

Electronic supplementary information

Cooperative tin oxide fullerene electron selective layers for high-performance planar perovskite solar cells

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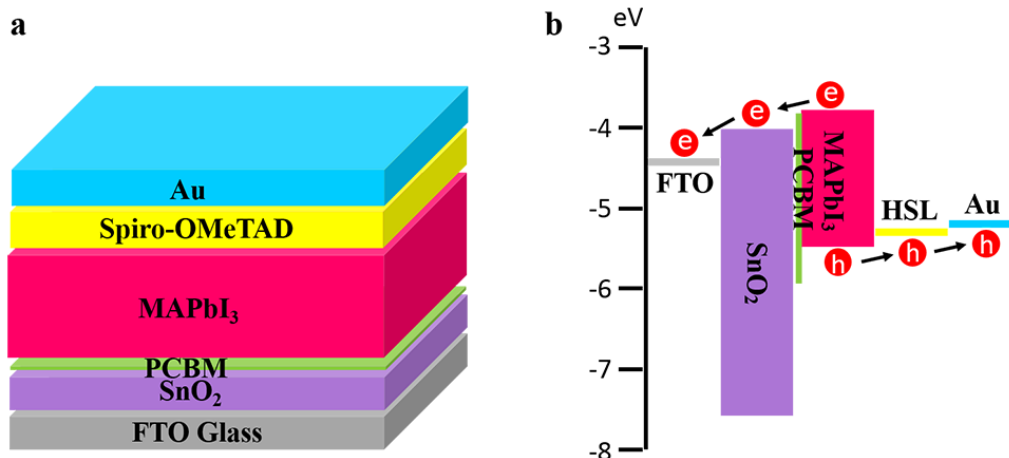


Fig. S1 (a) Schematic view and (b) energy band diagram of a planar perovskite solar cell using a SnO₂/PCBM ESL.

