

## Supporting Information

# Lewis-base-based antisolvent method for fabricating triple-cation perovskite solar cells

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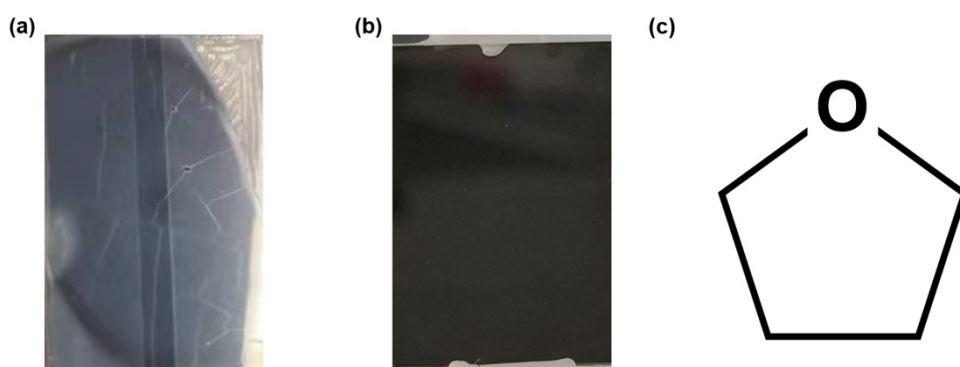


Figure S1. (a) Perovskite film subjected to the pure EA treatment. (b) Perovskite film subjected to the 20% THF-mixed antisolvent treatment. (c) Chemical structure of THF.

Table S1. Performance comparison between devices based on the 20% THF–EA-mixed antisolvent treatment and the IPA–DMSO method.

□Method	$V_{oc}$ (V)	$J_{sc}$ (mA cm <sup>-2</sup> )	Fill factor	PCE (%)
THF–EA	1.11	23.99	0.72	19.26
IPA–DMSO	1.10	21.74	0.73	17.24

Table S2. Comparison between  $J_{sc}$ – $JV$  (measured) and  $J_{sc}$ –EQE (calculated) values.

Device	$J_{sc}$ – $JV$	$J_{sc}$ –EQE	Difference (%)
Pure EA	21.01	18.89	10.09
20% THF	23.99	21.67	9.67

