

Electronic Supplementary Information

Centimeter-scaled lead-free two-dimensional $\text{FA}_3\text{Bi}_2\text{Br}_9$ perovskite single crystal for X-ray detection

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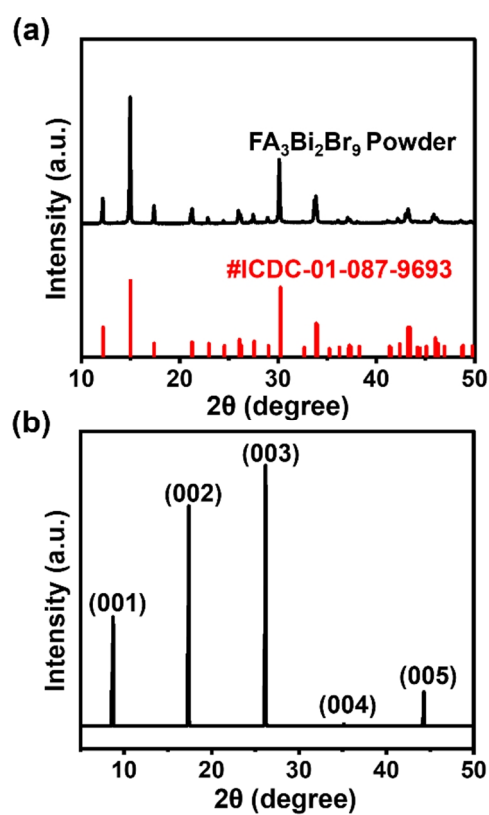


Fig. S1 XRD pattern of (a) $\text{FA}_3\text{Bi}_2\text{Br}_9$ powder. (b) $\text{FA}_3\text{Bi}_2\text{Br}_9$ single crystal.

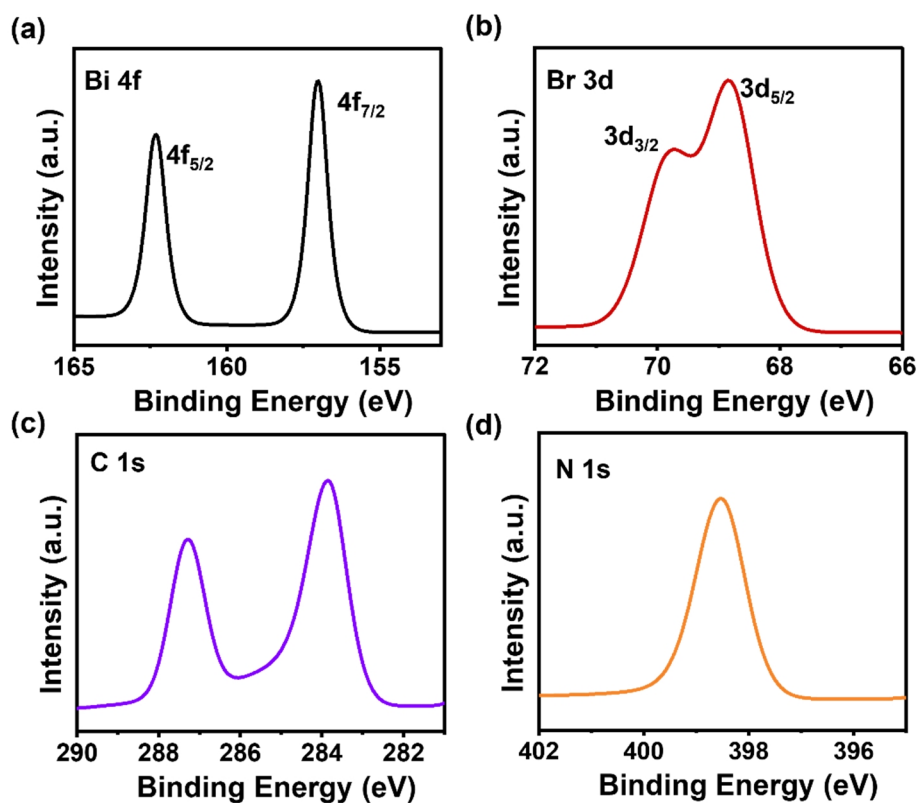


Fig. S2 XPS high resolution fine spectrum of (a) Bi 4f and (b) Br 3d, (c) C 1s and (d) N 1s.

