Supporting Information

Enhancing the Planar Heterojunction Perovskite Solar Cells Performance through Tuning Precursor Ratio

Jingjing Chang,[a,b*] Hai Zhu,[c] Juanxiu Xiao,[d] Furkan Halis Isikgor,[a] Zhenhua Lin,[b] Yue Hao,[b] Kaiyang Zeng,[d] Qing-Hua Xu,[c] and Jianyong Ouyang[a*]

[a]Department of Materials Science & Engineering, National University of Singapore, 7 Engineering Drive 1, Singapore 117574. *E-mail: mseoj@nus.edu.sg;

Fax: +65 6776 3604; Tel: +65 6516 1472

[b]State Key Laboratory of Wide Band Gap Semiconductor Technology, School of Microelectronics, Xidian University, 2 South Taibai Road, Xi'an, China 710071. *E-mail:jjingchang@xidian.edu.cn

[c]Department of Chemistry, National University of Singapore, 3 Science Drive 3, Singapore 117543.

[d] Department of Mechanical Engineering, National University of Singapore, 9 Engineering Drive 1, Singapore 117576.

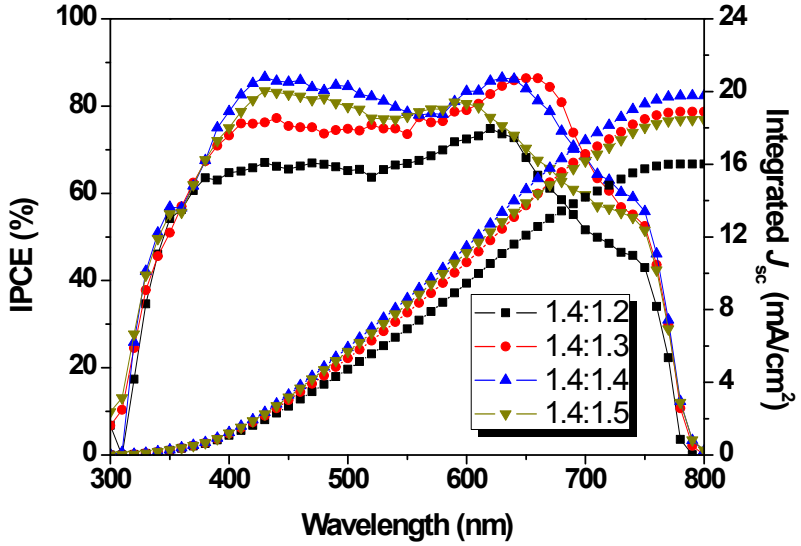

Figure S1. IPCE spectra and integrated J_{sc} of PSCs with perovskite layers prepared from precursor solutions with different PbI_2-to-MAI ratios.

