

Supplementary Information
Thermal-Induced Volmer-Weber Growth Behavior
for Planar Heterojunction Perovskites Solar Cells

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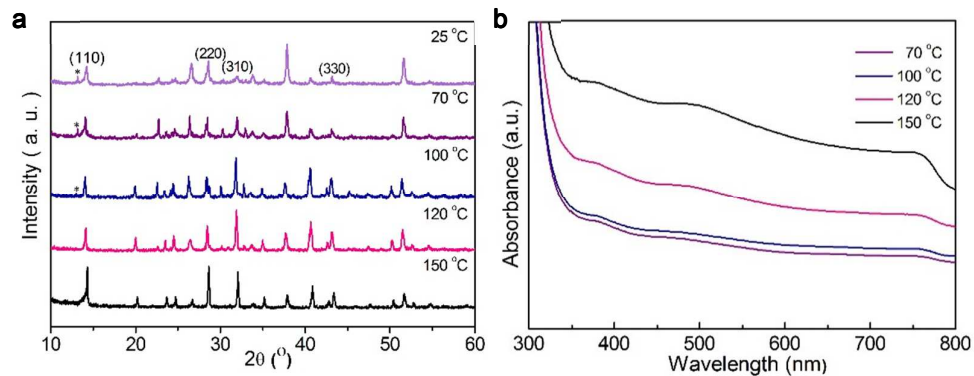


Figure S1. a) XRD, and b) UV-vis spectra of perovskite films prepared at different casting temperatures. The XRD peaks assigned to intermediate phase crystals are marked with stars. The samples for UV-vis spectra were stored in glove box overnight before be tested.

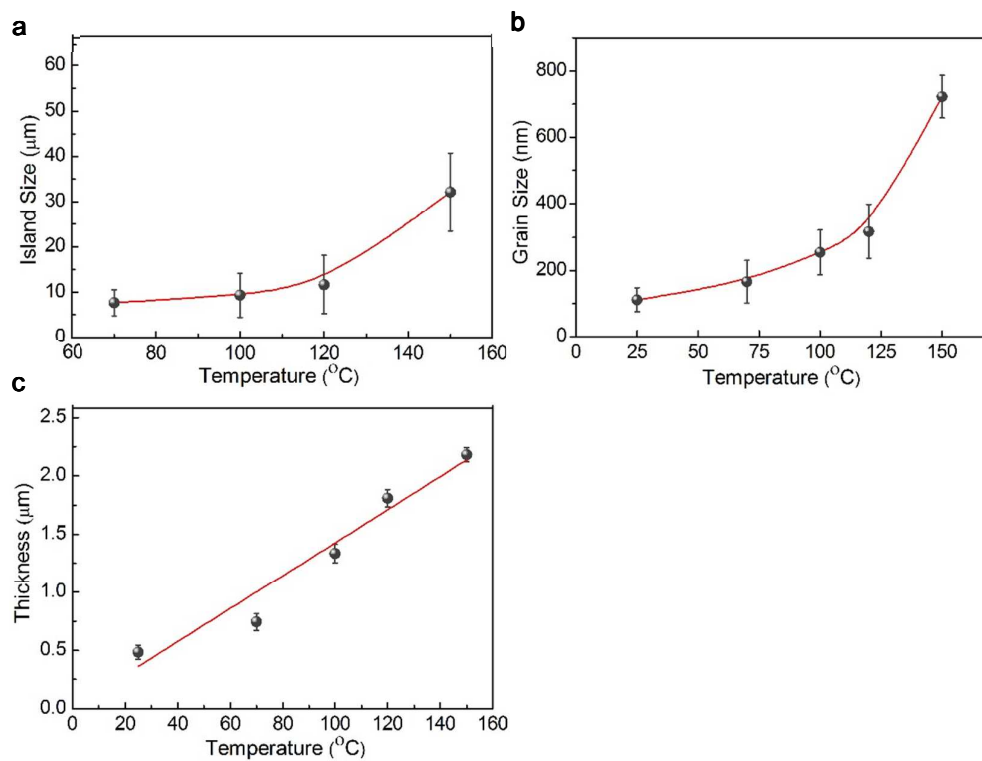


Figure S2. Relationship between the (a) island size, (b) grain size, and (c) thickness of perovskite films versus the casting temperatures. The amount of counted samples are 50 for (a), 100 for (b), 10 for (c).

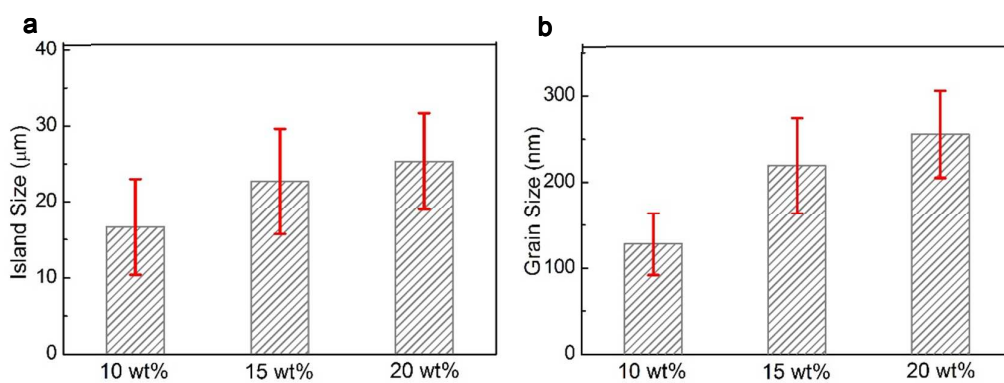


Figure S3. Relationship between the (a) island size, and (b) grain size of perovskite films versus the concentration of precursor solutions. The amount of counted samples are 50 for (a), 100 for (b).

