Supplementary Information (SI) for Journal of Materials Chemistry C.

Low-Temperature Quasi-Static Seeded Columnar Grain Growth of Thick Perovskite Films with Minimal Stress for Sensitive X-ray Detection

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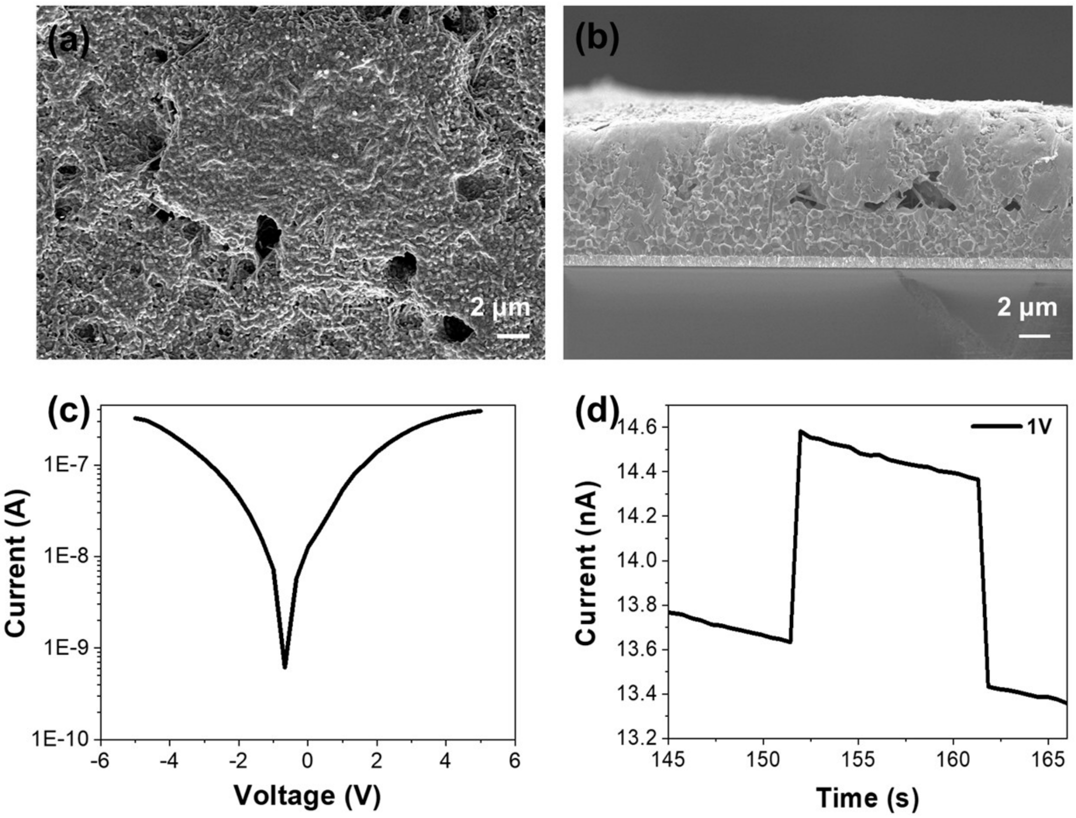

Fig. S1 The morphologies and X-ray response of $MAPbI_3$ perovskite thick film prepared using a gas-knife assisted blade-coating process. (a) Surface morphology. (b) Cross-sectional morphology. (c) Dark *I*-*V* curve. (d) X-ray response current.

