

## Supporting information

# Trimethylsulfonium Lead Triiodide (TMSPbI<sub>3</sub>) For Moisture-Stable Perovskite Solar Cells

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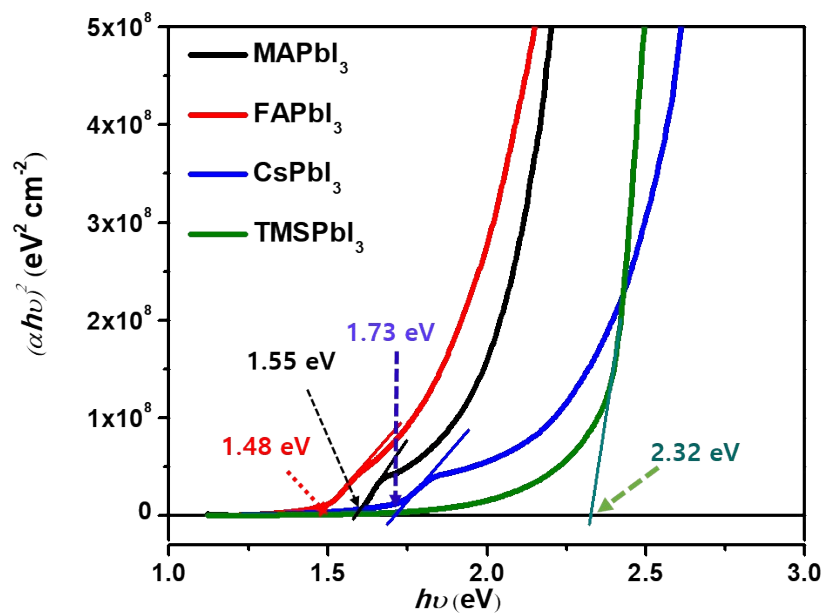
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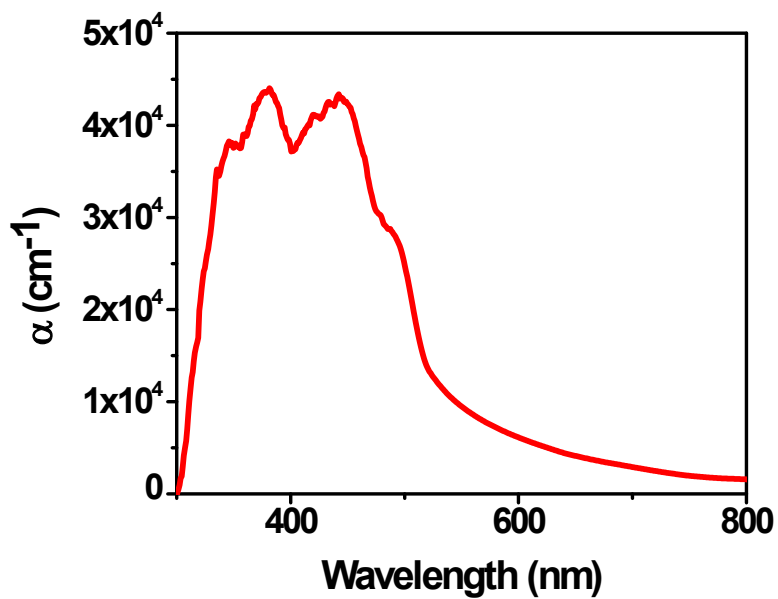
**Figure S1:** Tauc plots of TMSPbI<sub>3</sub>, MAPbI<sub>3</sub>, FAPbI<sub>3</sub>, and CsPbI<sub>3</sub> deposited on mesoporous TiO<sub>2</sub> electrodes.

## Calculation of absorption coefficient

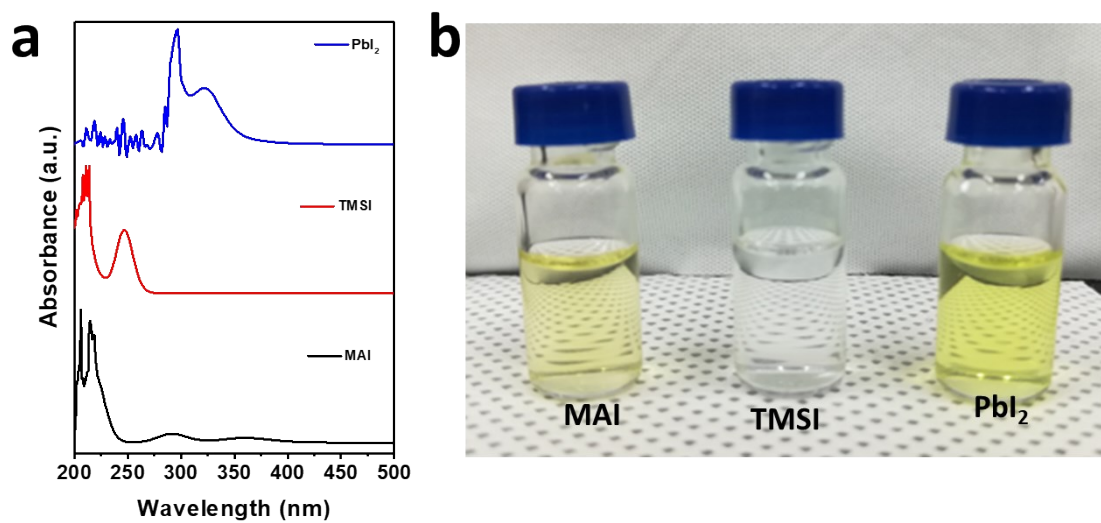
The absorption coefficient ( $\alpha$ ) was obtained from:

