Supporting Information

Performance enhancement of high temperature SnO$_2$-based planar perovskite solar cells: electrical characterization and mechanism understanding

Liangbin Xiong,[ab] Mingchao Qin,[a] Guang Yang,[a] Yaxiong Guo,[a] Hongwei Lei,[a] Qin Liu,[a] Weijun Ke,[a] Hong Tao,[a] Pingli Qin,[a] Songzhan Li,[a] Huaqing Yu[b] and Guojia Fang [a]*
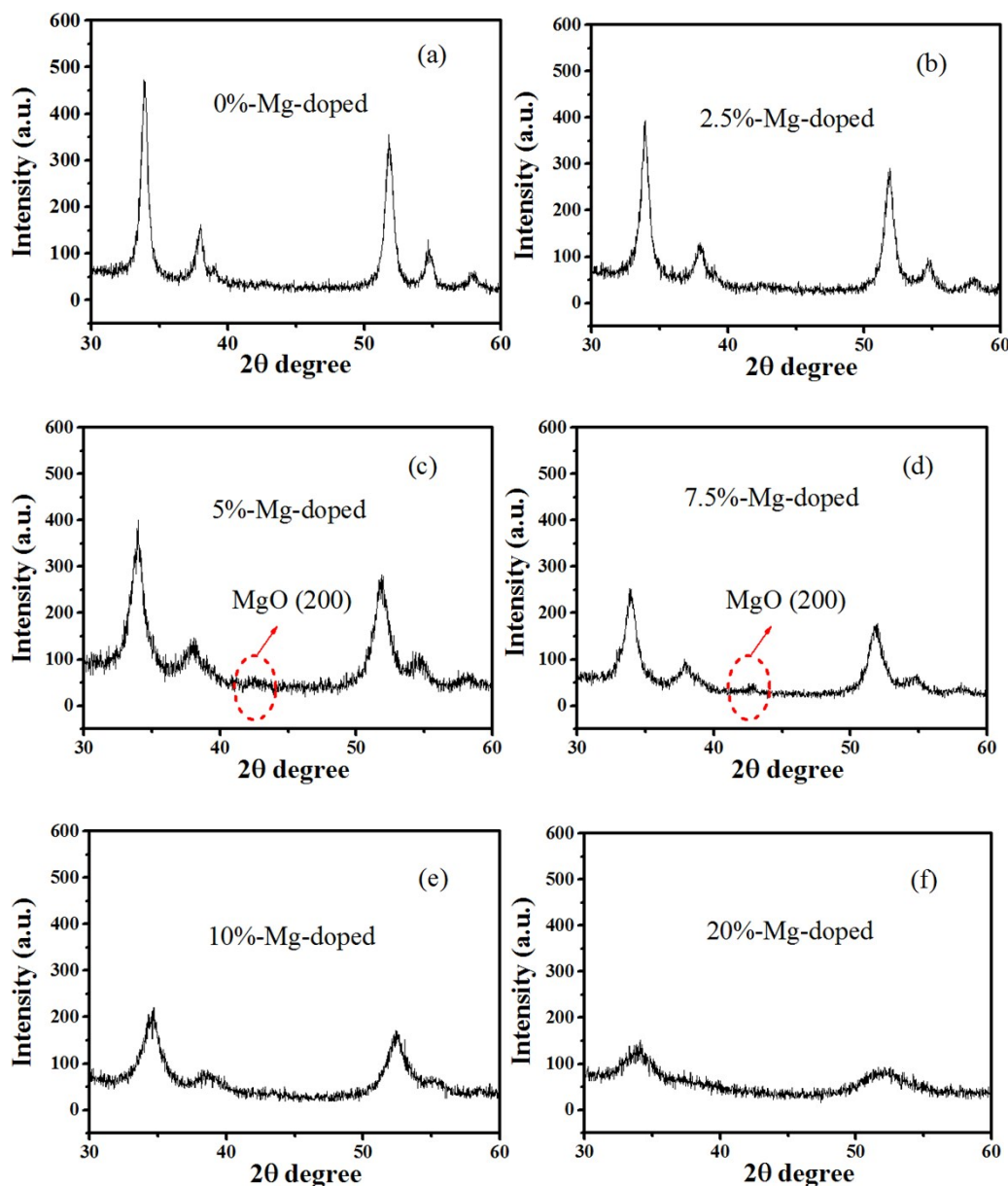
Figure S1 XRD patterns of 0% (a), 2.5% (b), 5% (c), 7.5% (d), 10% (e) and 20% (f) Mg-doped SnO$_2$. (200) plane of MgO appeared in Figure S1c and Figure S1d.
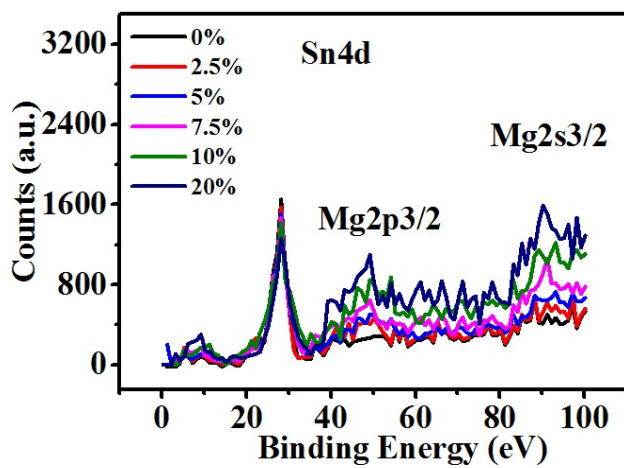
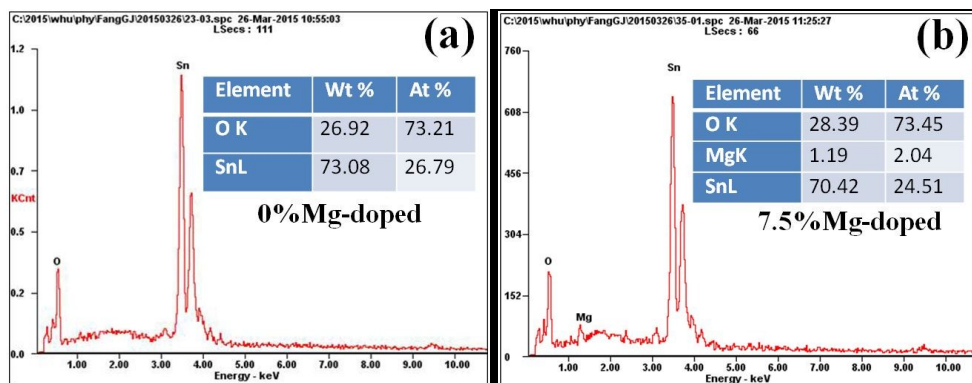Figure S2 Lower energy portion of the XPS spectra for 0, 2.5, 5, 7.5, 10 and 20% SnO_2.

