

## Supplementary Information

### **Solution-processed indium oxide electron transporting layer for high-performance and photo-stable perovskite and organic solar cells**

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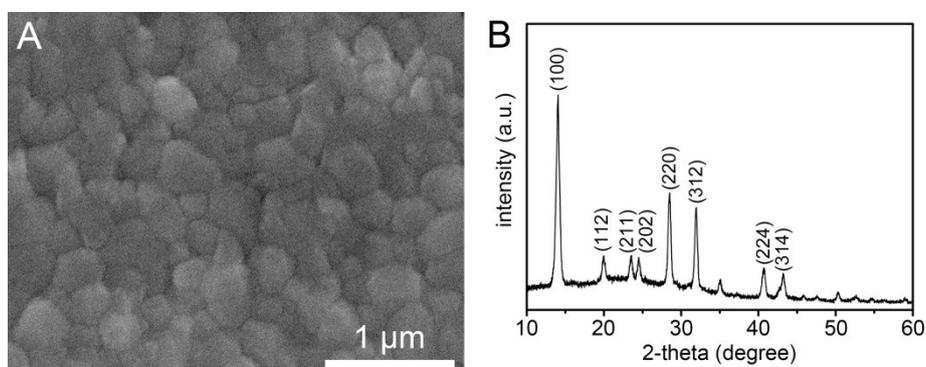
<sup>a</sup> These authors are equally contributed to this work.



**Figure S1.** Photograph of the In precursor ( $\text{In}(\text{NO}_3)_3 \cdot x\text{H}_2\text{O}$ ,  $\text{In}(\text{AcAc})_3$ , and  $\text{InCl}_3$ ) solutions (0.1 M) prepared by dissolving the precursors in ethanol containing  $>0.2\%$  water (**left**) and anhydrous ethanol (**right**). The solutions were held for 1 h.

**Table S1.** Bonding ratios of In-O,  $\text{O}_{\text{vac}}$  and In-OH obtained from XPS peaks of the  $\text{In}_2\text{O}_3$  ETLs at  $T = 200\text{ }^\circ\text{C} - 500\text{ }^\circ\text{C}$ .

Temp. [ $^\circ\text{C}$ ]	In-O [%]	$\text{O}_{\text{vac}}$ [%]	In-OH [%]
200	58.62	9.19	32.19
300	68.08	22.9	9.02
400	69.56	21.33	9.11
500	69.90	20.24	10.16



**Figure S2.** (A) SEM image of the  $\text{CH}_3\text{NH}_3\text{PbI}_3$  thin film deposited onto the  $\text{In}_2\text{O}_3$  ETL. (B) XRD spectrum of the  $\text{CH}_3\text{NH}_3\text{PbI}_3$  thin film. The characteristic peaks of  $\text{In}_2\text{O}_3$  are

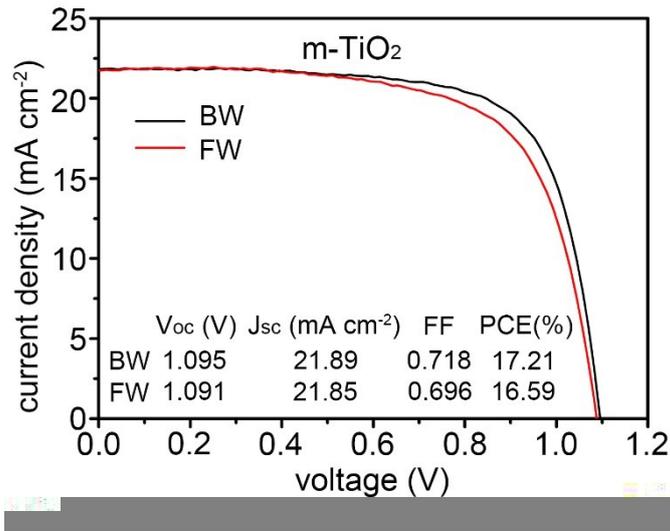
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**Table S2.** Time-resolved photoluminescence (TRPL) parameters fitted using a bi-exponential decay function.<sup>a)</sup>

