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

Supporting Information

A facile method to evaluate the influence of trap densities on perovskite solar cell performance

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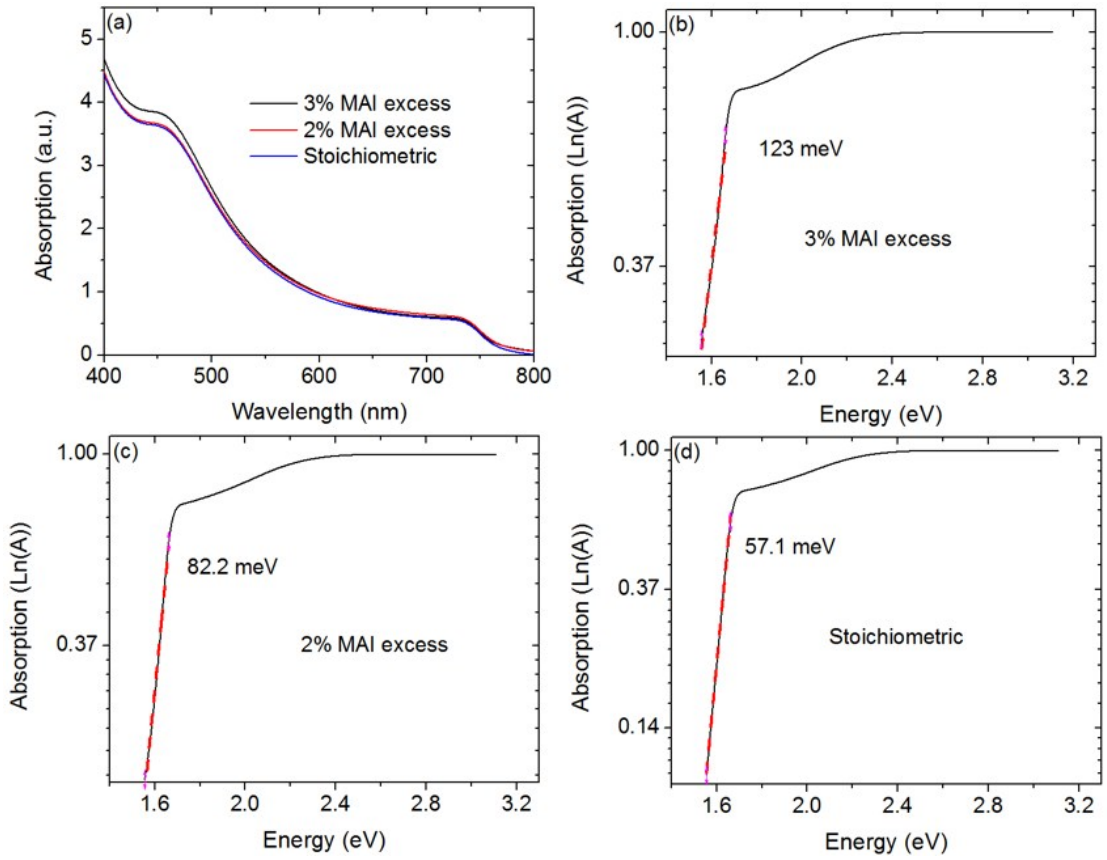

Figure S1. UV-Vis absorption spectra and plot of $ln(A)$ vs $E(=h\nu)$ used to extract the Urbach energy of $MAPbI_3$ perovskite films prepared by using MAI-excess and stoichiometric precursor solutions: (a) absorption spectra; (b) 3% MAI-excess; (c) 2% MAI-excess; (d) stoichiometric.

