



Supporting Information

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**MgO Nanoparticle Modified Anode for Highly Efficient
SnO₂-Based Planar Perovskite Solar Cells**

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Table S1. Photovoltaic parameters for the PSCs without and with different MgO films.

Molarity (M)	V_{oc} (V)	J_{sc} (mA cm ⁻²)	FF	PCE (%)
Pure FTO	1.06	15.11	0.56	9.12
FTO/0.045- MgO	1.09	16.51	0.61	11.03
FTO/SnO ₂	1.07	21.56	0.67	15.45
FTO/0.015- MgO/SnO ₂	1.08	22.23	0.71	17.04
FTO/0.045- MgO/SnO ₂	1.09	22.59	0.72	17.72

FTO/0.060- MgO /SnO ₂	1.06	21.74	0.72	16.59
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Table S2. The average photovoltaic parameters of PSCs on FTO without and with 0.045-MgO nanolayer.

	V _{oc} (V)	J _{sc} (mA cm ⁻²)	FF	PCE (%)
Without MgO	1.04 ± 0.04	21.48 ± 0.47	0.69 ± 0.02	15.43 ± 1.20
With MgO	1.07 ± 0.03	22.25 ± 1.03	0.72 ± 0.01	17.08 ± 1.24

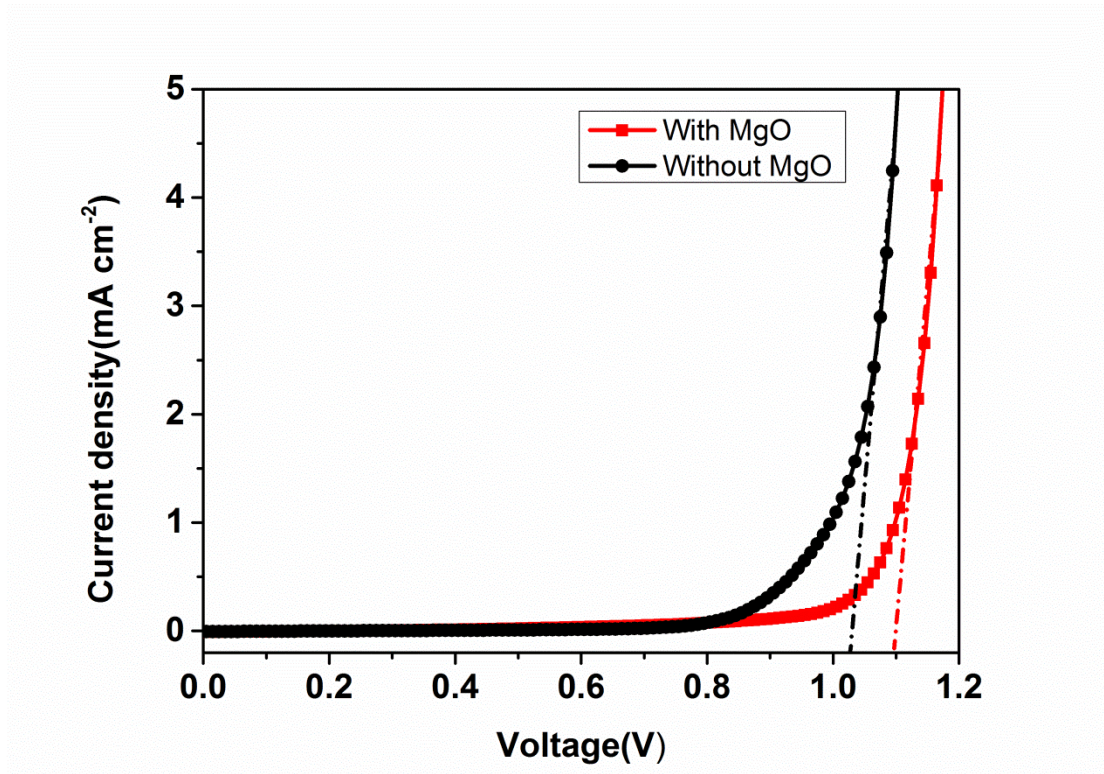


Figure S1. J-V curves of the PSCs without and without MgO films measured in the dark.