$$\alpha = \left(\frac{1}{L}\right) \ln \frac{I_0}{I}$$

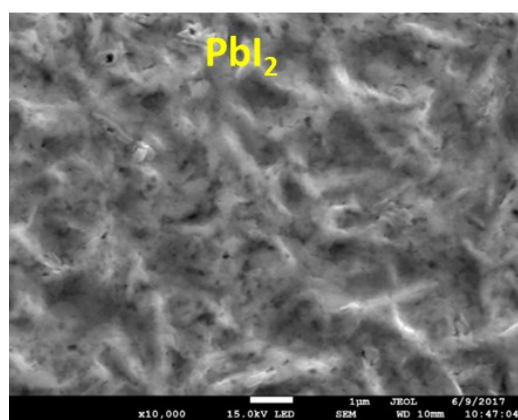
where,  $I$ ,  $I_0$  and  $L$  denotes the transmitted light intensity, incident light intensity, and sample thickness, respectively.



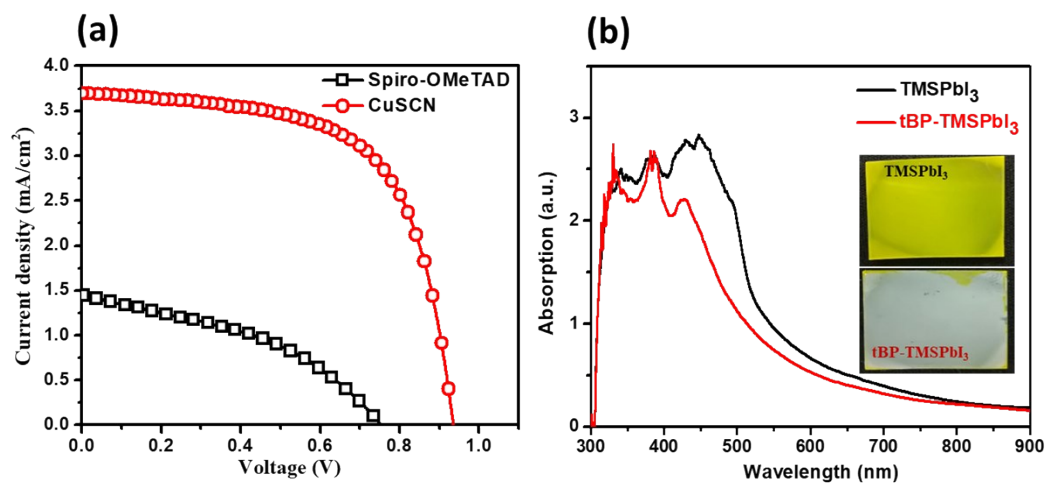
**Figure S2:** Plot of  $\alpha$  as a function of wavelength for  $\text{TMSPbI}_3$ .



**Figure S3:** UV-Visible absorption spectra (a) and photographic images (b) of TMSI, MAI, and  $\text{PbI}_2$  solution in ethanol, acetonitrile, and dimethylformamide (DMF), respectively.



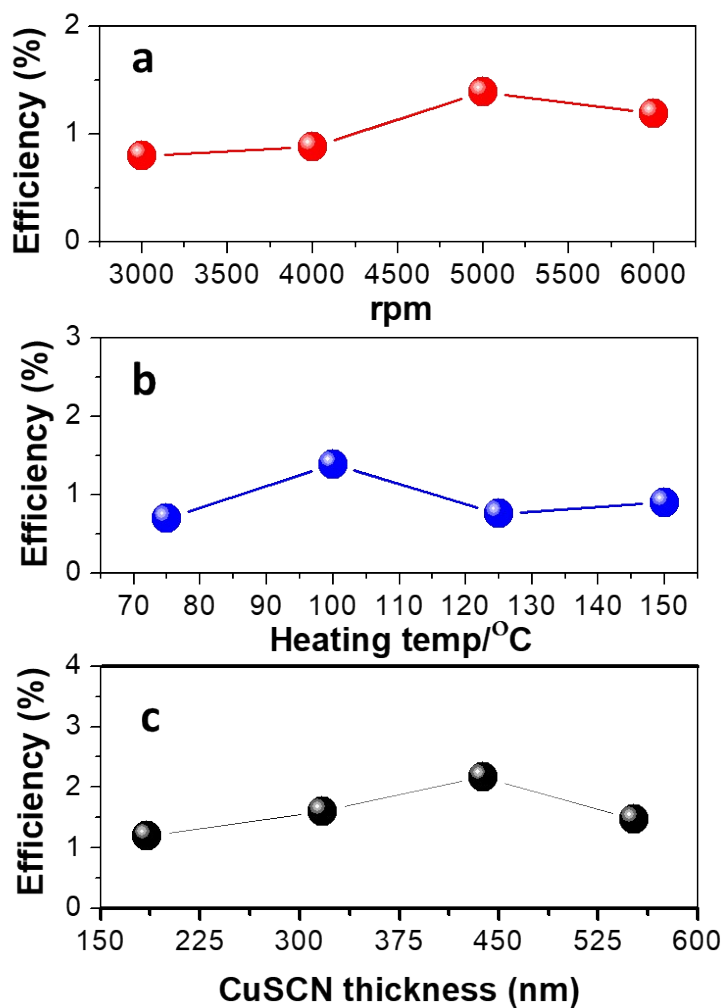
**Figure S4:** FE-SEM image of neat PbI<sub>2</sub> film after the first step of the deposition.



