

Supplementary informations

Cubic structure for mixed halide perovskite $\text{CH}_3\text{NH}_3\text{PbI}_{3-x}\text{Cl}_x$ by thermal annealing

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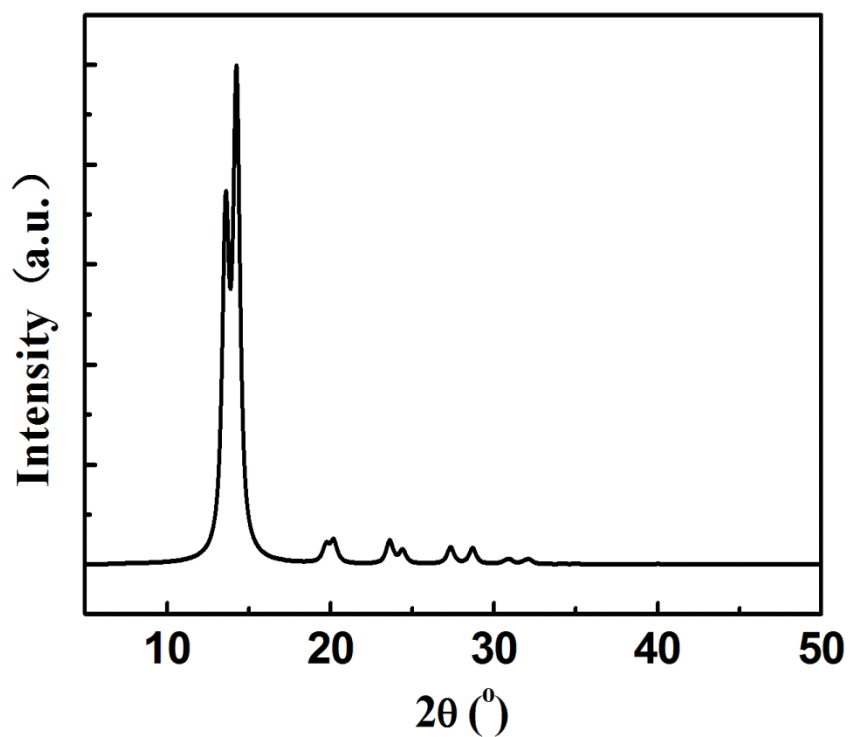


Fig. S1 The calculated XRD of $\text{MAPbI}_{3-x}\text{Cl}_x$ perovskite with tetragonal structure using a Mercury software, and crystal structure established basing on the regarding atomic coordination^{1,2}.