Table S3. the value of series resistance (R_s), shunt resistance(R_{sh}) and ideality factor (A) of the perovskite solar cells with or without MgO HBL.

	$R_s(\Omega \text{ cm}^2)$	$R_{sh}(\Omega \text{ cm}^2)$	A
Without MgO	2.21	2272.72	5.76
With MgO	4.85	4166.67	2.69

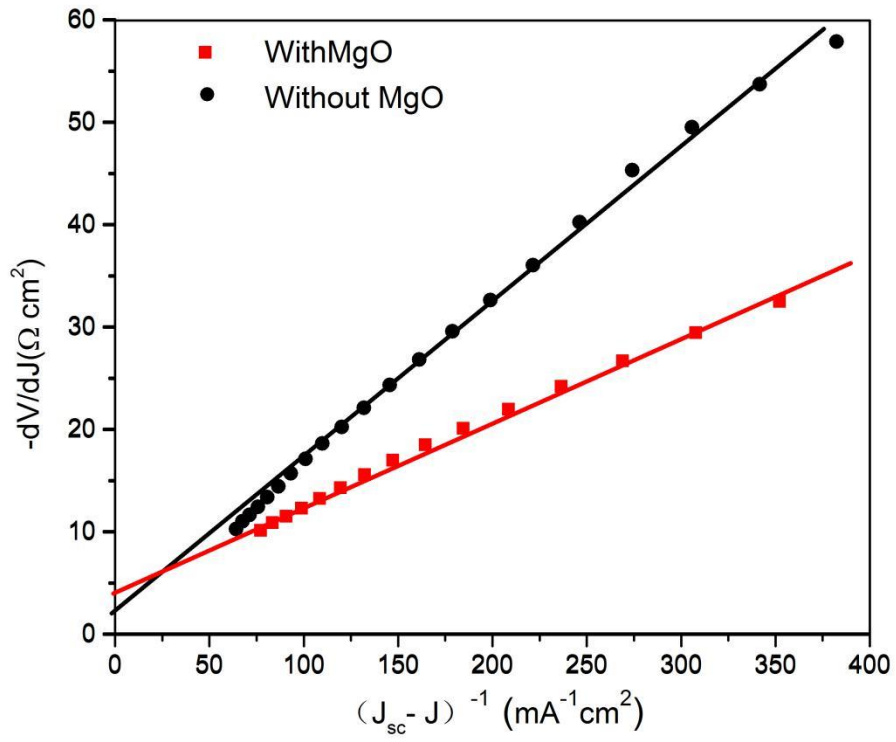


Figure S2. plots of $-dV/dJ$ vs $(J_{sc}-J)^{-1}$ and linear fitting curves of the PSCs based on the solar cells with or without MgO HBL under illumination.

