Electronic Supplementary Material (ESI) for Journal of Materials Chemistry C.

Supporting Information

A Comprehensive Optimization Strategy: Potassium Phytate-Doped SnO_2 as Electron-Transporting Layer for High-Efficiency Perovskite Solar Cells

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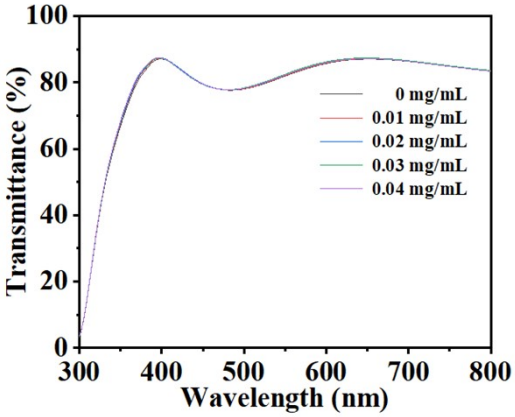

Fig. S1. Transmittance spectra of SnO_2 ETLs made with PP of different concentrations.

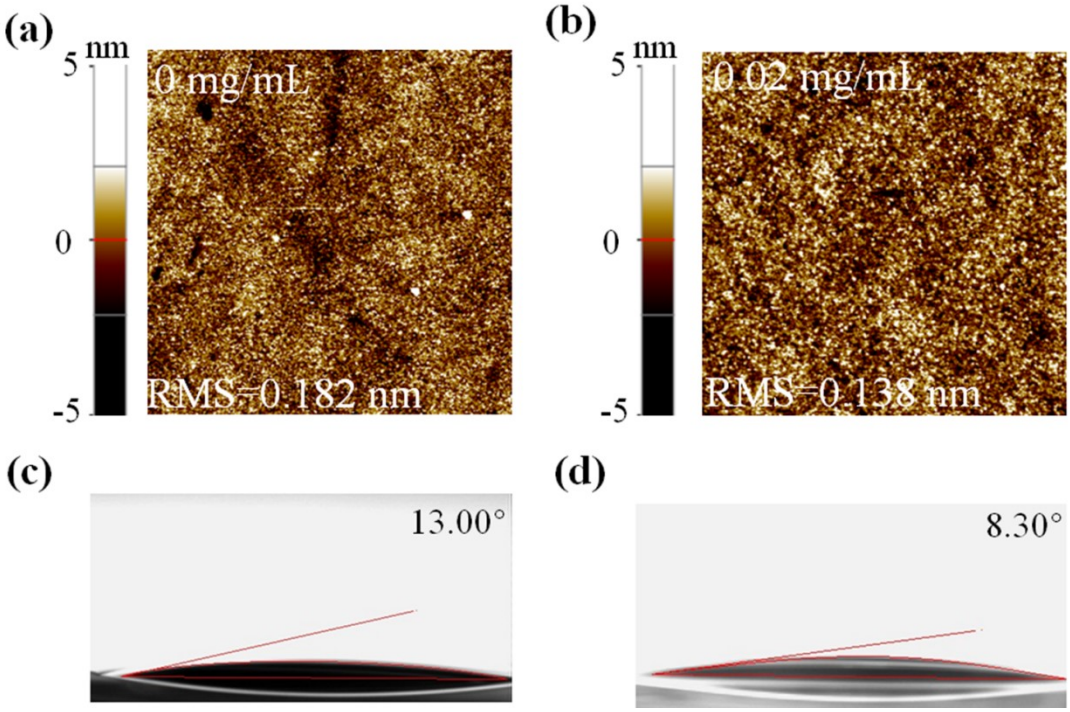

Fig. S2. AFM images of (a) SnO_2 and (b) PP-doped SnO_2 films, and the water contact angle images of (c) SnO_2 and (d) PP-doped SnO_2 films.

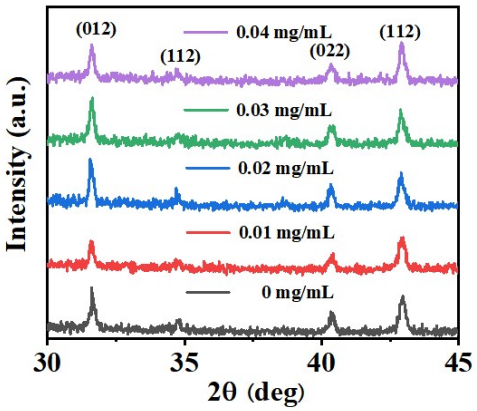

Fig. S3. (a) Magnified XRD patterns of SnO_2 films doped with different concentrations of PP.