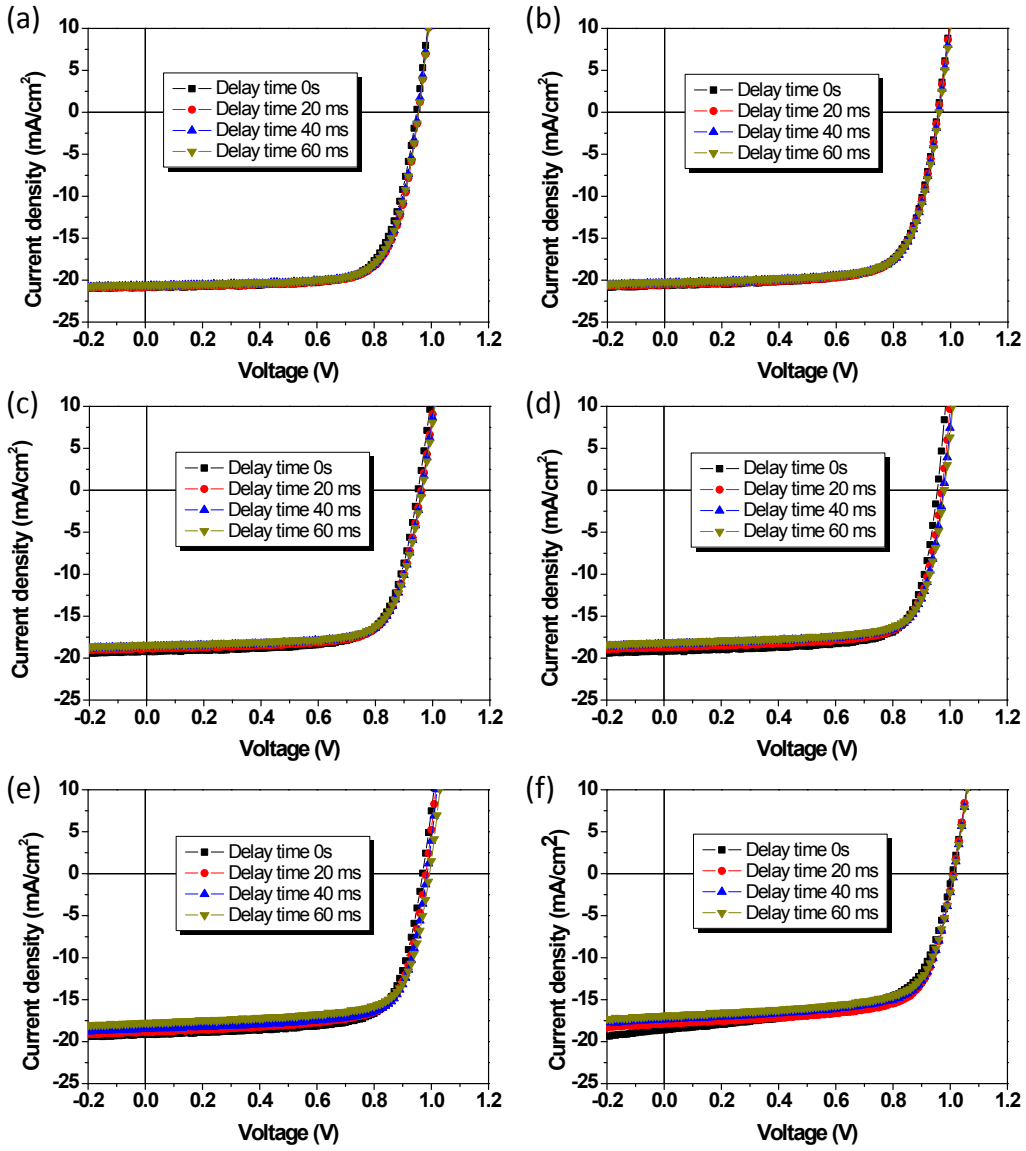

Figure S2. *J-V* characteristics of the PSCs with the perovskite layers prepared from precursor solutions with PbI_2-to-MAI ratios of 1.4:1.4 (a-b), 1.4:1.3 (b-d), and 1.4:1.2 (e-f) with respect to the scan direction (reverse: a, c, e; forward: b, d, f) and scan rate.

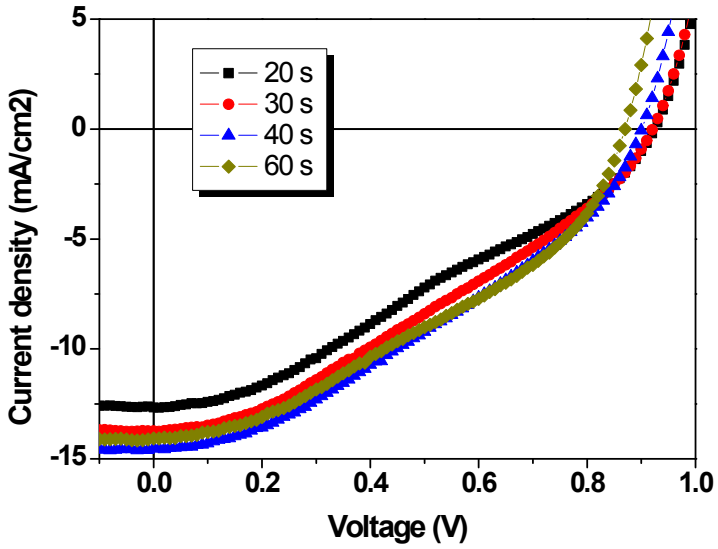

Figure S3. *J-V* characteristics of PSCs with the perovskite layer fabricated by sequential deposition.

