

Supporting Information

Low-temperature Processed Flower-like TiO₂ Array as Electron Transport Layer for High-performance Perovskite Solar Cells

Xiao Chen,^a Li Juan Tang,^a Shuang Yang,^a Yu Hou^{,a}, and Hua Gui Yang^{*,a}*

^a Key Laboratory for Ultrafine Materials of Ministry of Education, School of Materials Science and Engineering, East China University of Science and Technology, 130 Meilong Road, Shanghai 200237, China.

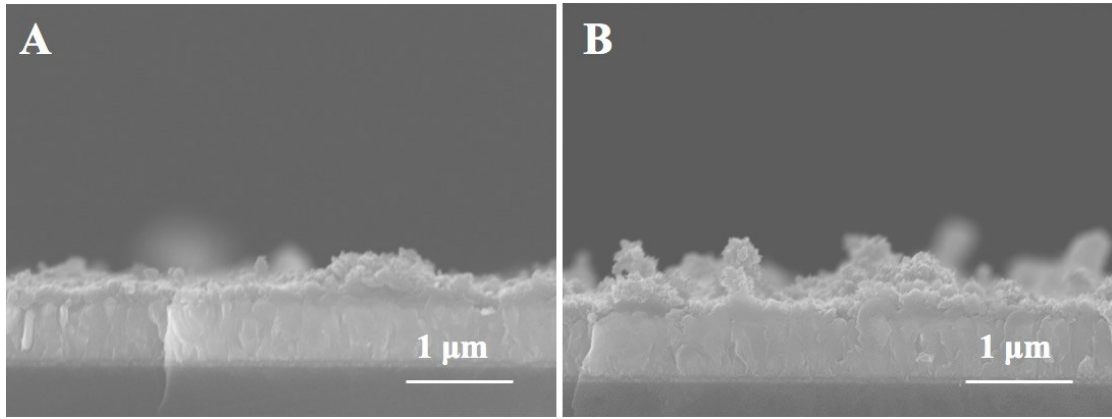


Figure S1. Cross-sectional SEM images of low-temperature CBD processed flower-like TiO₂ films with different reaction time of (A) 8 h and (B) 10 h.

