

## Supporting Materials

### Efficient inorganic solid solar cell composed of perovskite and PbS quantum dots

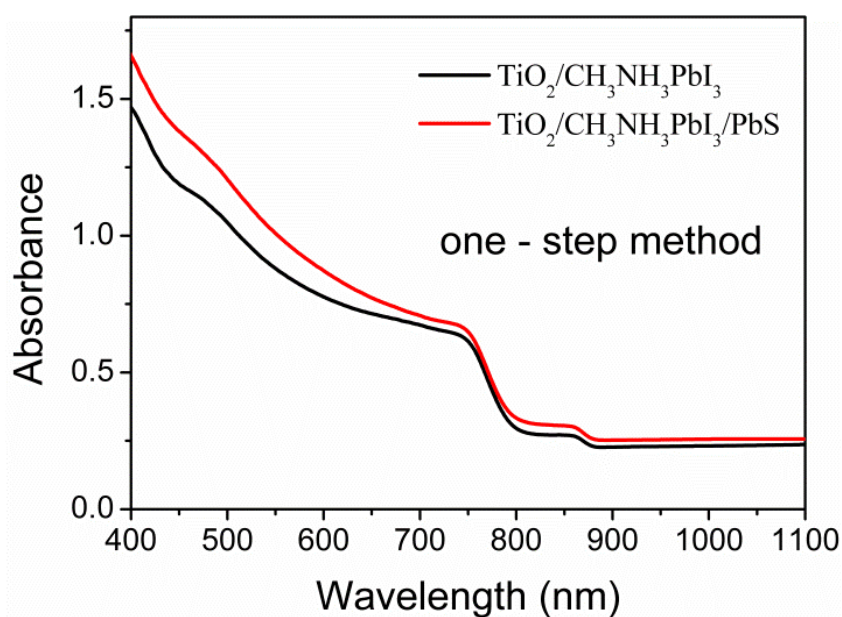
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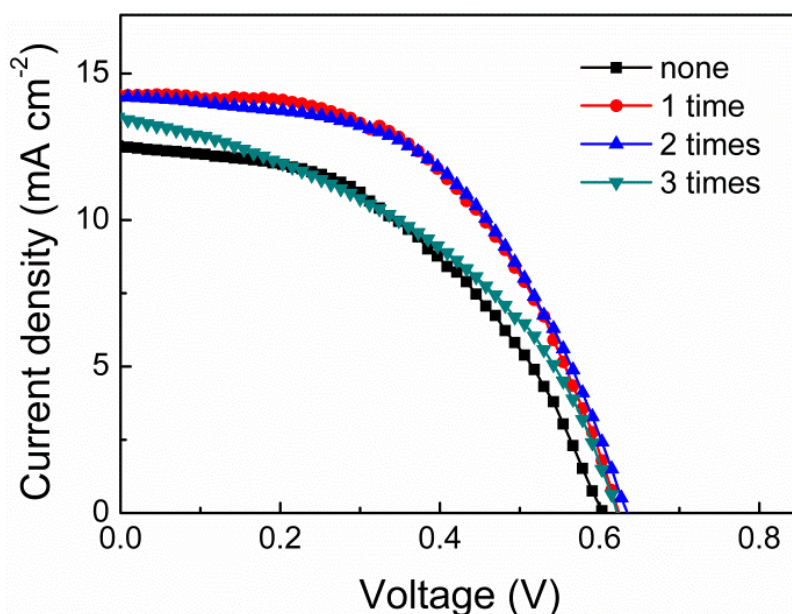
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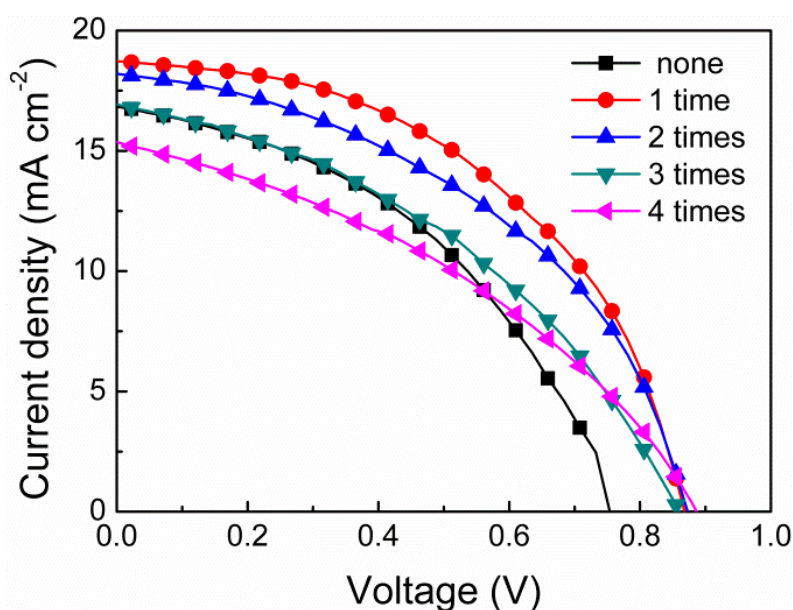
**Figure S1 | UV-visible absorption spectrum of TiO<sub>2</sub>/CH<sub>3</sub>NH<sub>3</sub>PbI<sub>3</sub> films before and after spinning PbS QDs.** 10 mg/mL PbS QDs in octane solution was used and the spinning speed is 3000 rpm for 30 s.



