

Supporting Information

Enhanced efficiency in small-molecule organic photovoltaic cells by a pyrene dimer morphology control layer

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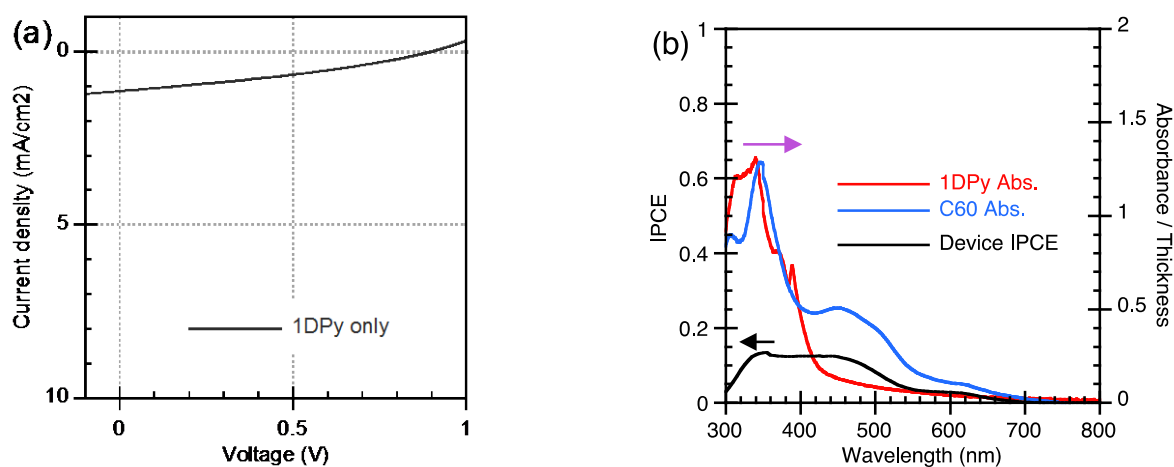


Figure S1. (a) J–V characteristics and (b) IPCE spectra of the [1DPy / C₆₀] OPVs and absorbance per thickness of 1DPy and C₆₀.

Table S1. Performance of the ITO/PEDOT:PSS (30 nm)/1DPy (60 nm) /C₆₀ (40 nm)/BCP (10 nm)/Al devices.

Donor	J _{sc} (mA/cm ²)	V _{oc} (V)	FF	PCE (%)	R _{se} (ohm·cm ²)	R _{sh} (ohm·cm ²)	@-1.0V (mA/cm ²)	@1.0V (mA/cm ²)
1DPy only	1.11	0.90	0.34	0.34	349	1340	-1.84	0.37

We show the device performance using 1DPy as a *p*-type layer (Figure S2, Table S1). The J_{SC} of the 1DPy/C₆₀ device is low, because the absorption of 1DPy overlaps with the absorption of C₆₀ in ultraviolet area. It is notable that the V_{OC} is relatively large. This is consistent with the higher HOMO level of 1DPy than that of pentacene, CuPc and DBP. Although FF and R_{Se} are relatively low, 1DPy shows the obvious electron-donor feature in an OPV device.

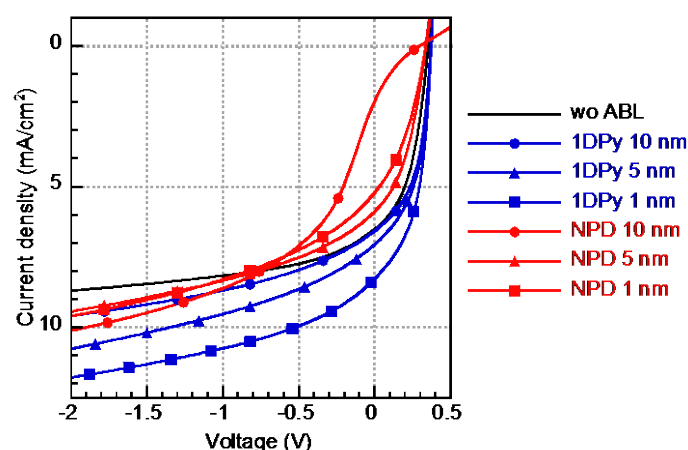


Figure S2. J–V characteristics of the [pentacene/C₆₀] OPVs with an 1DPy or NPD ABL.

