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

Supporting Information

Highly Crystalline Zn_2SnO_4 Nanoparticles as Efficient Electron-Transporting Layers toward Stable Inverted and Flexible Conventional Perovskite Solar Cells

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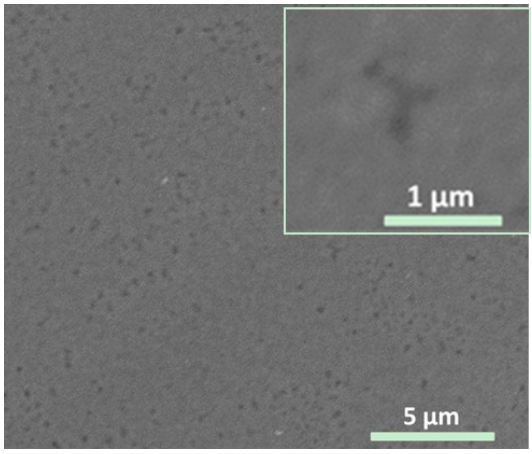

Figure S1. SEM image of ZSO film deposited on PCBM, which was processed from a precursor solution with a low concentration of 5 mg/mL in IPA.

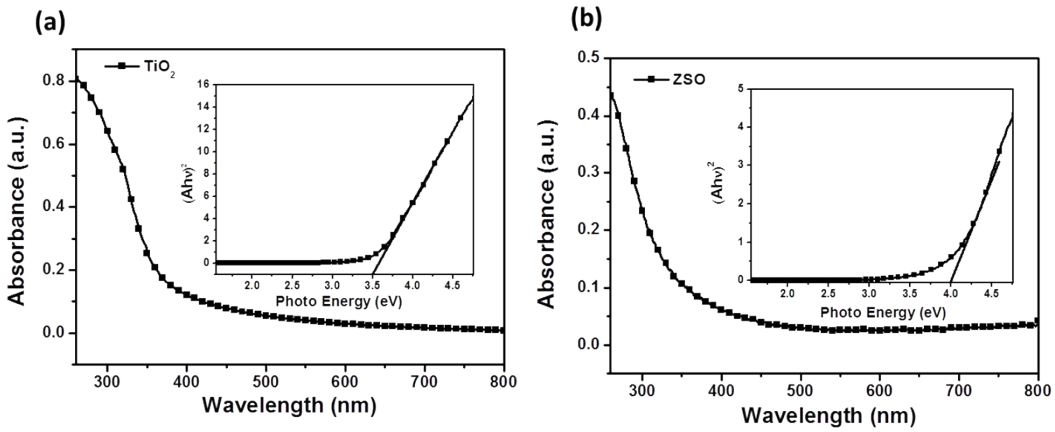

Figure S2. UV-Vis absorption and (inset) Kubelka-Munk-transformed diffuse reflectance spectrum of (a) TiO_2 and (b) ZSO films on quartz.

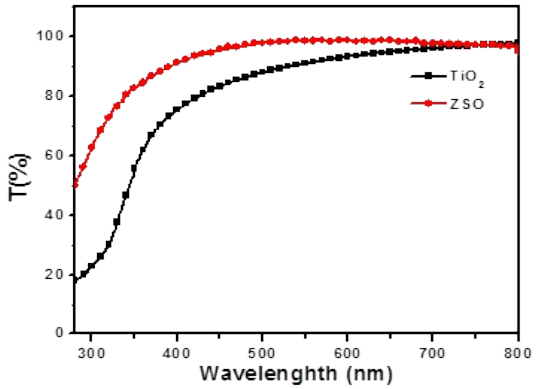

Figure S3. Transmittance of ZSO and TiO_2 films on quartz.

