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Supporting information

Distribution of bromine in mixed iodide-bromide organolead perovskites and its impact on photovoltaic performance

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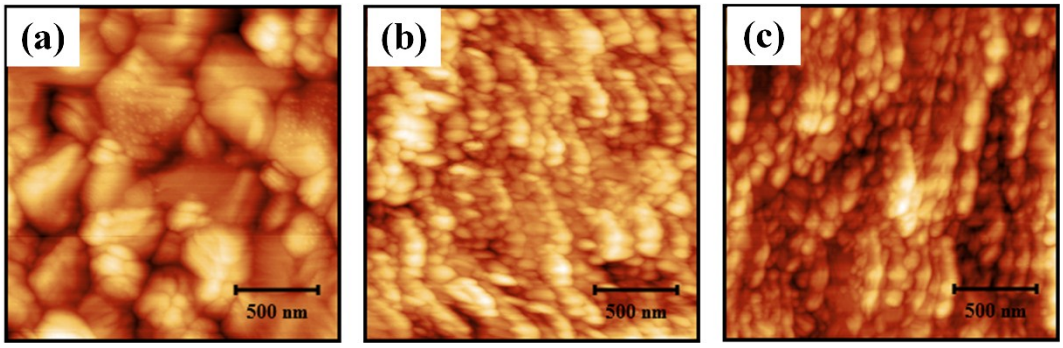

Figure S1. AFM images of $MAPb(I_{1-x}Br_x)_3$ films: (a) x=0, (b) x=0.03 and (c) x=0.11.

Table S1. The R_{ms} values of $MAPb(I_{1-x}Br_x)_3$ films with x=0, 0.03 and 0.11 derived from the raw data of AFM images.

x	0	0.03	0.12
R_{ms} (nm)	7.72	6.71	4.59

The grain size of the $MAPb(I_{1-x}Br_x)_3$ perovskite films is estimated from the full width at half maximum (FWHM) of the XRD peak (2Theta around 30°) according to Scherrer equation $B(2\theta) = \frac{K\lambda}{Lcos\theta}$ [1], where B is the sample's FWHM, θ is diffraction angle, L is the grain size, λ is the wavelength of Cu kα1 radiation (1.540562A) and K is a constant and for spherical crystals with cubic symmetry this value is 0.94 [1]. For the proper determination of the FWHM, the FWHM contributed by Cu kα2 radiation and the setup is removed. The FWHM contributed by the setup is estimated from the XRD peak (2Theta=30.14°) of the $MAPbBr_3$ single crystal. The estimated grain sizes are around 200nm for $MAPb(I_{1-x}Br_x)_3$ (x=0, 0.03 and 0.11) and are summarized in Table S2.

Table S2. The estimation of grain sizes of the $MAPb(I_{1-x}Br_x)_3$ perovskite films with x=0, 0.03, and 0.11.

x	0	0.03	0.11	1 (single crystal)
Peak position 2θ (°)	28.32	28.42	28.54	30.14
FWHM B (mrad)	0.68	0.70	0.77	0.63
Grain size (nm)	220	215	195	NA

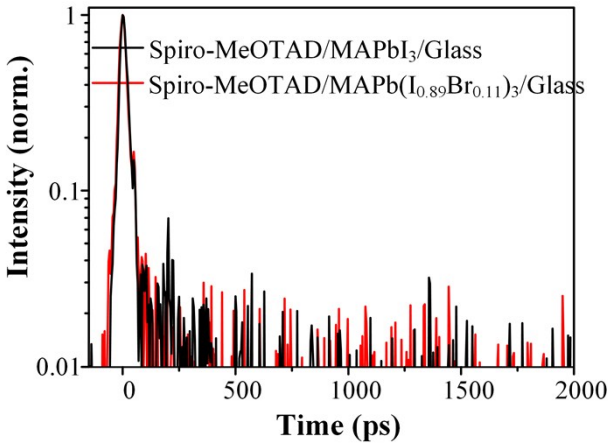

Figure S2. The TRPL decay of HI-aided $MAPb(I_{1-x}Br_x)_3$ (x=0 and 0.11) perovskite films incorporated in between glass and spiro-MeOTAD.

Table S3. Summary of the solar cell performance for $MAPb(I_{1-x}Br_x)_3$ perovskite (x=0, 0.03, 0.11, 0.20 and 0.29).

x	Thickness (nm)	J_{sc} (mA/cm^2)	V_{oc} (V)	FF (%)	PCE (%)
0	500	18.42±0.55	0.88±0.01	46.3±3.4	7.5±0.8
	330	21.10±0.30	0.98±0.01	68.5±3.3	14.2±0.6
	240	19.60±0.48	0.96±0.01	58.9±2.0	11.1±0.4
0.03	500	18.96±0.38	0.97±0.01	60.3±2.2	11.2±0.6
0.11	260	18.53±0.36	1.02±0.02	61.9±0.4	11.7±0.8
	340	20.44±0.20	1.00±0.01	59.0±1.8	12.1±0.4
	460	21.55±0.41	1.01±0.02	68.2±0.8	14.8±0.6
	510	22.38±0.28	1.01±0.02	70.3±1.7	15.8±0.6
	570	20.59±0.59	1.01±0.01	61.8±0.3	12.8±0.5
	660	17.99±0.37	1.00±0.01	58.0±0.5	10.4±0.2
0.20	510	19.86±0.35	1.09±0.01	63.7±0.2	13.8±0.6
0.29	510	13.54±0.62	0.92±0.02	36.8±0.9	4.6±0.3

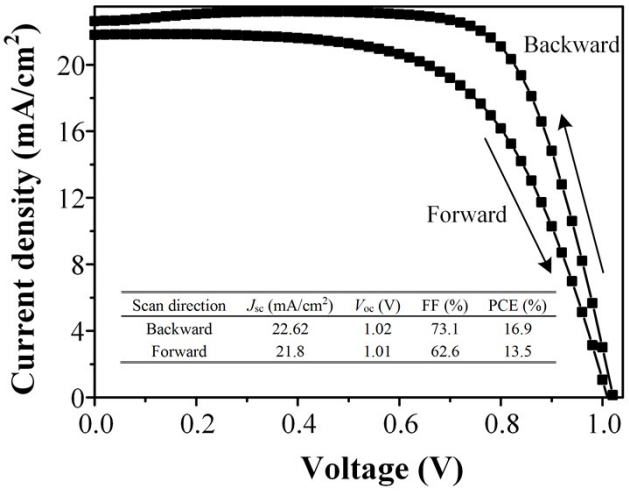

Figure S3. The PV performance of the champion cell prepared from $MAPb(I_{0.89}Br_{0.11})_3$ perovskite.