

# Supplementary Information

## The Maximum Limiting Performance Improved Counter Electrode based on Porous Fluorine Doped Tin Oxide Conductive Framework for Dye-sensitized Solar Cells

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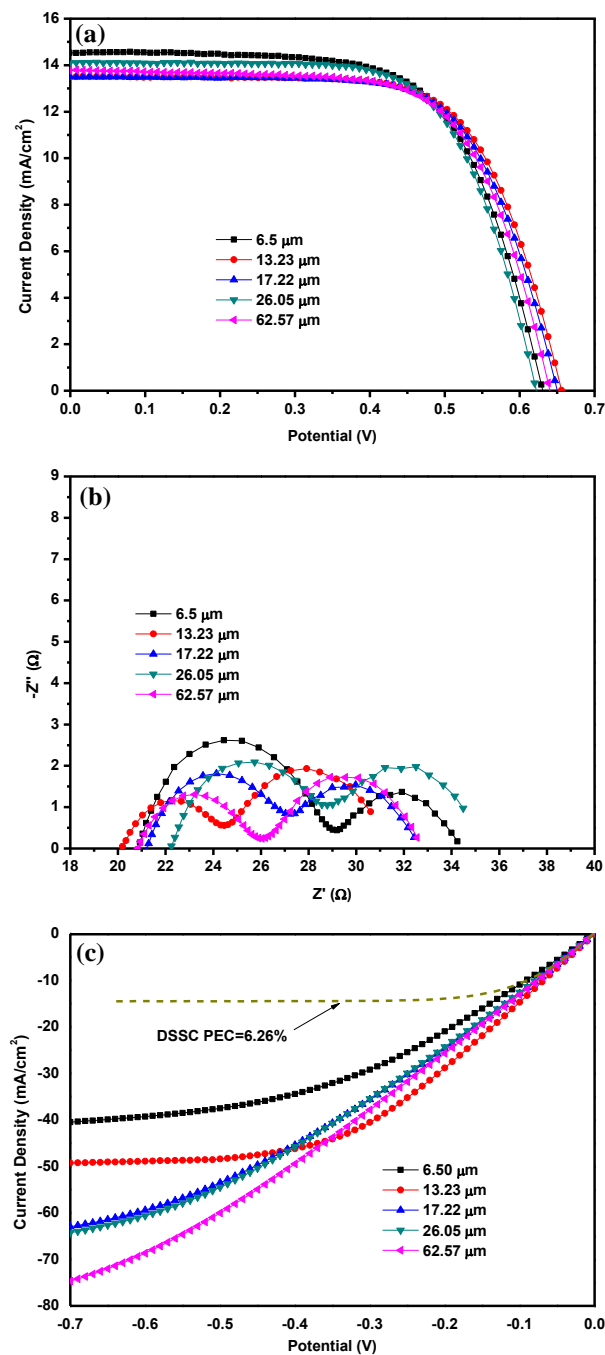
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**Table S1** Summary of characterization data obtained by adsorption-desorption of N<sub>2</sub>, the pore radius, pore volume, and specific surface area of PFTO, PFTO-Pt and PFTO-C.

	PFTO	PFTO-Pt	PFTO-C
BET Surface Area (m <sup>2</sup> /g)	42.54	43.86	75.33
Langmuir Surface Area(m <sup>2</sup> /g)	59.36	62.17	102.21
Single point adsorption total pore volume of pores (m <sup>3</sup> /g)	0.26	0.21	0.21
BJH Adsorption cumulative volume of pores (m <sup>3</sup> /g)	0.29	0.26	0.24
BJH Desorption cumulative volume of pores (m <sup>3</sup> /g)	0.29	0.26	0.24
Adsorption average pore width(nm)	24.44	18.88	11.21
BJH Adsorption average pore diameter (nm)	22.47	19.33	21.81
BJH Desorption average pore diameter (nm)	20.80	17.80	20.76