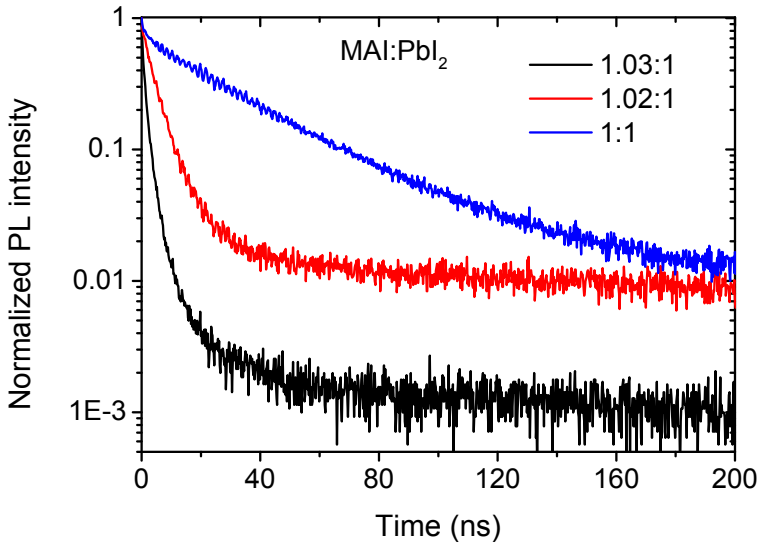

Figure S2. Time-resolved PL decay spectra of $MAPbI_3$ perovskite films prepared using precursors with different molar ratio of MAI and PbI_2

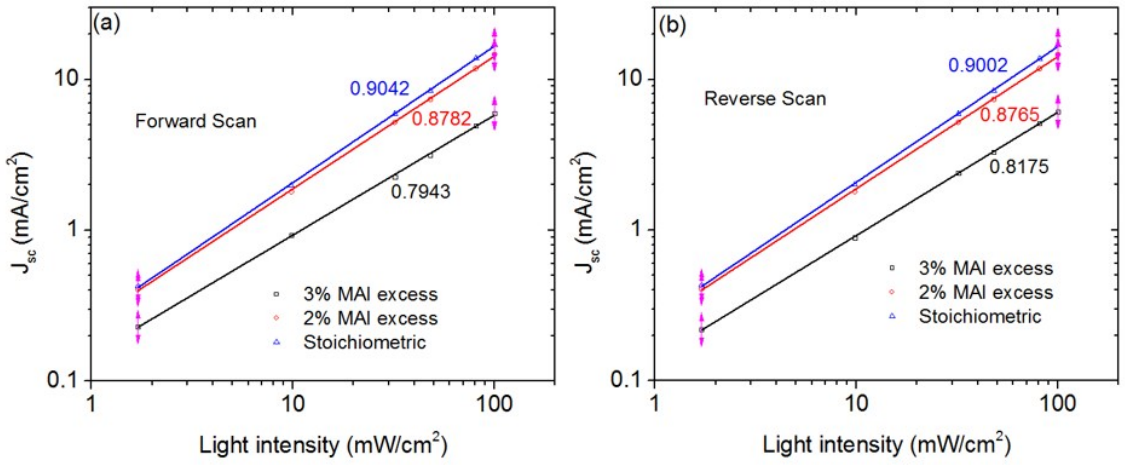

Figure S3. Light intensity-dependent J_{sc} for perovskite solar cells fabricated using MAI-excess and stoichiometric precursor solutions measured from short-circuit to open-circuit (FS) and open-circuit to short-circuit (RS) directions.

