Supporting Information for

Fully printed organic tandem solar cells using solution-processed silver nanowires and opaque silver as charge collecting electrodes

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Table S1 Reported PCE values for fully printed single-junction and tandem organic solar cells.

Year	PCE (%)	Architecture	Substrate	Note	Reference
2009	0.3	Single	Flexible	8-cell module	[S1]
	0.47		Glass		[S2]
2012	1.6	Single	Flexible		[S3]
	1.61				[S4]
	1.7			16-cell module	[S5]
	1.92				[S6]
2013	1.5	Single	Flexible		[S7]
	1.8				[S8]
	1.82			8-cell module	[S9]
	1.94		Glass		[S10]
	1.94		Flexible		[S9]
	2			14.7 m^2 module	[S11]
	2.2		Glass		[S12]
	3.5		Flexible		[S13]
	1.33	Tandem	Flexible		[S14]
2014	1.01	Single	Flexible		[S15]
	1.26				[S16]
	1.83				[S17]
	2.05				[S18]
	2.2				[S19]
	2.3		Glass		[S20]
	2.5		Flexible		[S21]
	2.6				[S22]
	2.77				[S23]
	2.9		Glass		[S24]
	3.2		Flexible		[S25]
	3.8				[S26]
	4.6				[S27]
	1.76	Tandem	Flexible	8-cell module	[S28]
	2.39				[S22]
	2.67				[S19]
2015	2.5	Single	Glass		[S29]
	3.8		Flexible		[S30]
	4.1		Glass		[S31]
	4.74				This work
	5.81	Tandem	Glass		
	4.85		Flexible		

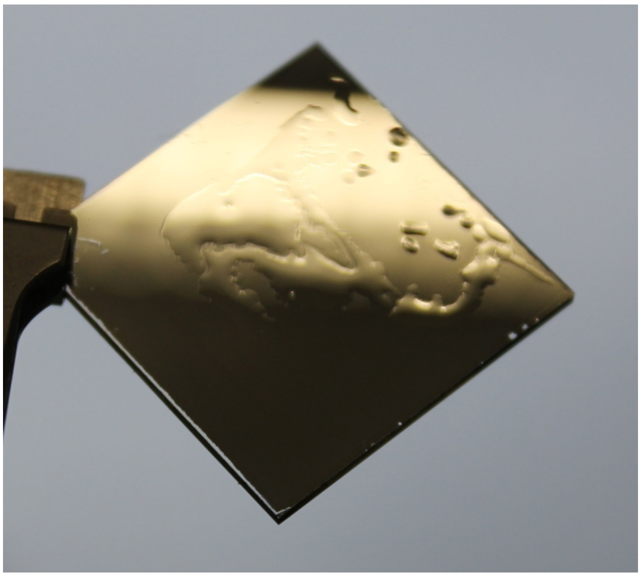

Figure S1 A digital photo of the as-coated Ag film on glass without underlying PEDOT:PSS.