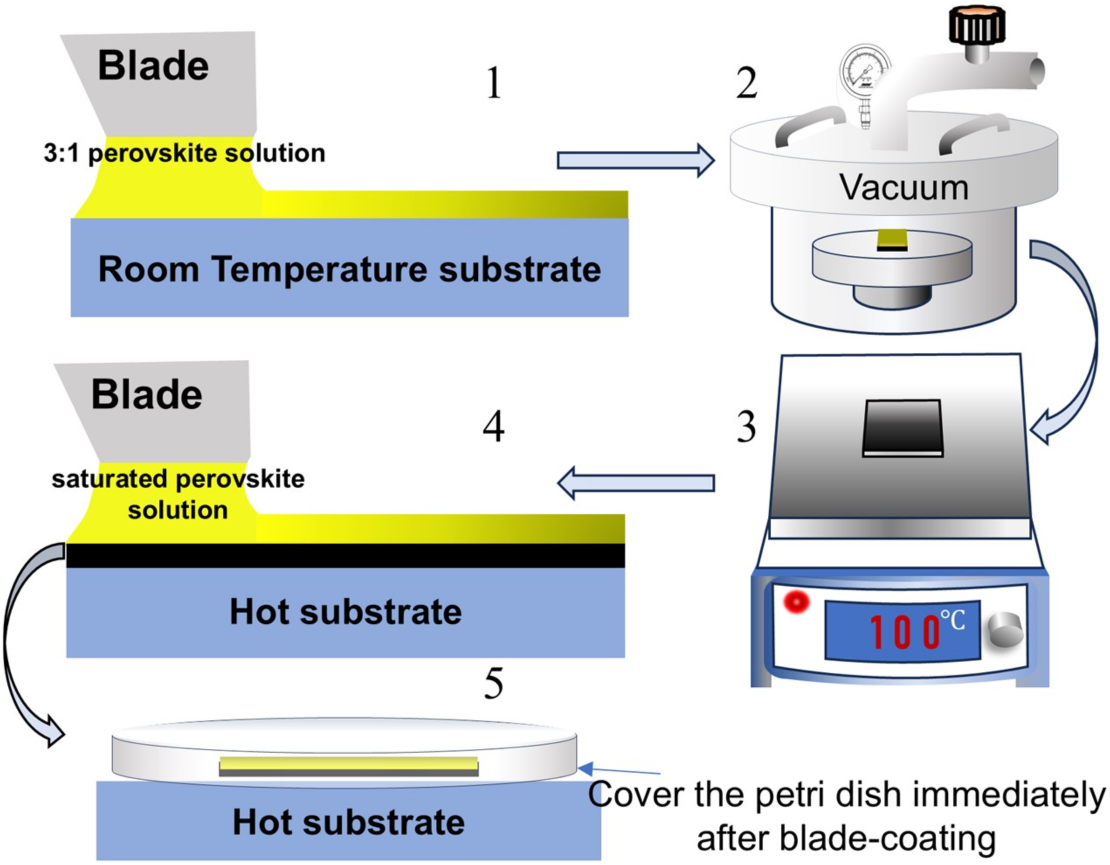

Fig. S2 Schematic diagram of the preparation process of $MAPbI_3$ thick film.