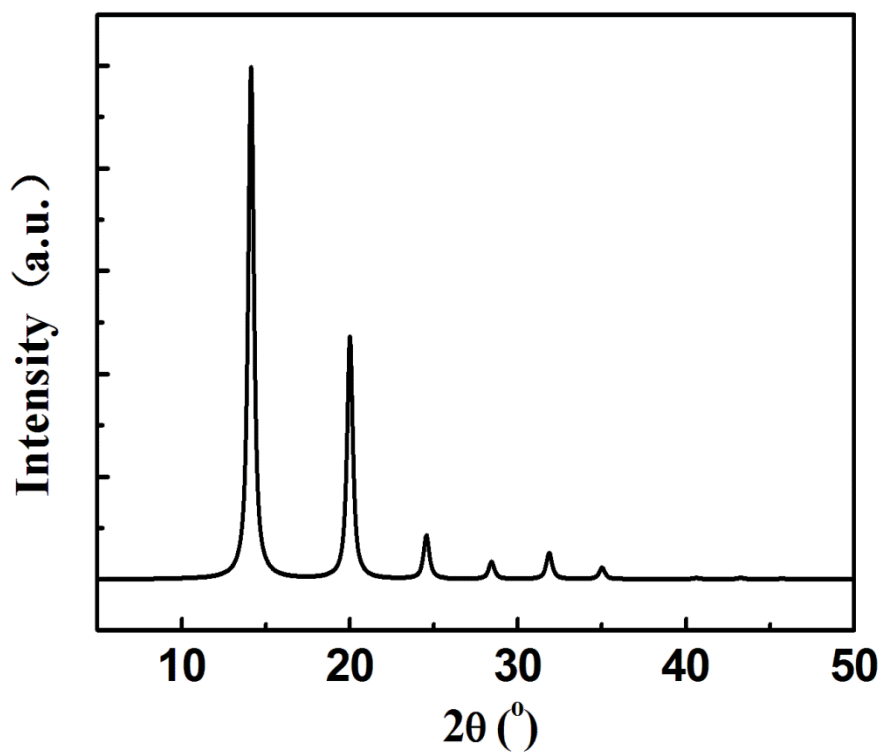


Fig. S2 The calculated XRD of MAPbI_{3-x}Cl_x perovskite with cubic structure using a Mercury software, and crystal structure established basing on the regarding atomic coordination.

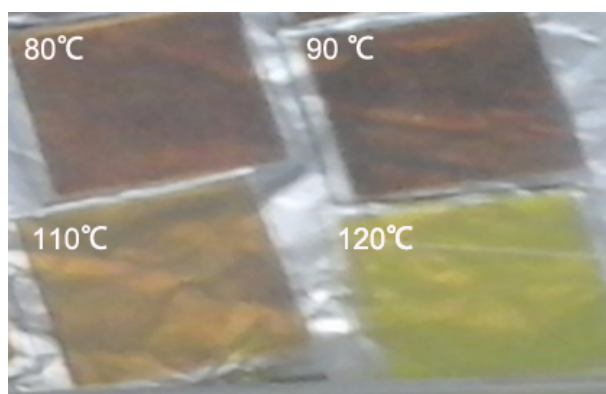


Fig S3. Photographs of samples undergo the different thermal annealing at 80°, 90°, 110° and 120°.

