

Supporting Information

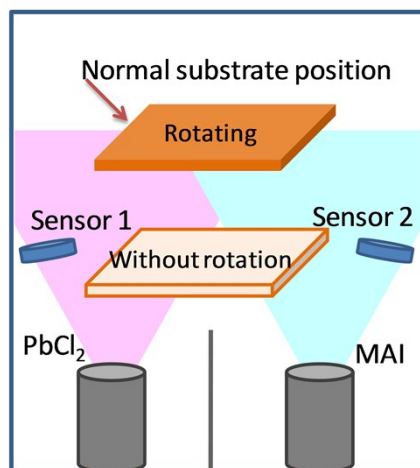


Figure S1. Schematic illustration of the fabrication procedure.

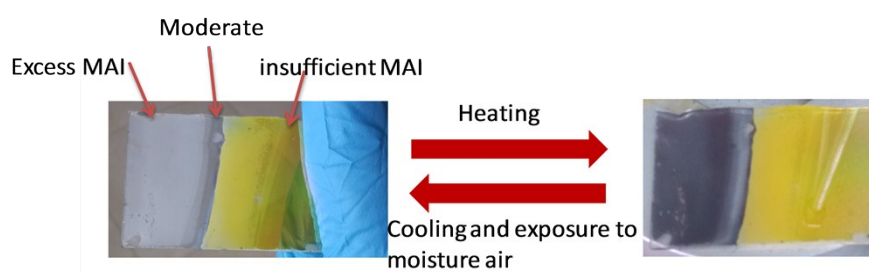


Figure S2. The appearance change of the evaporated sample placed in a much lower distance from the evaporation source. Judging from the appearance change, three zones are considered: (1) insufficient MAI, (2) moderate MAI and (3) excess MAI.

When the substrate was intentionally placed in a much lower distance from the evaporation source and no substrate rotation was applied, the sample with a composition gradient along the surface can be obtained, which is shown in Figure S2. From the left to the right, the amount of MAI in the evaporated film increases gradually. After annealing at 100 °C for 15 min, the color of the excess MAI zone changes from white to dark brown. On exposure to the moisture atmosphere, the dark brown would gradually convert into white again. However, when the sample is heated, the excess MAI zone would recover to brown dark again. In contrast, the middle zone with moderate MAI composition exhibits better stability and could kept the high

absorbance for hours.

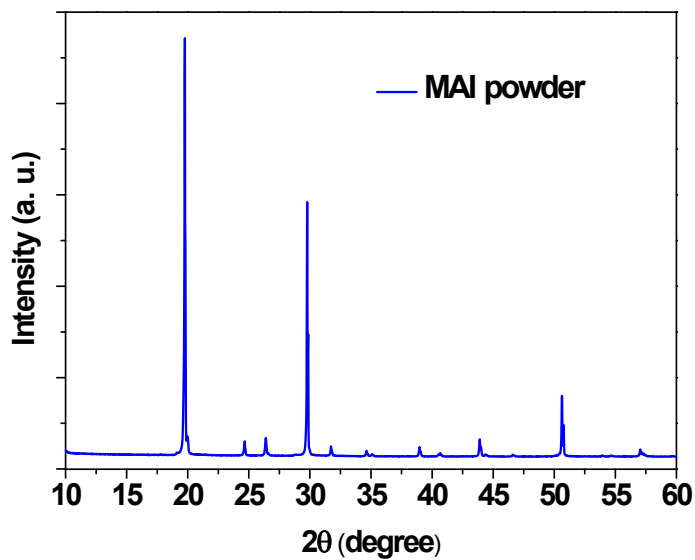


Figure S3. X-ray diffraction spectra of MAI powder material.

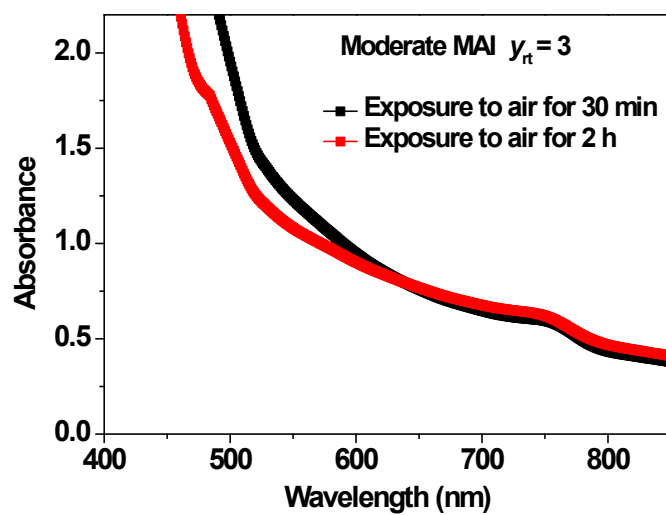


Figure S4. UV-vis absorbance spectra of the perovskite film with moderate MAI (deposition condition $y_{rt} = 3$) after exposing to the air.

Table S1. Detailed photovoltaic parameters of the perovskite solar cells under forward and reverse scan.

Sample	Scanning direction	V_{oc} (V)	J_{sc} (mA/cm ²)	FF (%)	PCE (%)
1	Forward	0.92	12.08	0.67	7.47
	Reverse	0.93	17.33	0.59	9.50
2	Forward	0.87	11.44	0.67	6.68
	Reverse	0.90	13.44	0.61	7.35
3	Forward	0.94	17.36	0.64	10.38
	Reverse	0.94	17.07	0.63	10.09
4	Forward	0.97	17.30	0.63	10.50
	Reverse	0.97	16.99	0.63	10.32
5	Forward	1.00	13.27	0.64	8.45
	Reverse	0.95	16.86	0.61	9.72
6	Forward	0.88	13.64	0.53	6.32
	Reverse	0.94	13.00	0.55	6.79
7	Forward	0.67	10.12	0.72	4.84
	Reverse	0.82	11.65	0.55	5.32
8	Forward	0.81	8.23	0.64	4.26
	Reverse	0.83	12.82	0.56	5.99
9	Forward	0.88	15.61	0.60	8.34
	Reverse	0.88	16.05	0.59	8.43
10	Forward	0.93	18.60	0.58	10.05
	Reverse	0.92	18.44	0.58	9.82
11	Forward	0.92	18.71	0.59	10.07
	Reverse	0.92	19.39	0.57	10.23
12	Forward	0.86	13.50	0.53	6.18
	Reverse	0.86	13.83	0.59	7.04
13	Forward	0.79	9.15	0.67	4.82
	Reverse	0.80	14.24	0.53	6.12
14	Forward	0.92	18.91	0.58	10.19
	Reverse	0.92	18.99	0.58	10.06
15	Forward	0.71	12.69	0.28	2.55
	Reverse	0.66	13.34	0.61	5.35
16	Forward	0.98	12.02	0.56	6.56
	Reverse	0.91	11.72	0.52	5.54
17	Forward	0.94	9.85	0.57	5.26
	Reverse	0.94	12.28	0.50	5.84
18	Forward	0.77	13.75	0.58	6.11
	Reverse	0.93	12.86	0.60	7.14
19	Forward	0.79	14.59	0.60	6.89
	Reverse	0.94	12.94	0.59	7.09

20	Forward	0.69	15.78	0.63	6.94
	Reverse	0.91	15.62	0.57	8.11