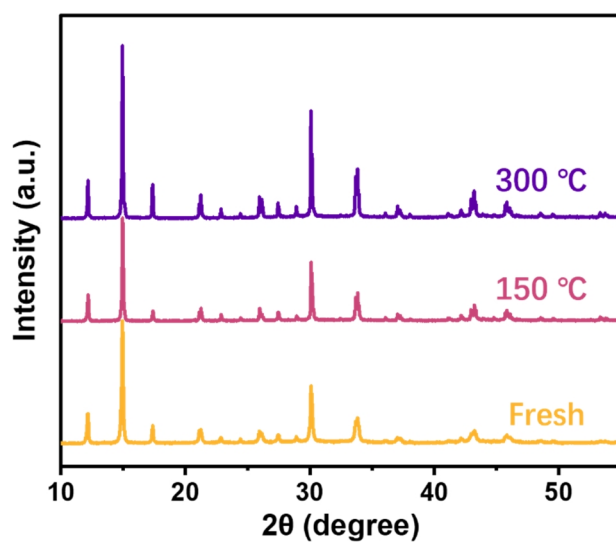


Fig. S3 XRD patterns of fresh $\text{FA}_3\text{Bi}_2\text{Br}_9$ powders and after heating at 150 °C and 300 °C for 2 h.

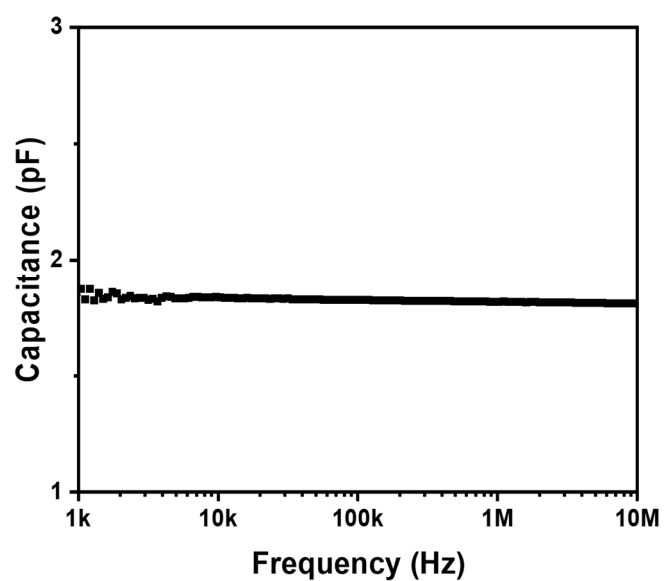


Fig. S4 Frequency-capacitance curve of $\text{FA}_3\text{Bi}_2\text{Br}_9$ SC.