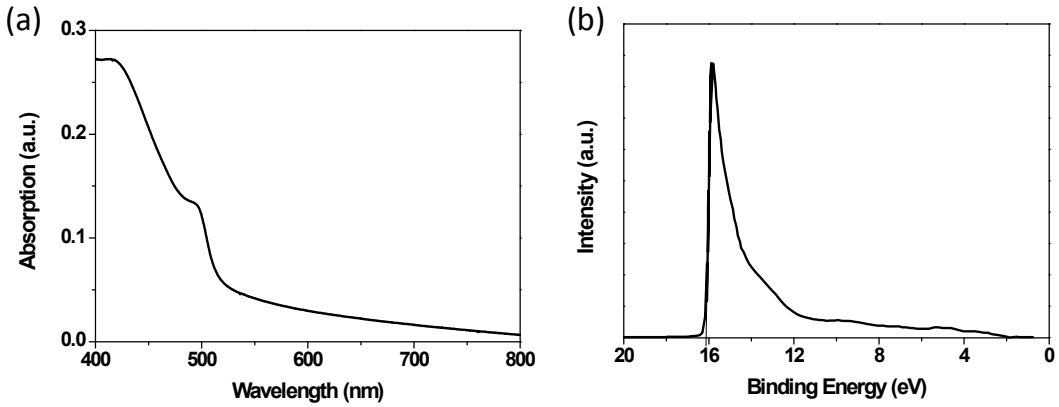

Figure S4. UV-vis absorption (a) and UPS (b) spectra of PbI_2 thin film.

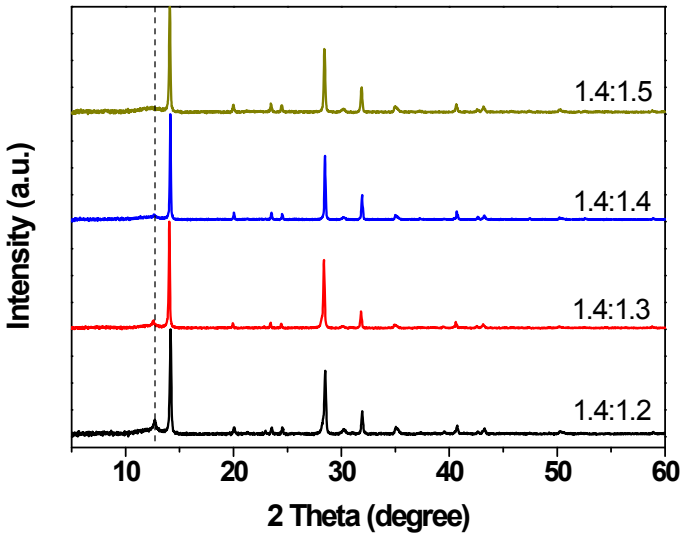

Figure S5. XRD patterns of perovskite thin films prepared from solutions of different PbI_2-to-MAI ratios.

