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Supporting Information

Sequential molecular doping of non-fullerene organic solar cells without hole transport layers

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Table S1. Photovoltaic parameters of best PBDB-T:ITIC solar cells at different doping conditions.

Doping method	HTL	Doping condition	V_{OC} (V)	J_{SC} (mA/cm^2)	FF (%)	PCE (%)
Bulk doping	MoO_x	0%	0.89	16.61	67.71	10.01
		0.1%	0.89	16.10	67.90	9.73
		0.2%	0.89	15.67	65.17	9.09
Sequential doping	MoO_x	30 s	0.89	16.83	71.16	10.66
	w/o	w/o	0.16	12.67	42.09	0.85
		0 s	0.87	16.28	64.24	9.10
		20 s	0.87	16.00	68.34	9.51
		40 s	0.87	17.01	67.34	9.97
		60 s	0.87	16.78	65.20	9.52
		80 s	0.87	16.06	64.96	9.07

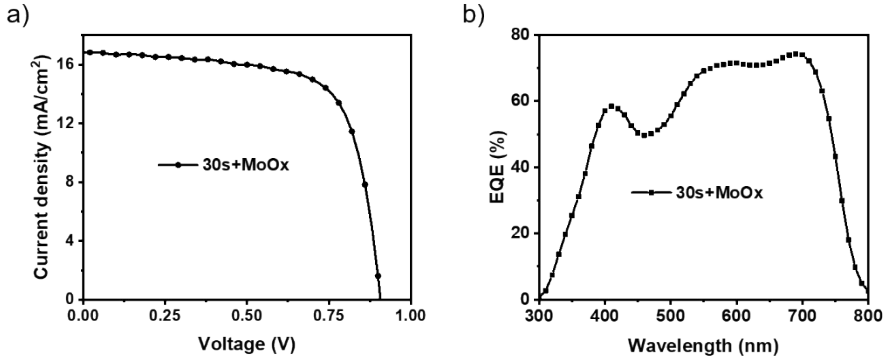

Figure S1. (a) Current density versus voltage (J-V) characteristics of sequential molecular doping device with MoOx after 30s penetration under AM 1.5 G solar irradiation. (b) EQE spectra of sequentially doped PBDBT:ITIC solar cells with MoOx after 30s penetration.