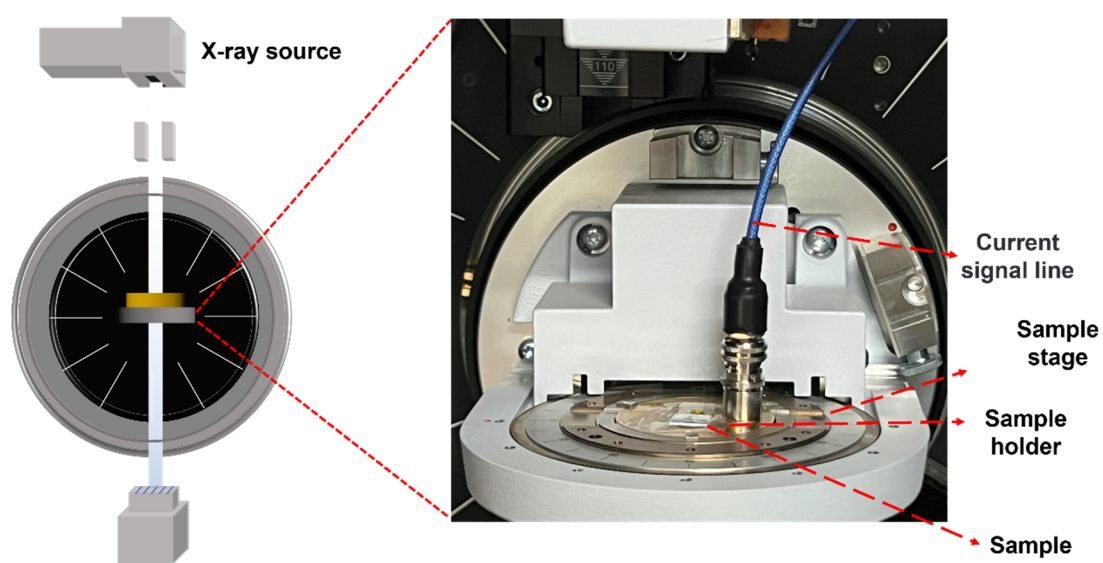


Fig. S5 Home-made setup for X-ray detector measurement. The X-ray source was provided by a commercial Bruker D8 Advance XRD system equipped with a Cu tube.

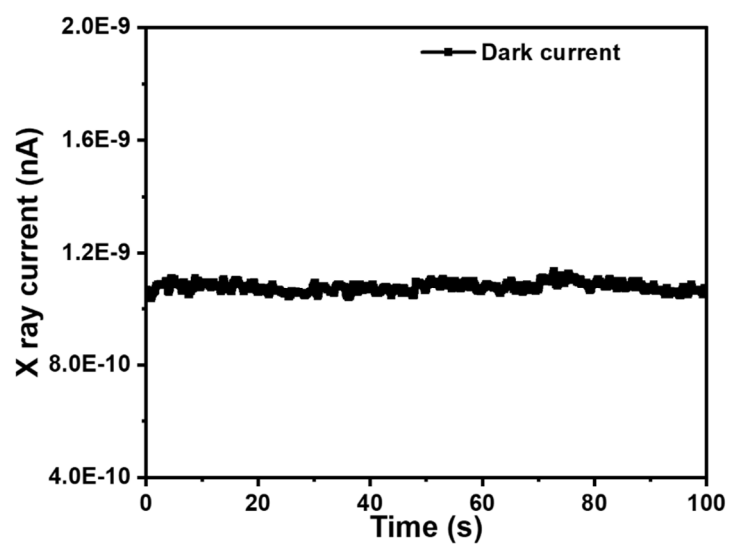


Fig. S6 Dark current of the FA₃Bi₂Br₉ SC detector under a bias voltage of 5V.

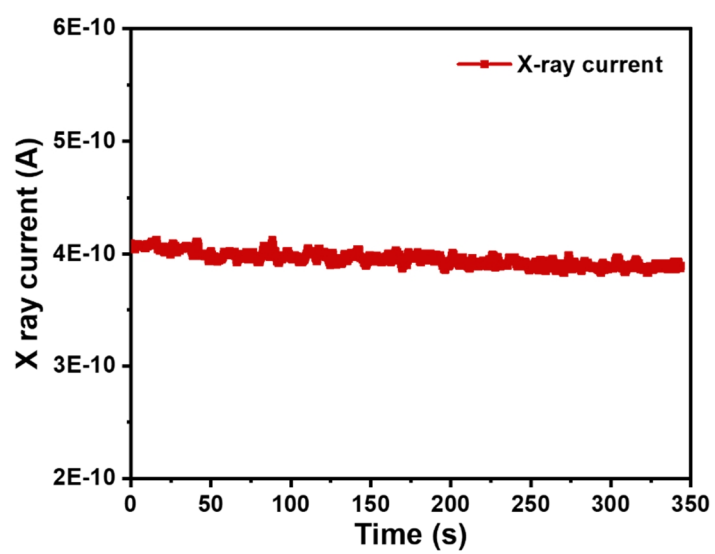


Fig. S7 X-ray current of FA₃Bi₂Br₉ single crystal device under continuous X-ray irradiation on the basis of 5 V and a dose rate of 241 $\mu\text{Gy s}^{-1}$.