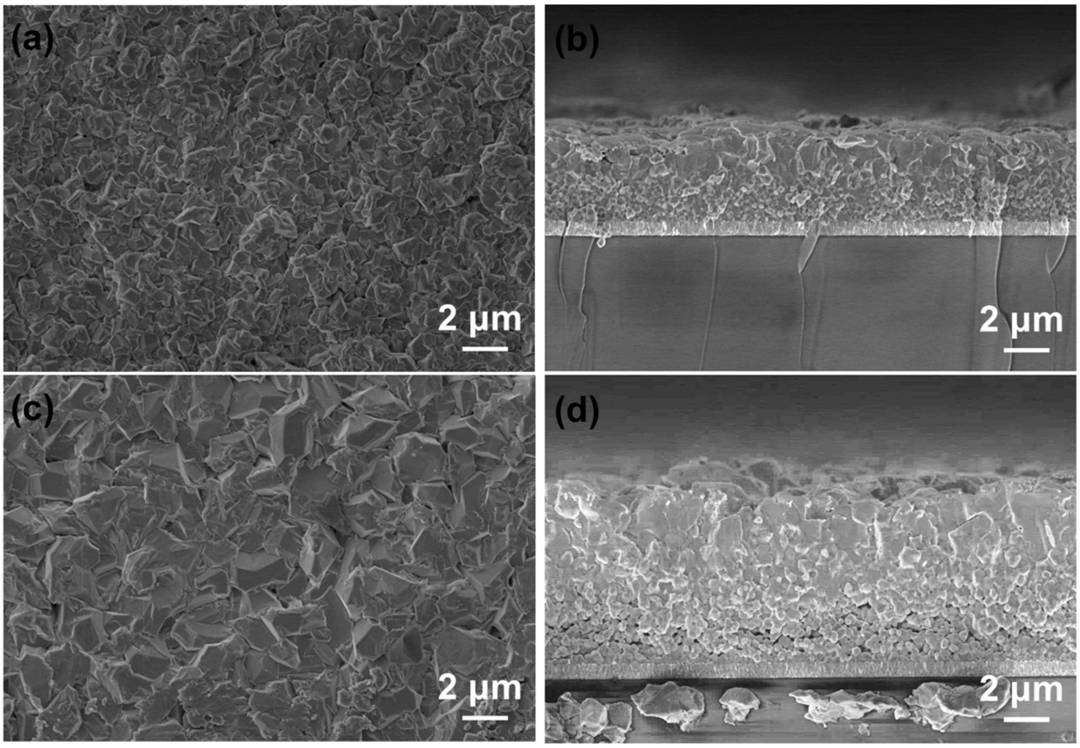

Fig. S3 The morphologies of perovskite films prepared by using a 2.0 M precursor solution with a substate temperature 40 °C and different blade-coating cycles. (a-b) Two blade-coating cycles. (c-d) Three blade-coating cycles.

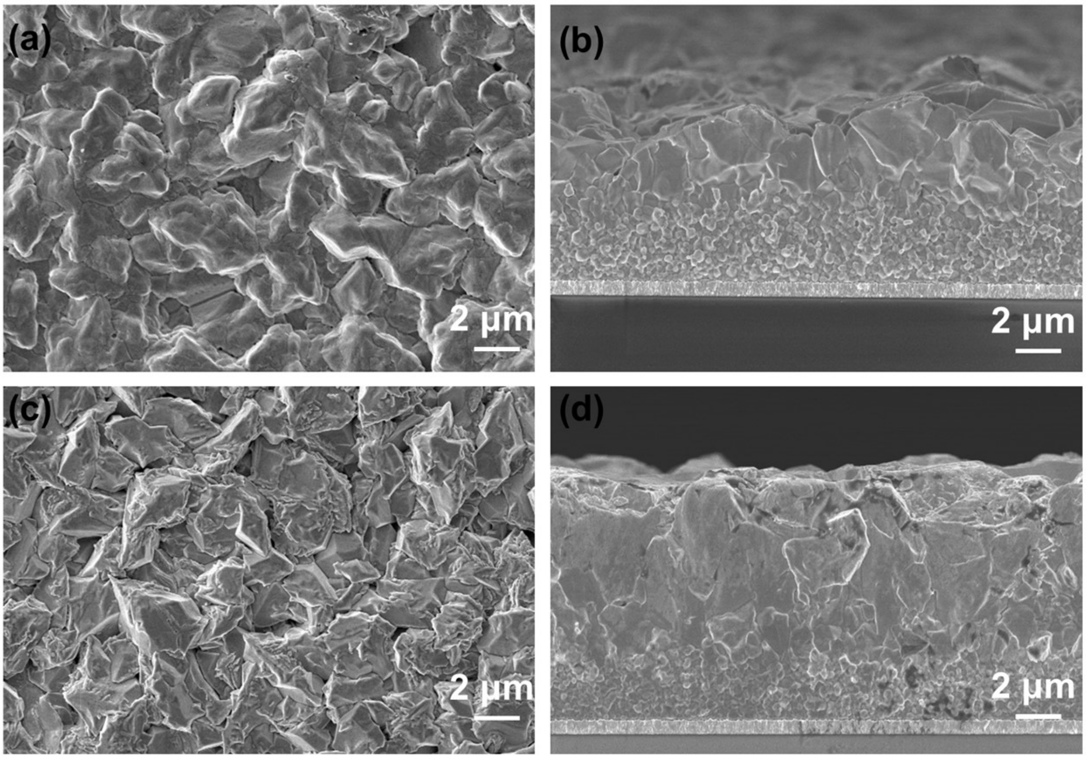

Fig. S4 The morphologies of perovskite films prepared by using a 2.5 M precursor solution with a substate temperature 40 °C and different blade-coating cycles. (a-b) Two blade-coating cycles. (c-d) Three blade-coating cycles.

