Supporting Information

Magnetron sputtered ZnO electron transporting layers for high performance perovskite solar cells

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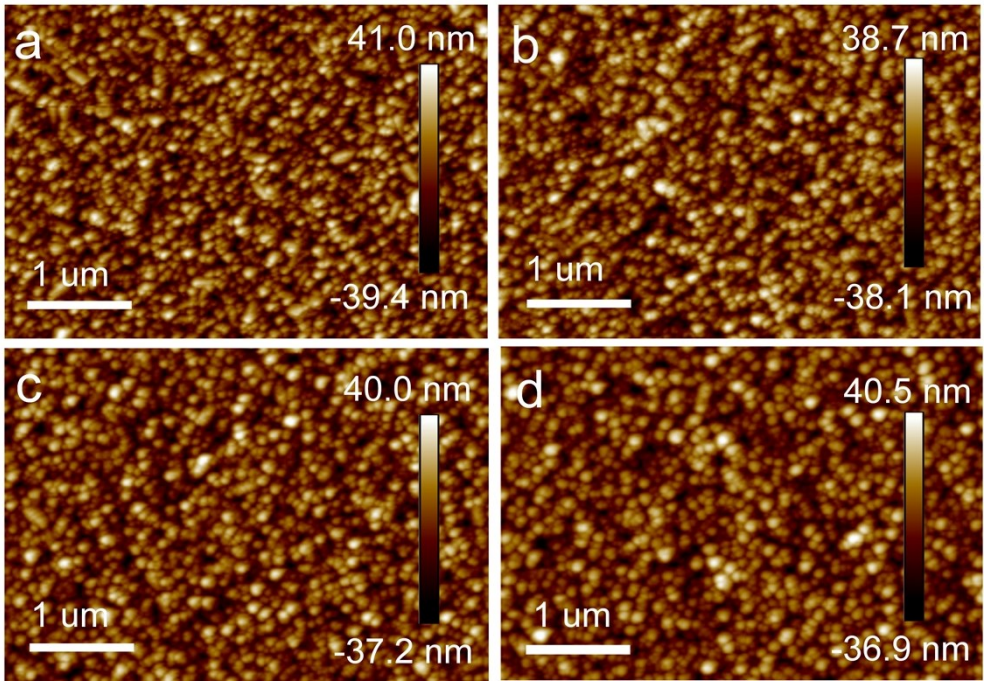

Figure S1 AFM images of (a) the bare FTO substrate and the sputtered ZnO films deposited under different sputtering time of (b) 1 min, (c) 2 min, and (d) 4 min.