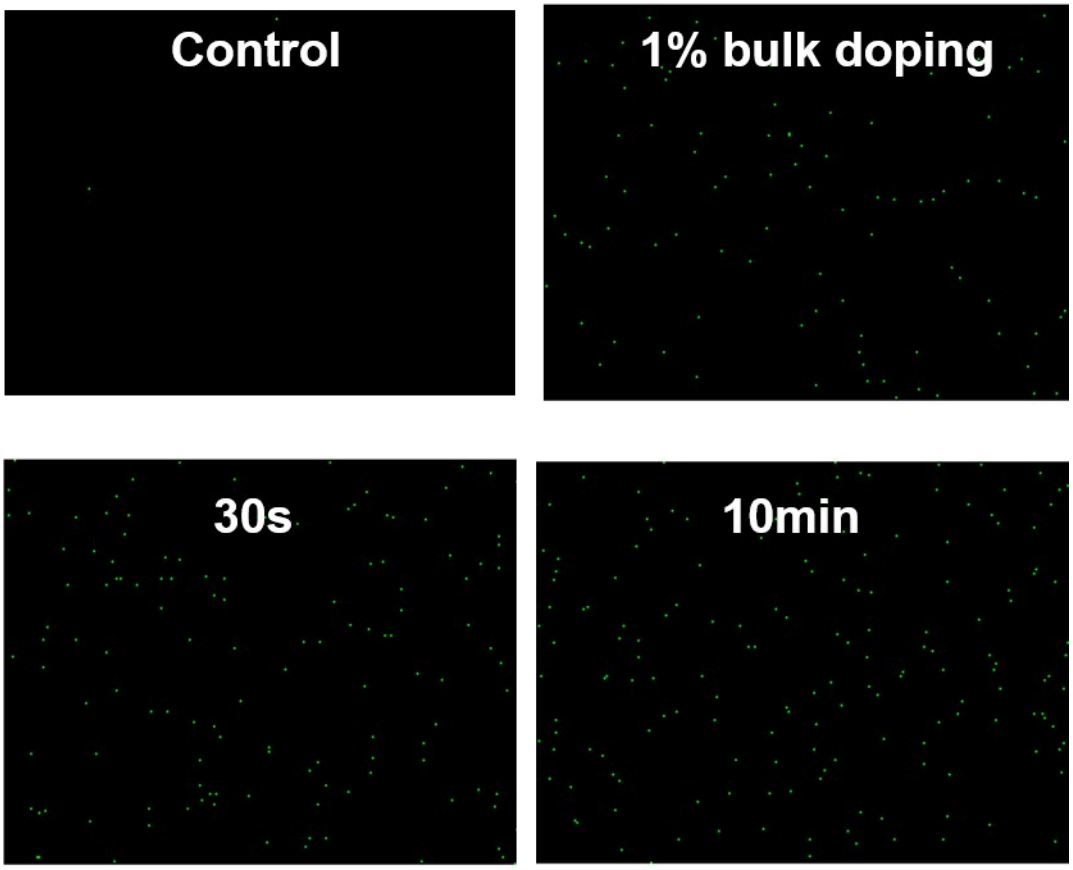

Figure S2. Elemental mapping of fluorine based on EDX analysis of PBDB-T:ITIC BHJ films with different doping methods.

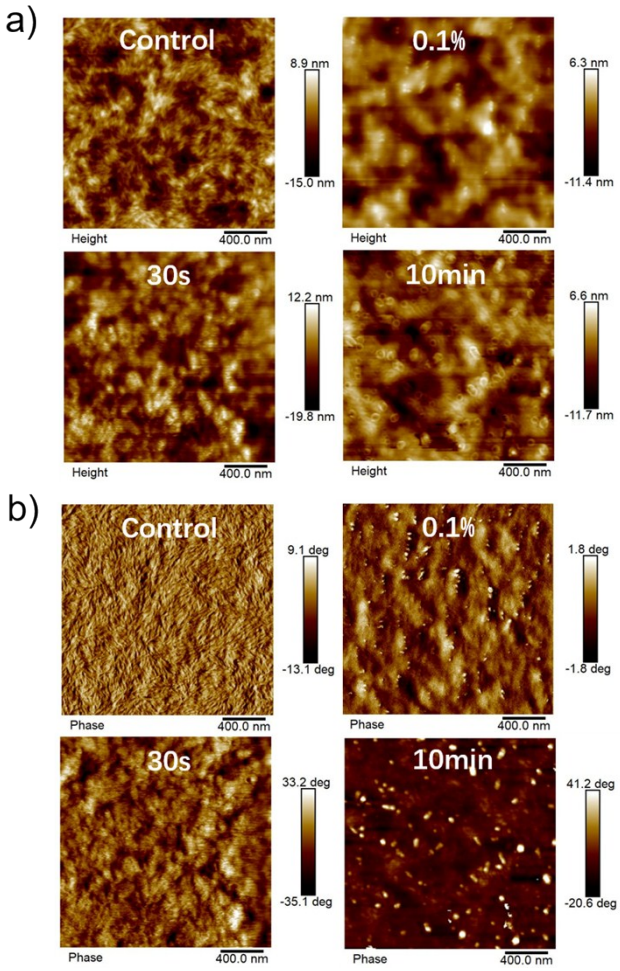

Figure S3. (a) Topographic and (b) phase images of pristine, bulk doped (0.1%) and sequentially doped (30 s and 10 min) PBDB-T:ITIC BHJ films.