Figure S3 EDX analysis of (a) undoped and (b) 7.5% SnO_2 films. EDX analysis of undoped SnO_2 indicating non-stoichiometric behavior of the film. EDX analysis of 7.5 % SnO_2 film shows that the sample contains 24.51 At% of Sn and 2.04 At % of Mg, thus indicating the presence of nearly 7.5% Mg in Mg-doped SnO_2 film.
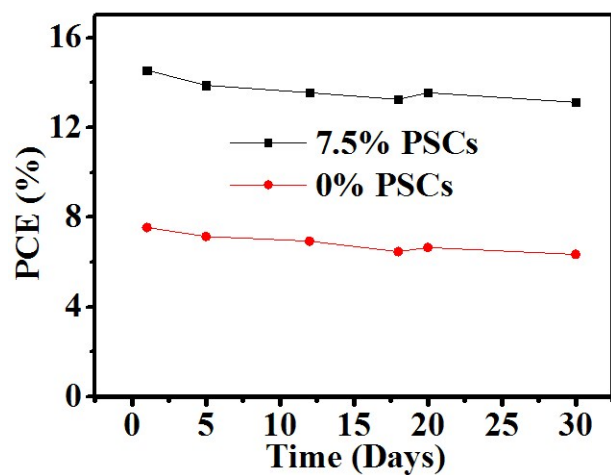
Figure S4 Power conversion efficiency as a function of time for unencapsulated 7.5% and 0% devices with their highest PCEs.
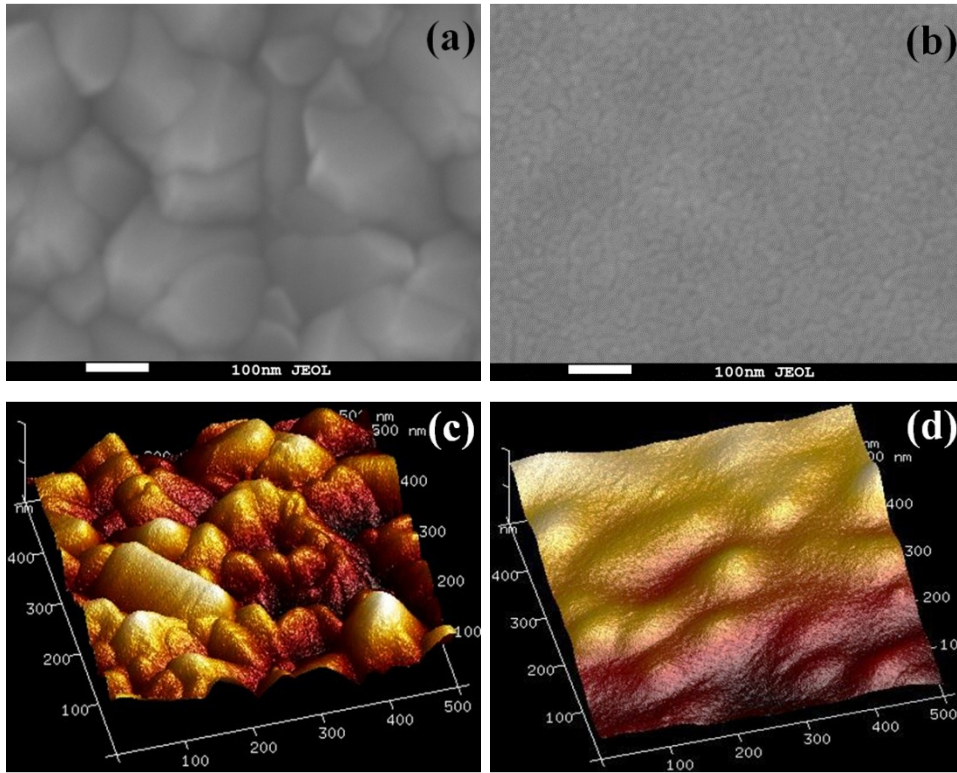
Figure S5 SEM images of (a) bare FTO, (b) 7.5% SnO_2 film on FTO substrate, AFM images of (c) bare FTO and (b) 7.5% SnO_2 film.
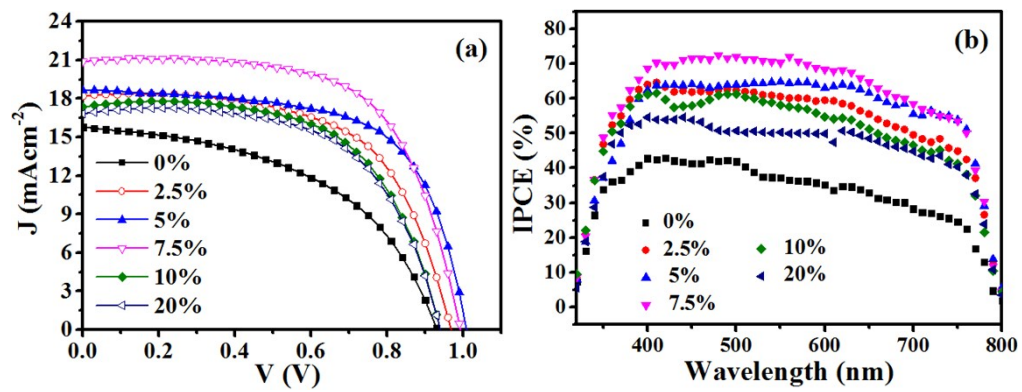
Figure S6 (a) J-V curves of devices with different Mg content, (b) IPCE spectra of devices based on the corresponding films.