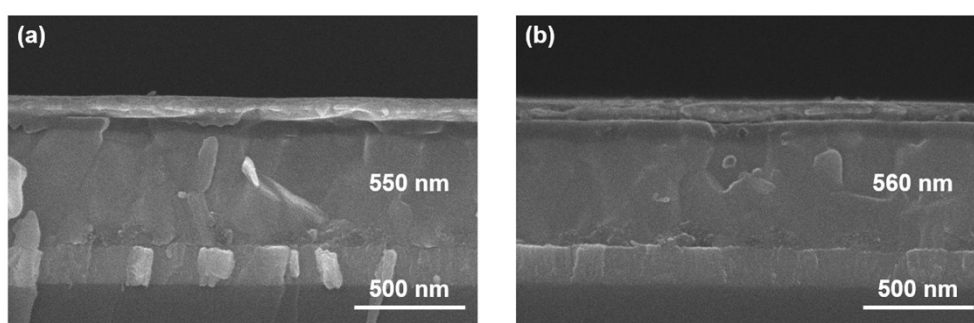


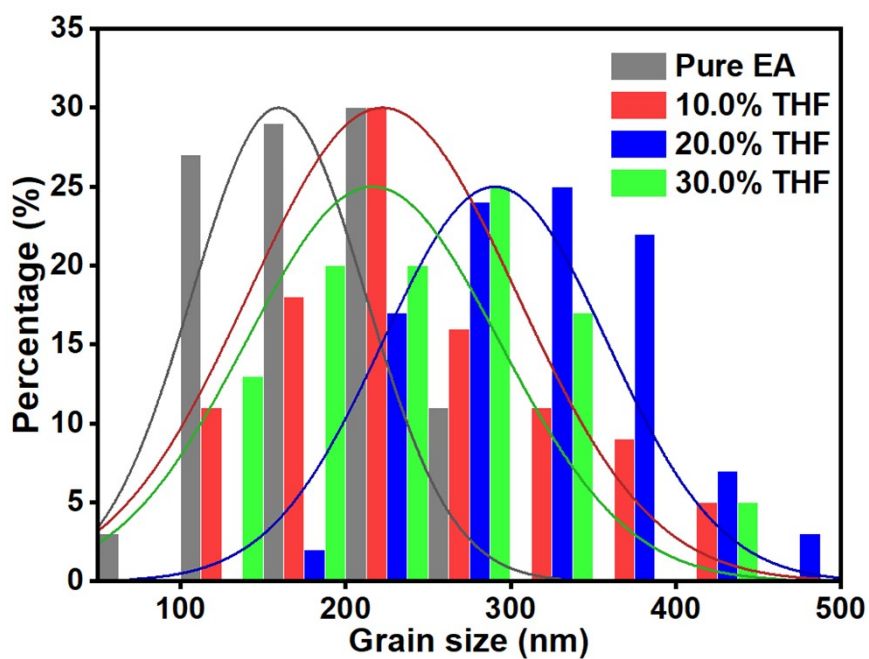
Figure S2. Cross-sections of perovskite films (a) without and (b) with THF-mixed antisolvent treatment.

Table S3. Device efficiency based on different precursor solvents and antisolvents

□Method	VOC (V)	J <sub>sc</sub> (mA/cm <sup>2</sup> )	FF	PCE (%)	Average PCE (%)
DMF/DMSO CB/IPA	1.08	19.9	0.74	15.88	15.98
	1.1	19.41	0.77	16.57	
	1.09	19.22	0.77	16.16	
	1.1	19.58	0.76	16.34	
	1.1	19.73	0.76	16.41	
	1.08	18.62	0.76	15.3	
	1.1	19.53	0.74	15.81	
	1.09	19.61	0.73	15.67	
	1.1	19.22	0.75	15.81	
	1.1	19.39	0.74	15.86	
DMF/DMSO EA/THF	1.09	21.43	0.72	16.85	16.81
	1.09	21.36	0.71	16.58	
	1.08	23.07	0.62	15.58	
	1.1	20.66	0.74	16.87	
	1.09	20.24	0.74	16.36	
	1.09	20.03	0.74	16.09	
	1.1	20.6	0.72	16.3	
	1.09	22.9	0.68	17.02	
	1.09	23.42	0.72	18.36	
	1.09	23.25	0.71	18.09	
DMF EA/THF	1.1	21.41	0.78	18.29	18.52
	1.1	21.5	0.78	18.36	
	1.1	22.89	0.77	19.24	
	1.09	21.7	0.77	18.28	
	1.1	22.81	0.75	18.79	
	1.09	23.06	0.72	18.18	
	1.09	23.42	0.72	18.36	
	1.1	23.29	0.73	18.67	
	1.11	23.5	0.68	17.79	
	1.11	23.99	0.72	19.26	
DMF EA/IPA	1.09	21.39	0.73	17.13	17.05
	1.09	21.54	0.75	17.7	
	1.09	21.24	0.75	17.29	
	1.09	21.11	0.74	17.06	
	1.09	21.32	0.75	17.41	
	1.1	20.19	0.76	17.02	
	1.1	20.18	0.77	17.06	
	1.1	20.16	0.77	16.95	
	1.09	20.07	0.76	16.6	
	1.1	19.54	0.76	16.31	
DMF CB/IPA	1.06	19.29	0.77	15.68	15.37
	1.07	19.28	0.76	15.66	
	1.08	18.62	0.76	15.3	
	1.1	20.15	0.67	14.82	