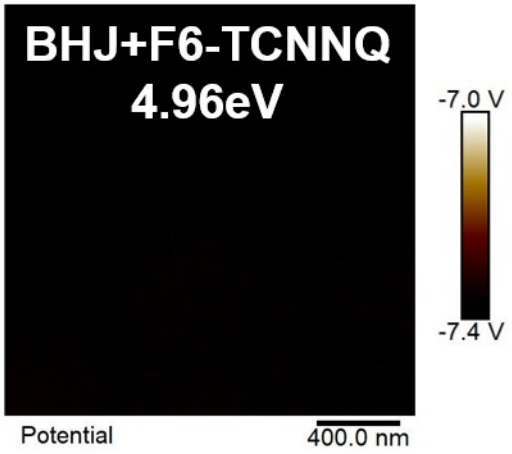

Figure S4. 2D mapping of the surface potential attained by scanning Kelvin probe microscopy for BHJ film spun-coat with F6-TCNNQ solution (conc. = 1.5 mg/mL).

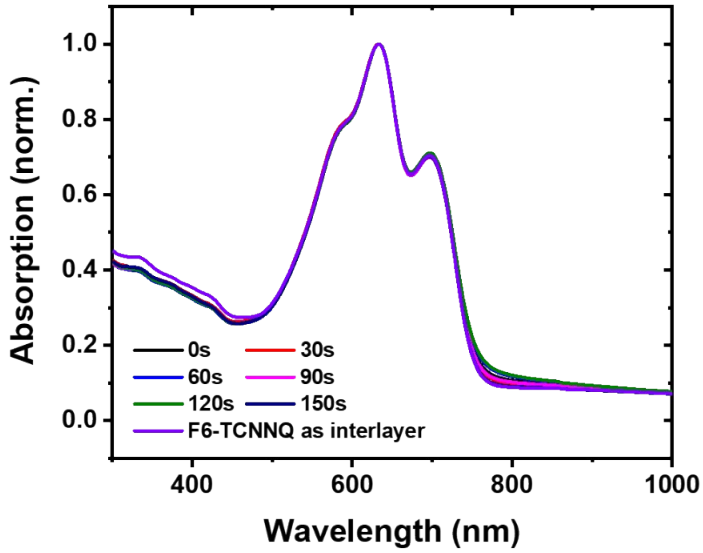

Figure S5. Absorption spectra of PBDB-T:ITIC BHJ films in different sequential doping conditions.