**Figure S2 | Photovoltaic performance of  $\text{TiO}_2/\text{CH}_3\text{NH}_3\text{PbI}_3/\text{PbS}$  solar cell as a function of spin-coating number for PbS QDs.**  $\text{CH}_3\text{NH}_3\text{PbI}_3$  was prepared on the  $\text{TiO}_2$  films by the one-step method. The PbS QDs in octane (10 mg/mL) was spread on the  $\text{FTO}/\text{TiO}_2/\text{CH}_3\text{NH}_3\text{PbI}_3$  substrates, which was spun for 30 s at speed of 3000 rpm in ambient atmosphere.

**Table S1 | Photovoltaic parameters of perovskite solar cells depending on the number of spin-coating for PbS QDs.**  $\text{CH}_3\text{NH}_3\text{PbI}_3$  was prepared on the  $\text{TiO}_2$  films by the one-step method.

Spin-coating times	$V_{oc}$ (V)	$J_{sc}$ (mA/cm <sup>2</sup> )	FF	PCE (%)
none	0.60	12.49	0.466	3.50
1 time	0.62	14.27	0.53	4.67
2 times	0.64	14.17	0.52	4.73
3 times	0.62	13.39	0.44	3.63

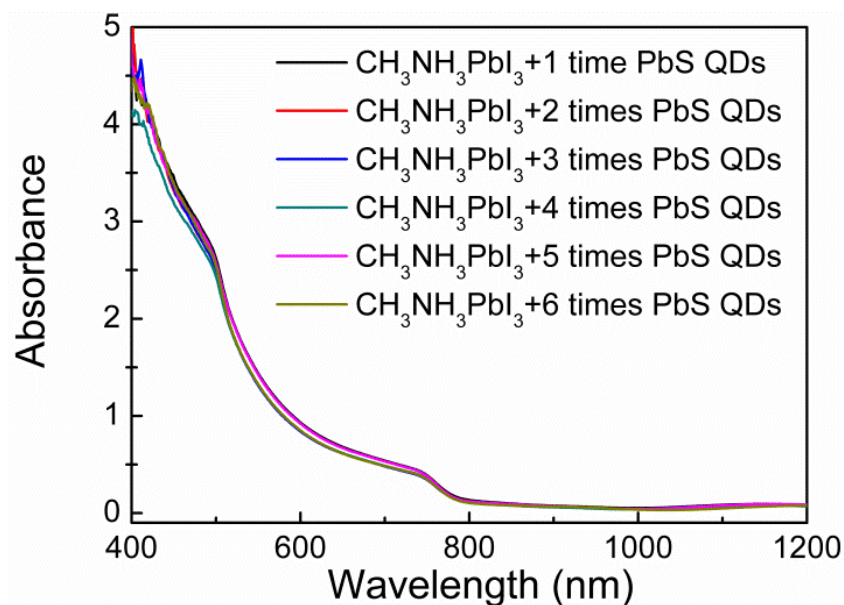


**Figure S3 | Photovoltaic performance of  $\text{TiO}_2/\text{CH}_3\text{NH}_3\text{PbI}_3/\text{PbS}$  solar cell as a function of spin-coating number for PbS QDs.**  $\text{CH}_3\text{NH}_3\text{PbI}_3$  was prepared on the  $\text{TiO}_2$  films by the two-step method. The PbS QDs in octane (10 mg/mL) was spread on the  $\text{FTO}/\text{TiO}_2/\text{CH}_3\text{NH}_3\text{PbI}_3$

