Electronic Supplementary Material (ESI) for Journal of Materials Chemistry A.

Supporting Information

Preparation of Metal Halide Perovskite Solar cells through Liquid Droplet Assisted method

Karunakara Moorthy Boopathi[a,b,c], Mohan Ramesh[c], Packiyaraj Perumal[d], Yu-Ching Huang[e], Cheng-Si Tsao[e], Yang-Fang Chen[d], Chih-Hao Lee[a], Chih-Wei Chu[c,*]

[a]*Department of Engineering and Systems Science, National Tsing Hua University, Hsinchu 30013, Taiwan*
[b]*Nano Science and Technology Program, Taiwan International Graduate Program, Academia Sinica and National Tsing Hua University*
[c]*Research Center for Applied Science, Academia Sinica, Taipei 115, Taiwan*
[d] *Department of Physics, National Taiwan University, Taipei 10617, Taiwan*
[e] *Institute of Nuclear Energy Research, Longtan, Taoyuan 32546, Taiwan*
*e-mail: gchu@gate.sinica.edu.tw
http://www.rcas.sinica.edu.tw/faculty/gchu.html

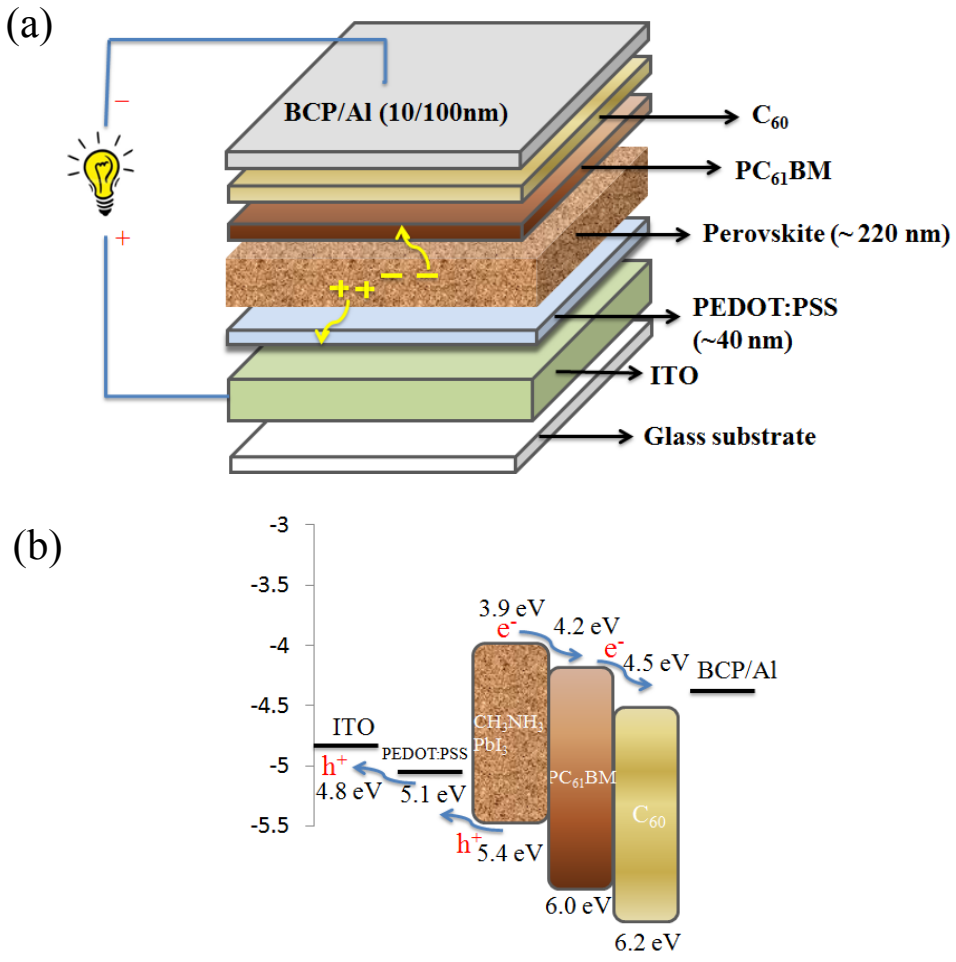

Fig. S1 (a) Schematic device structure of lead iodide perovskite solar cell, (b) corresponding energy band diagram for each layer present in the device structure.

