Supporting Information

Low Ion Migration and Defect Density $MAPbX_3$ Single Crystals Grown at Low Temperature for X-Ray Detections

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Fig.S1 LT-$MAPbBr_3$ single crystal in the left bottle and LT-$MAPbCl_3$ single crystal in the right bottle

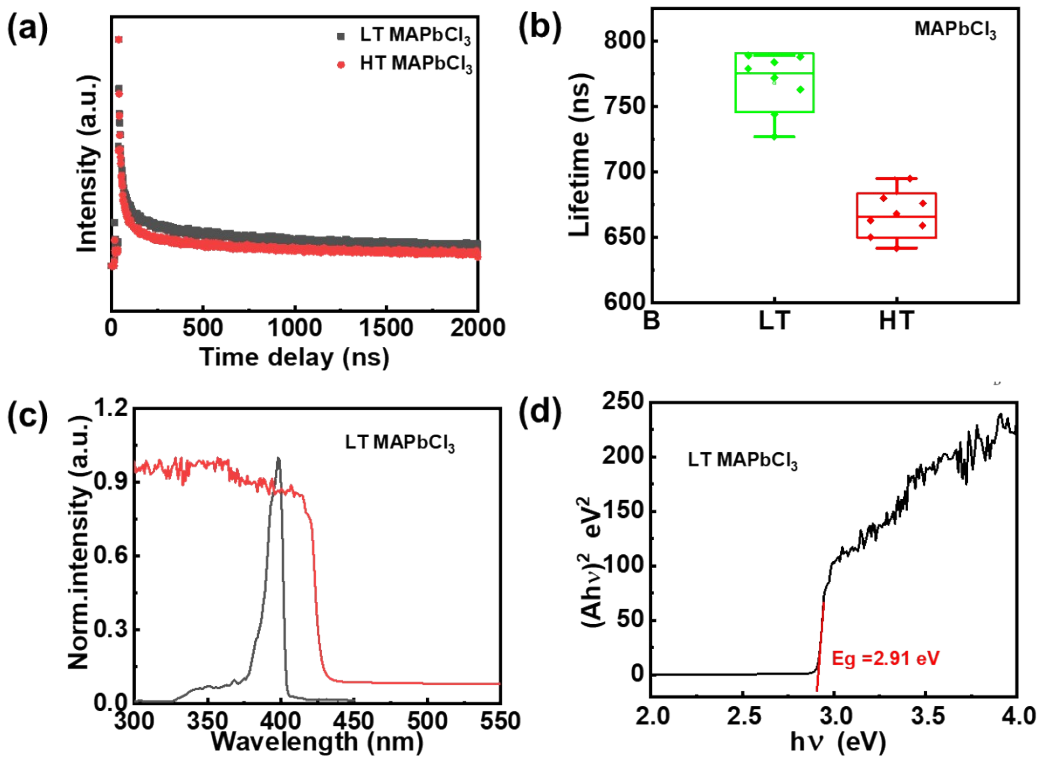

Fig.S2 (a) fluorescence lifetimes of LT-$MAPbCl_3$ and HT- $MAPbCl_3$ single crystals; (b) Statistical distribution comparison of the fluorescence lifetimes of LT-$MAPbCl_3$ and HT-$MAPbCl_3$ PSCs; (c)PL spectrum and UV-Vis absorption spectrum of LT-$MAPbCl_3$ PSCs; (d) Eg of LT-MAPbCl3 PSCs.