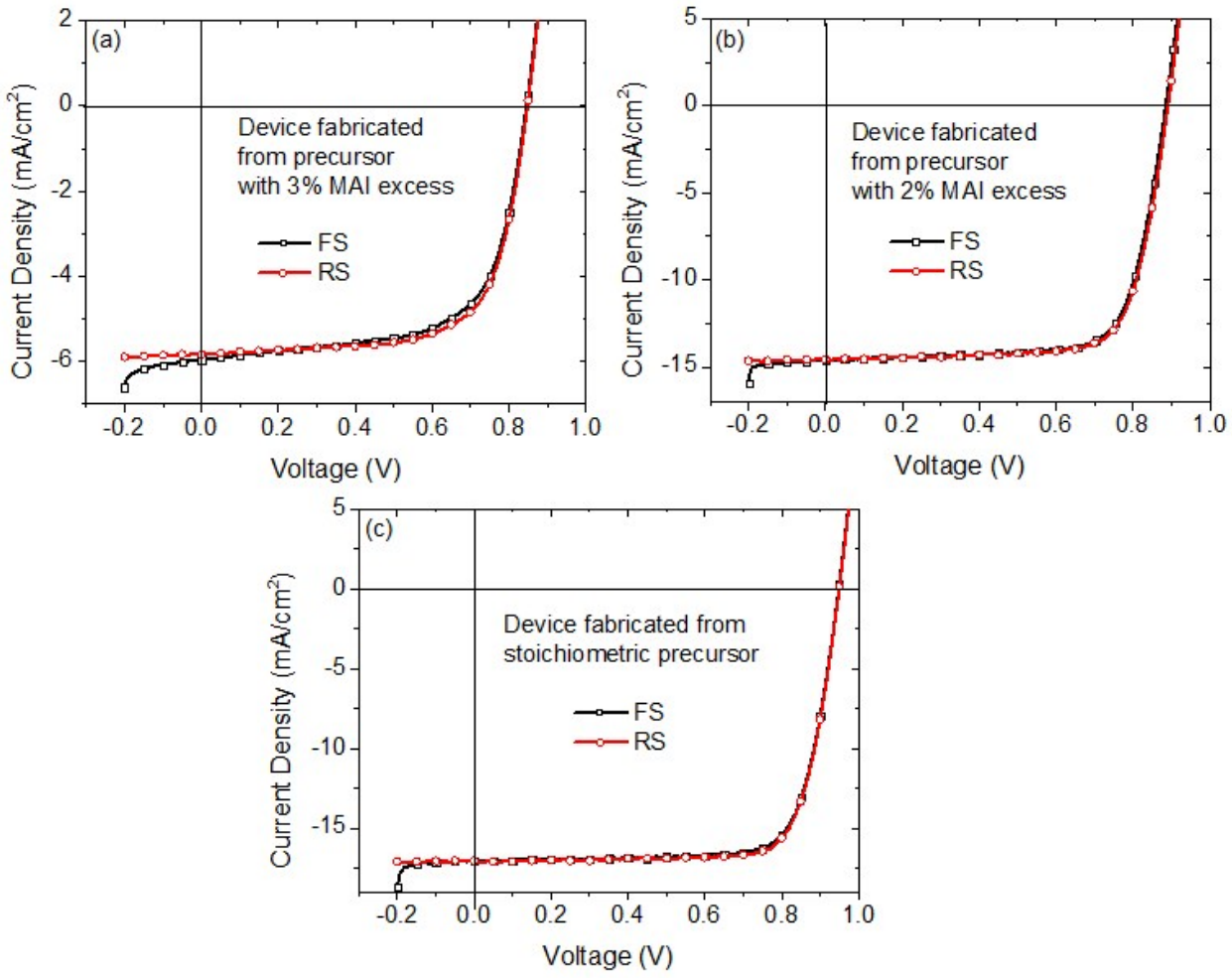

Figure S4. Reverse and forward scanning *J-V* curves of $MAPbI_3$ perovskite solar cells fabricated using MAI-excess and stoichiometric precursor solutions under one sun illumination: (a) 3% MAI excess; (b) 2% MAI excess; (c) stoichiometric.

Table S1 Device parameters of $MAPbI_3$ perovskite solar cells with different grain sizes under one sun illumination

Ratio of MAI and PbI_2		V_{oc} (V)	J_{sc} (mA/cm^2)	FF (%)	PCE (%)	R_s ($\Omega \cdot cm^2$)	Hysteresis Index (HI) (%)
1.03:1	FS	0.846	5.97	0.648	3.27	15.7	1.37
	RS	0.848	5.84	0.688	3.34	14.2	
1.02:1	FS	0.885	14.62	0.739	9.56	6.28	1.02
	RS	0.891	14.56	0.747	9.68	6.22	
1:1	FS	0.948	17	0.77	12.37	5.14	0.67
	RS	0.949	17.04	0.779	12.53	5.24	

$$Hysteresis\ Index\ (HI) = \frac{\int_{SC}^{OC} (J_{RS}(V) - J_{FS}(V))dV}{\int_{SC}^{OC} J_{RS}(V)dV}$$

