

# **Simple Fabrication of High Efficiency Planar Perovskite Solar Cells: Controlled Film Growth with Methylammonium Iodide and Green Antisolvent Sec-Butyl Alcohol**

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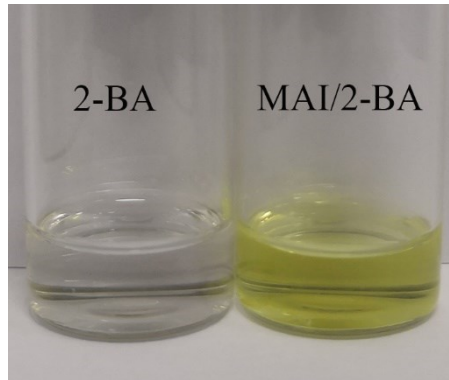
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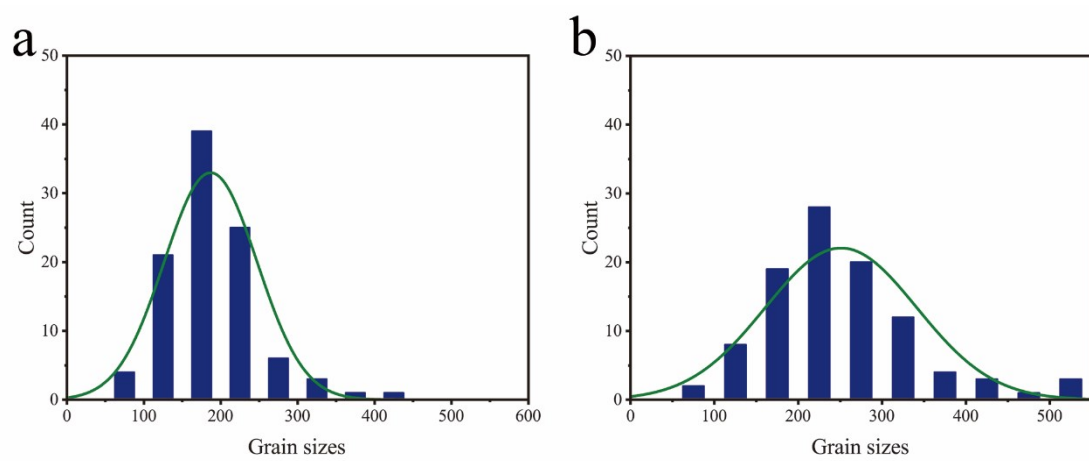
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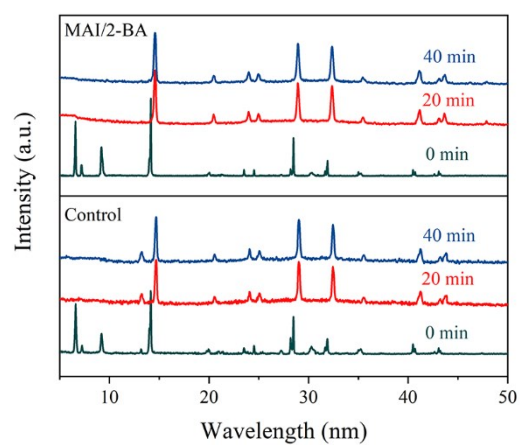
E-mail addresses: dupf@zstu.edu.cn (P. Du); jxiong@zstu.edu.cn (J. Xiong).



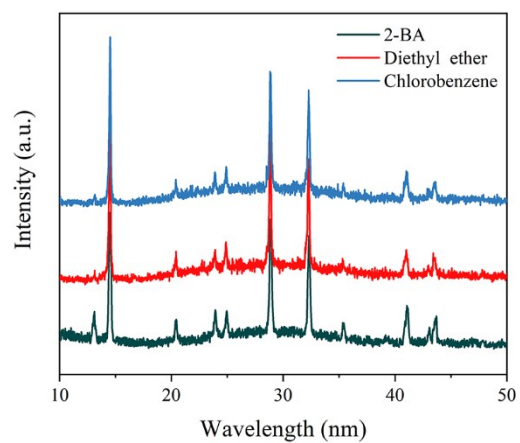
**Figure S1.** The photograph of the 2-BA solution and MAI/2-BA solution.