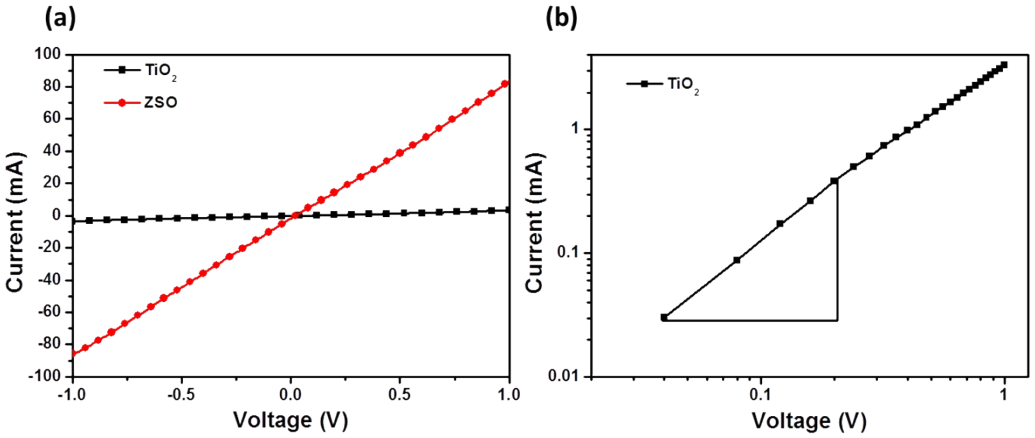

Figure S4. I-V curves of ITO/ZSO/Ag and FTO/TiO_2/Ag devices.

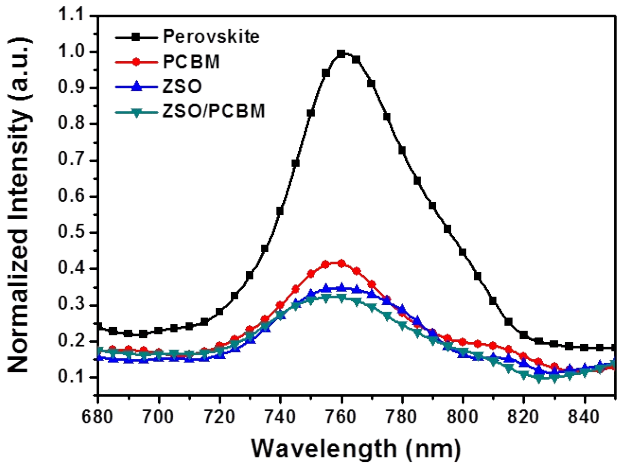

Figure S5. PL spectra of perovskite film and its bilayered film comprising PCBM, ZSO, and ZSO/PCBM ETLs

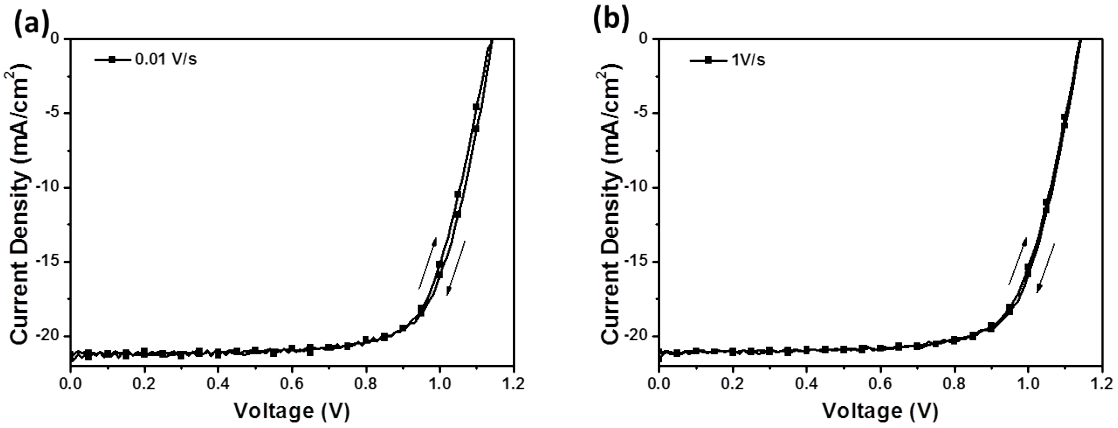

Figure S6. The photovoltaic performance of the inverted PVSC measured by different scan rates (a) 0.01 V/s and (b) 1 V/s under forward and reverse scans.

Table S1. Photovoltaic parameters of the inverted PVSCs measured by different scan rates under forward and reverse scans.

Scan Rate	Scan direction	V_{OC} (V)	J_{SC} (mA/cm²)	FF (%)	PCE (%)	PCE_{AVG} (%)
0.01 V/s	Forward	1.15 ± 0.01	21.54 ± 0.27	71.2 ± 0.4	17.64 ± 0.47	17.71
	Reverse	1.15 ± 0.01	21.24 ± 0.21	72.8 ± 0.4	17.78 ± 0.44	
1 V/s	Forward	1.15 ± 0.01	21.49 ± 0.43	70.6 ± 0.5	17.46 ± 0.63	17.61
	Reverse	1.15 ± 0.01	21.10 ± 0.29	73.2 ± 0.7	17.75 ± 0.58	

