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# Supporting Information for

# Crystallization management for high-performance mixed cation

## perovskite solar cells by introducing antisolvent into perovskite

## precursor †

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#### **Experimental details**

**Preparation of PbI<sub>2</sub>·DE adduct.** 461 mg of PbI<sub>2</sub> was dissolved in 2 mL of DMF, which was stirred for 6 h. After obtaining the clear solution, 10 mL DE was slowly added into the solution. The precipitation was then filtered and dried in vacuum condition for 1 h, which was subsequently measured with FTIR.



Fig. S1. Schematic diagram for the PSC with construction of glass/ITO/SnO<sub>2</sub> /perovskite/Spiro-OMeTAD/AU.



Fig. S2. Photograph of the related perovskite materials dissolved into mixed solvent with corresponding blending ratio.



Fig. S3. Photographs of the (a) just-prepared and (b) 60-days-old perovskite precursors with 10% DE at about 25 °C.



Fig. S4. UV-vis spectra for perovskite films formed by precursor with various DE mixing ratio.



Fig. S5. FTIR spectra of DE and  $PbI_2 \cdot DE$ 



Fig. S6. Schematic illustration for the turbid point of samples during the spin-coating process, where ASA precursor in the figure indicates the 10% DE added perovskite precursor.



Fig. S7. Top-view SEM images of the perovskite film DE deposited from 10% DE-mixed precursor with the film thicknesses of (a) 400 nm, (b) 450 nm, and (c) 500 nm.



Fig. S8. XRD spectra for various of perovskite films.



Fig. S9. TRPL spectra of perovskite films using precursors without (0%) and with DE (10%) as the solvent additive.



Fig. S10. J-V characteristics of SCLC based on perovskite films using precursors without (0%) and with DE (10%) as the solvent additive.



Fig. S11. Equivalent circuit for EIS measurement.

Table S1. The saturated vapor pressure values of DMF and DE at 25 °C

Solvent	Saturated vapor pressure		
DE	71 kPa		
DMF	0.5 kPa		

Table S2. Delayed turbid point time for different DE mixing ratios (mean value of 30 samples).

DE mixing ratio	Delayed time

0%	0 s
5%	3 s
10%	5 s
20%	5 s

Table S3 Photovoltaic parameters of the PSCs with different perovskite film thicknesses based on 10%

DE mixed precursor.

Film thickness of perovskite (nm)	$V_{ m oc}\left({ m V} ight)$	$J_{\rm sc}$ (mA cm <sup>-2</sup> )	FF	PCE (%)
400	1.07	21.3	0.76	17.3
450	1.09	22.6	0.78	19.2
500	1.07	21.7	0.75	17.4