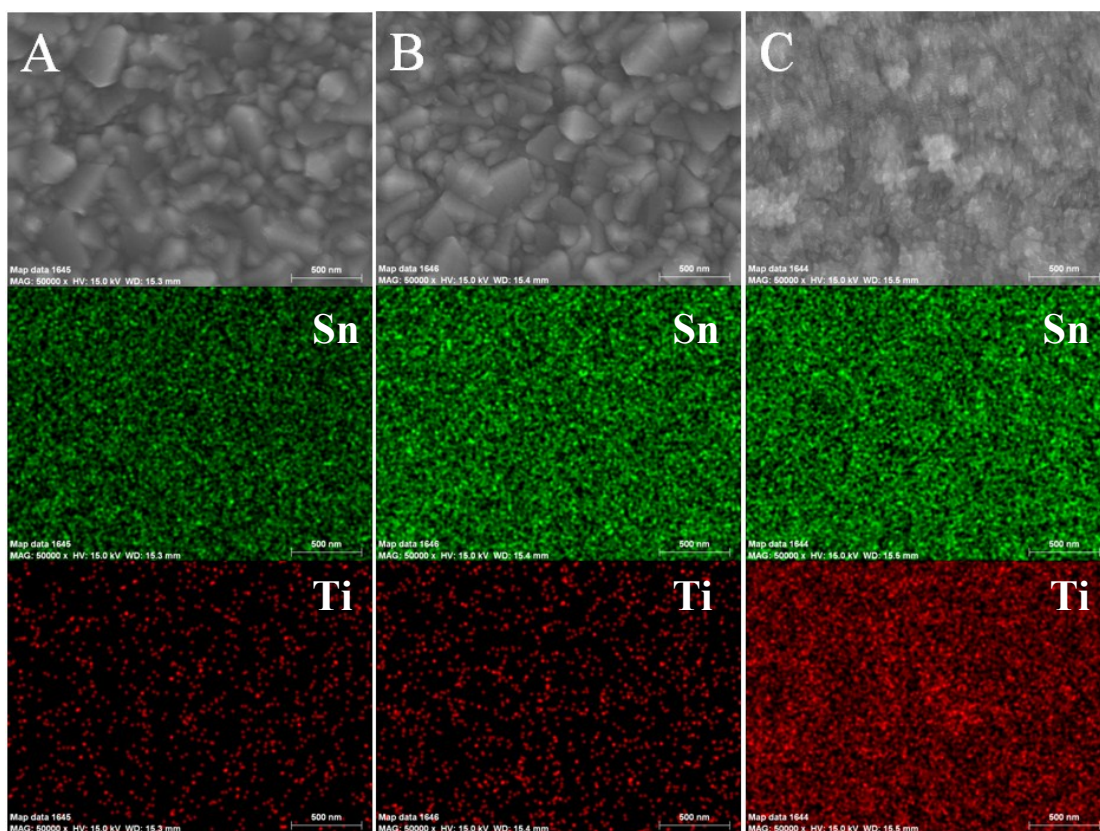


Figure S2. SEM images and corresponding elemental mapping of Sn and Ti from samples treated in TiCl_3 for different time (A: 4h, B: 6h, C: 8h).

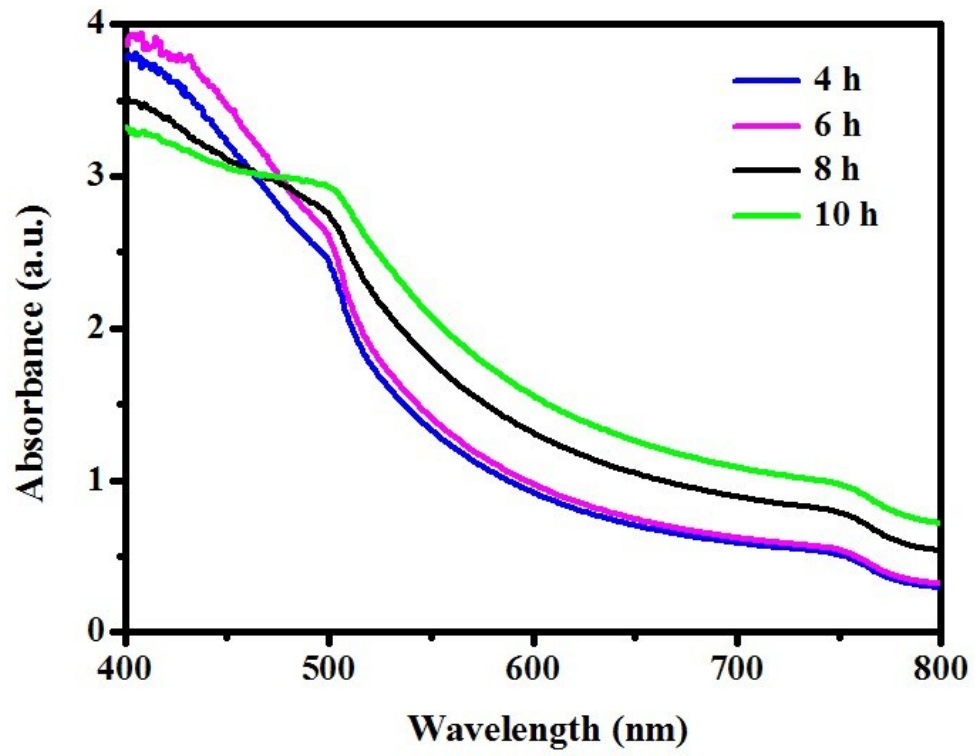


Figure S3. Absorption spectra of the perovskite-coated flower-like TiO₂ ETL films on FTO substrates.