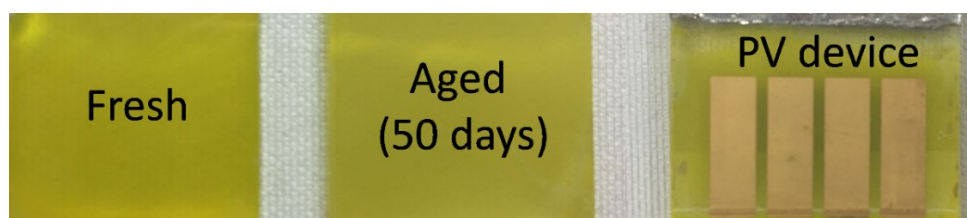
**Figure S5:** (a)  $J$ - $V$  characteristics of the TMSPbI<sub>3</sub> based PSCs fabricated using Spiro-MeOTAD and CuSCN-HTL layers. (b) Absorption spectra of TMSPbI<sub>3</sub> and tBP coated TMSPbI<sub>3</sub> films (inset shows the digital images of the as-fabricated perovskite films).

**Table S1.** PV parameters of the PSCs fabricated with different HTL (Spiro-MeOTAD and CuSCN) materials.

HTL	$V_{oc}$ (V)	$J_{sc}$ (mA cm <sup>-2</sup> )	$FF$ (%)	$PCE$ (%)
CuSCN	0.936	3.698	63.29	2.19
Spiro-OMeTAD	0.753	1.446	40.24	0.438

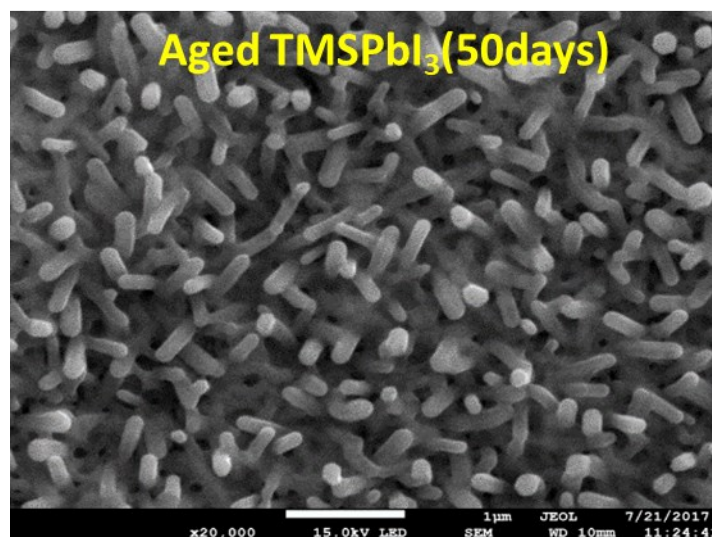


**Figure S6:** (a) Efficiency vs. rpm for  $\text{PbI}_2$  deposition on  $\text{TiO}_2$ , (b) efficiency vs. crystallization temperature of  $\text{TMSpBi}_3$ , and (c) efficiency vs. thickness of CuSCN-HTL layer.

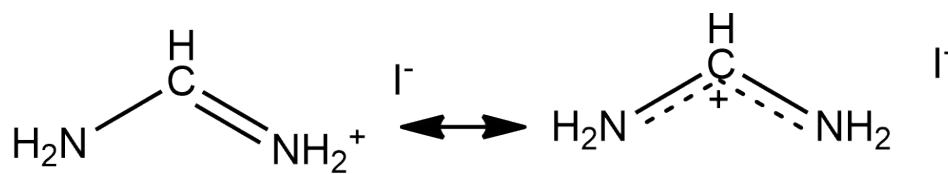


**Figure S7:** Digital images of a freshly prepared  $\text{TMSPbI}_3$  film, aged film, and PSC device.





**Figure S8:** FE-SEM image of the aged perovskite film.



**Figure S9:** Resonance structure of FA<sup>+</sup> cation.