

A Facile Way to Improve the Performance of Perovskite Solar Cells by Toluene and Diethyl Ether Mixed Anti-Solvent Engineering

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Supplementary Materials

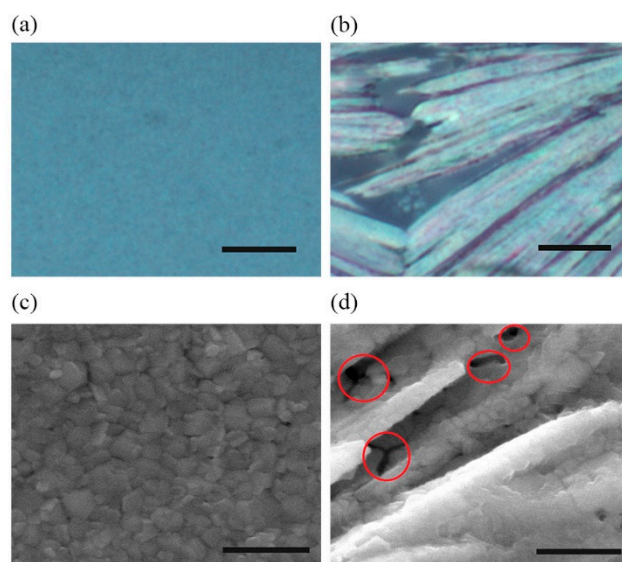


Figure S1. Optical microscope images of (a) the control perovskite film adopting pure toluene as anti-solvent and (b) the perovskite film without involving anti-solvent. The scale bar in optical microscope images is 500 μm . SEM topography images of (c) the control perovskite film and (d) the perovskite film without involving anti-solvent. The scale bar in SEM images is 1 μm .

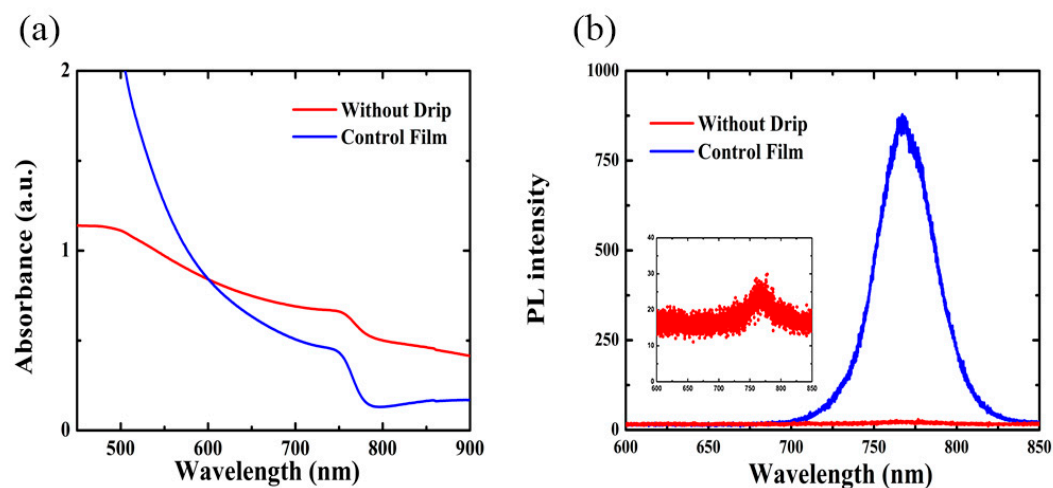


Figure S2. (a) The wavelength-dependent absorbance spectra and (b) steady-state photoluminescence (PL) spectra for control film and the film without involving anti-solvent. Inset picture in (b) is the high magnification for the film without involving anti-solvent.