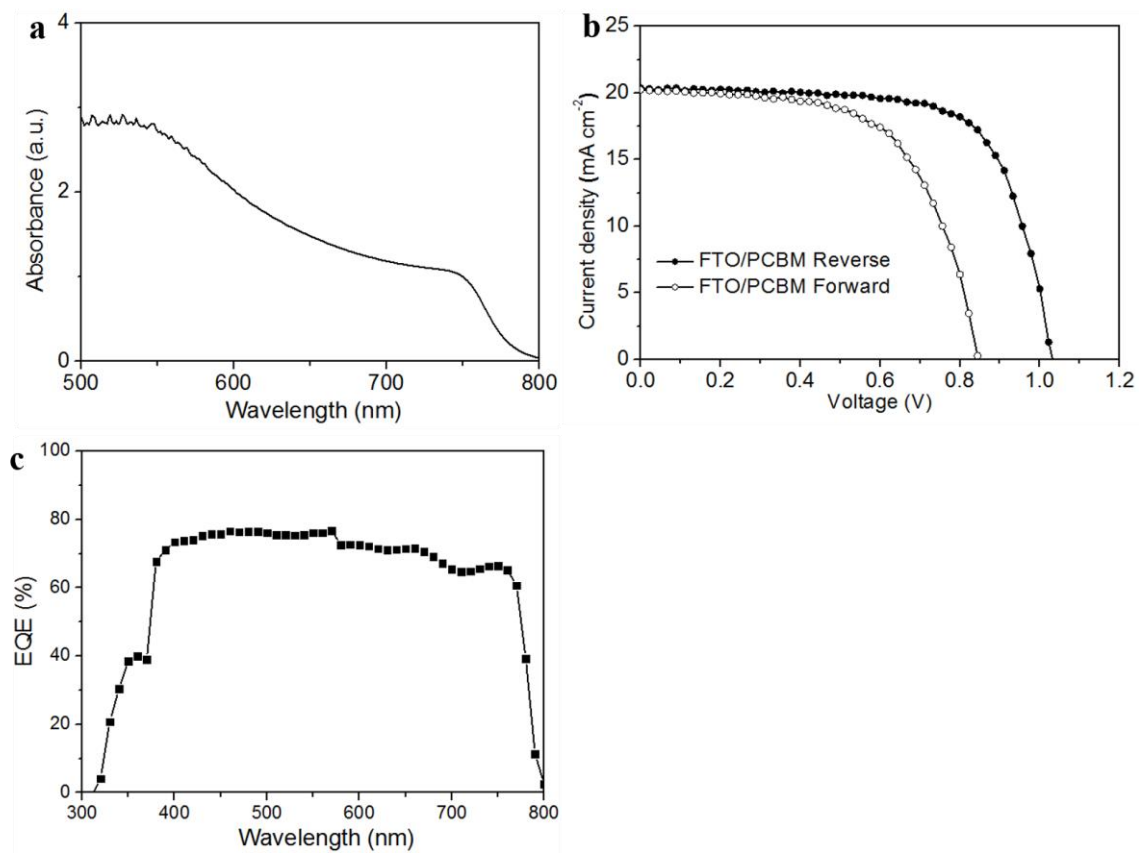


Fig. S2 (a) UV-vis absorbance spectrum, (b) J - V curves, and (c) EQE spectrum of a perovskite solar cell using a PCBM ESL.

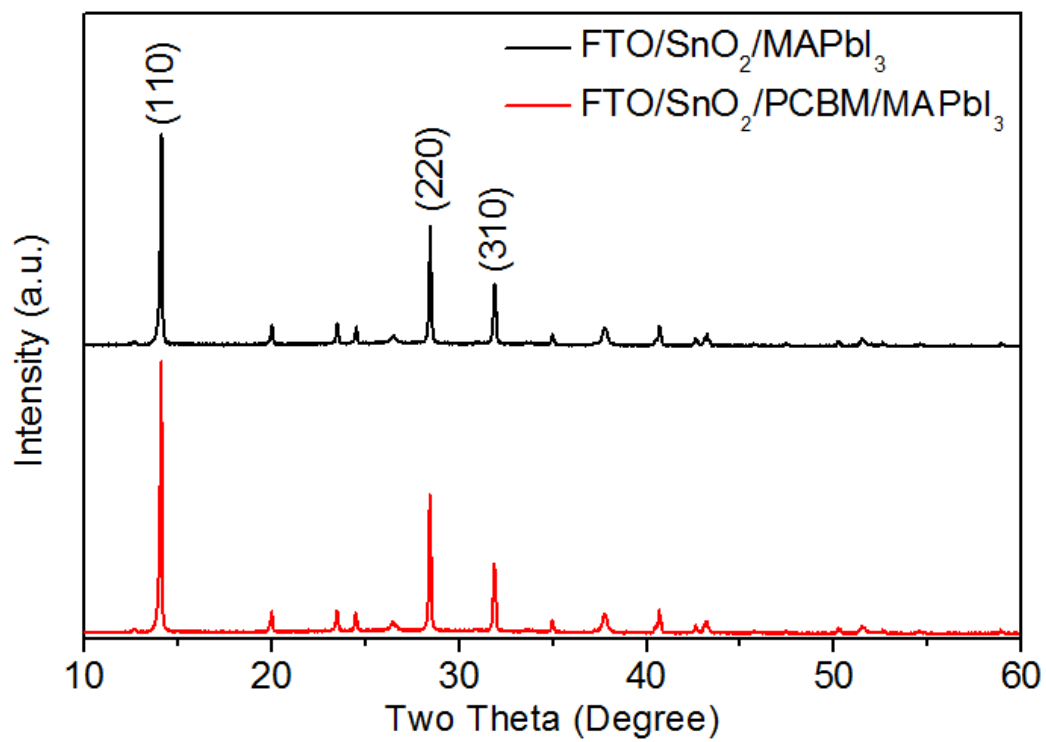


Fig. S3 XRD patterns of perovskite films grown on SnO₂ and SnO₂/PCBM ESLs.