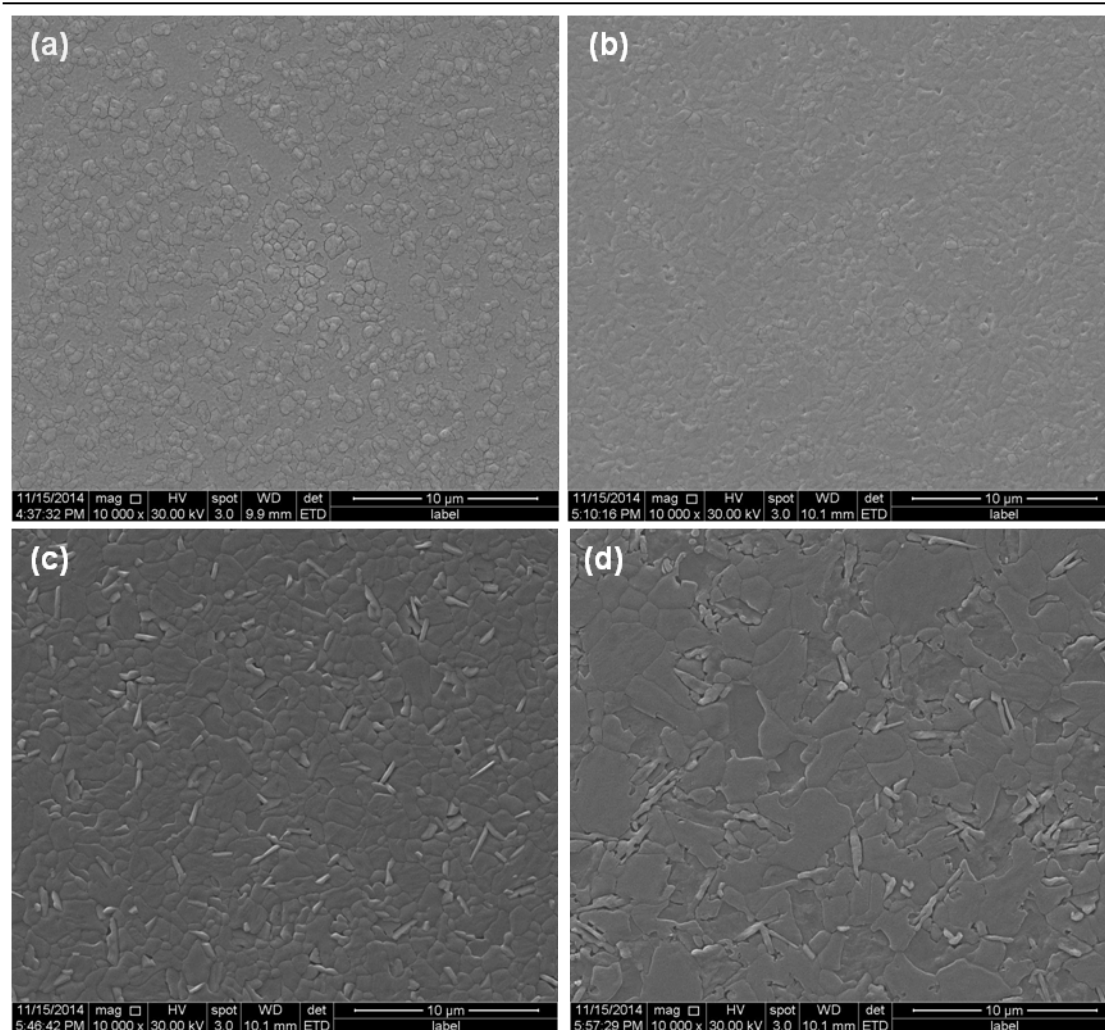


Fig S4. SEM images (a-d) of MAPbI_{3-x}Cl_x perovskite layer before and after thermal annealing at 90°, 100° and 110°.

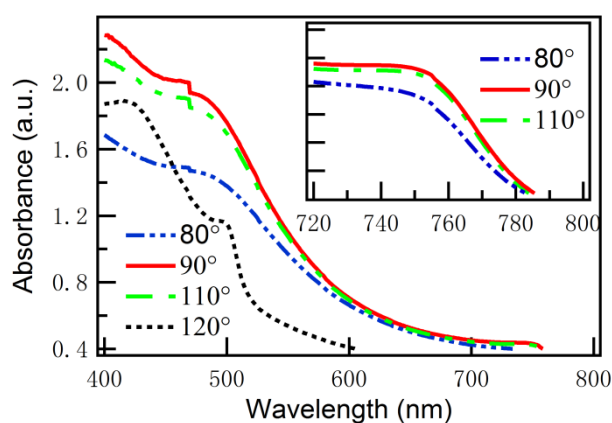


Fig S5. UV-visible light absorption of MAPbI_{3-x}Cl_x growth on the FTO substrates through varied thermal-annealing treatments

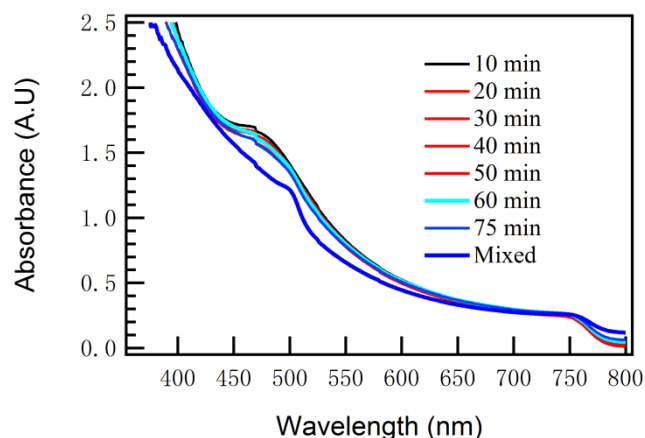


Fig S6. UV-visible light absorption of MAPbI_{3-x}Cl_x growth on the FTO substrates though varied thermal-annealing treatment from 0 to 75 minutes at 100°.

Table. S1. EDX datas of as-grow MAPbI_{3-x}Cl_x mixed halide perovskite

Elements	Weight (%)	Atom (%)
C K	1.18	4.05
O K	9.05	23.31
SiK	32.8	48.11
MoL	0.85	0.37
ClK	0.11	0.13
InL	11.57	4.15
SnL	2.46	0.85
CaK	10.9	11.2
I L	11.51	3.74
AuL	13.49	2.82
PbL	6.06	1.21

1. C. C. Stoumpos, C. D. Malliakas and M. G. Kanatzidis, *Inorganic chemistry* **52** (15), 9019 (2013).
2. J. Feng and B. Xiao, *The Journal of Physical Chemistry Letters* **5** (7), 1278 (2014).