Electronic Supplementary Information

Efficient Solid-State Perovskite Solar Cells Based on Nanostructured Zinc Oxide Designed by Strategic Low Temperature Water Oxidation

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Table S1. Materials and photovoltaic parameters of perovskite solar cells based on ZnO or TiO_2 as electron-transporting layers.

ETL	Perovskite	HTL	V_{oc} (eV)	PCE_{max} (%)	Ref.
ZnO nanorods	$CH_3NH_3PbI_3$	P3HT	0.82	5.96	This work
ZnO nanorods	$CH_3NH_3PbI_3$	P3HT	0.56	3.05	[1]
ZnO nanorods/TiO_2 nanoparticle	$CH_3NH_3PbI_3$	P3HT	0.50	3.41	[1]
TiO_2 compact film	$CH_3NH_3PbI_3$	P3HT	0.64	4.24	[2]
ZnO nanowires	$CH_3NH_3PbI_3$	P3HT	0.79	4.8	[3]
TiO_2 compact film	$CH_3NH_3PbI_3$	P3HT	0.64	5.67	[4]
TiO_2 compact film	$CH_3NH_3PbI_{3-x}Cl_x$	P3HT	0.74	6.06	[5]
ZnO film	$CH_3NH_3PbI_{3-x}Cl_x$	P3HT	1.04	6.3	[6]

Table S2. Summary of photovoltaic parameters recorded for perovskite solar cells based on nanostructured ZnO formed by wet oxidation under varying oxidation time at 90°C, under 1 Sun illumination (AM 1.5G, 100 mW cm^{-2})

Time [h]	Scan Direction	J_{sc} [mA cm^{-2}]	Voc [eV]	FF	PCE_{ave} [%]	PCE_{max} [%]
2	Forward	13.0	0.591	0.36	1.57	2.77
	Reverse	12.9	0.456	0.38	2.04	2.28
4	Forward	16.4	0.528	0.37	2.88	3.24
	Reverse	16.5	0.521	0.38	2.62	3.23
8	Forward	16.5	0.820	0.44	5.28	5.96
	Reverse	18.0	0.780	0.42	5.46	5.91
16	Forward	13.6	0.771	0.42	4.00	4.42
	Reverse	12.8	0.787	0.42	3.69	4.23
24	Forward	10.1	0.799	0.42	2.94	3.40
	Reverse	9.43	0.809	0.41	2.72	3.14

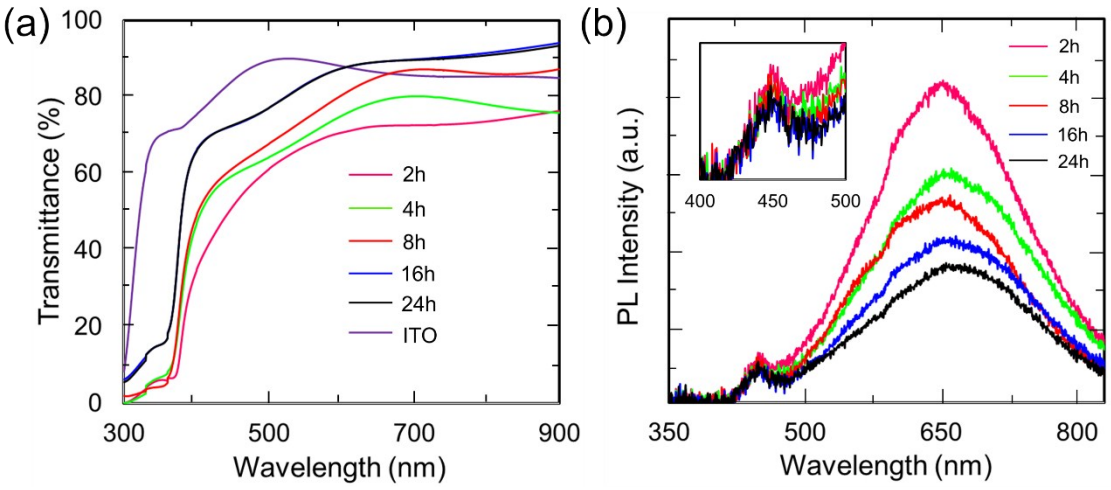

Fig. S1. (a) Optical transmission spectra of ITO and wet oxidized ZnO nanostructures grown at different oxidation times.(b) Photoluminescence spectra of the corresponding ZnO samples.