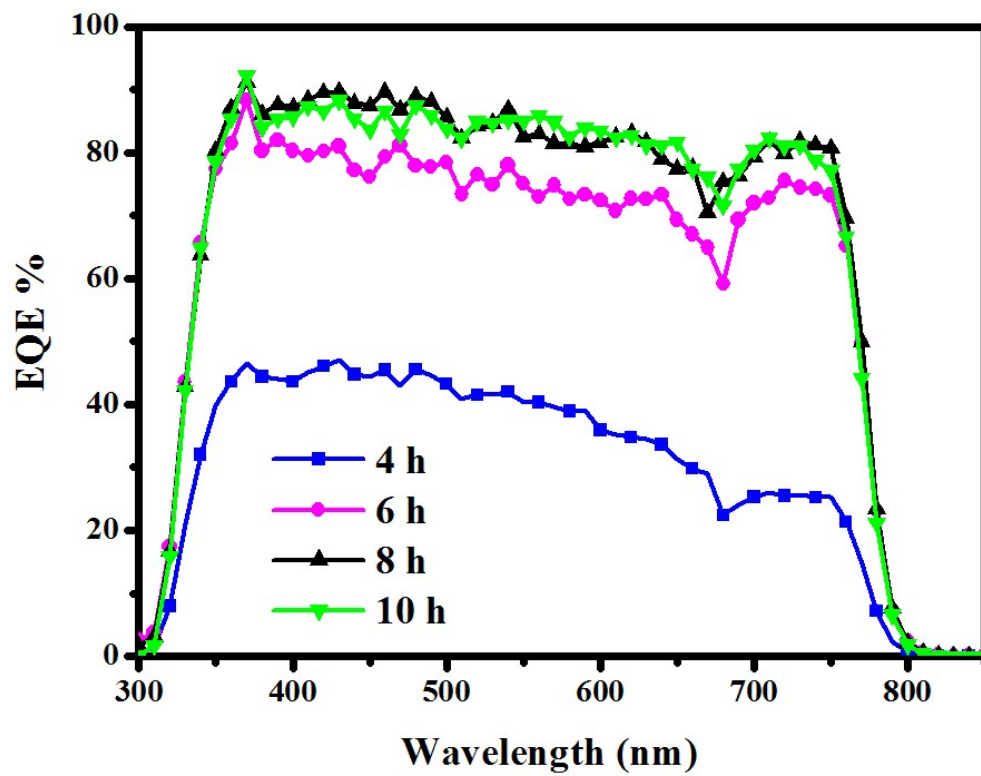


Figure S4. EQE spectra of different reaction time flower-like TiO₂ ETLs based perovskite solar cells.

Table S1. Photovoltaic parameters of perovskite solar cells with different reaction time ETLs, measured at a simulated AM 1.5 G solar irradiation.

<i>Reaction time (h)</i>	J_{sc} (mA cm ⁻²)	V_{oc} (mV)	<i>FF</i>	η (%)
4	9.52	907.13	0.51	4.42
6	19.58	958.96	0.62	11.68
8	21.18	972.27	0.69	14.19
10	21.28	973.86	0.57	11.84