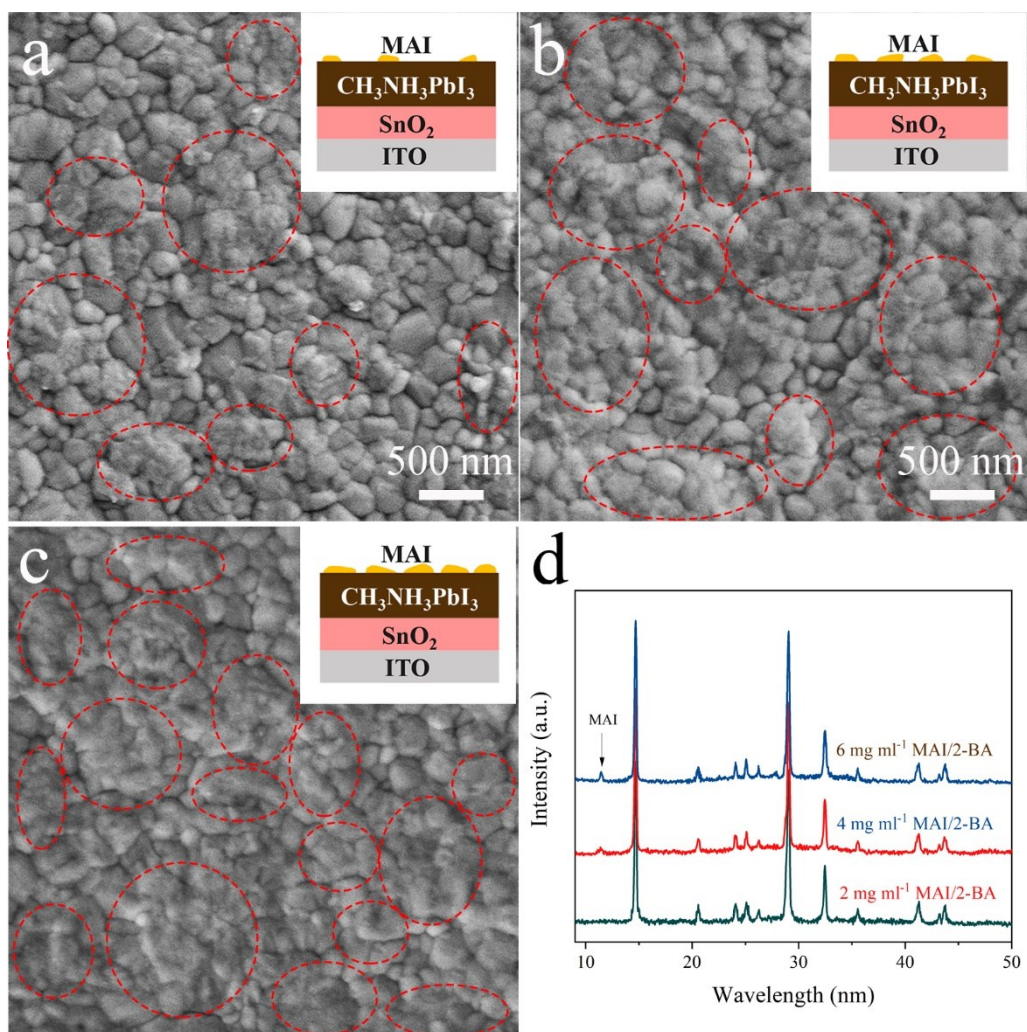
**Figure S2.** The grain sizes distribution statistics corresponding to Figure 2a and c.



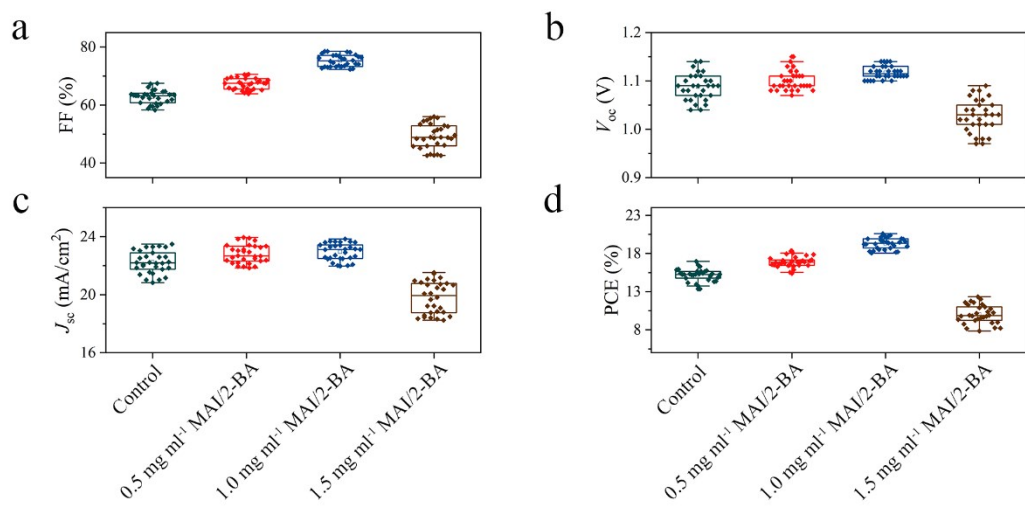
**Figure S3.** The XRD patterns of perovskite films under different annealing time.