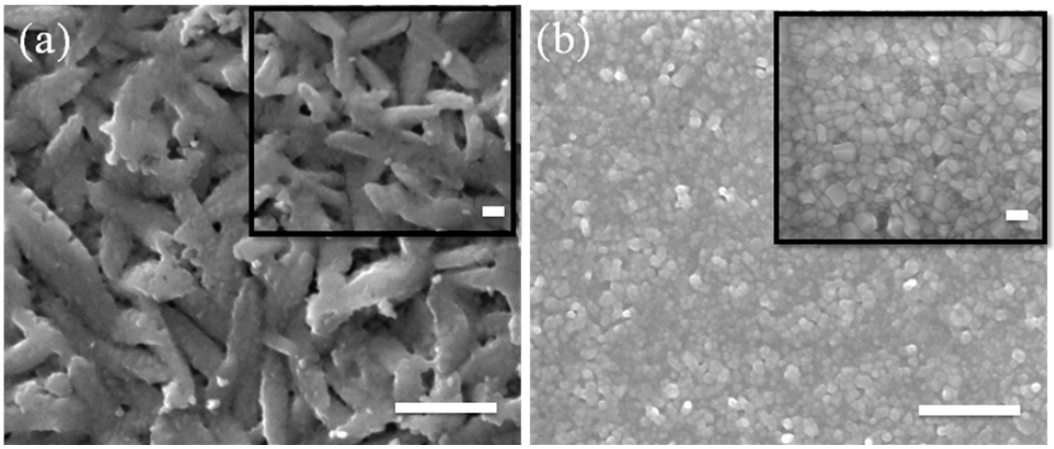

Fig. S2 SEM image of (a) one step mixed solution (CH_3NH_3I:PbI_2 (1:0.75) molar ratio) and (b) spin (PbI_2) / spin (CH_3NH_3I) on PEDOT:PSS. Scale corresponds to 2 µm (Insert scale bar represent 500 nm).

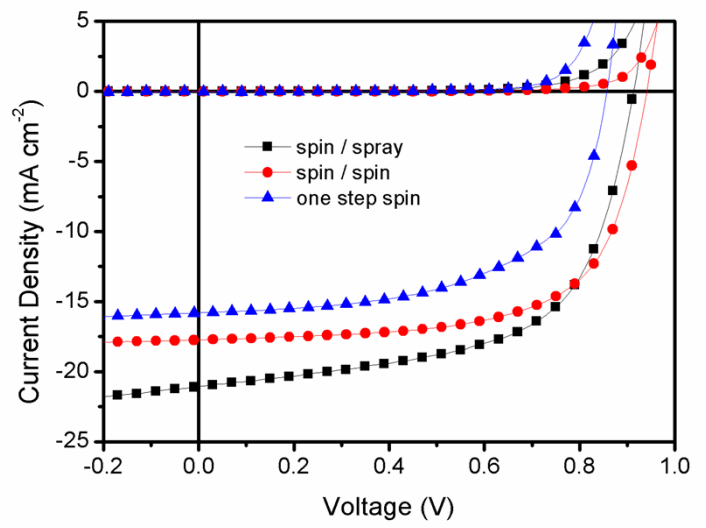

Fig. S3 J-V characteristic of spin (PbI_2) / spray (CH_3NH_3I), spin (PbI_2) / spin (CH_3NH_3I) and one step mixed solution (CH_3NH_3I:PbI_2 (1:0.75) molar ratio) spin coating with same device structure shown in fig. S1

Table S1. Device performance parameters of different perovskite film formation techniques

