

## Supporting Information

### Charge-transport efficiently in hybrid lead iodide perovskite solar cells

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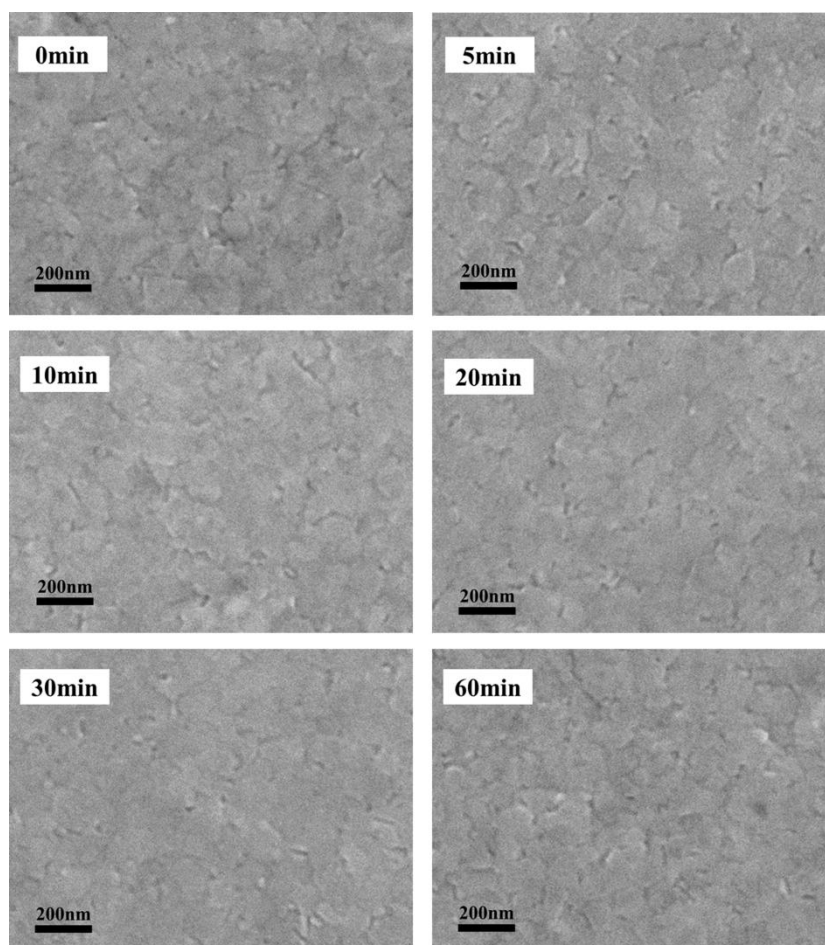
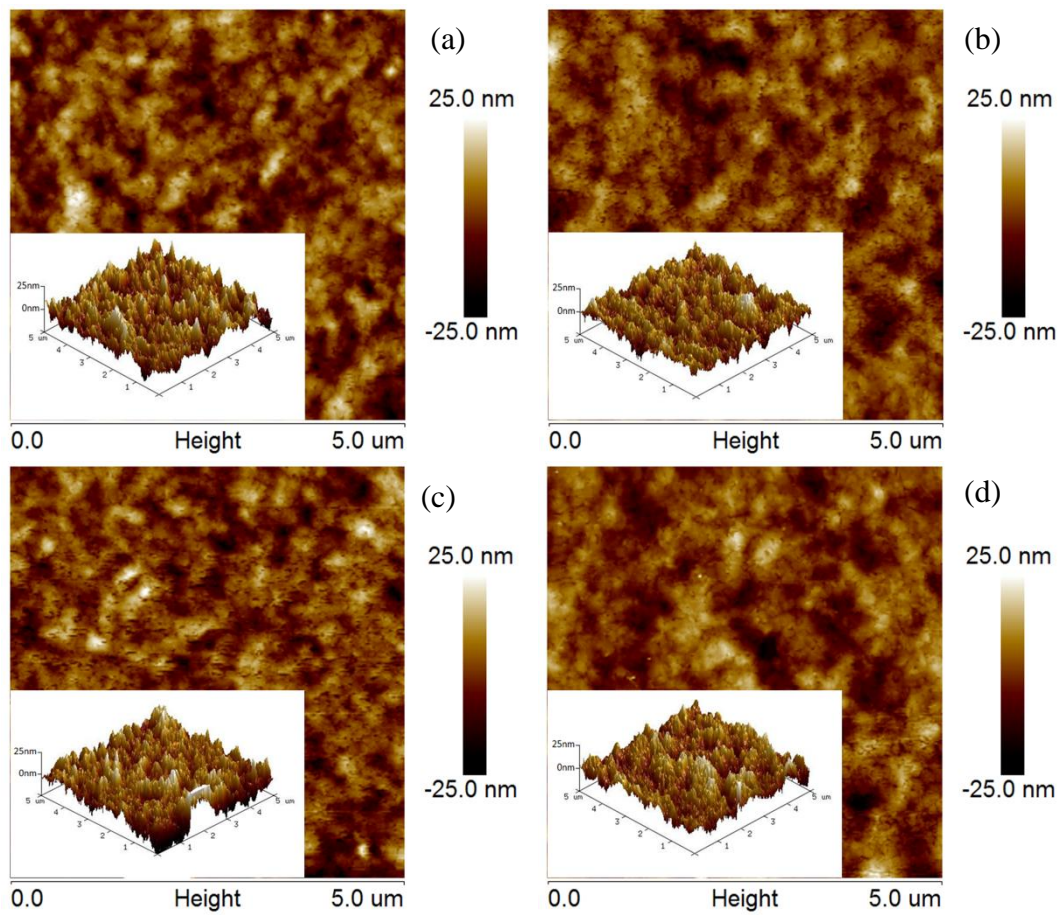