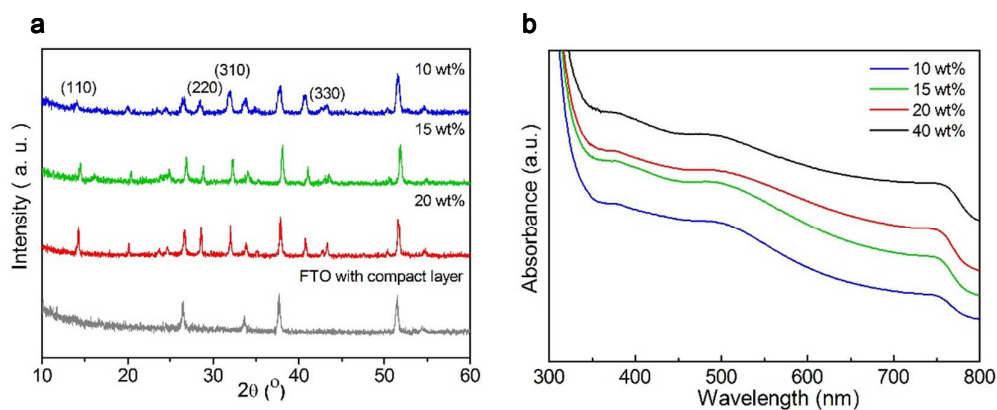


Figure S4. (a) XRD of perovskite films prepared from different precursor concentrations. The XRD pattern of the TiO_2 compact layers coated FTO substrate is also shown for comparison. (b) UV-vis absorption of $\text{CH}_3\text{NH}_3\text{PbI}_3$ films of different concentrations with 150 °C casting temperature.

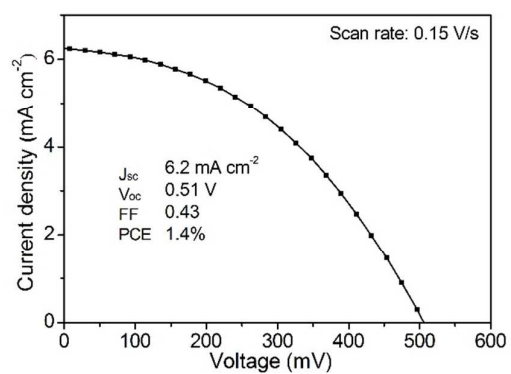


Figure S5. A J-V curve measured with a scan rate of 0.15 V s⁻¹ for a device prepared by conventional method using a 40 wt% precursor solution.

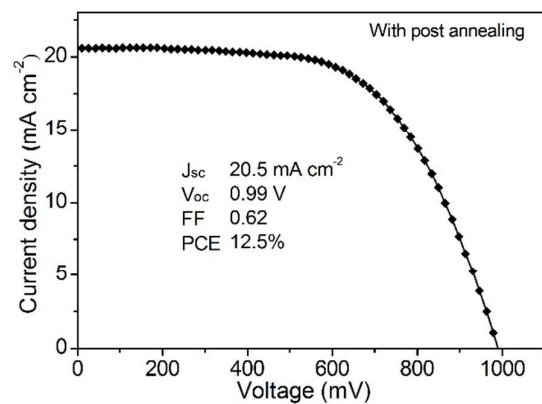


Figure S6. A J-V curve measured with a scan rate of 0.15 V s⁻¹ for a device prepared with a 15 wt% precursor solution at 150 °C casting temperature, with post annealing at 100 °C for 5 min.

Device	V_{oc} / V	J_{sc} / mA cm ⁻²	FF	PCE / %
Conventional	0.51 ± 0.03	5.7 ± 1.0	0.43 ± 0.03	1.4 ± 0.2
10 wt%	0.82 ± 0.05	15.2 ± 0.3	0.56 ± 0.01	6.7 ± 0.3
15 wt%	1.00 ± 0.02	20.3 ± 0.3	0.62 ± 0.02	12.6 ± 0.3
20 wt%	0.97 ± 0.02	20.2 ± 0.2	0.55 ± 0.02	11.0 ± 0.3
40 wt%	0.91 ± 0.05	19.9 ± 0.3	0.46 ± 0.01	8.5 ± 0.2

Table S1. Photovoltaic performance of perovskite solar cells using different precursor concentration. All substrates except conventional devices were casted to 150 °C. Data are averaged from 10 devices.

Cells	V _{oc} / V	J _{sc} / mA cm ⁻²	FF	PCE / %
1	1.04	20.6	0.64	13.1
2	0.99	20.4	0.62	12.5
3	1.00	20.6	0.63	12.9
4	0.99	20.4	0.63	12.6
5	0.99	20.0	0.62	12.3
6	1.01	20.2	0.60	12.2
7	1.03	20.5	0.62	12.8
8	1.00	19.7	0.65	12.9
9	1.01	20.7	0.60	12.4
10	0.99	20.3	0.61	12.2
Average	1.00 ± 0.02	20.3 ± 0.3	0.62 ± 0.02	12.6 ± 0.3

Table S2. Photovoltaic parameters of a batch of ten devices fabricated with 15 wt% precursor solution.