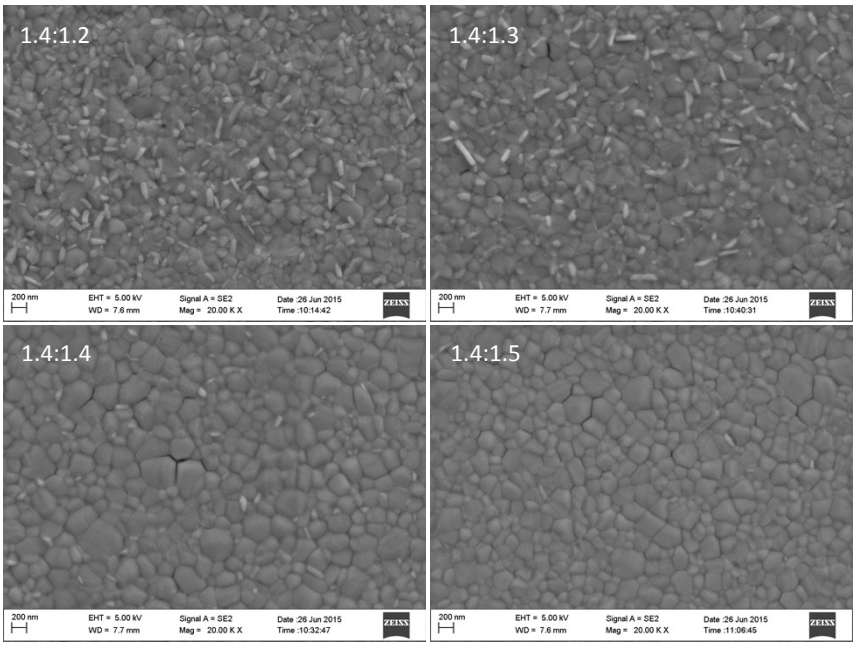

Figure S6. SEM images of perovskite thin films prepared from precursor solutions with different PbI_2-to-MAI ratios.

Table S1. Photovoltaic performances of perovskite solar cells with the perovskite layer prepared by the sequential deposition with different dipping durations.

Device	Dipping duration	J_{sc} (mA/cm^2)	V_{oc} (V)	FF	PCE (%)
1	20 s	12.12	0.92	0.31	3.48
2	30 s	13.15	0.92	0.33	4.04
3	40 s	13.90	0.90	0.36	4.45
4	60 s	14.73	0.88	0.43	5.60
5	80s	14.77	0.87	0.40	5.14

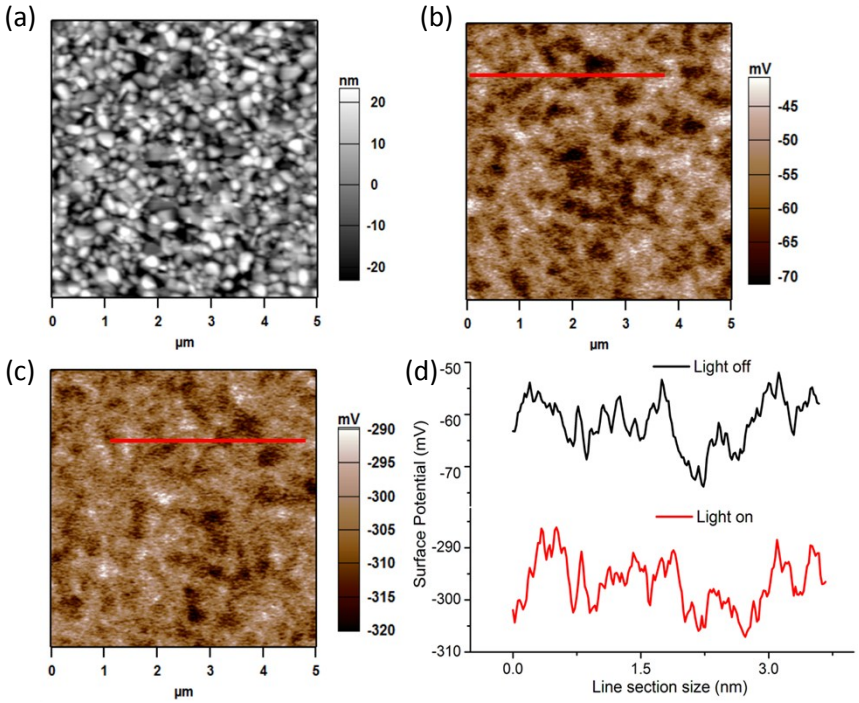

Figure S7. (a) Topography and surface potential images of a perovskite thin film measured (b) in dark and (c) under light. (d) Line profiles of the marked lines in the surface potential images (b) and (c). The perovskite film was prepared from a solution with the PbI_2-to-MAI ratio of 1.4:1.35.

Table S2. Fitted decay times of perovskite films prepared from precursor solutions with different PbI_2-to-MAI ratios.

PbI_2:MAI	**A1**	τ_1	**A2**	τ_2
1.4:1.2	71%	1.80	29%	10.21
1.4:1.3	62%	2.82	38%	13.83
1.4:1.4	68%	3.43	32%	24.04
1.4:1.5	69%	0.91	31%	5.54