Different film formation techniques	V_{OC} (V)	J_{SC} (mA/cm^2)	η (%)	FF (%)
spin (PbI2) / spray (CH_3NH_3I)	0.91	21.06	11.66	60.84
spin (PbI2) / spin (CH_3NH_3I)	0.94	17.73	10.96	65.76
one step spin coating	0.86	15.81	7.96	58.54

Table S2. Device performance parameter of different thickness of 40 wt% PbI_2 layer and different volumes of 3 wt% CH_3NH_3I

PbI_2 (40 wt %) Spin speed	**CH_3NH_3I (3 wt%) volume**	**Voc (V)**	**Jsc (mA/cm^2)**	**η (%)**	**FF (%)**
135±5 nm (4000 rpm)	**300 ul**	0.89	16.19	8.36	58.02
	400 ul	0.92	17.25	9.70	61.12
	500 ul	0.89	10.55	5.21	55.49
110±5 nm (5000 rpm)	**300 ul**	0.91	17.65	8.72	54.29
	350 ul	0.93	18.51	10.16	59.02
	400 ul	0.91	17.64	9.25	57.56
	450 ul	0.91	16.22	8.07	54.47
100±5 nm (6000 rpm)	**200 ul**	0.87	16.45	7.97	55.69
	250 ul	0.89	18.03	9.37	58.39
	300 ul	0.91	20.84	11.12	58.64
	350 ul	0.91	18.59	10.38	61.36
90±5 nm (7000 rpm)	**200 ul**	0.94	19.44	10.72	58.66
	300 ul	0.96	17.24	9.95	60.12
	350 ul	0.91	16.75	8.83	57.93
	400 ul	0.92	16.07	8.61	58.23
80±5 nm (8000 rpm)	**200 ul**	0.89	18.03	9.37	58.39
	300 ul	0.91	17.04	8.81	57.46
	350 ul	0.90	16.74	8.13	53.96

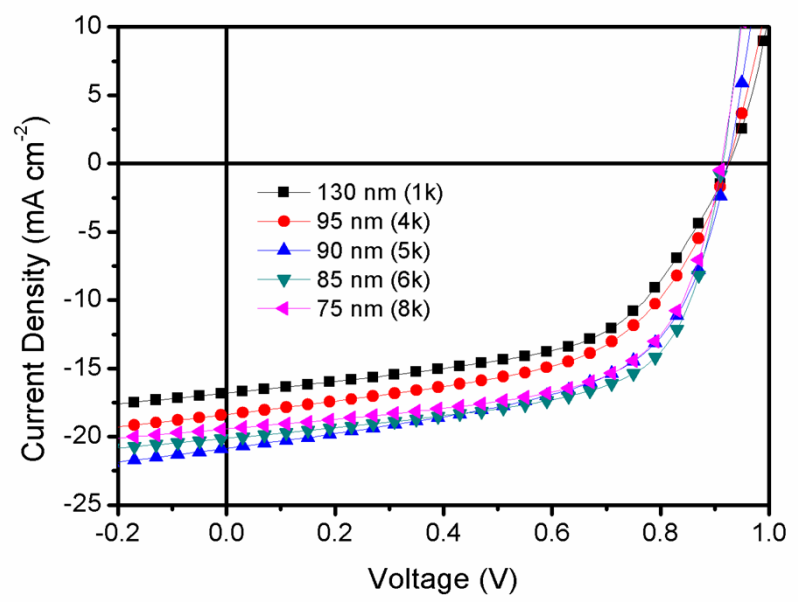

Fig. S4 J-V characteristics of device with perovskite thickness of 220 ±5 nm while varying the $PC_{61}BM$ thickness

Table S3. Device performance parameters of 220 ±5 nm perovskite film with different thickness of $PC_{61}BM$ layer

PCBM thickness (spin speed in rpm)	**Voc (V)**	**Jsc (mA/cm^2)**	**η (%)**	**FF (%)**
130 nm (1k)	0.93	16.82	8.63	55.17
95 nm (4k)	0.92	18.39	9.31	55.03
90 nm (5k)	0.91	20.86	11.12	58.58
85 nm (6k)	0.91	20.12	11.55	63.08
75 nm (8k)	0.91	19.43	10.91	61.70