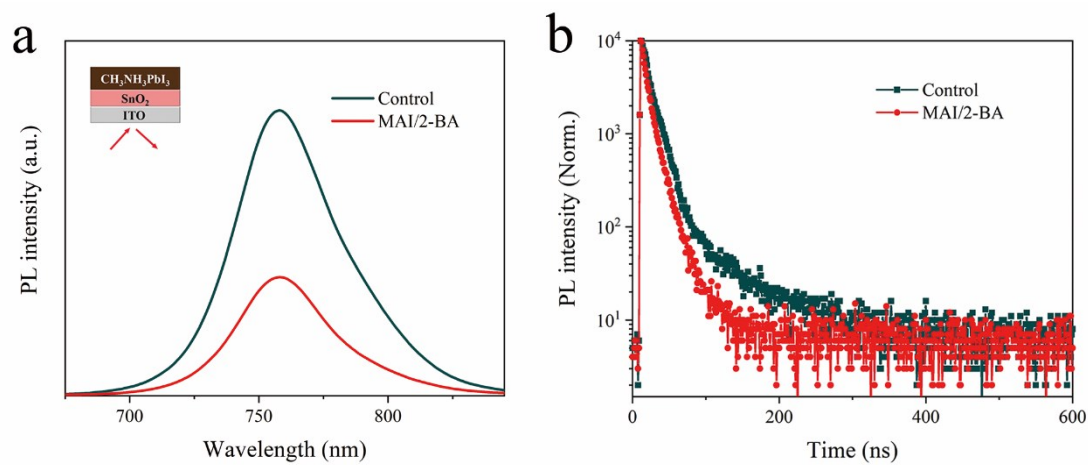
**Figure S4.** The XRD patterns of perovskite films fabricated by anti-solvent 2-BA, diethyl ether and chlorobenzene, respectively.



**Figure S5.** SEM top-view image of perovskite films treated by high concentration MAI/2-BA: (a) 2 mg ml<sup>-1</sup>, (b) 4 mg ml<sup>-1</sup> and (c) 6 mg ml<sup>-1</sup>; (d) The XRD patterns of perovskite films treated by high concentration MAI/2-BA.



**Figure S6.** Statistical device performance of PSCs treated with the 2-BA, 0.5 mg ml<sup>-1</sup> of MAI/2-BA, 1 mg ml<sup>-1</sup> of MAI/2-BA and 1.5 mg ml<sup>-1</sup> of MAI/2-BA



**Figure S7.** The PL and TRPL spectra of the as-obtained perovskite films, the inset displays the device structure.

**Table S1.** The full photovoltaic parameters for fabricated PSCs corresponding to Figure 4b.

Sample	$J$ (mA/cm <sup>2</sup> )	$V$ (V)	FF (%)	PCE (%)
Control	22.16±1.33	1.09±0.05	62.9±4.6	15.16±1.80
average value	22.24	1.09	62.80	15.18
0.5 mg ml <sup>-1</sup> MAI/2-PA	22.90±1.05	1.11±0.04	67.3±3.4	16.85±1.47
average value	22.80	1.10	67.25	16.87
1 mg ml <sup>-1</sup> MAI/2-PA	22.91±0.94	1.12±0.02	75.4±3.1	19.32±1.27
average value	22.95	1.12	75.30	19.31
1.5 mg ml <sup>-1</sup> MAI/2-PA	18.94±2.60	1.03±0.06	49.3±6.7	10.09±2.24
average value	19.74	1.03	49.20	9.99

**Table S2.** The detailed fitting internal series resistance ( $R_s$ ) and recombination resistance ( $R_{ct}$ ) for PSCs treated with the 2-BA and MAI/2-BA

Sample	$R_s$ ( $\Omega$ )	$R_{ct}$ ( $\Omega$ )
Control	21.5	22490.7
MAI/2-PA	18.4	33035.5

**Table S3.** Fitted parameters of TRPL spectra corresponding to Figure 4d.

Sample	$A_1$ (%)	$\tau_1$ (ns)	$A_2$ (%)	$\tau_2$ (ns)	$\tau_{avg}$ (ns)
Control	76	3.6	24	14.8	9.2
MAI/2-PA	69	7.8	31	42.4	25.1

**Table S4.** Fitted parameters of TRPL spectra corresponding to Figure S7.

Sample	$A_1$ (%)	$\tau_1$ (ns)	$A_2$ (%)	$\tau_2$ (ns)	$\tau_{avg}$ (ns)
Control	76	11.6	24	46.2	28.9
MAI/2-PA	79	7.6	21	20.6	14.1