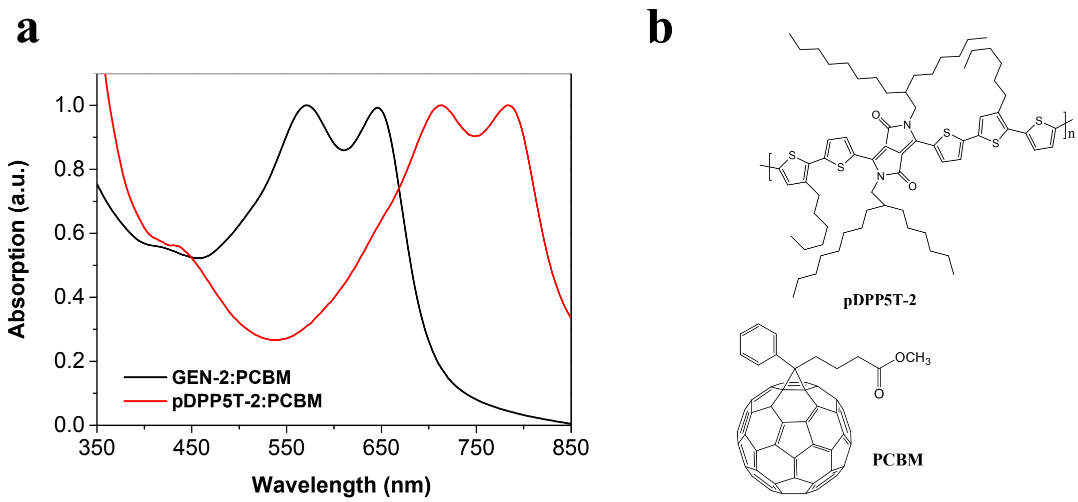

Figure S2 (**a**) Absorption spectra of GEN-2:PCBM and pDPP5T-2:PCBM in solid film. (**b**) Chemical structures of the photoactive materials pDPP5T-2 and PCBM.

Optical simulations

Optical simulations were performed by means of Transfer Matrix Formalism.[S32,S33] This method is widely adopted for the calculation of transmittance, reflectance, absorptance and electric field distribution of thin-film multilayer stacks with consideration of interference effects. The optical constants of the materials (n and k) were measured by spectroscopic ellipsometry and verified by transmission measurements. The wavelength-dependent absorptance in a specific layer is calculated as the difference of the energy density flowing into and out of the layer. The number of absorbed photons is then obtained by convolution of the absorptance and the AM1.5G solar spectrum. To calculate the J_{SC} values from the number of absorbed photons, we assumed constant IQE values of 65% for pDPP5T-2:PCBM and 75% for GEN-2:PCBM sub-cells.