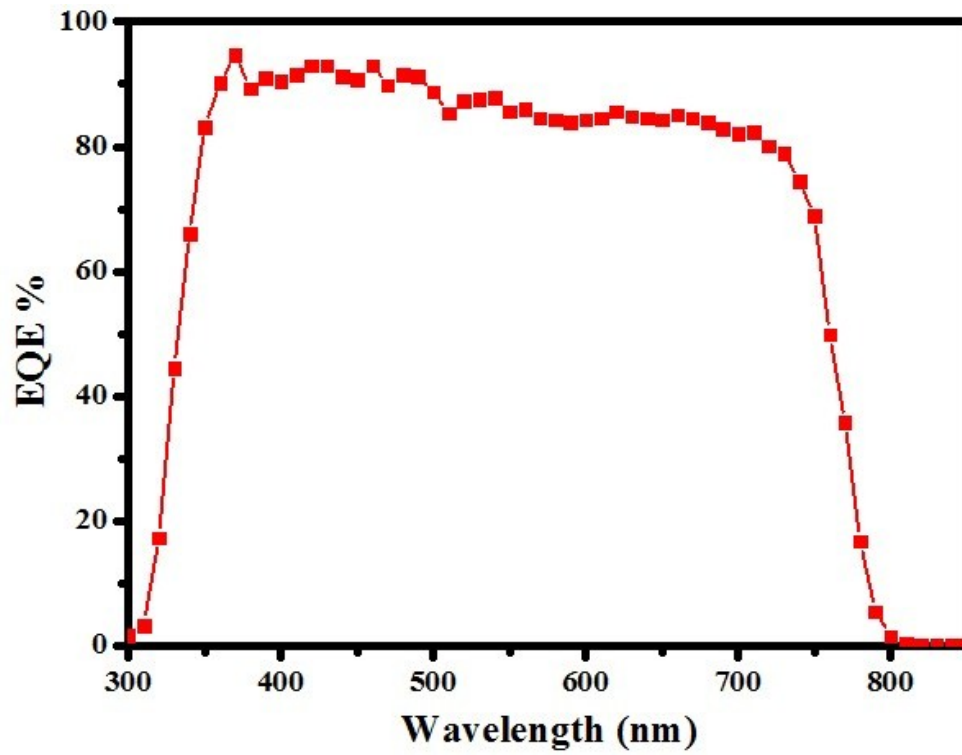


Figure S5. EQE spectrum of the best performing flower-like TiO₂ ETL based perovskite solar cell.

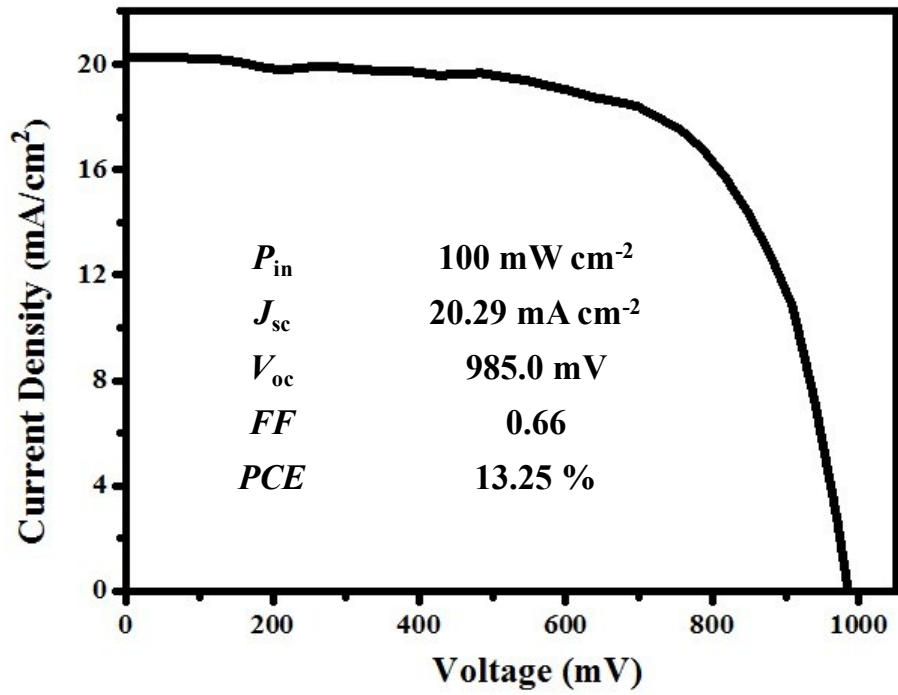


Figure S6. J - V curves for perovskite solar cells based on traditional mesoporous TiO₂ ETL measured under a simulated AM 1.5 G solar irradiation.