	1.08	20.17	0.67	14.65	
	1.08	20.47	0.71	15.76	
	1.08	19.57	0.75	15.81	
	1.1	20.65	0.65	14.63	
	1.09	19.6	0.74	15.89	
	1.08	19.65	0.73	15.51	
	1.09	19.51	0.58	12.33	
	1.08	19.38	0.63	13.28	
	1.11	20.21	0.66	14.76	
	1.1	20.47	0.69	15.49	
DMF	1.11	20.96	0.6	14.07	14.19
CB/THF	1.11	21.11	0.6	14.06	
	1.1	20.65	0.65	14.63	
	1.08	19.09	0.73	15.1	
	1	20.17	0.68	13.62	
	1.08	19.96	0.68	14.61	
	1.04	19.37	0.63	12.68	
	1.03	22.39	0.55	12.76	
	1.07	19.97	0.65	13.84	
	1.05	17.37	0.54	9.81	
DMF	1.08	19.96	0.67	14.5	12.64
EA/Ethanol	1.08	19.81	0.68	14.53	
	1.06	17.23	0.66	12	
	1.06	17.17	0.62	11.25	
	1.05	19.78	0.64	13.32	
	1.06	18.48	0.6	11.72	

**(a)**



(b)

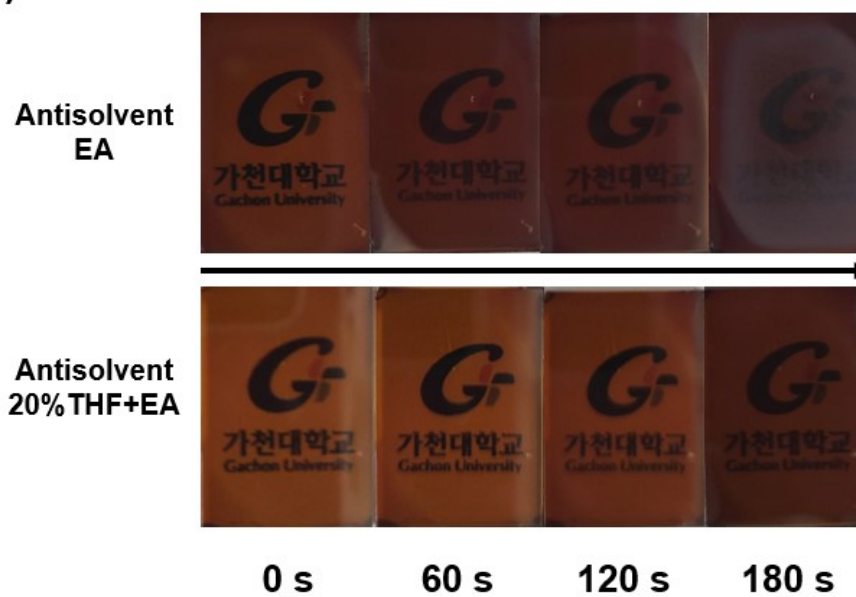


Figure S3. (a) Distribution graph of the perovskite grain size based on EA with different THF ratios. (b) Temporal evolution of photographs of the control and target CsFAMA perovskite wet films under an ambient environment of 20 °C and relative humidity of ~ 25%.