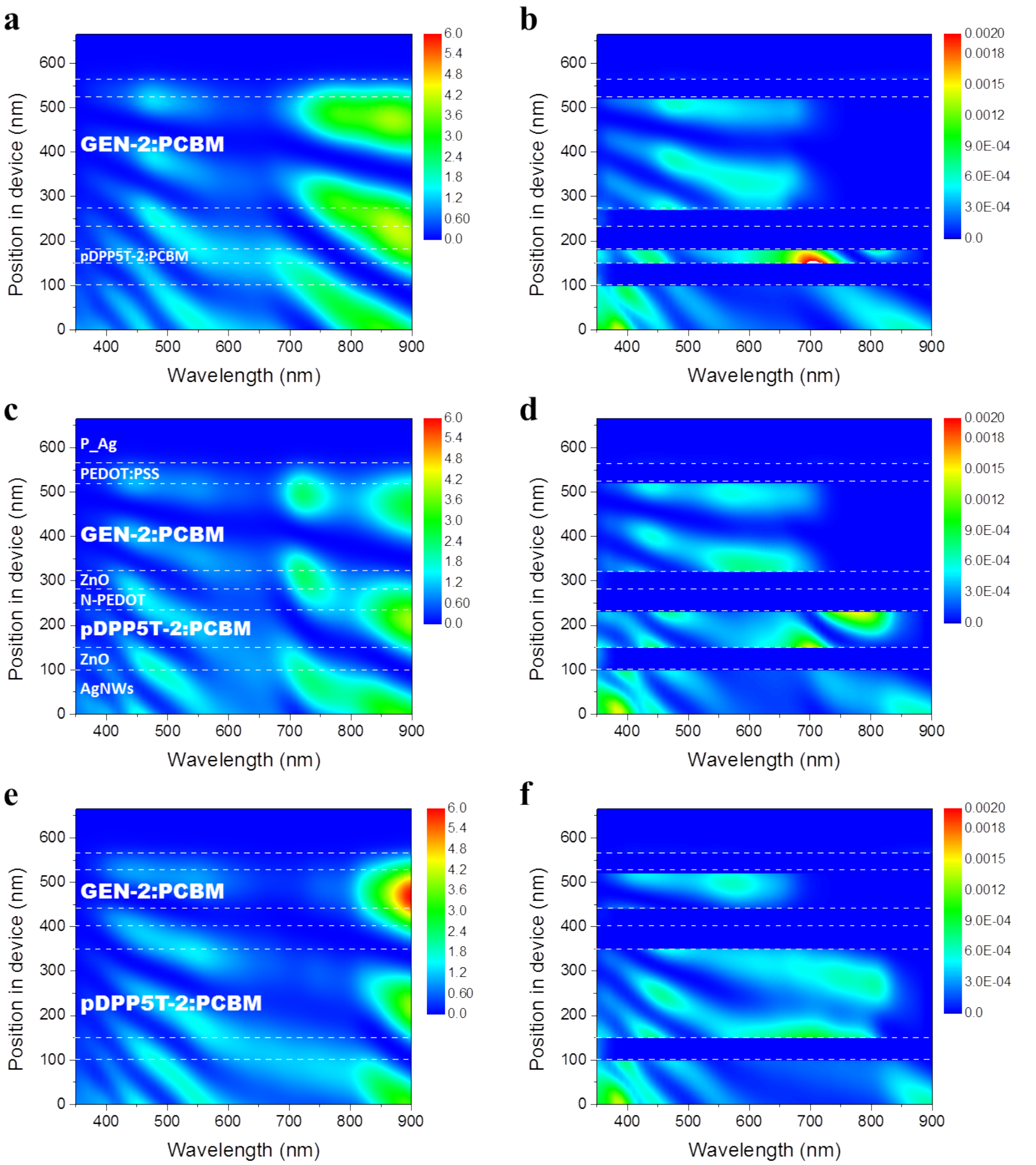

Figure S3 Electric field intensity $|\mathbf{E}(\lambda,d)|^2$ distribution inside the fully printed tandem cells for the active layer thicknesses (pDPP5-2:PCBM / GEN-2:PCBM) of 30/250 nm (**a**), 80/200 nm (**c**) and 200/80 nm (**e**). The corresponding absorption density distributions within devices for the active layer thickness combinations: 30/250 nm (**b**), 80/200 nm (**d**) and 200/80 nm (**f**). The thicknesses of the interface layers and the two electrodes are obtained from the cross sectional TEM image shown in **Figure 4b**. Note that, both the electric field and absorption density values shown in the scale bars are arbitrary values.

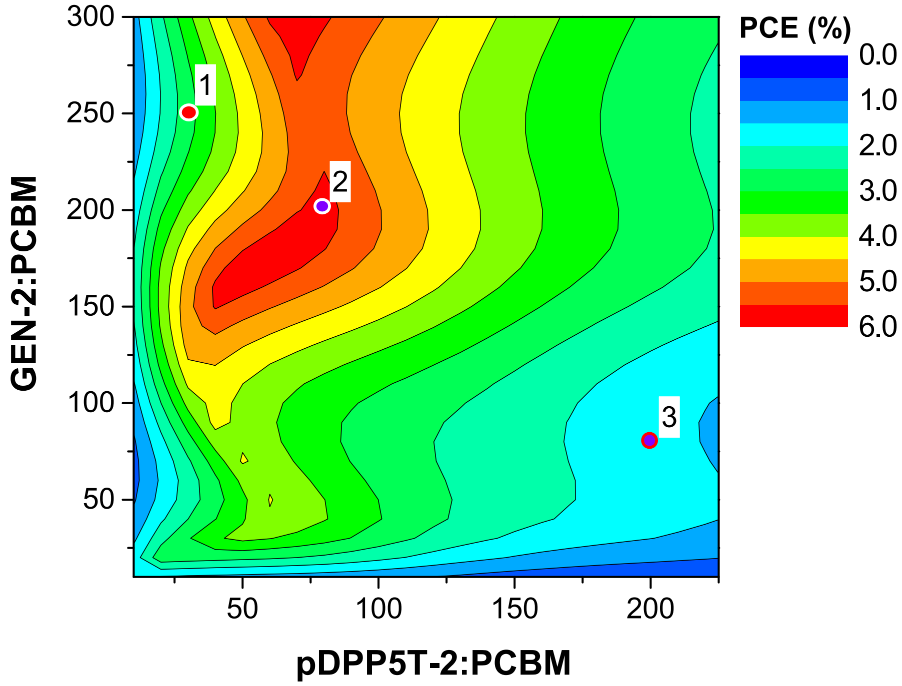

Figure S4 PCE prediction for the fully printed tandem OSCs constructed in this work. The PCEs were calculated based on the following assumptions: a V_{oc} = 1.29 V; a FF = 61%; a constant IQE = 65% for pDPP5T-2:PCBM front cell and a constant IQE = 75% for GEN-2:PCBM back cell. The current of the series-connected tandem cell is assumed to be equal to the lower current from the subcells. The thicknesses in the marked positions 1, 2 and 3 correspond to the electric field intensity and absorption density distributions of the tandem cells shown in **Figure S3**.