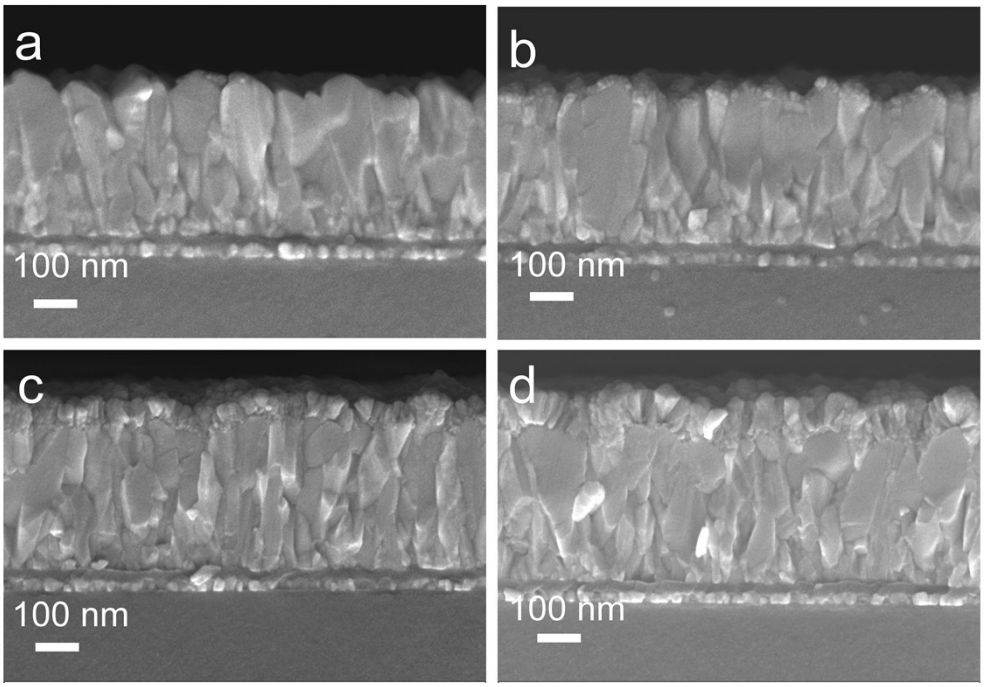

Figure S2 Cross-sectional SEM images of (a) the bare FTO substrate and sputtered ZnO films deposited under various sputtering time of (b) 1 min, (c) 2 min, and (d) 4 min.

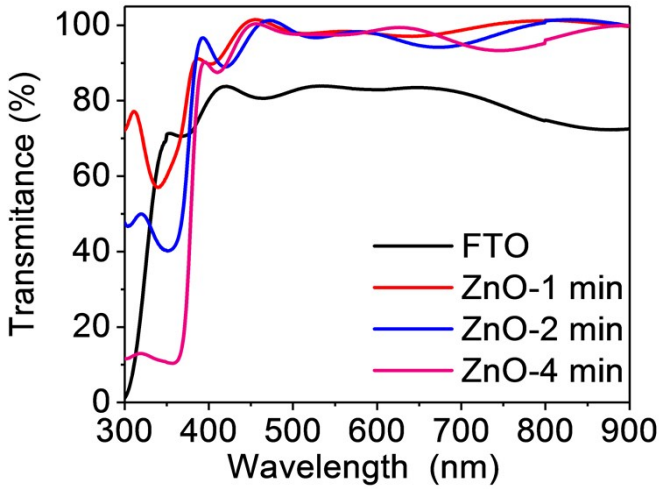

Figure S3 Optical transmittance spectra of (a) the bare FTO substrate and sputtered ZnO films deposited under various sputtering time of (b) 1 min, (c) 2 min, and (d) 4 min.

Table S1 The photovoltaic parameters derived from *J-V* curves of PSCs based on the sputtered and spin-coated ZnO ETLs, measured under the illumination of One Sun (AM1.5, 100 mW cm^{-2}).

Device	V_{oc} (V)	J_{sc} (mA/cm^2)	FF (%)	η (%)	R_s (Ω)	R_{sh} (Ω)
ZnO-1 min	1.11	15.69	60.37	10.54	72.61	3158.36
ZnO-2 min	1.13	17.29	66.92	13.04	51.49	3922.63
ZnO-4 min	1.06	9.64	40.77	4.15	234.31	1705.35
Spin-coated ZnO	1.06	16.35	48.00	8.34	215.24	4910.14

Table S2 The stability measurements of PSCs based on the sputtered and spin-coated ZnO ETLs. The photovoltaic parameters were derived from *J-V* curves measured under the illumination of one sun (AM1.5, 100 mW cm^{-2}).

Device		V_{oc} (V)	J_{sc} (mA/cm^2)	FF (%)	η (%)	R_s (Ω)	R_{sh} (Ω)
Sputtered ZnO	1 day	1.13	17.29	66.92	13.04	51.49	3922.63
	20 day	1.11	16.40	61.58	11.26	55.38	3243.19
	180 day	1.10	14.83	62.66	10.20	68.58	3930.99

	1 day	1.06	16.35	48.00	8.34	215.24	4910.14
Spin-coated	20 day	1.00	13.18	37.97	4.98	248.30	1401.07
ZnO	180 day	0.85	3.96	44.15	1.48	543.79	3899.58

Table S3 The fitted parameters of the impedance spectra for ZnO and ZnO/SnO_2 based PSCs.

Device	R_s (Ω)	R_{rec} (Ω)	CPE-T (F)	CPE-T (F)
ZnO	5.79	94990	7.95×10^{-8}	0.79
ZnO/SnO_2	2.60	116400	1.06×10^{-7}	0.77