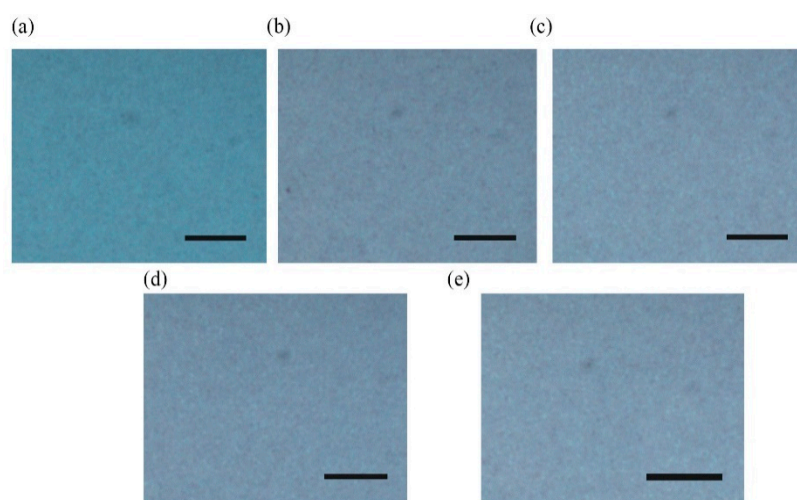


Figure S3. Optical microscope images of perovskite films treated with (a) 100% (b) 75% (c) 50% (d) 25% and (e) 0% toluene in the mixed anti-solvent. The scale bar in optical microscope images is images is 500 μm .

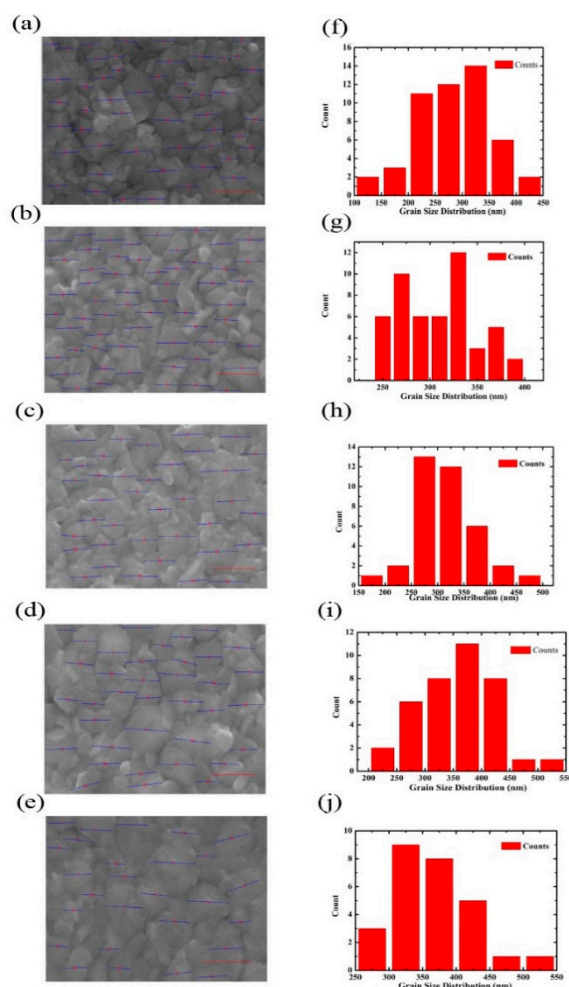


Figure S4. SEM images and grain size distribution histograms of perovskite films treated with (a) 100% (b) 75% (c) 50% (d) 25% and (e) 0% toluene in the mixed anti-solvent. Image size was $2.5 \mu\text{m} \times 2.5 \mu\text{m}$.

Table S1. Polarity index and boiling point of the commonly used solvent as anti-solvent.

Solvent	Polarity Index	Boiling Point ($^{\circ}\text{C}$)
Chlorobenzene	2.7	132.2
Isopropanol(IPA)	3.9	82.4
Toluene	2.4	110.6
Chloroform	4.1	61.3
Diethyl Ether	2.8	34.6
Dichlorobenzene	2.7	180.5

Table S2. Peak intensity of perovskite films prepared from different mixed anti-solvent obtained from XRD.

Proportion of Toluene in the Mixed Anti-Solvent (%)	(110) Peak Intensity	(220) Peak Intensity	Ratio of (110)/(220)
100%	2921	1505	1.94
25%	3389	1540	2.20
50%	3958	1713	2.31
75%	2876	1343	2.14
0%	1367	888	1.54

Table S3. The average value of hysteresis indices (HI) of PSCs obtained with different mixed anti-solvent.

Proportion of Toluene in the Mixed Anti- Solvent (%)	100%	75%	50%	25%	0%
HI	0.046	0.040	0.035	0.043	0.054

^a Each value of HI is extracted from 5 PSCs.