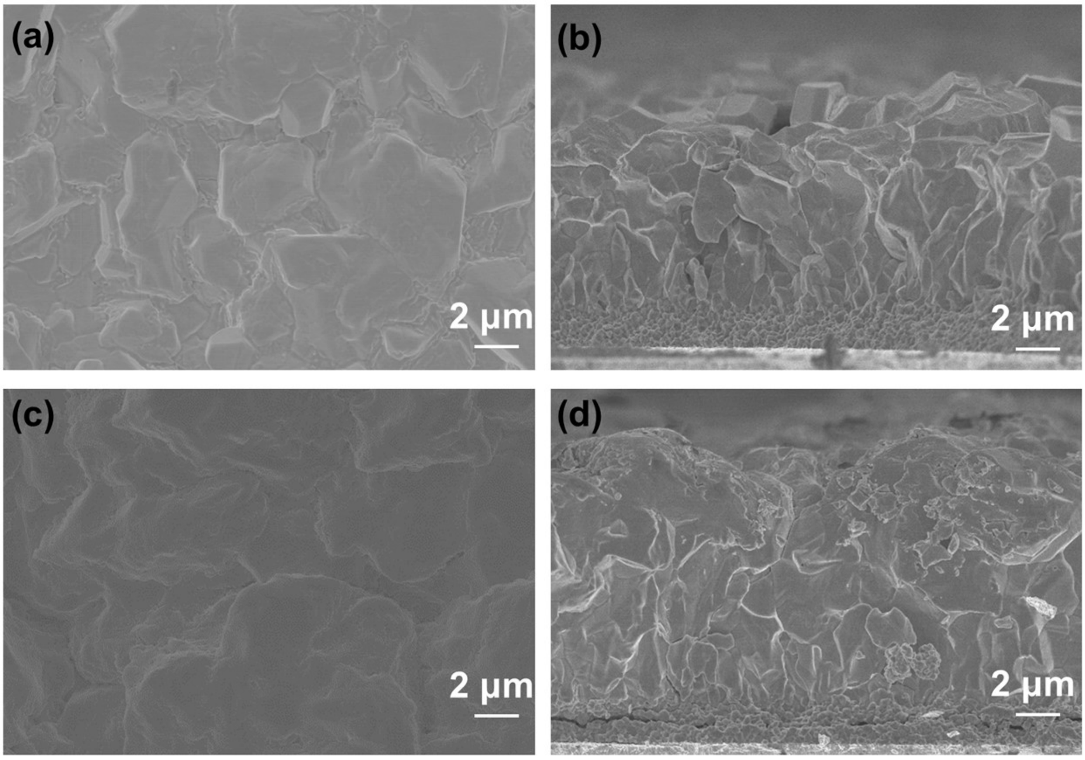

Fig. S5 The morphologies of perovskite films prepared by using a 3.0 M precursor solution with a substate temperature 40 °C and different blade-coating cycles. (a-b) Two blade-coating cycles. (c-d) Three blade-coating cycles.