Fig. S1 SEM images of PbI<sub>2</sub> films deposited on the mesoporous TiO<sub>2</sub> films adjusted by different the TiCl<sub>4</sub> processing times (0min, 5min, 10min, 20min, 30min, and 60min, respectively).



(e)

Device	0min	<b>30min</b>	60min	120min
Root mean square Roughness(nm)	6.07	<b>5.97</b>	8.94	6.26

Fig. S2 Tapping-mode AFM height images (a-d) of  $\text{PbI}_2$  films deposited on mesoporous  $\text{TiO}_2$  films by different  $\text{TiCl}_4$  processing times at 0min, 30min, 60min and 120min, respectively. (Inset: the corresponding 3D topographic image). (e) Surface roughness of the corresponding  $\text{PbI}_2$  films.

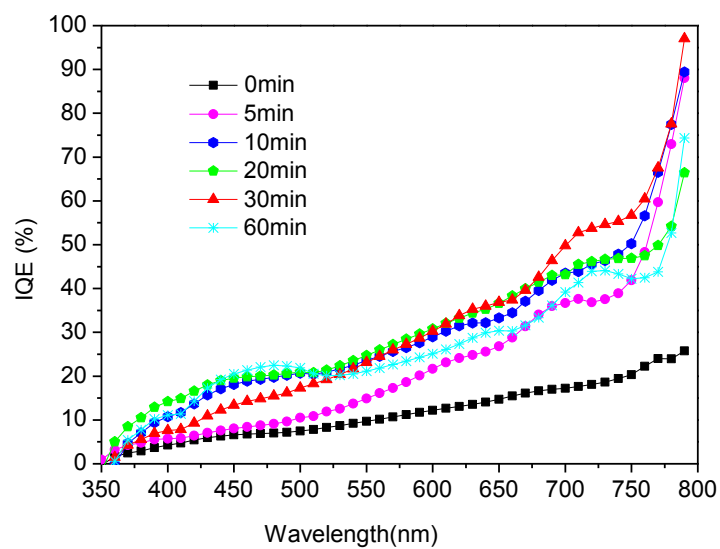


Fig. S3 Internal quantum efficiency (IQE) of perovskite solar cell with controlled  $\text{TiCl}_4$  solution treatment. All the curves are fitted with the function  $\text{IQE} = \text{EQE} / (1 - R - T)$ , (R is the UV-Vis light reflectivity of perovskite solar cells, T is the light transmittance of perovskite solar cells, EQE is External quantum efficiency.)

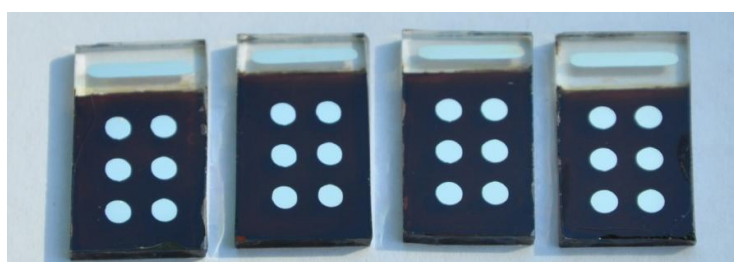


Fig. S4 The Photos of Perovskite solar cells with 30min  $\text{TiCl}_4$  processing