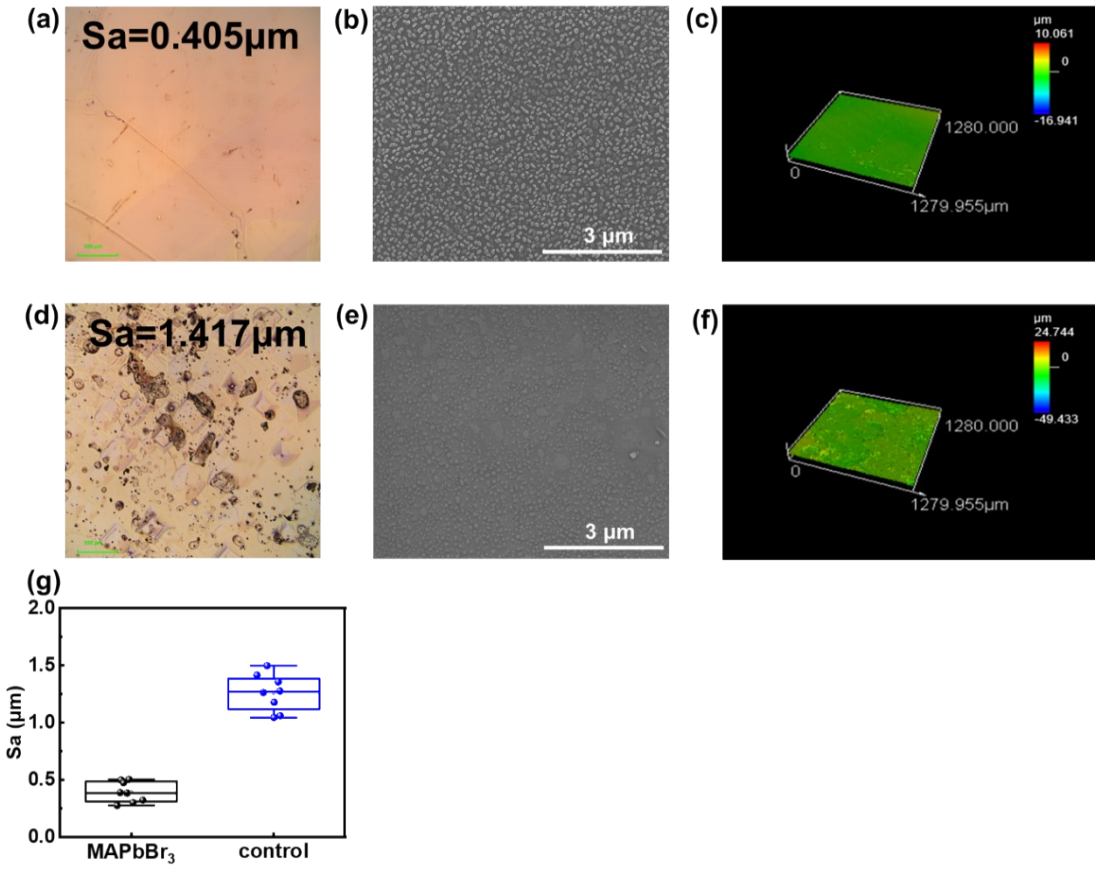

Fig.S3. (a) Confocal microscope image, (b) SEM image, and (c) 3D-Confocal microscope image of LT-$MAPbBr_3$ PSCs; (d) Confocal microscope image, (e) SEM image, and (f) 3D-Confocal microscope image of HT-$MAPbBr_3$ PSCs; (g) Statistical distribution comparison of the Surface roughness of LT-$MAPbBr_3$ and HT-$MAPbBr_3$ PSCs.