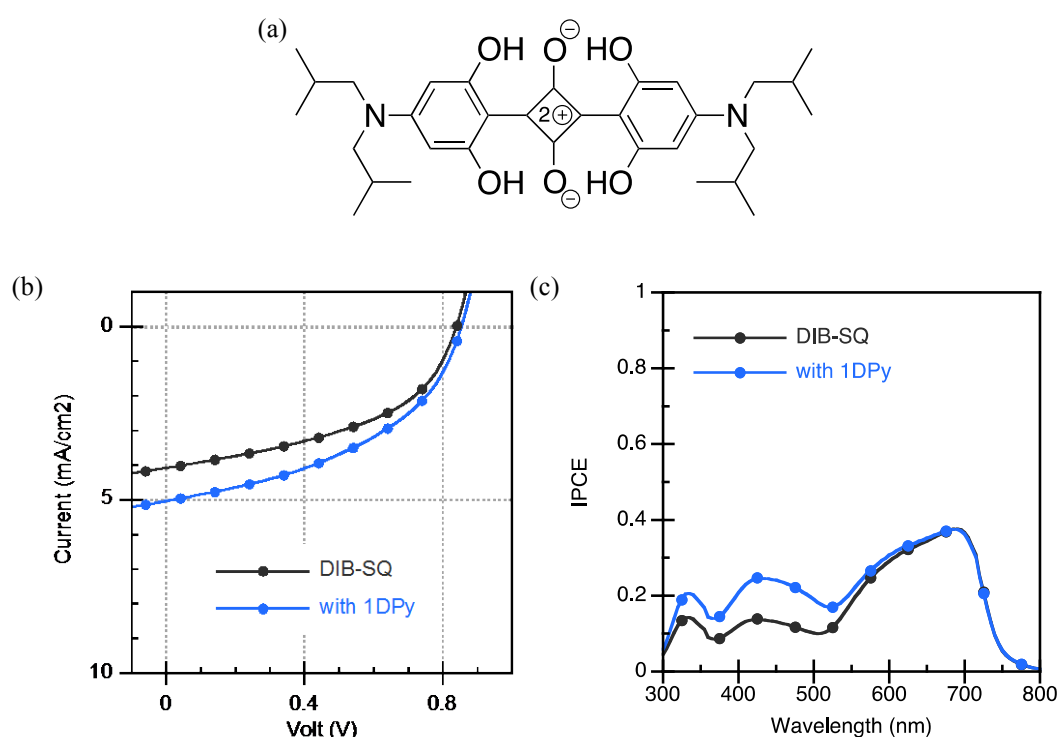


Figure S3. (a) Chemical structure of DIB-SB, (b) J–V characteristics and (c) IPCE spectra of the [DIB-SQ / C₆₀] OPVs with an 1DPy ABL.

Table S2. Performance of the ITO/PEDOT:PSS (30 nm)/1DPy (0 or 1 nm)/DIB-SQ (20 nm)/C₆₀ (40 nm)/BCP (10 nm)/Al devices.

	J _{sc} (mA/cm ²)	V _{oc} (V)	FF	PCE (%)	R _{se} (ohm·cm ²)	R _{sh} (ohm·cm ²)	@-1.0V (mA/cm ²)	@1.0V (mA/cm ²)
DIB-SQ	4.08	0.84	0.47	1.60	33.0	635	-5.55	10.0
with 1DPy	5.03	0.85	0.46	1.91	29.4	562	-6.48	9.60

We fabricated devices based on a DIB-SQ, which is not aromatic hydrocarbon molecules, donor layer with a thickness 20 nm instead of pentacene (Figure S3, Table S2). The J_{SC} values of the DIB-SQ devices increased with the insertion of 1 nm of 1DPy and resulted in enhancements of the PCE

from 1.60% to 1.91%. The IPCE spectra were improved in the absorption wavelength range of the C₆₀ especially. The behavior of J-V curves as inserting 1DPy is similar to CuPc or DBP. These results also supported our explanation that the intended grain control by 1DPy can be achieved to a pentacene layer probably because of specific intermolecular π - π interaction. However 1DPy is still useful to increase J_{SC} of the devices with CuPc, DBP, SIB-SQ.