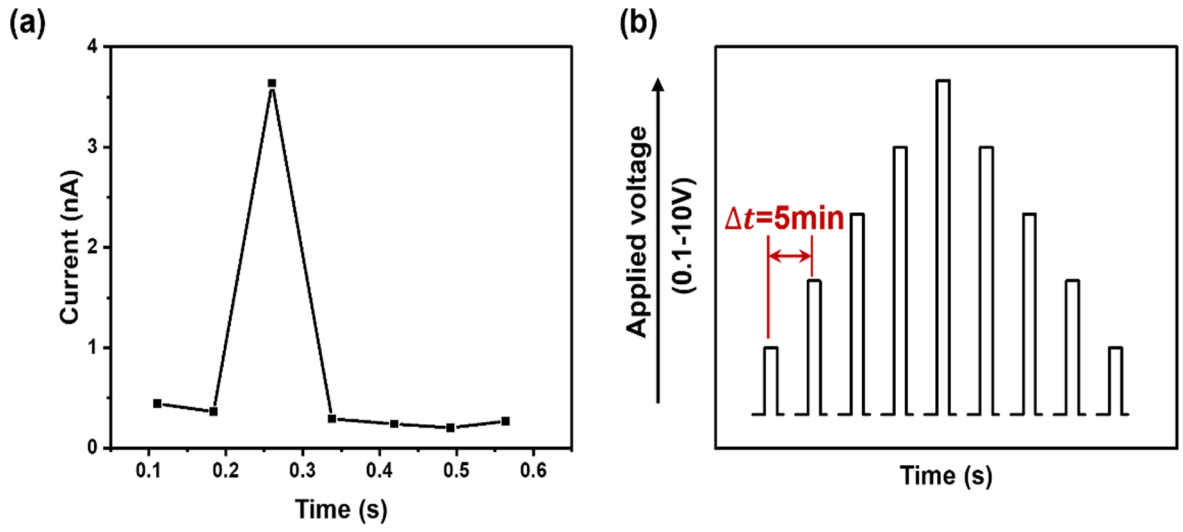


Fig. S8 (a) The processing time for single pulsed voltage in the Pulsed-SCLC measurement. (b) In the diagram of pulsed voltage applied, the time interval between different pulse voltage values is 5 min.

Table S1. Key parameters comparison of different perovskites-based X-ray detectors.

2D hybrid halide perovskite single crystal	Electrical field (V/cm)	$\mu\tau$ ($\text{cm}^2 \text{V}^{-1}$)	Sensitivity ($\mu\text{C Gy}^{-1}\text{cm}^{-2}$)	Lowest detection limit (nGy s^{-1})	Reference
BA ₂ EA ₂ Pb ₃ Br ₁₀	50	1.0×10^{-2}	6800	5500	1
(F-PEA) ₂ PbI ₄	1333	5.1×10^{-4}	3402	23	2
(BA) ₂ CsAgBiBr ₇	50	1.21×10^{-3}	4.2	-	3
(CPA ₄)AgBiBr ₈	50	1.0×10^{-3}	0.8	-	4
Cu-(PMA) ₂ PbI ₄	12500	8.05×10^{-3}	283	2130	5
(BDA)PbI ₄	3100	4.43×10^{-4}	242	430	6
(DFPIP) ₄ AgBiI ₈	~1000	1.10×10^{-5}	188	3130	7
(PA) ₄ AgBiBr ₈	1250	-	6.89	2070000	8
FA₃Bi₂Br₉	1000	4.53×10^{-4}	410	2100	This work
	2000		623		

*BA = n-butylammonium

EA = ethylammonium

CPA = chloropropylammonium

BDA = 1,4-butanediammonium

DFPIP = 4,4-difluoropiperidinium

F-PEA = fluorophenethylammonium

Reference

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