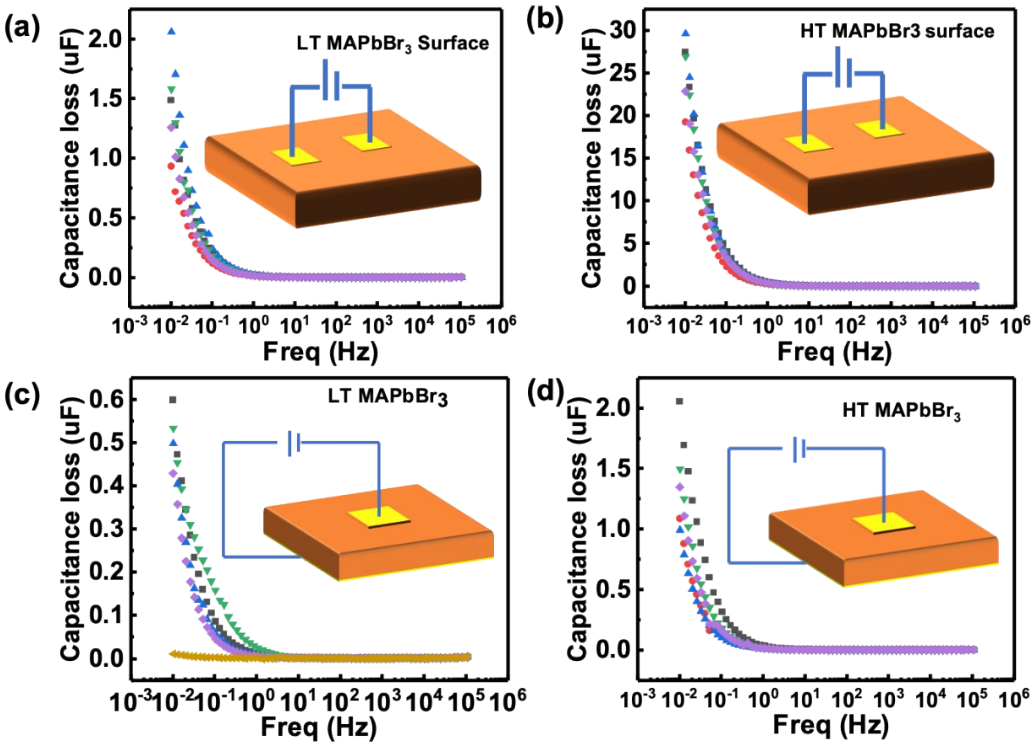

Fig.S4 Surface capacitance loss in the planar direction of (a) LT-$MAPbBr_3$ PSCs and (b) HT-$MAPbBr_3$ PSCs; bulk phase capacitance loss of (c) LT-$MAPbBr_3$ PSCs and (d) HT-$MAPbBr_3$ PSCs.

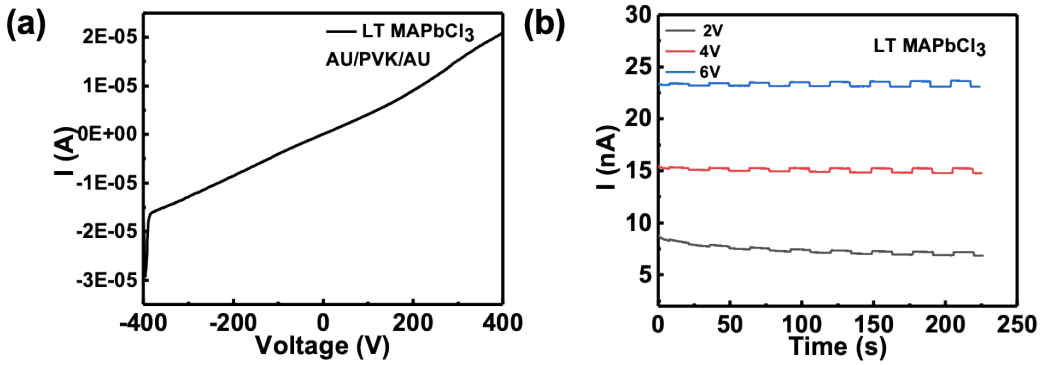

Fig.S5 (a) dark current-voltage characteristcs of LT-$MAPbCl_3$ PSCs, (b) On-off photocurrent response of LT-$MAPbCl_3$ X-ray detectors under different dose rates at different bias of -2 V, -4 V, -6 V, respectively.

