Electronic Supplementary Material (ESI) for Journal of Materials Chemistry A.

Supporting Information

Boosting the Performance of Planar Heterojunction Perovskite Solar Cell by Controlling the Precursor Purity of Perovskite Materials

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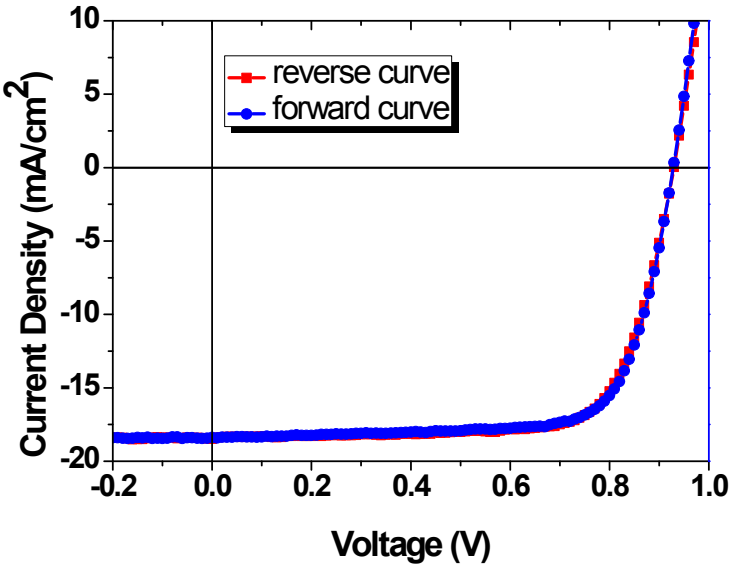

Figure S1. *J-V* curves of perovskite solar cell device based on low purity perovskite thin film under different scan directions.

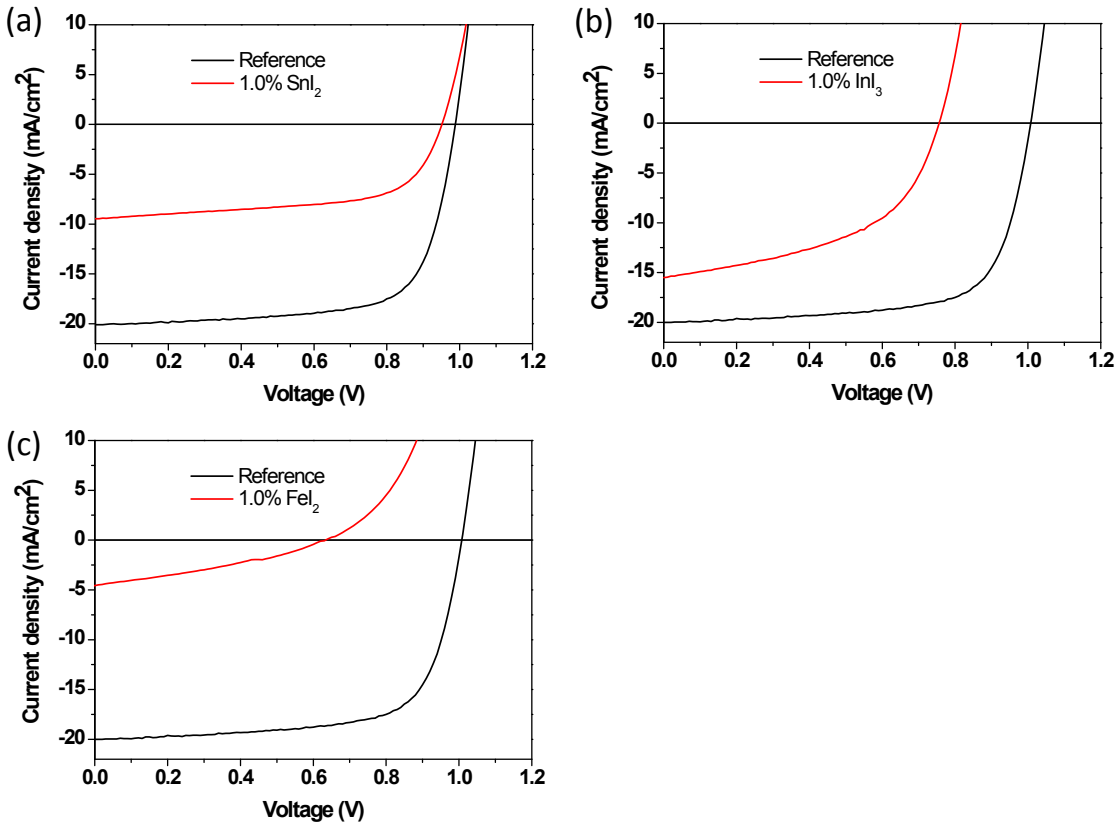

Figure S2. *J-V* curves of perovskite solar cell device based on different impurities in the precursor solutions.