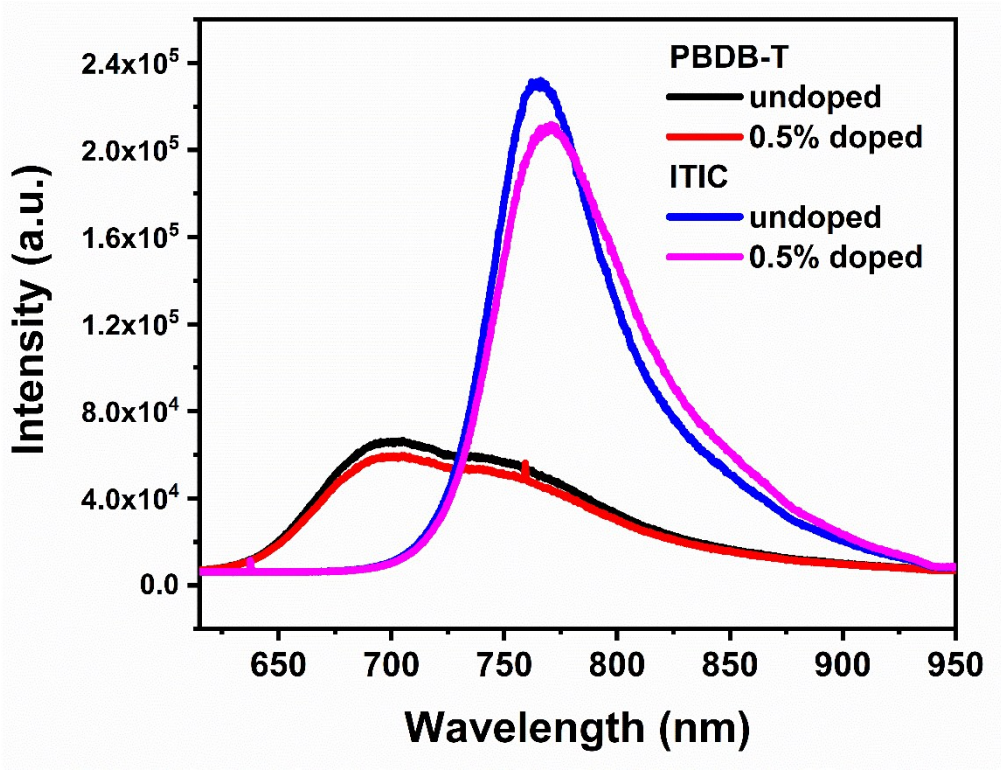

Figure S6. Steady-state photoluminescence (PL) spectra of undoped and F6-TCNNQ doped PBDB-T or ITIC films in different conditions.

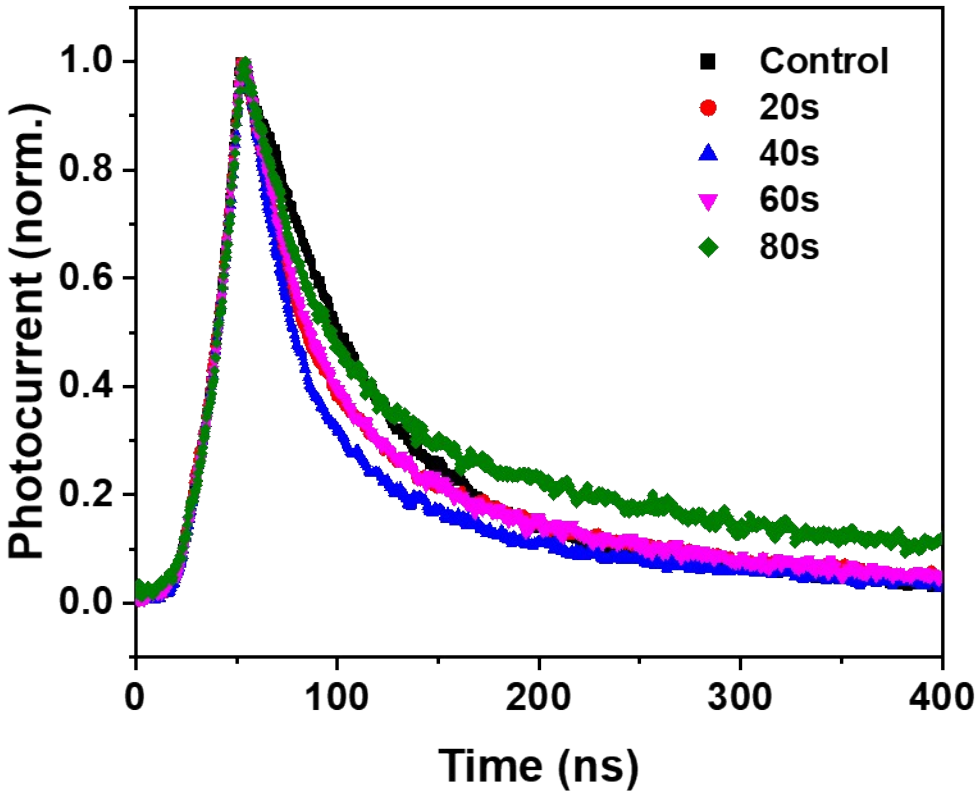

Figure S7. Transient photocurrent (bias = 0 V) decay traces of sequentially doped PBDBT:ITIC solar cells without MoOx under 488 nm excitation.