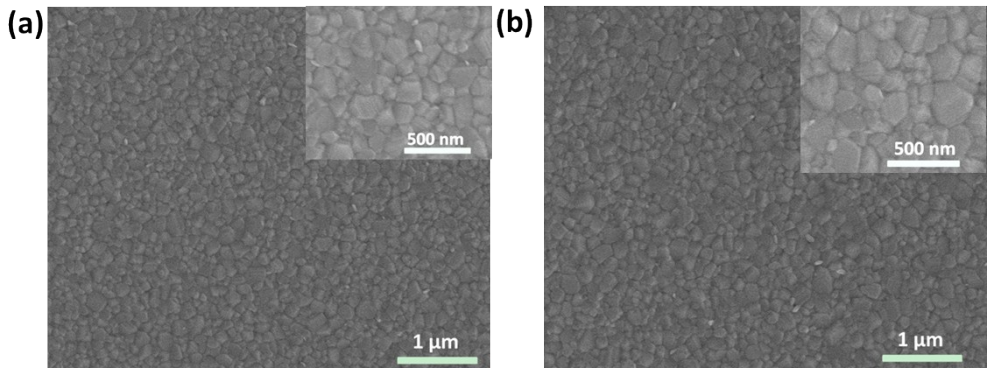

Figure S7. SEM images of perovskite film grown on (a) TiO_2/PCBM and (b)ZSO/PCBM. Insets are the high magnification images.

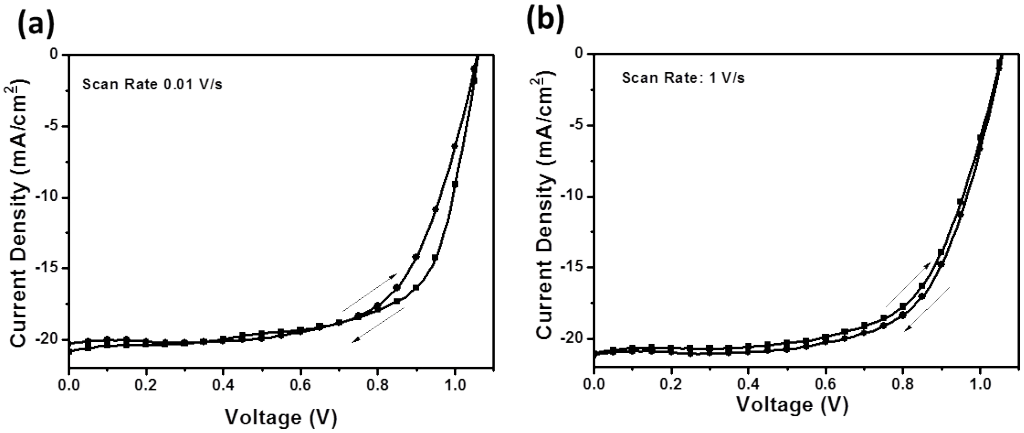

Figure S8. The photovoltaic performance of the conventional PVSC measured at different scan rates (a) 0.01 V/s and (b) 1V/s under forward and reverse scans.

Table S2. Photovoltaic parameters of the conventional PVSCs measured by different scan rate under forward and reverse scans.

Scan Rate	Scan direction	V_{OC} (V)	J_{SC} (mA/cm^2)	FF (%)	PCE (%)	PCE_{AVG} (%)
0.01 V/s	Forward	1.06 ± 0.01	20.33 ± 0.45	65.5 ± 0.61	14.13 ± 0.57	14.48
	Reverse	1.07 ± 0.01	20.86 ± 0.30	66.5 ± 0.60	14.83 ± 0.48	
1 V/s	Forward	1.06 ± 0.01	21.15 ± 0.30	63.6 ± 0.45	14.27 ± 0.44	14.49
	Reverse	1.06 ± 0.01	21.19 ± 0.28	65.5 ± 0.40	14.72 ± 0.43	

Table S3. Photovoltaic parameters of the flexible conventional PVSC using ZSO/PCBM ETL.

Flexible substrate	Scan direction	V_{OC} (V)	J_{SC} (mA/cm^2)	FF (%)	PCE (%)	PCE_{AVG} (%)
PET/ITO	Forward	1.03 ± 0.01	17.83 ± 0.38	61.3 ± 0.55	11.25 ± 0.45	11.43
	Reverse	1.05 ± 0.01	17.35 ± 0.40	63.8 ± 0.50	11.61 ± 0.47	