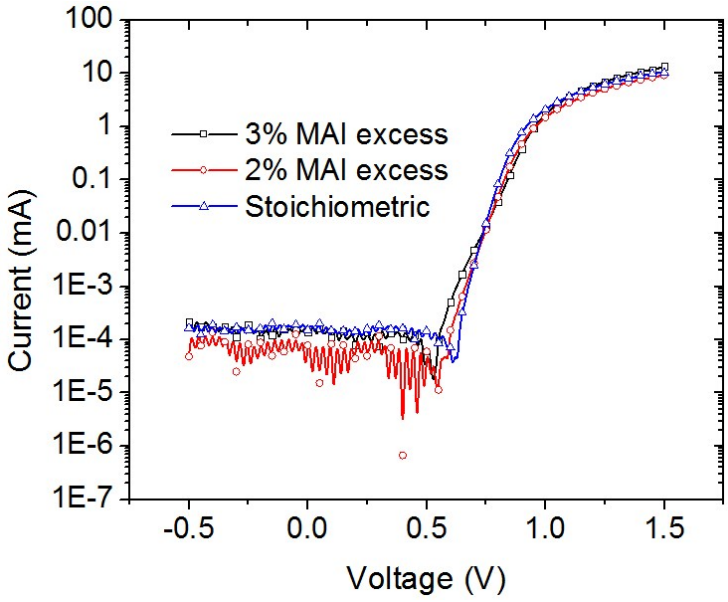

Figure S5. The current-voltage characteristics of the MAI-excess and stoichiometric perovskite solar cells measured under dark.

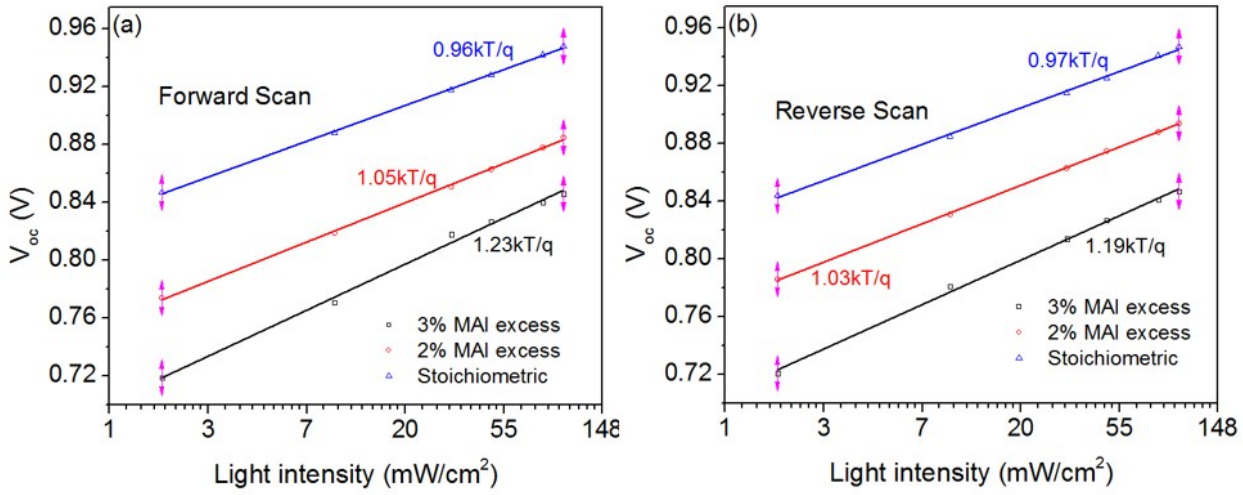

Figure S6. Light intensity-dependent V_{OC} for perovskite solar cells fabricated using MAI-excess and stoichiometric precursor solutions measured from short-circuit to open-circuit (FS) and open-circuit to short-circuit (RS) directions.