

## Supporting Information

# A solution mediated halide exchange engineering for fabrication of thick CsPbCl<sub>3</sub> film and its application in photovoltaics with outstanding performance

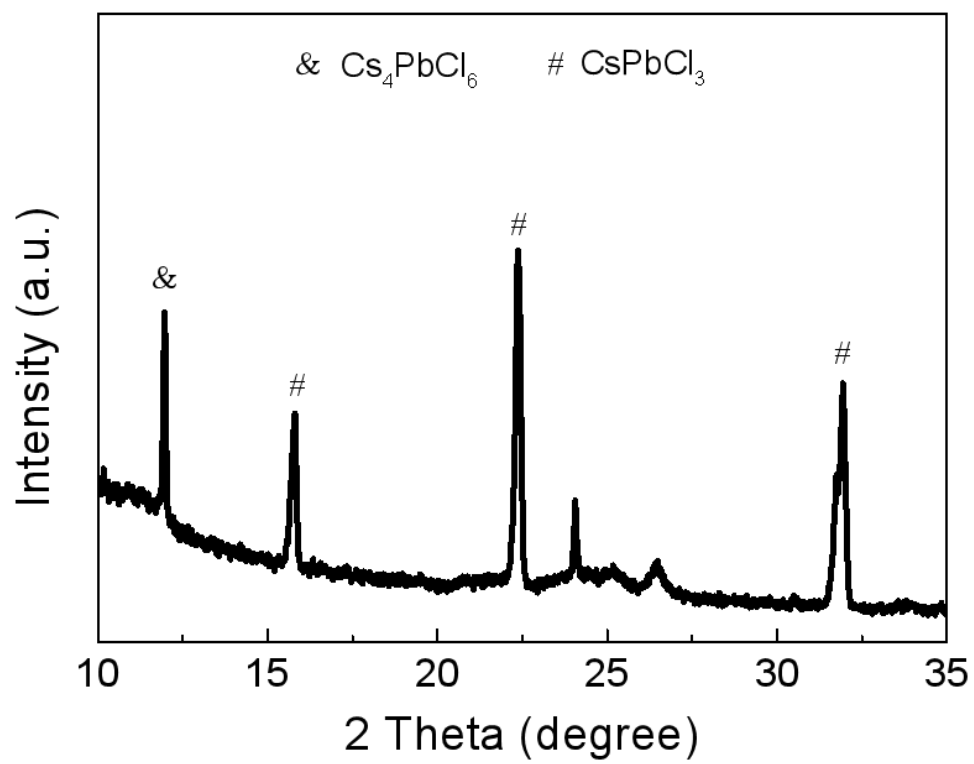
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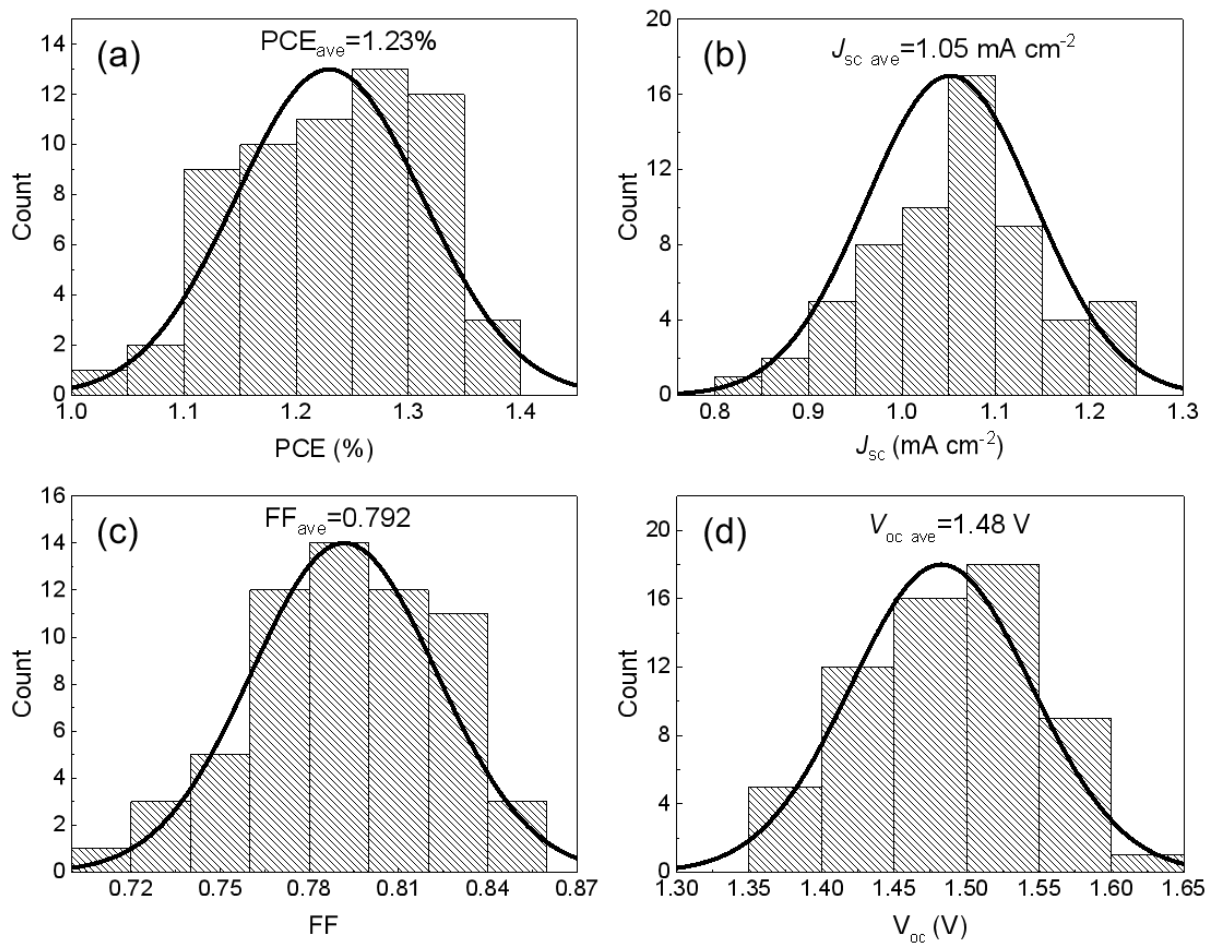