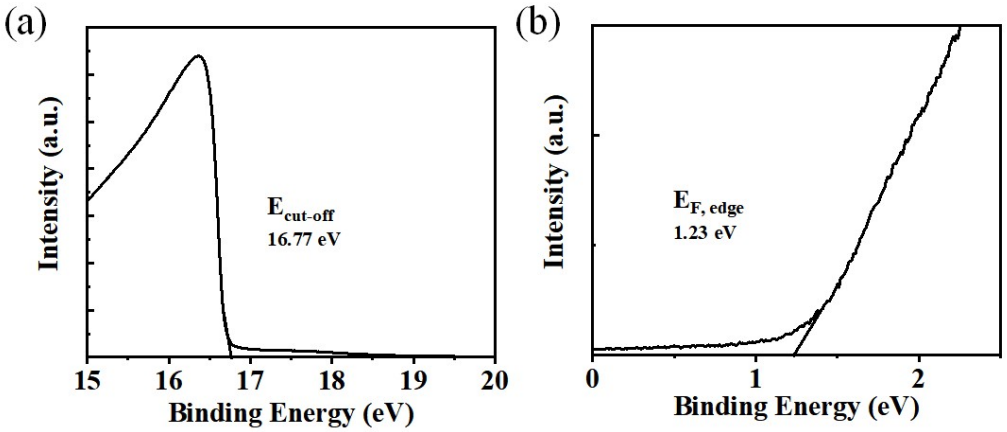

Fig. S4. UPS spectra describing (a) the cut-off energy ($E_{cut\text{-}off}$) and (b) Fermi edge ($E_{F,\ edge}$) for perovskite film.

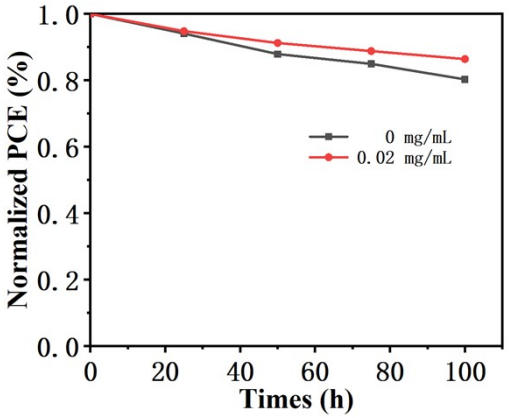

Fig. S5. The photostability performance of the PSCs under continuous maximum power point tracking (MPPT) for 100 hours under nitrogen gas conditions with continuous full-sun illumination (1 sun, 100 mW cm^2).

Table S1. Conductivities of PP doped SnO_2 with different doping concentrations.

ETL	0mg/mL	0.01mg/mL	0.02mg/mL	0.03mg/mL	0.04mg/mL
Conductivity ($\times 10^{-5}$ S/cm)	3.57	4.33	5.10	5.68	4.55

Table S2. O 1s XPS peaks of SnO_2 films treated without or with PP of 0.02 mg/mL.

Area ratio / Samples	529.33 (±0.06) eV	530.20 (±0.04) eV	531.48 (±0.00) eV	531.77 (±0.03) eV
0 mg/mL	4.03	75.88	0	20.09
0.02 mg/mL	2.42	63.53	11.93	22.12

Table S3. Sn $3d_{5/2}$ XPS peaks of SnO_2 films treated without or with PP of 0.02 mg/mL.

Area ratio / Samples	486.60 (±0.07) eV	486.10 (±0.07) eV	484.90 (±0.00) eV
0 mg/mL	21.44	74.42	4.14
0.02 mg/mL	16.12	83.65	0.23

Table S4. PL delay lifetime fitted by a bi-exponential decay function.

Concentration (mg/mL)	τ_1 （ns）	A_1 (%)	τ_2 （ns）	A_2 (%)
0	312.78	27.05	1233.51	72.95
0.01	170.62	26.50	1535.57	73.50
0.02	143.16	26.24	1795.76	73.76
0.03	170.30	26.16	1574.62	73.84
0.04	174.24	32.49	1383.26	67.51

Table S5. Fitted electrical property data using the equivalent circuit shown in the inset of Figure 9a for each kind of device.

Concentration (mg/mL)	*R*s (ohm)	*R*rec (ohm)
0	76.24	6265
0.01	79.20	9562
0.02	40.34	10670
0.03	46.80	7450
0.04	46.46	7049

Table S6. Performance parameters of PSCs with different concentration of PP doped in SnO_2, the average parameters were obtained based on twenty devices for each kind.

Concentration (mg/mL)	Voc （V）	Jsc （mA/cm^2）	FF	PCE （%）
0	1.11±0.02	24.54 ±0.29	0.72±0.02	19.53±0.35
0.01	1.12±0.02	24.74 ±0.27	0.75±0.01	20.75±0.63
0.02	1.14±0.01	24.85 ±0.27	0.76±0.01	21.49±0.39
0.03	1.13±0.01	24.71 ±0.20	0.75±0.01	20.73±0.39
0.04	1.12±0.01	24.41 ±0.50	0.73±0.01	19.99±0.53