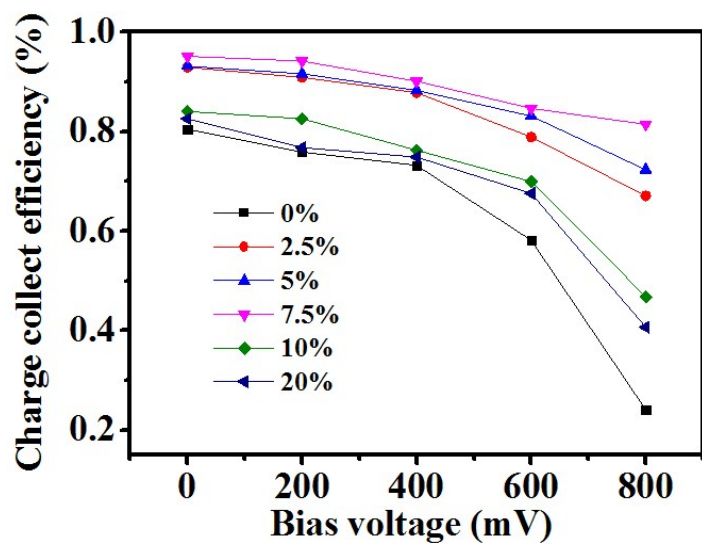
Figure S7 Charge collection efficiency calculated from the R_{tr} and R_{rec} of SnO$_2$-based PSCs under a full simulated irradiation.

Table S1 V_{OC}, J_{SC}, FF, PCE of devices using 0 and 7.5% PSCs with their highest PCEs.

Samples	V_{OC} (V)	J_{SC} (mAcm^{-2})	FF (%)	PCE (%)
7.5% reverse	1.003	21.44	0.708	15.24%
7.5% forward	0.985	20.98	0.655	13.54%
0% reverse	0.944	17.39	0.500	8.208%
0% forward	0.825	16.64	0.465	6.384%

Table S2 V_{OC}, J_{SC}, FF, PCE of devices with different amounts of Mg-doped SnO_2 films.

	0%	2.5%	5%	7.5%	10%	20%
V_{OC}	0.93	0.96	1.01	0.99	0.95	0.95
J_{SC}	15.7	18.2	18.6	20.9	17.3	16.8
FF	0.47	0.6	0.61	0.65	0.56	0.51
PCE	7.03	10.9	12.1	13.5	10.3	9.94