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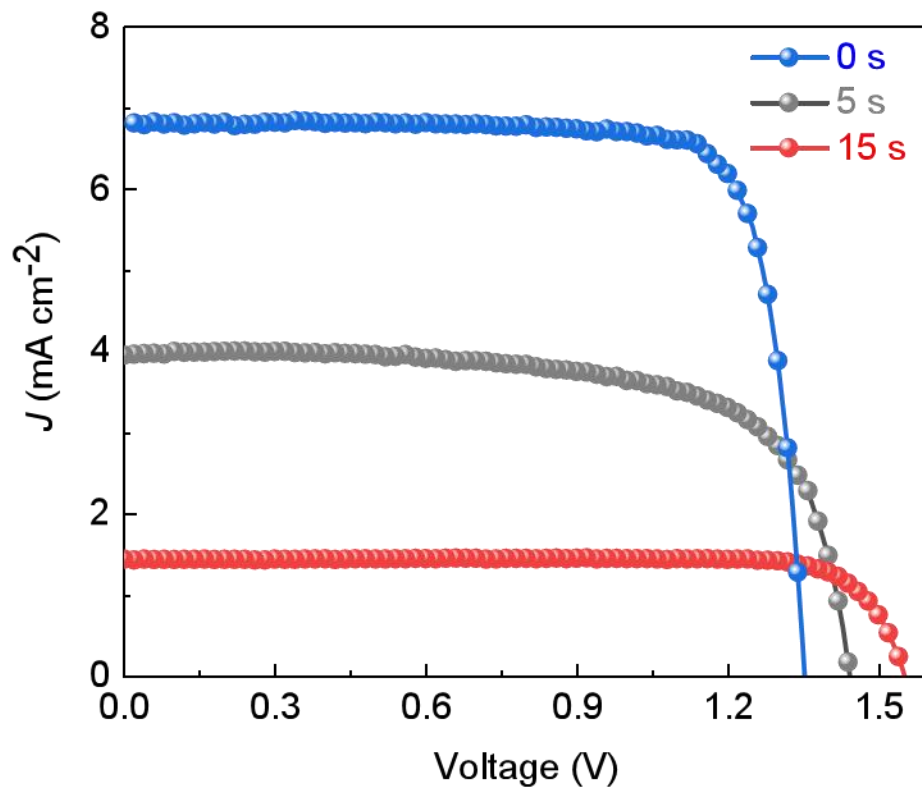
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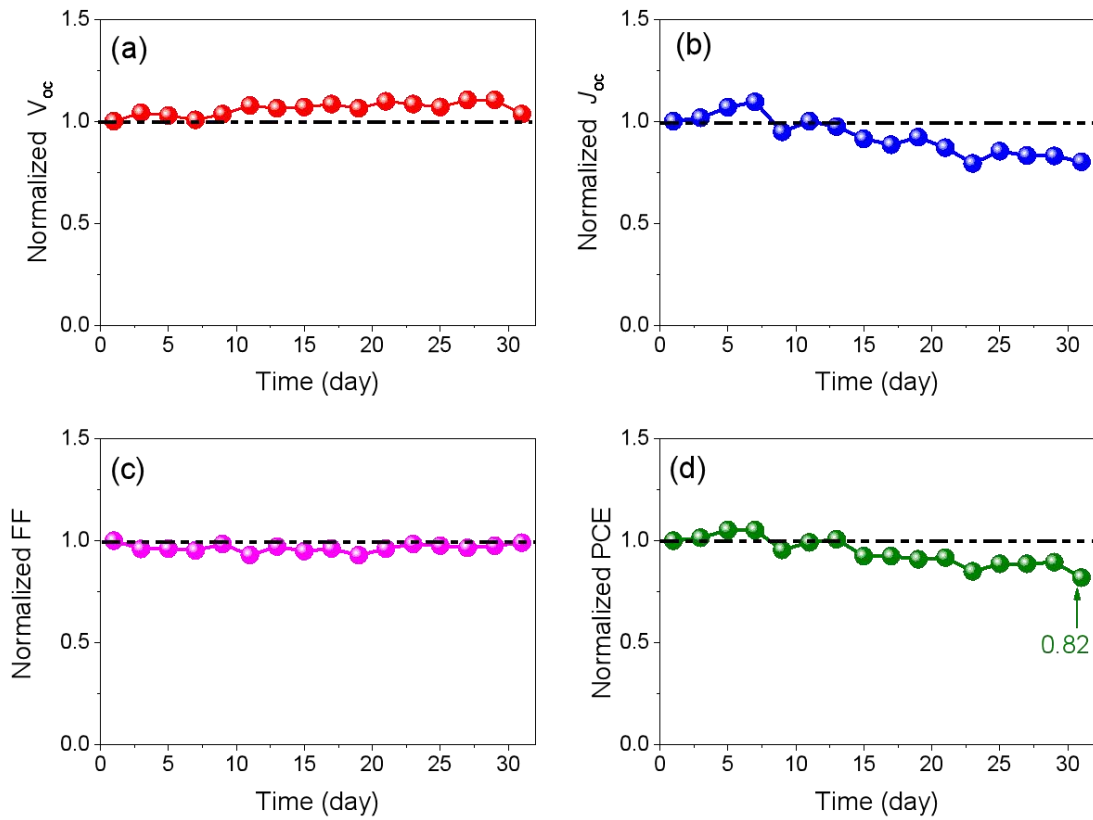
**Figure S1** XRD curve of Cs-Pb-Cl films prepared by dipping CsPbBr<sub>3</sub> films into high concentrated commercial HCl/methanol solution (~4.0 M).