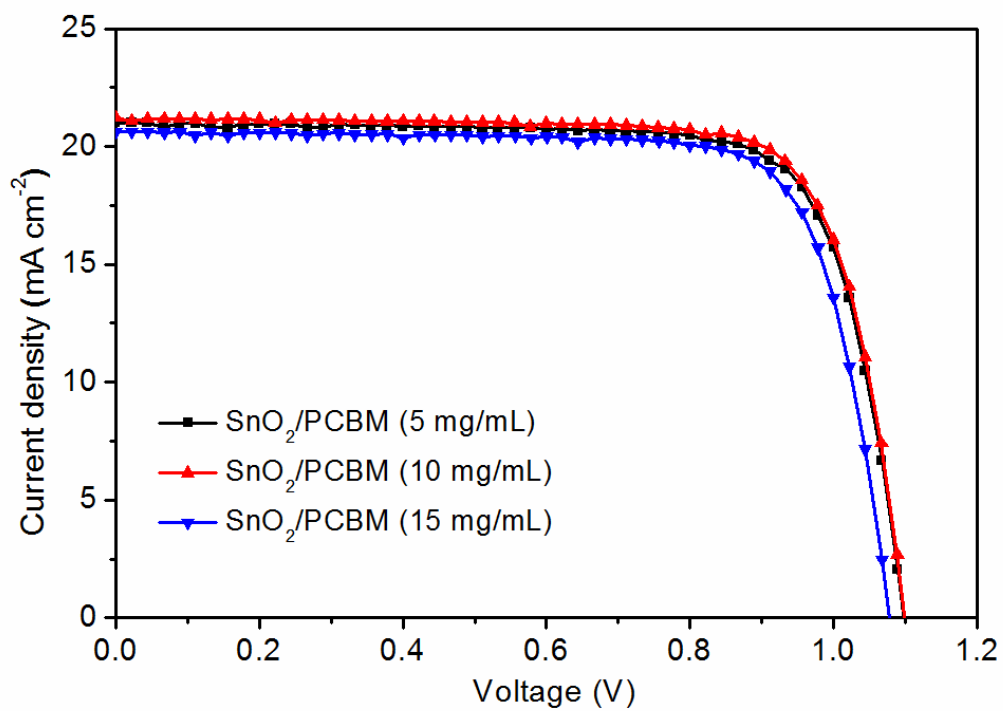


Fig. S4 (a) *J-V* curves of the cells using SnO₂/PCBM ESLs with PCBM films prepared by the precursors containing 5, 10, and 15 mg/mL PCBM in dichlorobenzene solutions measured under reverse voltage scanning.

Table S1 Summary of the photovoltaic parameters of the cells using SnO₂/PCBM ESLs with PCBM films prepared by different PCBM concentrations in dichlorobenzene solutions measured under reverse voltage scanning.

PCBM Concentration [mg/mL]	V_{oc} [V]	J_{sc} [mA cm ⁻²]	FF [%]	PCE [%]
5	1.10	21.00	77.11	17.77
10	1.10	21.22	77.52	18.08
15	1.08	20.63	77.65	17.26

Table S2 Values for TRPL characteristics of perovskite films deposited on SnO₂ and SnO₂/PCBM ESLs.

	τ_1	Ratio	τ_2	Ratio
	[ns]	[%]	[ns]	[%]
SnO ₂ ESL	0.07	93.77	0.83	6.23
SnO ₂ /PCBM ESL	0.06	95.46	0.33	4.54