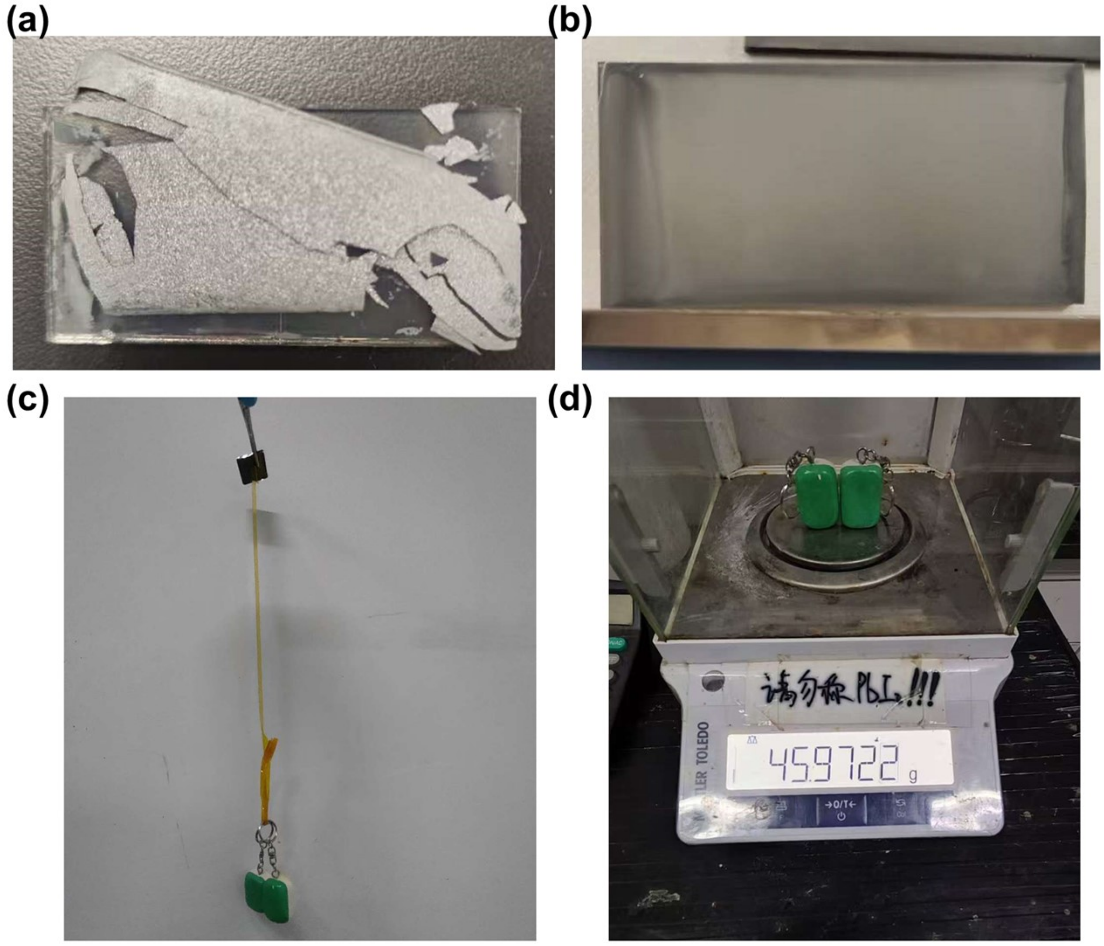

Fig. S6. (a) The optical picture of perovskite thick film annealed under 100 °C. (b) The optical picture perovskite thick film prepared at 40 °C. (c-d) The optical picture of thick perovskite film prepared at 40 ^{o}C hang with a ~46g weigh on its surface.

