

# Supporting Information

## Hysteresis-free and highly stable perovskite solar cells produced via a chlorine-mediated interdiffusion method

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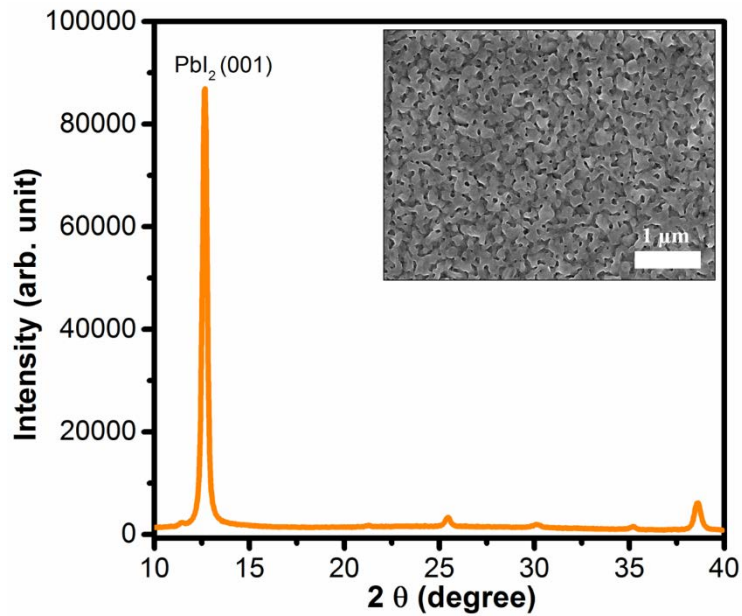
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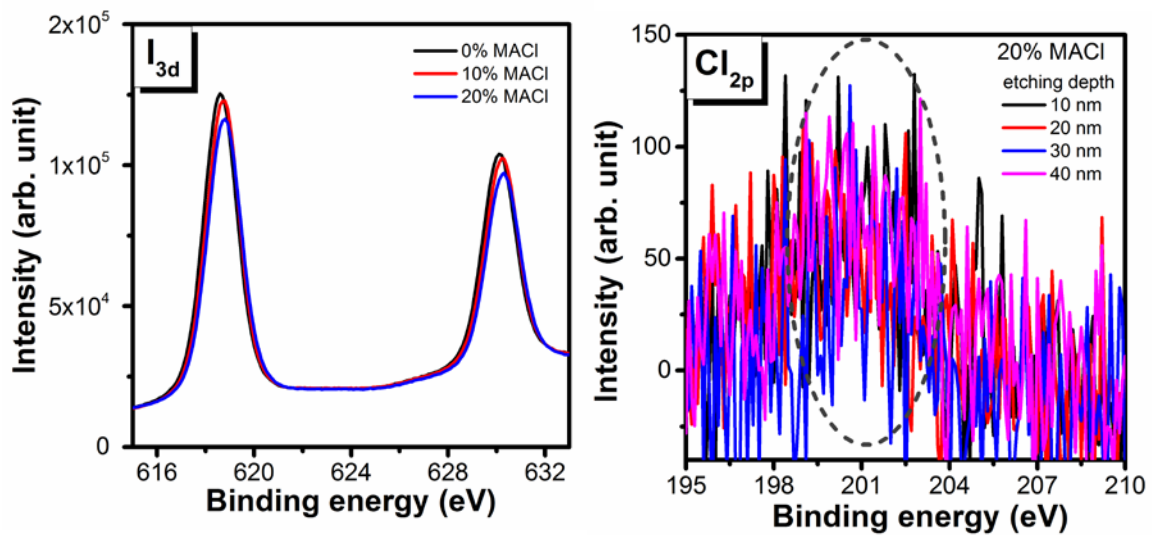
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**Table S1:** Weight percentages of Cl, I, and Pb, estimated from EDX analysis.