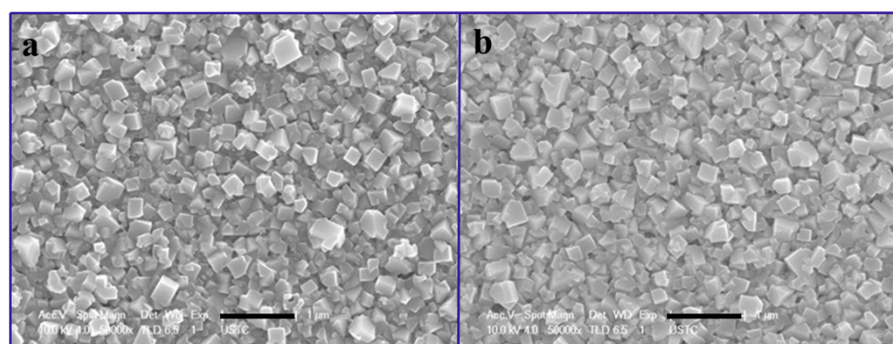
substrates, which was spun for 30 s at speed of 3000 rpm in ambient atmosphere.

**Table S2 | Photovoltaic parameters of perovskite solar cells depending on the number of spin-coating for PbS QDs.  $\text{CH}_3\text{NH}_3\text{PbI}_3$  are prepared on the  $\text{TiO}_2$  films by the two-step method.**

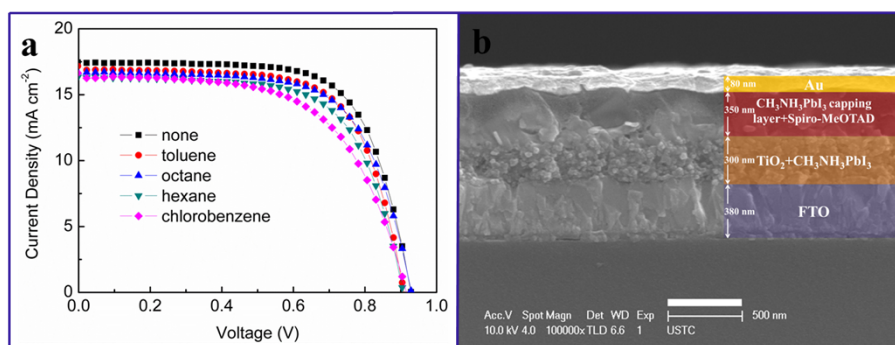
Spin-coating times	$V_{oc}$ (mV)	$J_{sc}$ (mA/cm <sup>2</sup> )	FF	PCE (%)
none	761	16.78	0.431	5.52
1 time	868	18.69	0.486	7.88
2 times	875	18.14	0.453	7.15
3 times	860	16.87	0.405	5.86
4 times	884	15.32	0.382	5.17



**Figure S4 | Effect of PbS QD spin-coating number on the absorption spectra of  $\text{TiO}_2/\text{CH}_3\text{NH}_3\text{PbI}_3/\text{PbS}$  films.**



**Figure S5 | Surface SEM images of  $\text{CH}_3\text{NH}_3\text{PbI}_3$  grown on a mesoporous  $\text{TiO}_2$  layer by the two-step method before (a) and after (b) spinning octane solvent. Scale bar: 1  $\mu\text{m}$**



**Figure S6 | (a)  $J$ - $V$  curves of the FTO/ $\text{CH}_3\text{NH}_3\text{PbI}_3$ /spiro-MeOTAD/Au solar cells.**  $\text{CH}_3\text{NH}_3\text{PbI}_3$  was deposited on  $\text{TiO}_2$  film by the two-step method. Different solvents were spanned on the surface of  $\text{CH}_3\text{NH}_3\text{PbI}_3$  perovskite before the spiro-MeOTAD being spanned. **(b) Cross sectional SEM image of the FTO/ $\text{CH}_3\text{NH}_3\text{PbI}_3$ /spiro-MeOTAD/Au solar cell with octane.**

**Table S3 | Photovoltaic parameters derived from  $J$ - $V$  measurements of perovskite solar cells in Fig. S6.**

Solvent	$V_{oc}$ (V)	$J_{sc}$ ( $\text{mA}/\text{cm}^2$ )	FF	PCE (%)
None	0.93	17.39	0.69	11.11
toluene	0.91	16.90	0.68	10.42
octane	0.93	16.69	0.67	10.32
hexane	0.91	16.28	0.66	9.78
chlorobenzene	0.92	16.28	0.60	9.00