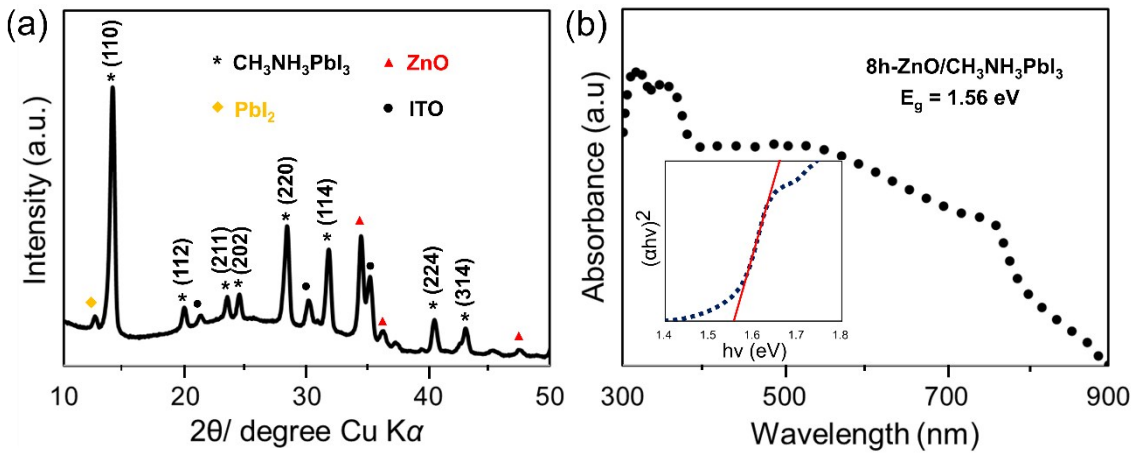

Fig. S2. (a) XRD pattern and (b) optical absorption spectrum of perovskite film on top of 8h-ZnO sample.

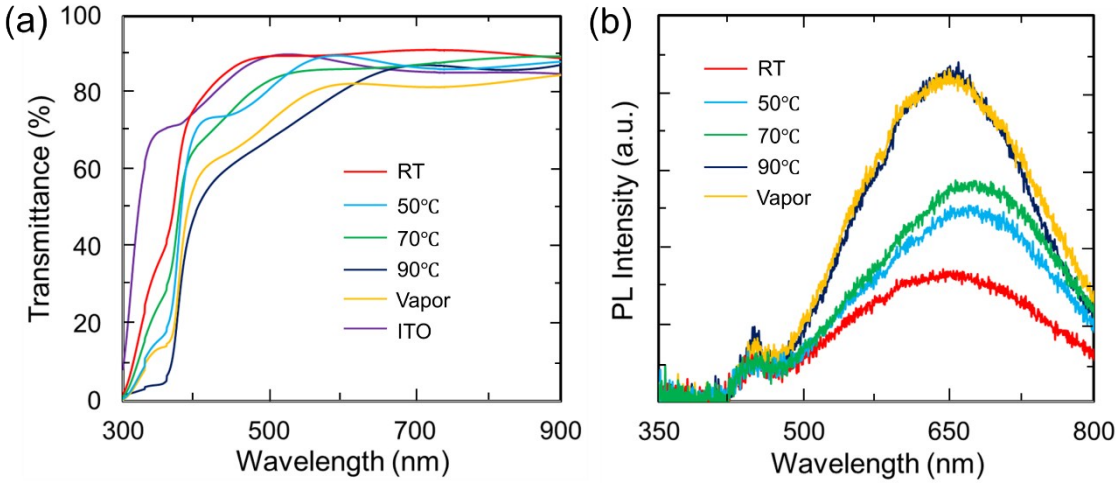

Fig. S3. (a) Optical transmission spectra of ITO and wet oxidized ZnO nanostructures grown at different growth temperatures. (b) Photoluminescence spectra of the corresponding ZnO samples.

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