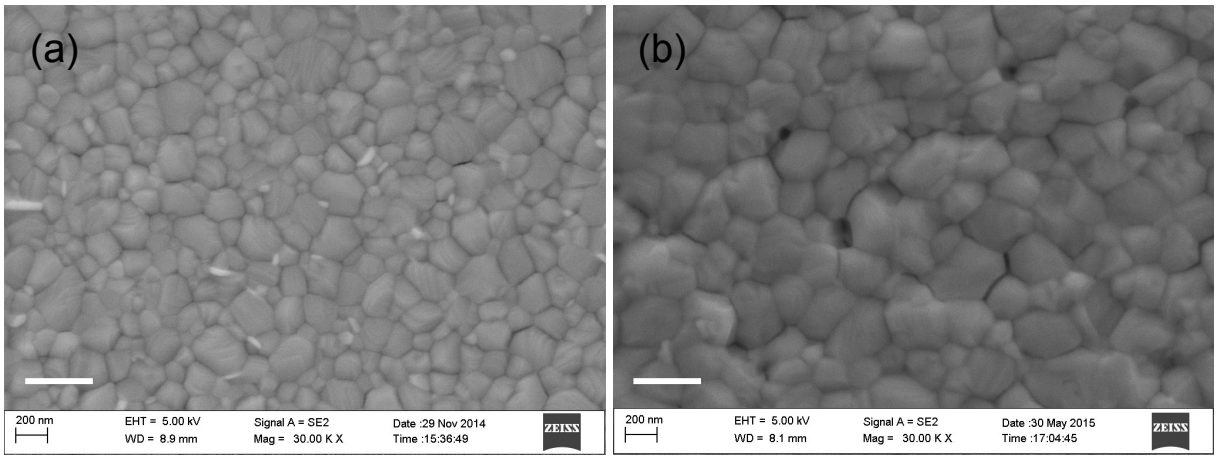

Figure S3. The FE-SEM images of low purity (a) and high purity (b) based perovskite thin films. The scale bar is 400 nm.

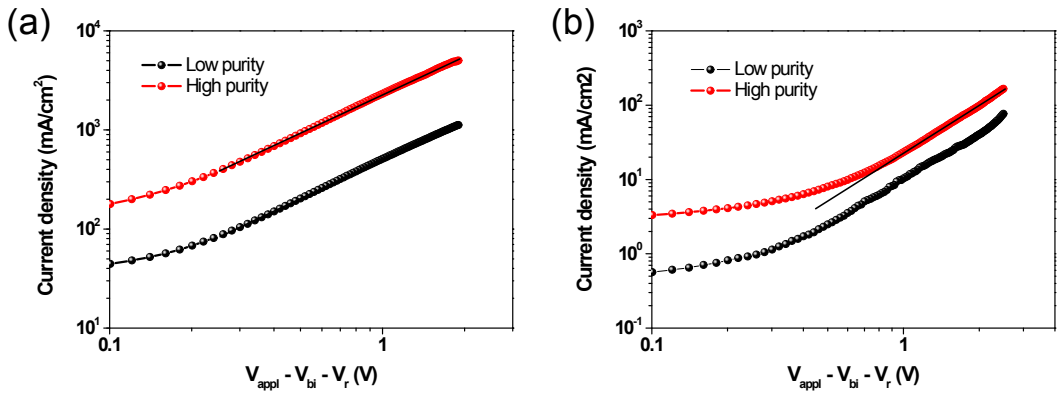

Figure S4. The dark J-V curves of the electron-only devices and hole-only device based on low purity and high purity thin films.

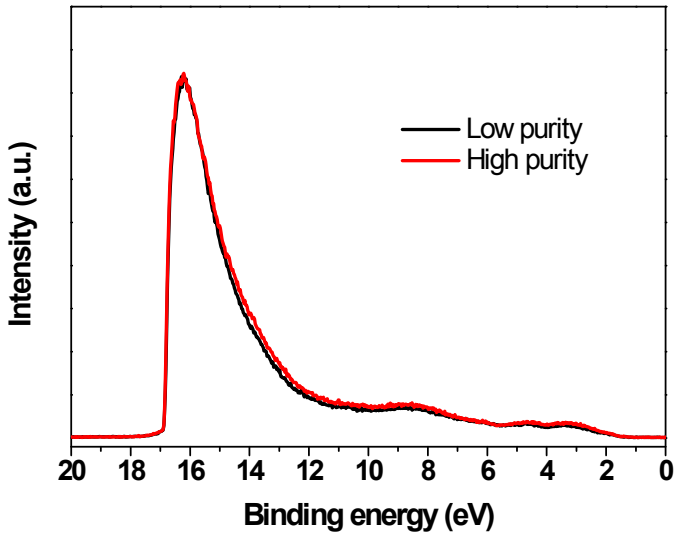

Figure S5. The UPS spectra of $MAPbI_3$ with Fermi level and VBM of around 4.30 eV and 5.70 eV, respectively. Considering its bandgap of about 1.58 eV, the CBM of $MAPbI_3$ is calculated to be around 4.12 eV.

The carrier diffusion length was calculated via the 1D diffusion model, well described in *Xing, et al's* work, and temporal total charge number $N(\mathrm{t})$ is given by **equation S1**:

$$N(\mathrm{t}) = \frac{2n_0 L}{\pi}\exp(-kt)\sum_{m=0}^{\infty}(\exp(-\frac{\pi^2 D}{L^2}(\mathrm{m}+\frac{1}{2})^2\,\mathrm{t})\frac{\exp(-\alpha L)\pi(\mathrm{m}+\frac{1}{2})+(-1)^m\alpha L}{((\alpha L)^2+\pi^2(\mathrm{m}+\frac{1}{2})^2)(\mathrm{m}+\frac{1}{2})})$$

Where L is the thickness of perovskite thin films, k is the PL decay rate in absence of quenchers.

Table S1. Bleaching kinetics fitting parameters for high and low purity perovskite thin films.

	A_1	τ_1	A_2	τ_2	x_1	x_2	y_0
High purity	0.2628	1.639±0.138	0.7056	335.4±2.44	2.645	3.143	0.2376
Low purity	0.8269	1.727±0.085	0.8231	246.6±11.4	1.471	3.641	0.1713