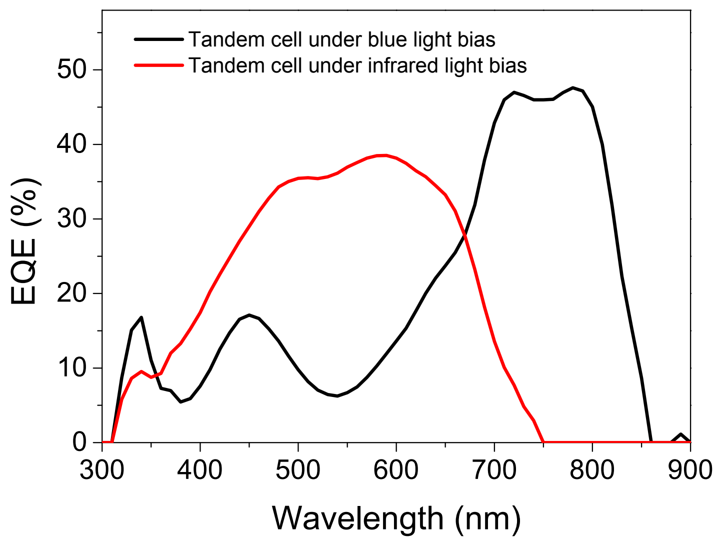

Figure S5 EQE spectra of a fully printed tandem OSC under blue and infrared light bias.

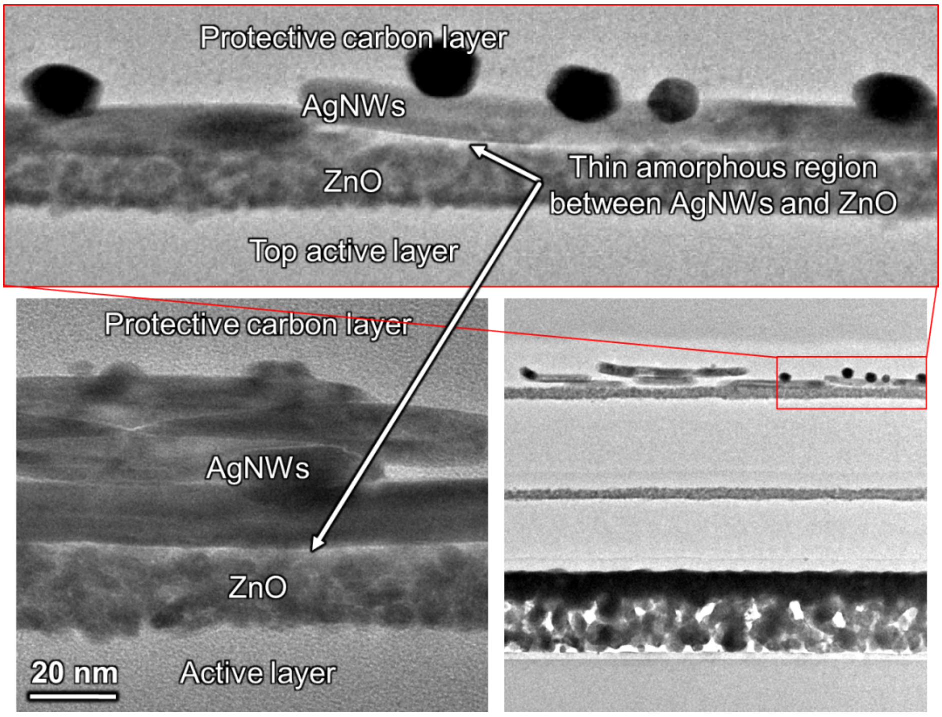

Figure S6 Cross-sectional TEM images of a fully printed tandem OSC. Thin amorphous regions were clearly found between AgNWs and ZnO, which increases the R_S of the entire device.