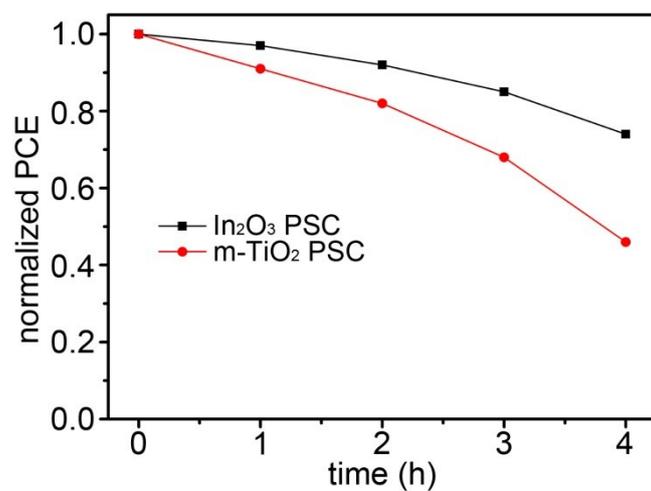
Temp. [°C]	a <sub>1</sub>	τ <sub>1</sub> [ns]	a <sub>2</sub>	τ <sub>2</sub> [ns]	τ <sub>avg</sub> <sup>b)</sup> [ns]
200	0.508	2.981	0.484	22.73	12.51
300	0.898	2.485	0.128	20.25	1.95
400	0.802	2.101	0.227	17.16	3.28
500	0.525	3.134	0.473	9.496	6.14

<sup>a)</sup> Fit function =  $a_1 e^{-t/\tau_1} + a_2 e^{-t/\tau_2}$

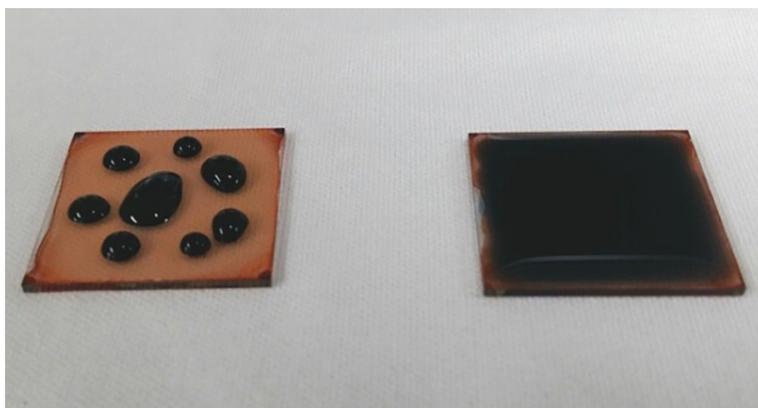
<sup>b)</sup>  $\tau_{avg} = \left( \sum_i a_i \tau_i \right) / \left( \sum_i a_i \right)$ , where  $\sum_i a_i = 1$



**Figure S3.** J-V curves of the mesoporous TiO<sub>2</sub>-PSC measured with the backward-forward sweep at a scan-delay time of 200 ms.



**Figure S4.** Normalized PCEs of the In<sub>2</sub>O<sub>3</sub>-PSC and the TiO<sub>2</sub>-PSC measured under 1 sun illumination at a relative humidity of 30 % and 32 °C for 4 h.



**Figure S5.** Photograph for wettability test of PEDOT:PSS (**left**) and modified PEDOT:PSS with Triton X-100 (**right**) on a P3HT:PCBM layer.

**Table S3.** Series resistance ( $R_s$ ) and shunt resistance ( $R_{sh}$ ) of PSCs and OSCs.

Temp. [°C]	PSC		OSC	
	$R_s$ [ $\Omega$ ]	$R_{sh}$ [k $\Omega$ ]	$R_s$ [ $\Omega$ ]	$R_{sh}$ [k $\Omega$ ]
200	154	8.33	358	1.45
300	33	13.55	74	7.96
400	51	11.97	110	6.48
500	94	97.59	188	2.13