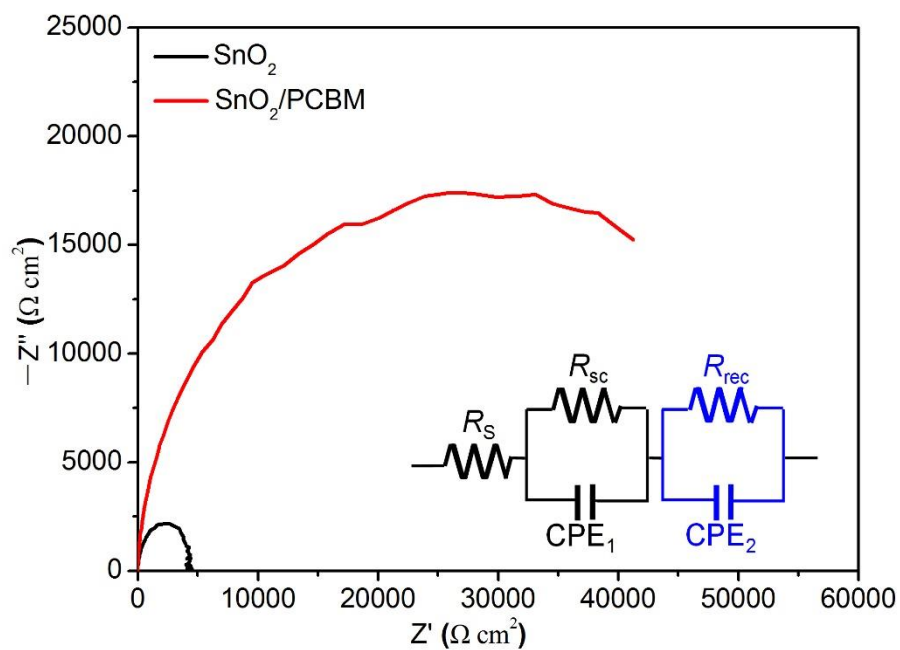


Fig. S5 Nyquist plots of the cells using unpassivated SnO₂ and SnO₂/PCBM ESLs.

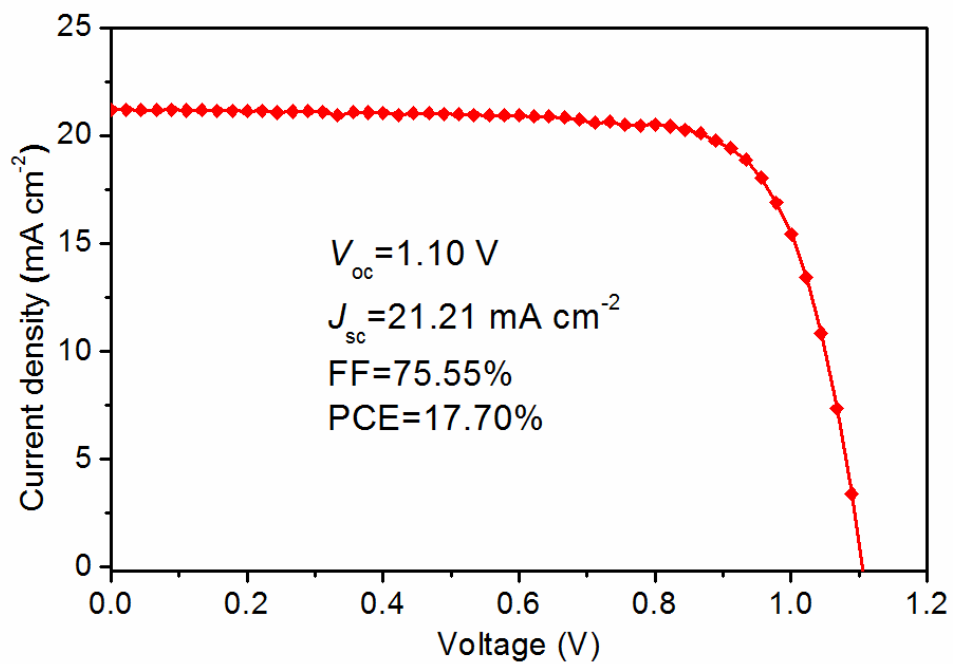


Fig. S6 *J-V* curve of the planar perovskite solar cell using a SnO_2 ESL with a 5 nm thick C_{60} film measured under reverse voltage scanning.