**Figure S2** The statistic results of photovoltaic parameters extracting from  $J$ - $V$  curves based on 61 PSCs. (a) PCE; (b)  $J_{sc}$ ; (c) FF; (d)  $V_{oc}$ .



**Figure S3**  $J$ - $V$  curves the best PSCs prepared from different dipping time.



**Figure S4** The evolution of normalized photovoltaic parameters of PSC in open air. (a)  $V_{oc}$ ; (b)  $J_{sc}$ ; (c) FF; (d) PCE.

**Table S1** The comparison of the detailed parameters of solar cells using wide bandgap (~2.9 eV) perovskite films as light harvest layer.

<b>Configuration</b>	$V_{oc}$ (V)	$J_{sc}$ (mA cm <sup>-2</sup> )	<b>FF</b>	<b>PCE</b> (%)	<b>Ref.</b>
FTO/c-TiO <sub>2</sub> /m-TiO <sub>2</sub> /MAPbCl <sub>3</sub> /Spiro-OMeTAD/Au	1.78	0.71	0.68	0.87	1
FTO/c-TiO <sub>2</sub> /m-TiO <sub>2</sub> /MAPbCl <sub>3</sub> /Spiro-PT/Au	1.14	0.66	0.44	0.33	2
FTO/c-TiO <sub>2</sub> /m-TiO <sub>2</sub> /MAPbCl <sub>3</sub> /PTTA/Au	1.63	0.91	0.68	1.01	3
ITO/Cl:TiO <sub>2</sub> /MAPbCl <sub>3</sub> /Spiro-OMeTAD/Au	1.65	0.28	0.69	0.32	4
FTO/c-TiO <sub>2</sub> /m-TiO <sub>2</sub> /MAPbCl <sub>3</sub> /Spiro-PT/EC	1.04	0.53	0.51	0.28	5
ITO/PEDOT/MAPbCl <sub>3</sub> /C <sub>60</sub> /BCP/Ag/Alq <sub>3</sub>	1.18	0.67	0.41	0.33	6
FTO/TiO <sub>2</sub> /CsPbCl <sub>3</sub> /Carbon	1.48	1.13	0.75	1.27	7
FTO/TiO <sub>2</sub> /CsPbCl <sub>3</sub> /Carbon	1.55	1.20	0.68	1.26	8
FTO/TiO <sub>2</sub> /CsPbCl <sub>3</sub> /Carbon	1.53	1.08	<b>0.838</b>	<b>1.39</b>	This work
FTO/TiO <sub>2</sub> /CsPbCl <sub>3</sub> /Carbon	<b>1.61</b>	0.85	0.78	1.01	This work

## References:

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**Table S1** The details of the photovoltaic parameters of the PSCs prepared from different dipping time

Dipping times	$V_{oc}$ (V)	$J_{sc}$ (mA cm <sup>-2</sup> )	FF	PCE (%)
0 s	1.35	6.85	0.81	7.48
5 s	1.44	4	0.69	3.95
15 s	1.55	1.46	0.82	1.86