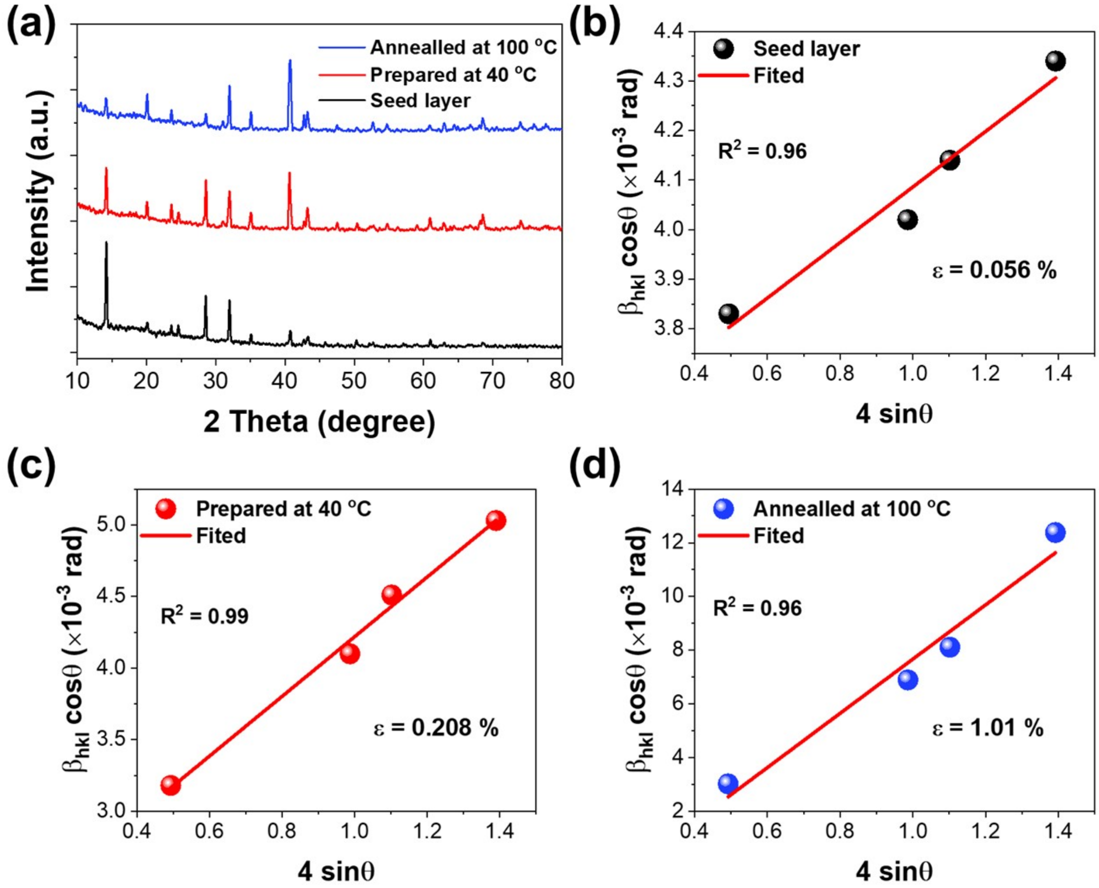

Fig. S7. Characterization of microstrain in $MAPbI_3$ perovskite films prepared under different conditions: (a) X-ray diffraction (XRD) patterns of $MAPbI_3$ perovskite films prepared under different conditions, including the seed layer, the thick film prepared at 40 °C and the thick film annealed at 100 °C. The microstrain analysis of perovskite films by using Williamson–Hall method for (b) the seed layer, (c) thick film prepared at 40 °C and (d) the thick film annealed at 100 °C.

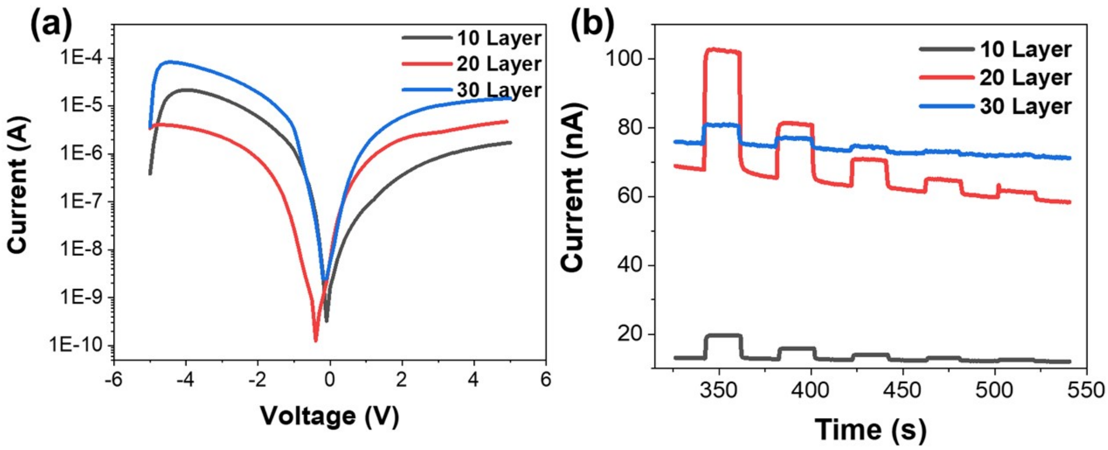

Fig. S8 (a) The dark I-V curve and (b) X-ray response of perovskite films prepared by different blade-coating cycles.

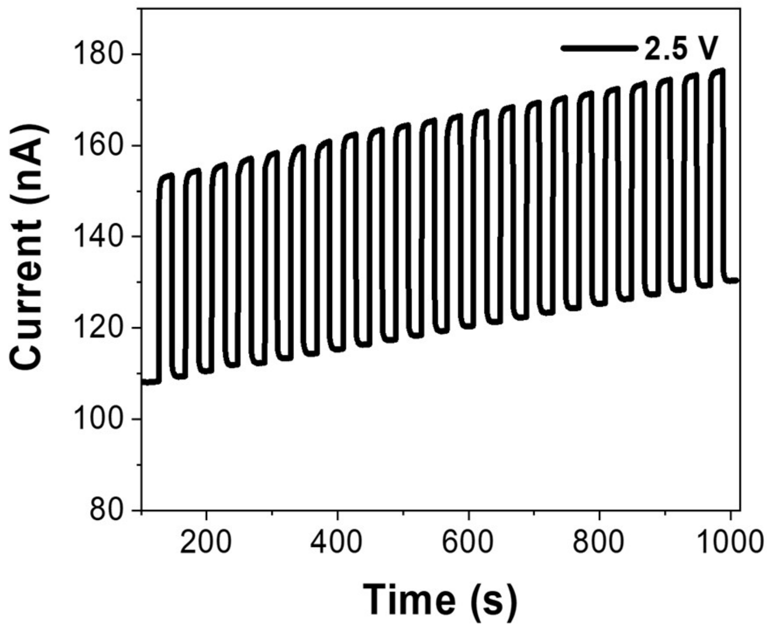

Fig. S9 Stability test of the X-ray detector under repeated on/off X-ray irradiation.