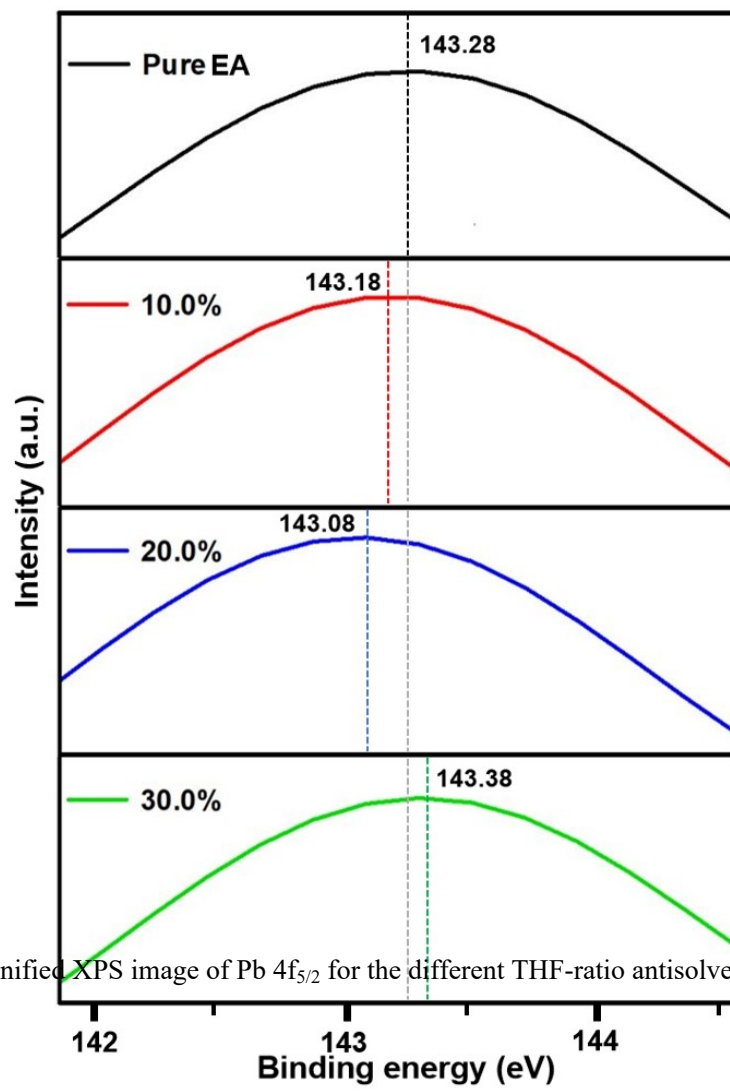


Figure S4. Magnified XPS image of Pb 4f<sub>5/2</sub> for the different THF-ratio antisolvents.