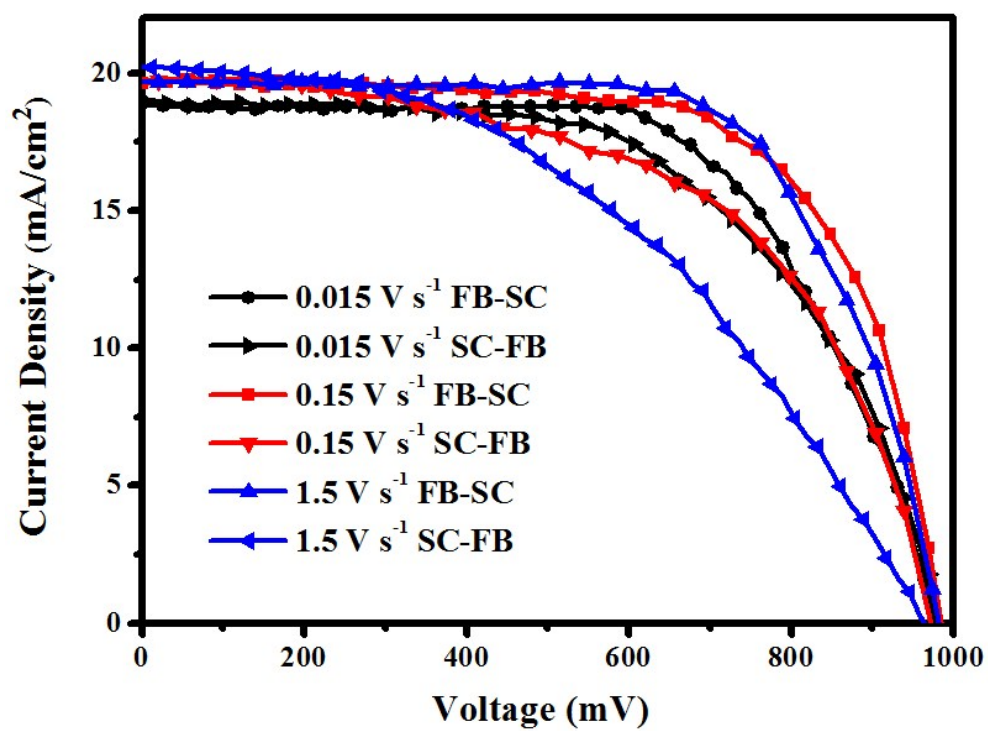


Figure S7. FB-SC and SC-FB J - V curves measured with different sweeping rates for the perovskite solar cell based on traditional mesoporous TiO₂ ETL measured under a simulated AM 1.5 G solar irradiation.

Table S2. Photovoltaic parameters of flower-like TiO₂ ETL (8 h) based perovskite solar cells with different sweeping rates and directions, measured at a simulated AM 1.5 G solar irradiation.

<i>Sweeping rate</i> (<i>V s⁻¹</i>)	<i>Sweeping direction</i>	<i>J_{sc}</i> (mA cm ⁻²)	<i>V_{oc}</i> (mV)	<i>FF</i>	<i>η</i> (%)	Hysteresis index
0.015	FB-SC	21.02	973.97	0.67	13.73	0.084
	SC-FB	21.01	985.52	0.59	12.13	
0.15	FB-SC	21.75	958.35	0.67	14.03	0.191
	SC-FB	21.49	984.57	0.52	11.08	
1.5	FB-SC	21.85	977.31	0.65	13.95	0.466
	SC-FB	21.33	998.94	0.39	8.28	

Table S3. Photovoltaic parameters of mesoporous P25 ETL (300 nm thickness) based perovskite solar cells with different sweeping rates and directions, measured at a simulated AM 1.5 G solar irradiation.

<i>Sweeping rate</i> ($V s^{-1}$)	<i>Sweeping direction</i>	J_{sc} (mA cm ⁻²)	V_{oc} (mV)	FF	η (%)	Hysteresis index
0.015	FB-SC	18.77	977.63	0.64	11.79	0.157
	SC-FB	19.04	983.90	0.58	10.79	
0.15	FB-SC	19.62	985.41	0.67	13.05	0.297
	SC-FB	19.76	972.69	0.56	10.81	
1.5	FB-SC	19.68	982.06	0.69	13.30	0.560
	SC-FB	20.26	964.66	0.45	8.72	