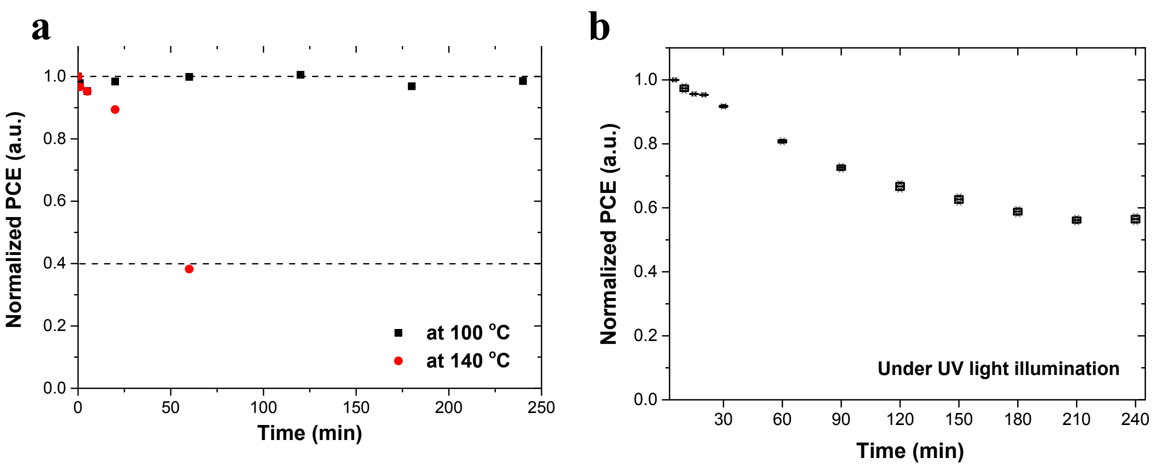

Figure S7 (**a**) Thermal stability of the fully printed tandem cells which are baked at 100 °C and 140 °C. (**b**) Stability of the fully printed tandem cells under continuous UV light illumination. The illumination was provided by UVACUBE 100 (from Dr. Hönle AG).

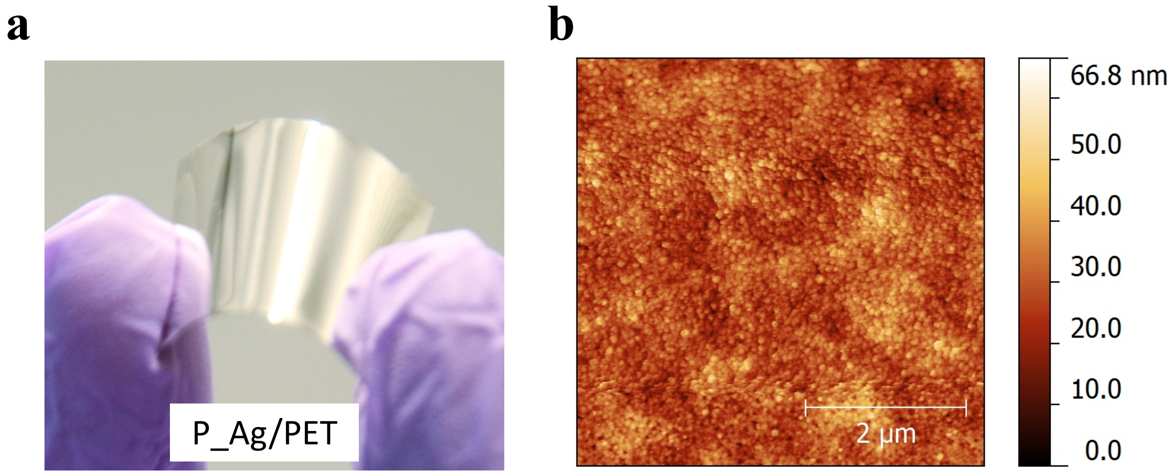

Figure S8 Digital photo **(a)** and AFM image **(b)** of the printed Ag electrode on PET.

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