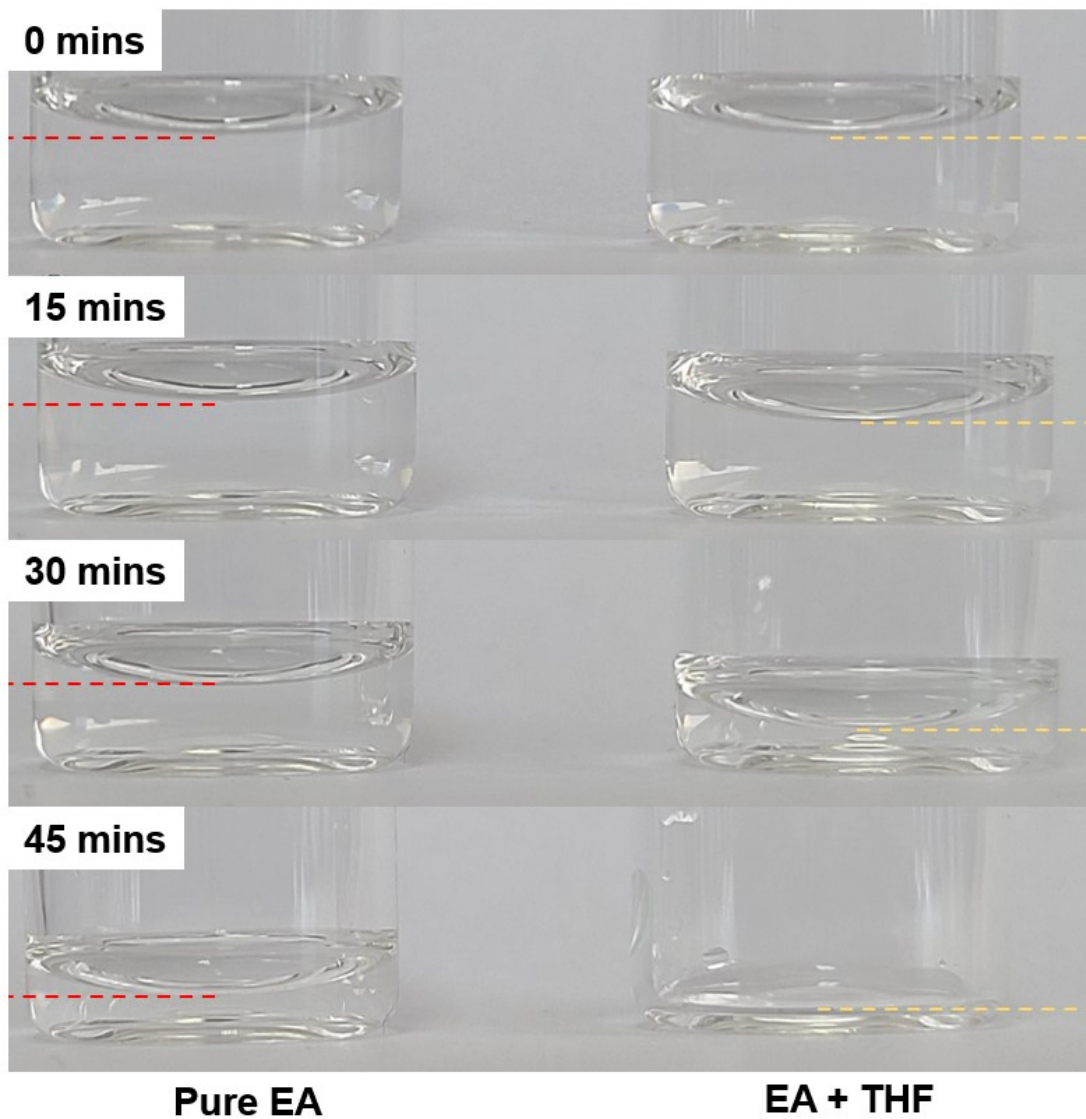


Figure S5. Evaporation rate test for the pure EA and 20% THF-EA at an annealing temperature of 110 °C.

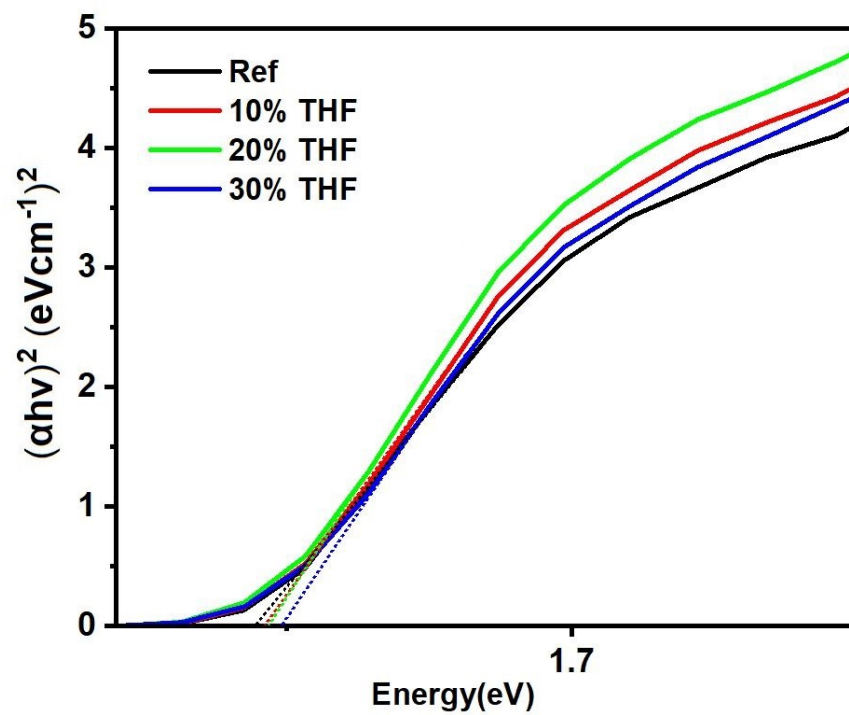


Figure S6. Tauc plots for the perovskites treated with the pure EA and 10%, 20%, and 30% THF-EA antisolvents.