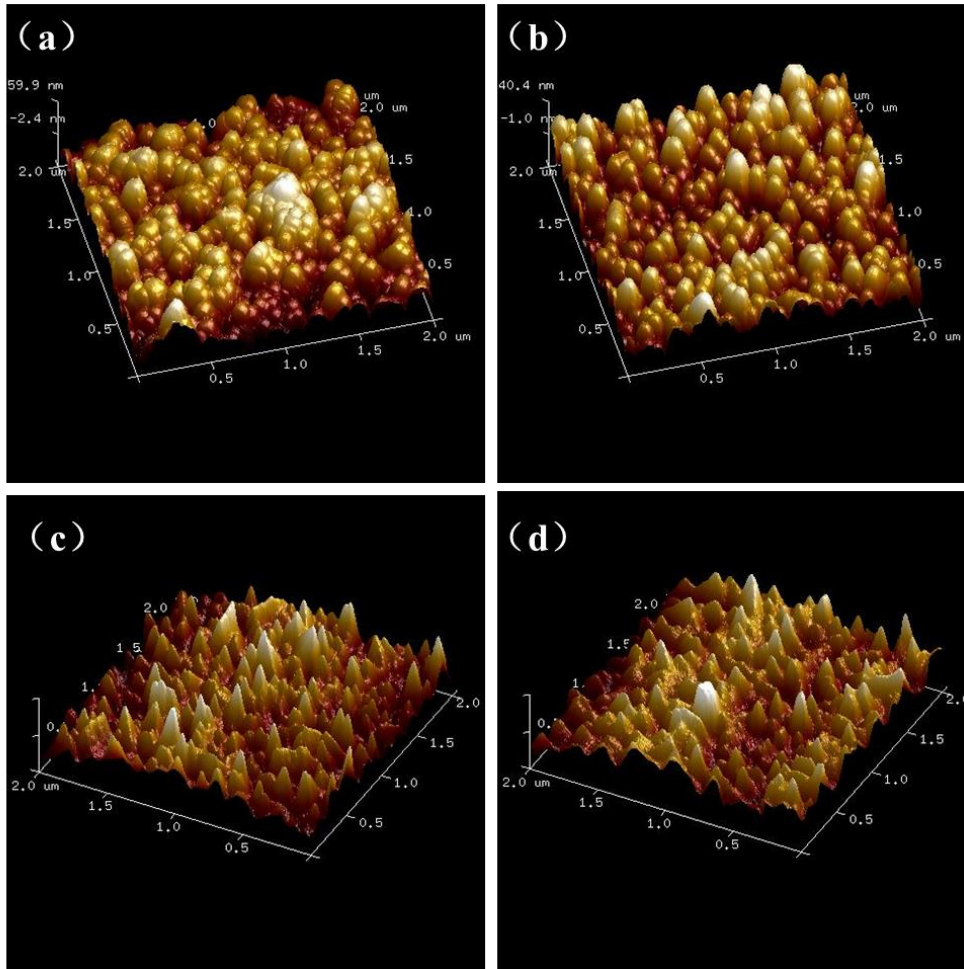


Figure S3. AFM image of a) bare FTO b) a FTO substrate coated with MgO c) a FTO substrate coated with SnO₂ d) FTO substrate coated with MgO/SnO₂

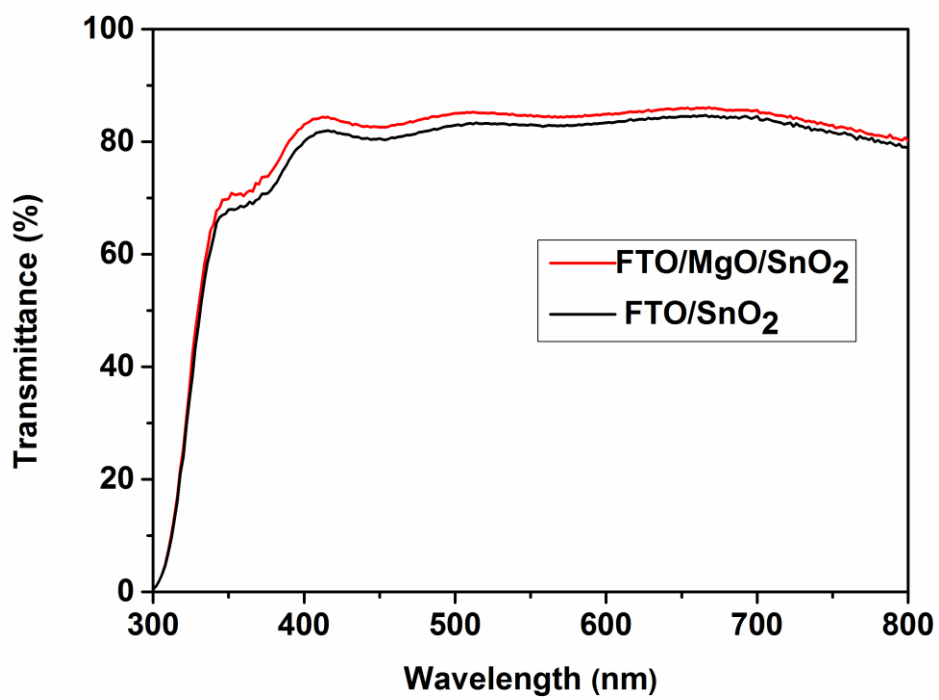


Figure S4. Transmittance spectra of FTO/SnO₂ and FTO/MgO/SnO₂.