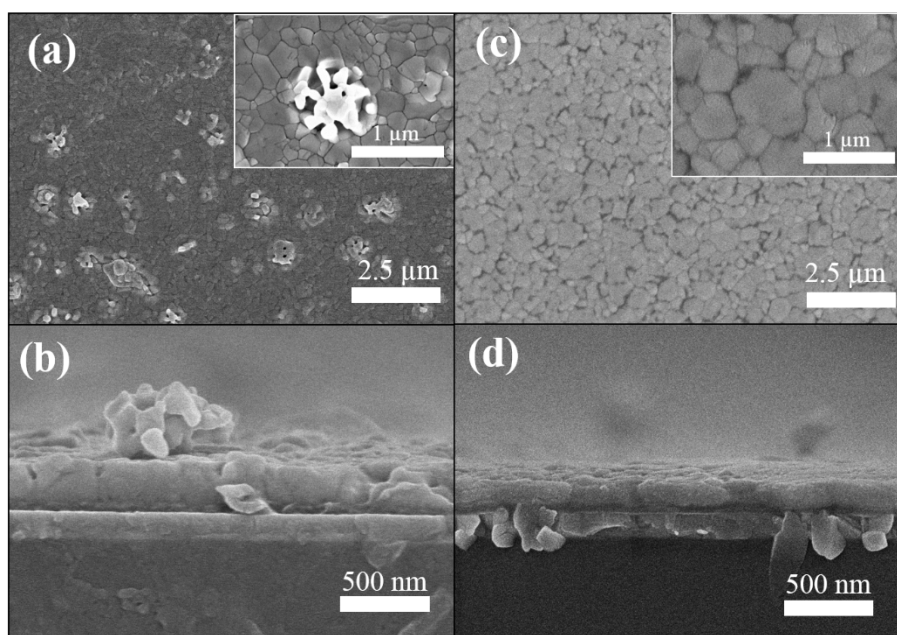
Elements	MAPbI3 (No MACl)	MAPbI <sub>3-x</sub> Cl <sub>x</sub> (10 wt% MACl)	MAPbI <sub>3-x</sub> Cl <sub>x</sub> (20 wt% MACl)	MAPbI <sub>3-x</sub> Cl <sub>x</sub> (30 wt% MACl)
Cl	-0.30	0.83	1.26	1.54
I	67.70	58.74	63.97	57.04
Pb	32.68	40.43	34.77	41.43



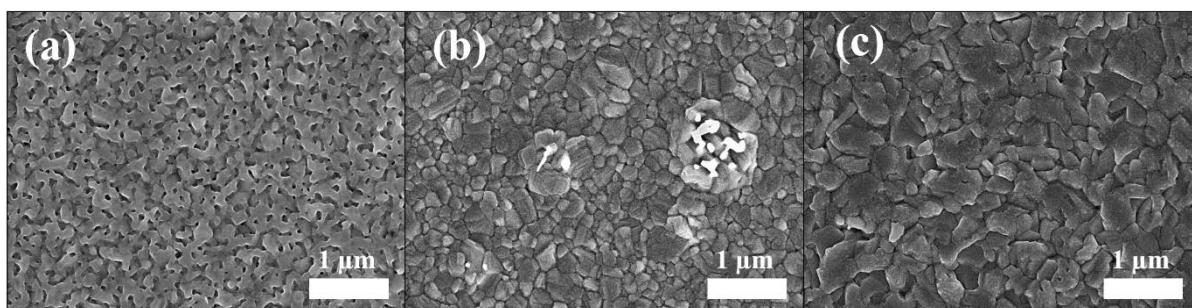
**Figure S1:** XRD patterns of  $\text{PbI}_2$  annealed at  $70^\circ\text{C}$  for 30 min. (inset shows the corresponding SEM image)



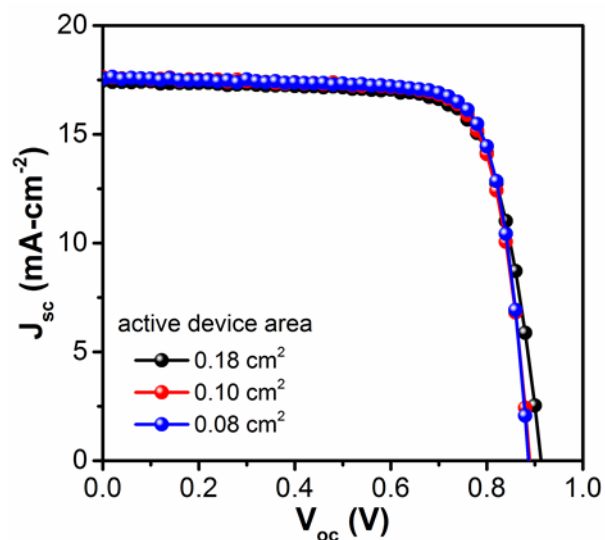
**Figure S2:** XPS spectra of (a)  $\text{I}_{3d}$  core levels with different MACl concentration (b)  $\text{Cl}_{2p}$  core level spectra of 20% MACl doped perovskite film at different penetration depths.



**Figure S3:** SEM images of  $\text{MAPbI}_3$  and  $\text{MAPbI}_{3-x}\text{Cl}_x$  perovskite films before annealing: (a)-(b) top and cross-sectional view of  $\text{MAPbI}_3$ , respectively (c)-(d) top and cross-sectional view of  $\text{MAPbI}_{3-x}\text{Cl}_x$ , respectively.



