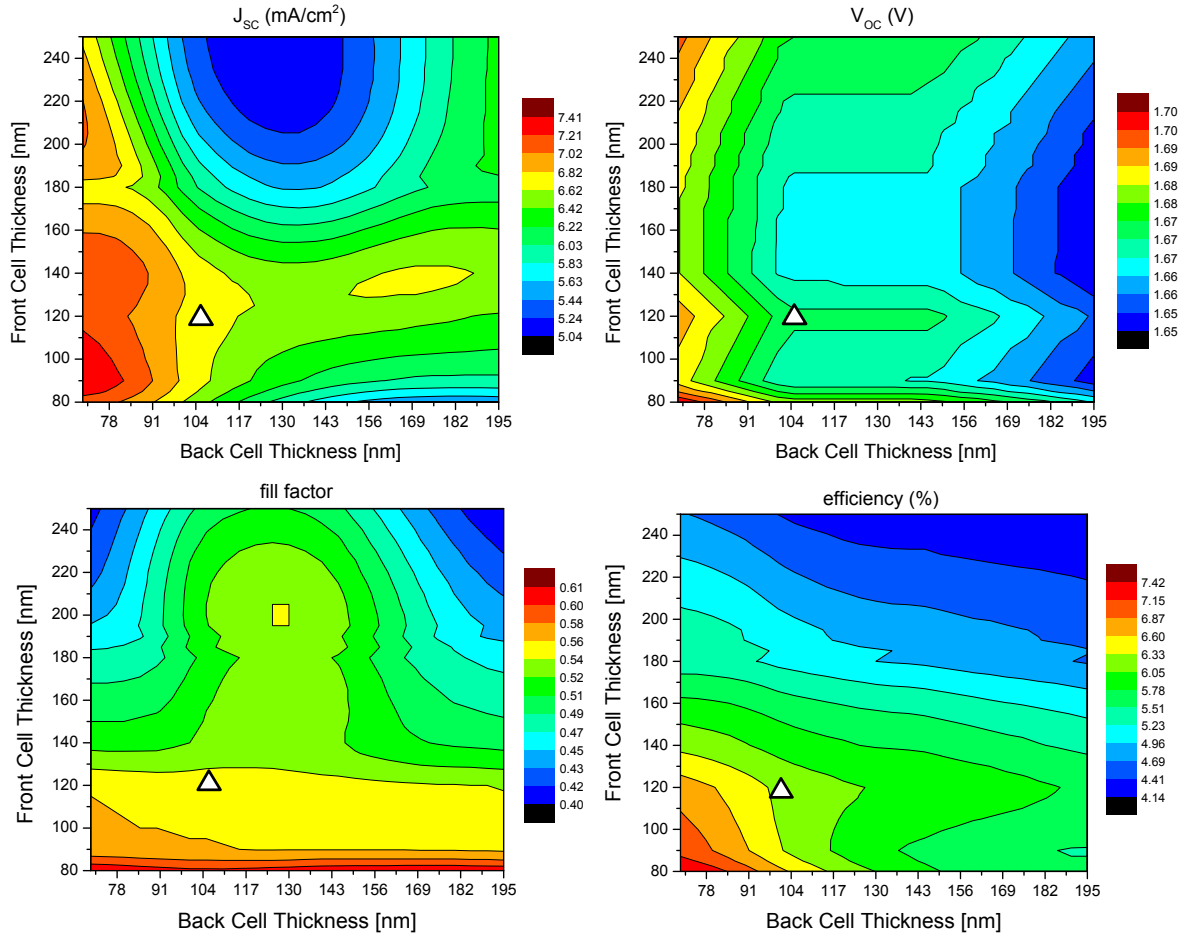
**Figure S3.** Spectrally (AM1.5G) integrated internal quantum efficiency of PCDTBT:[70]PCBM and PDPPTPT:[60]PCBM as a function of layer thicknesses. IQE was determined from the corresponding EQE of single junction cells with varying active layer thicknesses. The wide band gap single junction cells have the configuration: glass / ITO (115 nm) / ZnO (64 nm) / PCDTBT:[70]PCBM / PEDOT:PSS (40 nm) / Ag (100 nm) and the small band gap single junction cells have the configuration: glass / ITO (115 nm) / ZnO (64 nm) / PDPPTPT:[60]PCBM / MoO<sub>3</sub> (10 nm) / Ag (100 nm).



**Figure S4.** Simulation results for tandem cells on a glass/ITO substrate with the configuration: glass / ITO (115 nm) / ZnO (64 nm) / PCDTBT:[70]PCBM / PEDOT:PSS (40 nm) / ZnO (30 nm) / PDPPTPT:[60]PCBM / MoO<sub>3</sub> (10 nm) / Ag (100 nm). Predicted solar cell parameters for tandem device (on ITO substrates) as a function of front cell (80-250 nm) and back cell (70-195 nm) thicknesses.



**Figure S5.** Comparison of the  $J$ – $V$  characteristics obtained by SETFOS calculation and actual measurement for the tandem devices fabricated on a transparent glass/ITO substrate (a) and on an opaque glass/Au substrate (b).



**Figure S6.** Simulation results for tandem cells on an opaque glass/Au substrate with the configuration: glass/ Cr (5nm) / Au (100 nm) / ZnO (64 nm) / PDPPTPT:[60]PCBM / MoO<sub>3</sub> (10 nm) / Ag (1 nm) / ZnO (30 nm) / PCDTBT:[70]PCBM / PH1000 (100 nm) / Ag-grid (100 nm). Predicted parameters for tandem solar cell (on opaque substrates) as a function of front cell (80-250 nm) and back cell (70-195 nm) thickness.