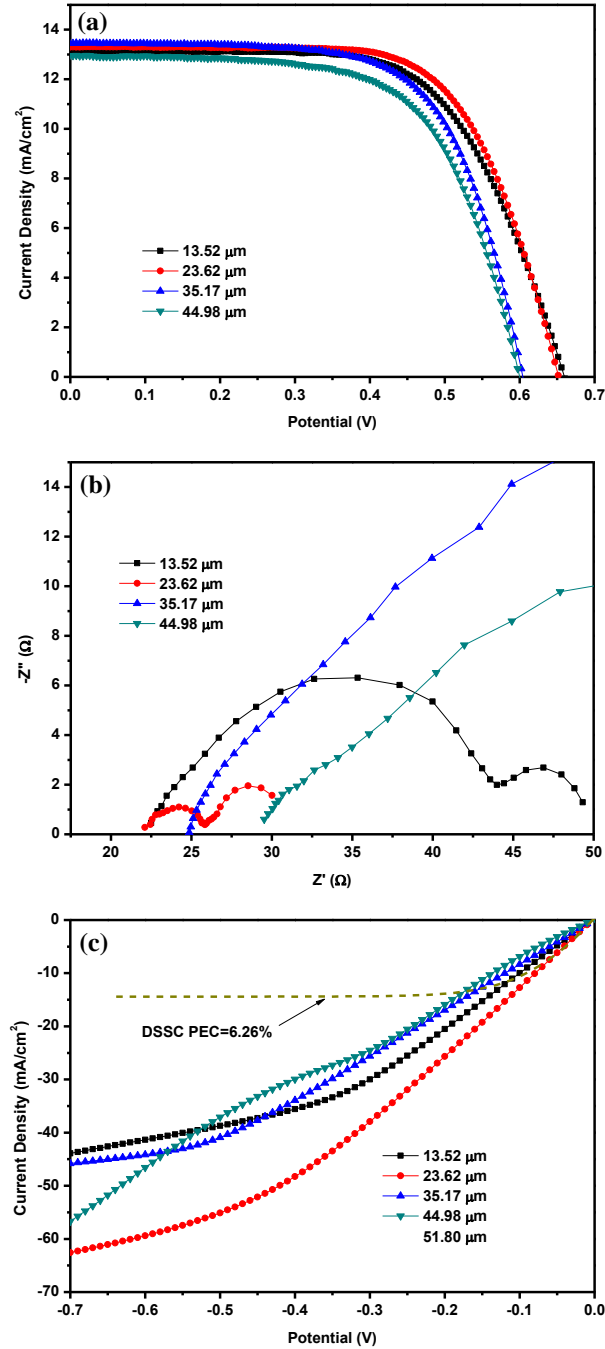


**Fig. S1** Photovoltaic and electrochemical performance of Pt modified PFTO CE with different thickness. (a) J-V curves of DSSCs based on PFTO-Pt CE with different thickness. (b) Nyquist plots of symmetrical cells of PFTO-Pt CE with different thickness. (c) Polarization curves of symmetrical cells of PFTO-Pt CE with different thickness

**Table S2** Photovoltaic performance of DSSCs with Pt modified PFTO CE with different thickness and the electrochemical parameters of the corresponding symmetrical cells.

CE thickness (μm)	Voc (V)	Jsc (mA/cm <sup>2</sup> )	FF (%)	PCE (%)	R <sub>s</sub> (Ω cm <sup>2</sup> )	R <sub>CT</sub> (Ω cm <sup>2</sup> )	R <sub>s</sub> +R <sub>CT</sub> (Ω cm <sup>2</sup> )	R <sub>s</sub> +R <sub>CT</sub> * (Ω cm <sup>2</sup> )	PCE <sub>lim</sub> (%)
6.5 μm	0.63	14.54	65.74	6.03	2.61	1.01	3.62	4.80	14.58
13.23 μm	0.66	13.51	68.65	6.09	2.52	0.48	3.00	3.47	20.25
17.22 μm	0.65	13.50	68.53	6.02	2.65	0.76	3.41	4.08	18.28
26.05 μm	0.62	14.23	67.82	6.01	2.78	0.84	3.62	4.15	18.37
62.57 μm	0.64	13.78	67.58	5.96	2.61	0.63	3.24	3.91	19.80

\* This column was obtained from polarization curves of symmetrical cells of CE.



**Fig. S2** Photovoltaic and electrochemical performance of C modified PFTO CEs with different thickness. (a) J-V curves of DSSCs based on PFTO-C CEs with different thickness. (b) Nyquist plots of symmetrical cells of PFTO-C CEs with different thickness. (c) Polarization curves of symmetrical cells of PFTO-C CEs with different thickness

**Table S3** Photovoltaic performance of DSSCs with C modified PFTO CEs with different thickness and the electrochemical parameters of the corresponding symmetrical cells.

CE thickne (μm)	Voc (V)	Jsc (mA/cm <sup>2</sup> )	FF (%)	PCE (%)	R <sub>S</sub> (Ω cm <sup>2</sup> )	R <sub>CT</sub> (Ω cm <sup>2</sup> )	R <sub>S</sub> +R <sub>CT</sub> (Ω cm <sup>2</sup> )	R <sub>S</sub> +R <sub>CT</sub> * (Ω cm <sup>2</sup> )	PCE <sub>lim</sub> (%)
13.52	0.66	13.15	64.12	5.56	2.79	2.65	5.44	3.96	15.12
23.62	0.65	13.29	67.03	5.81	2.75	0.51	3.26	3.93	19.58
35.17	0.60	13.45	66.16	5.38	3.10	1.05	4.15	4.73	--
44.98	0.60	12.94	64.28	4.99	3.61	0.82	4.43	5.15	--

\* This column was obtained from polarization curves of symmetrical cells of CEs.