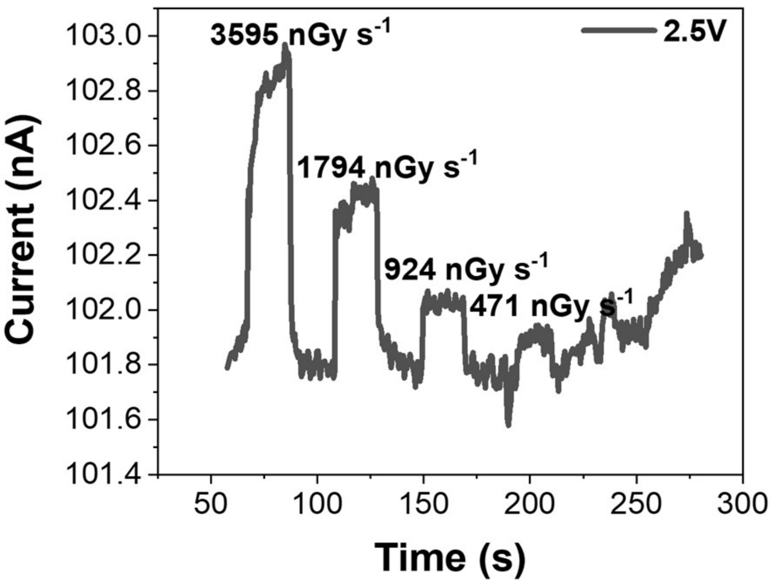

Fig. S10 Current response of the detector based on 20-cycle thick perovskite film to low dose rate X-ray.

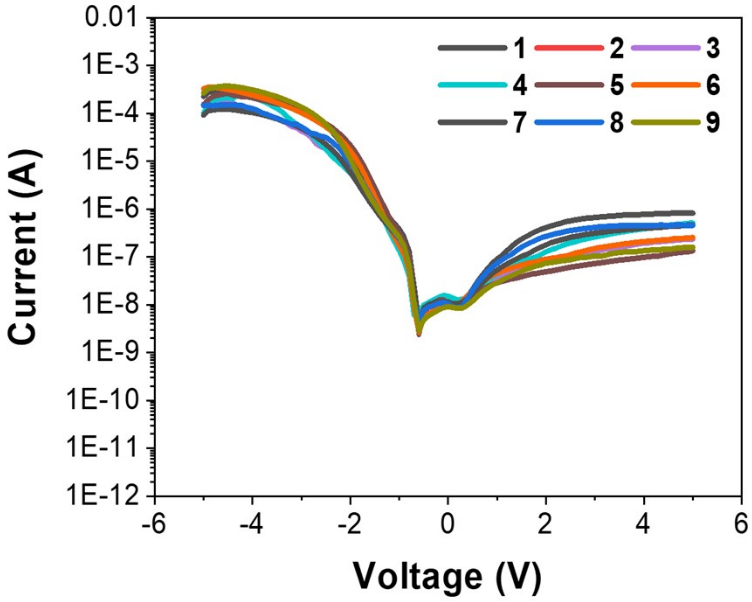

Fig. S11 Characterization the spatial uniformity of a 5 cm × 5 cm perovskite film-base X-ray detector by measure its dark *I-V* curves at different positions.

Table S1 Performance comparison of $MAPbI_3$ perovskite-based X-ray detector in the literature.

Perovskite morphology	Device structure	Film thickness (μm)	Sensitivity (μC Gy_{air}^{-1} cm^{-2})	Detection limit (nGy_{air} s^{-1})	References
Polycrystalline thick film	FTO/$MAPbI_3$/C	100	7304	154	[1]
Polycrystalline thin film	ITO/SnO_2/$MAPbI_3$/Ag	19	2600	11	[2]
Microcrystalline thick film	ITO/PEDOT:PSS/$MAPbI_3$/C_{60}/BCP/Cu	400	35500（0V）	4.35	[3]
Polycrystalline thick film	ITO/$MAPbI_3$/C	110	2751.25	15.1	[4]
Polycrystalline thick film	FTO/$MAPbI_3$/Au		35900		[5]
Polycrystalline thick film	$MAPbI_3$/ACA/α-Si TFT	721.3	19800		[6]
Polycrystalline thick film	ITO/$MAPbI_3$/Au	300	20600	107	[7]

References

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