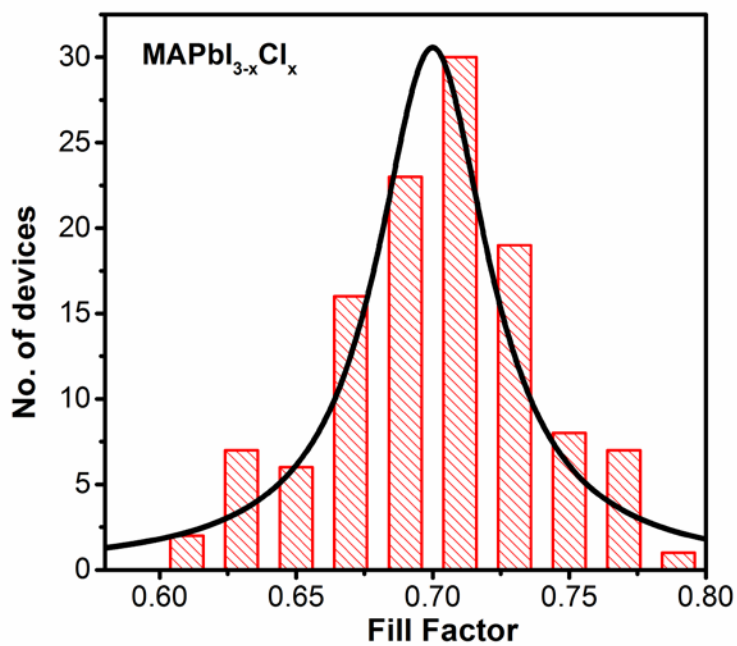
**Figure S4:** Comparison of SEM images (a)  $\text{PbI}_2$ , annealed at  $70^\circ\text{C}$  for 30 min (b)  $\text{PbI}_2/\text{CH}_3\text{NH}_3\text{PbI}_3$  annealed at  $100^\circ\text{C}$  for 2 h. (c)  $\text{PbI}_2/\text{CH}_3\text{NH}_3\text{PbI}_{3-x}\text{Cl}_x$  annealed at  $100^\circ\text{C}$  for 2 h.



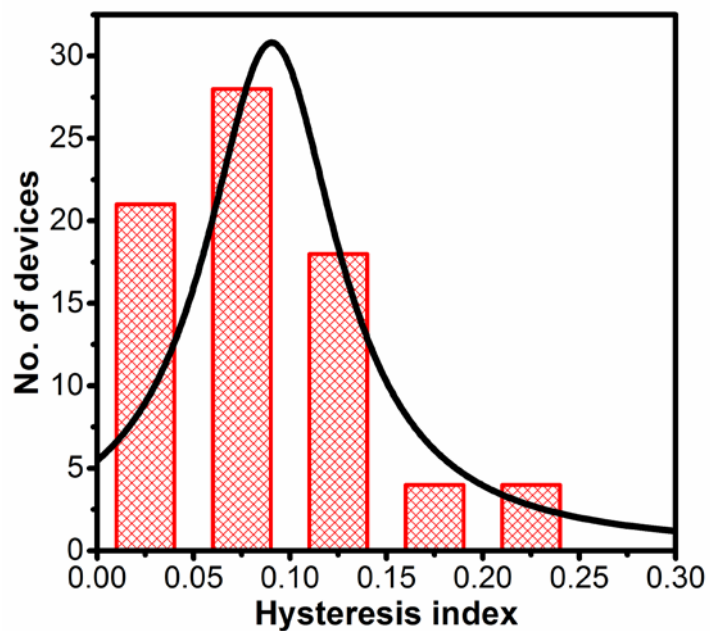
**Figure S5:** The device performance dependences on the aperture size

**Table S2:** The device performance as function of the aperture size.

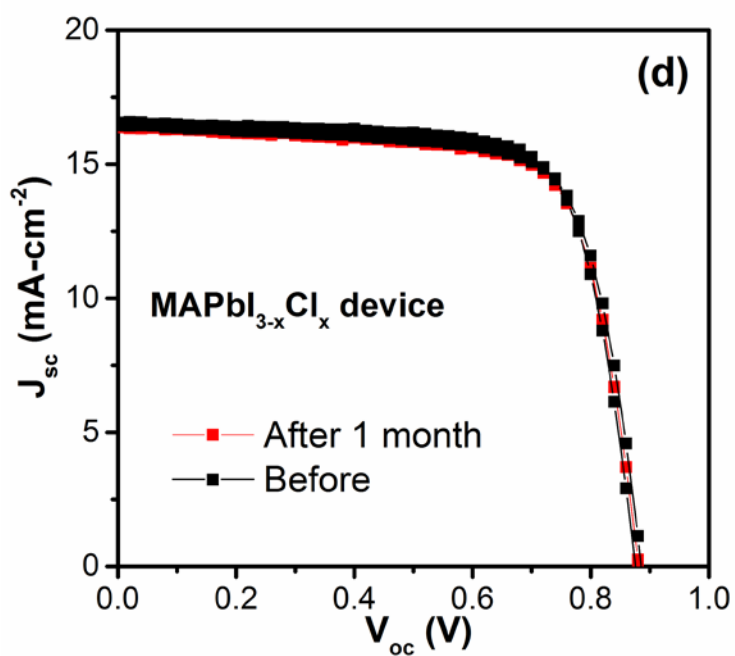
<i>Device area</i>	<i>J<sub>sc</sub> (mA-cm<sup>-2</sup>)</i>	<i>V<sub>oc</sub> (V)</i>	<i>FF</i>	<i>PCE (%)</i>
0.18 cm <sup>2</sup>	17.49	0.90	0.75	11.98
0.10 cm <sup>2</sup>	17.64	0.88	0.78	12.17
0.08 cm <sup>2</sup>	17.59	0.87	0.79	12.25