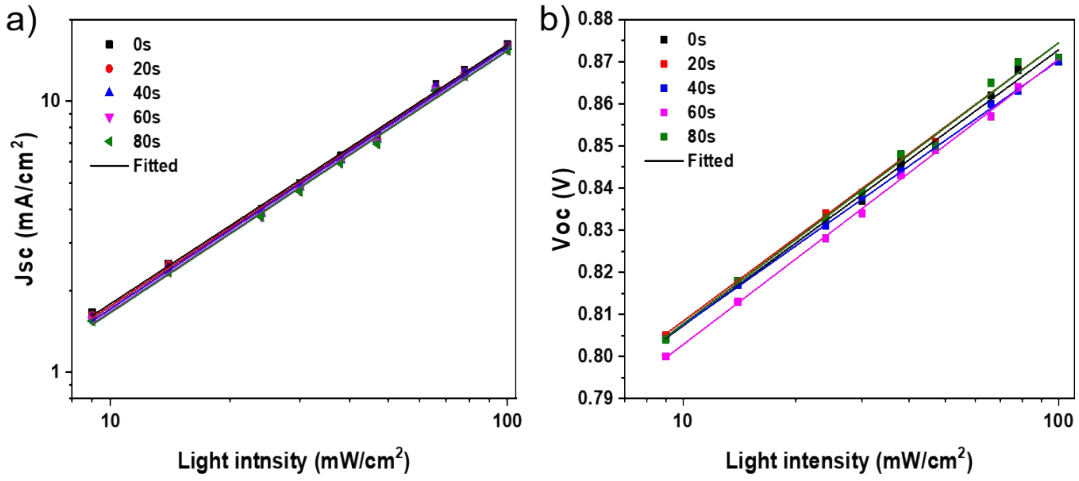

Figure S8. Short-current (J_{SC}) and open-circuit voltage (V_{OC}) versus light intensity characteristics.

Table S2. Extracted slopes of J_{SC} vs. P_{light} and V_{OC} vs. P_{light} characteristics.

Doping condition	Slope of J_{SC} vs. P_{light}	Slope of Vo_C vs. P_{light} (k_BT/q)
0 s	0.956	1.109
20 s	0.958	1.119
40 s	0.966	1.065
60 s	0.966	1.130
80 s	0.966	1.148

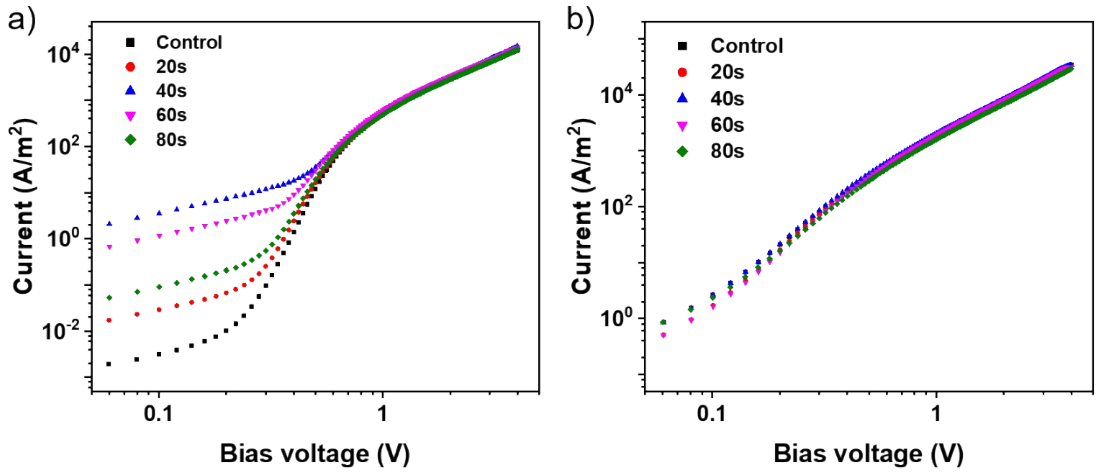

Figure S9. Dark *J-V* characteristics of (a) hole-only devices based on the structure of ITO/PEDOT:PSS/doped BHJ/Au and (b) electron-only devices based on the structure of ITO/ZnO/doped BHJ/ BCP/Al. The active layers are PBDB-T:ITIC blend films in different doping conditions.