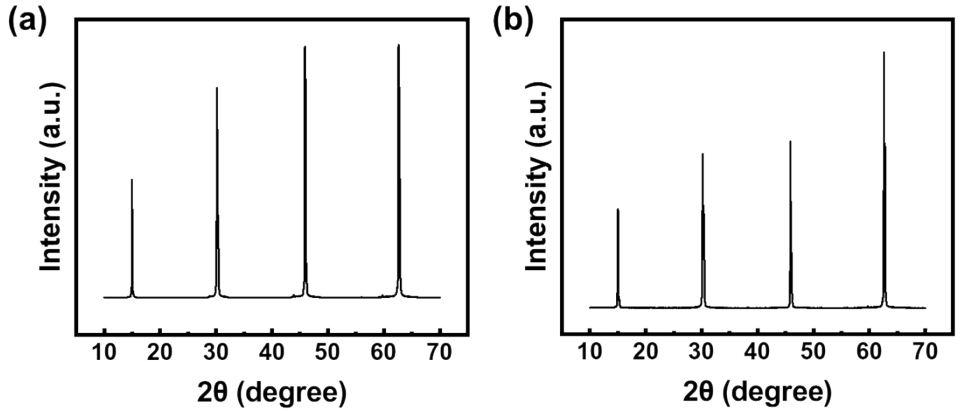

Fig.S6 XRD patterns of $MAPbBr_3$ crystals grown using LT-LDSC method (a) fresh crystal (b) crystal after six months since fabricated.

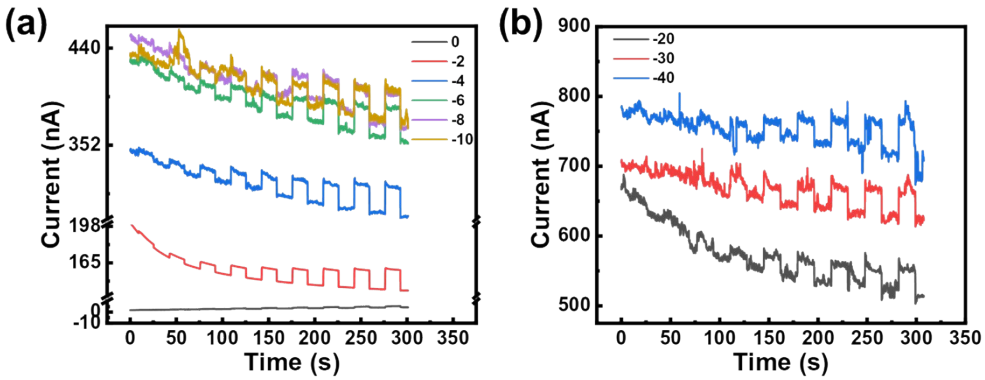

Fig.S7 On-off photocurrent response of LT-$MAPbBr_3$ PSCs after six months since fabricated under different dose rates at bias of (a) 0, -2 V, -4 V, -6 V, -8 V, -10 V and (b) -20 V, -30 V and -40 V, respectively;

Table S1. Summary of $MAPbBr_3$ PSC properties and device performances of resulting X-ray detectors in published representative work

Ref.	FWHM of Rocking curve (°)	Eg (eV)	PL Peak (nm)	τ (ns)	n_{trap} ($x10^9$ cm^{-3})	Mobility ($cm^2V^{-1}s^{-1}$)	Lowest detectable dose rate ($\mu Gy \cdot S^{-1}$)	Sensitivity (μC $Gy^{-1}cm^{-2}$)
1	0.0183(001) 0.0173(002)	2.15	577	235	e：27 ± 2 h：22 ± 1	/	/	39.3
1	0.0163(001) 0.0096(002)	2.15	577	997	e：6.5 ± 0.4 h：4.4 ± 0.2	/	1.2	184.6
2	/	/	/	/	h：5.64	27.5	7.5	307
3	/	/	/	692	/	201	0.1	$2.1x10^4$
4	/	/	550	/	/	217	0.5	80
5	0.009(001)	/	533	44.87	/	/	0.087	$1.5 x10^4$
6	/	2.16	/	17.14	h:16.9	60	/	632
7	0.017(001)	/		103.73	/	/	/	426.43

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