**Figure S6:** Fill Factor distribution of 120 MAPbI<sub>3-x</sub>Cl<sub>x</sub> devcies with device area 0.18 cm<sup>2</sup>.



**Figure S7:** Hysteresis index distribution of 80 MAPbI<sub>3-x</sub>Cl<sub>x</sub> devices with device area 0.18 cm<sup>2</sup>.



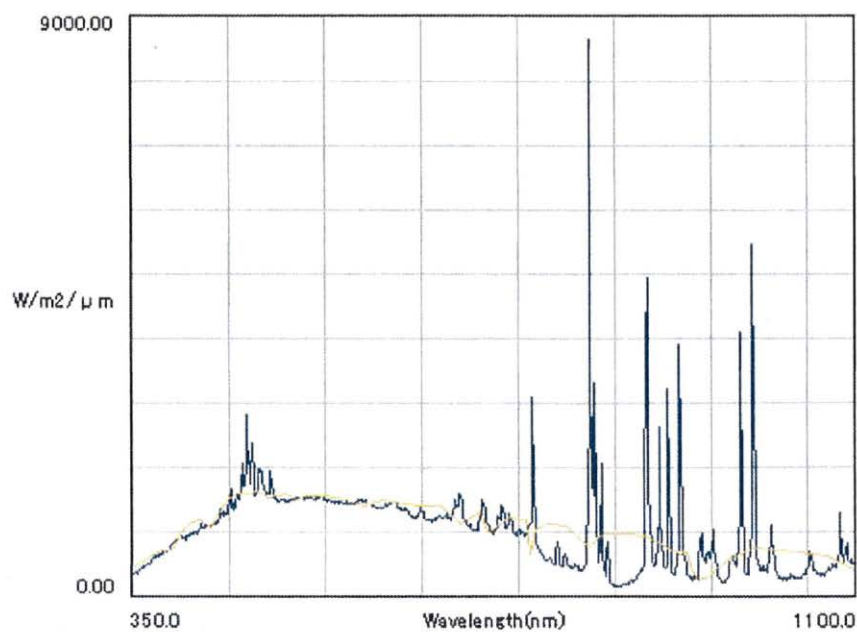
**Figure S8:** J-V curve of MAPbI<sub>3-x</sub>Cl<sub>x</sub> device before and after 1 month.

Spectral match for c-Si:

StartWL	EndWL	Sample Integr.	Sample%	Solar Integr.	Solar%	Coincidence	Judgement
400.00	500.00	141.31	19.36	138.71	18.46	1.05	A
500.00	600.00	148.81	20.39	151.28	20.13	1.01	A
600.00	700.00	130.71	17.91	137.47	18.30	0.98	A
700.00	800.00	97.77	13.39	111.49	14.84	0.90	A
800.00	900.00	84.43	11.57	92.04	12.25	0.94	A
900.00	1100.00	126.92	17.39	120.34	16.02	1.09	A
Sum		729.95	100.00	751.33	100.00	0.97	

Spectral match for a-Si:

StartWL	EndWL	Sample Integr.	Sample%	Solar Integr.	Solar%	Coincidence	Judgement
350.00	400.00	31.49	6.19	33.68	6.49	0.95	A
400.00	450.00	54.70	10.75	59.86	11.53	0.93	A
450.00	500.00	86.61	17.02	78.85	15.18	1.12	A
500.00	550.00	75.75	14.88	77.50	14.92	1.00	A
550.00	600.00	73.05	14.35	73.78	14.21	1.01	A
600.00	650.00	67.84	13.33	72.36	13.93	0.96	A
650.00	700.00	62.86	12.35	65.11	12.54	0.99	A
700.00	750.00	56.68	11.14	58.21	11.21	0.99	A
Sum		509.01	100.00	519.35	100.00	0.98	



**Figure S9:** Emission spectrum of the light source used for J-V characterizations.