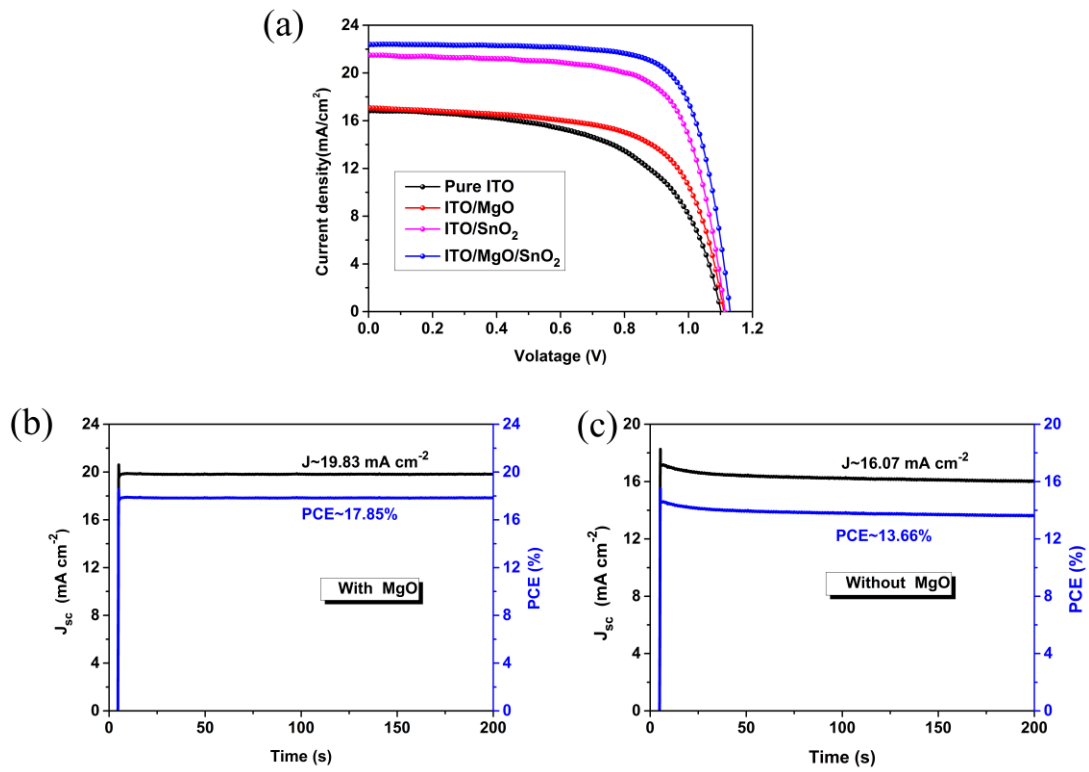


Figure S5. a) J-V curves of the PSCs without and with MgO films based on ITO anode. Steady-state efficiencies of the PSCs with SnO₂ ETL based on ITO anode. b) with and c) without a MgO HBL at a constant bias voltages of 0.90 V and 0.85 V, respectively.

Table S4. Photovoltaic parameters for the PSCs without and with MgO films based on ITO anode.

	V_{oc} (V)	J_{sc} (mA cm ⁻²)	FF	PCE (%)
Pure ITO	1.10	16.84	0.58	10.79
ITO/ MgO	1.12	17.07	0.65	12.39
ITO/SnO ₂	1.12	21.49	0.71	16.92
ITO/MgO/SnO ₂	1.14	22.39	0.74	18.82