Electronic Supplementary Material (ESI) for Journal of Materials Chemistry C.

Supplemental Information

Inch-size $Cs_3Bi_2I_9$ polycrystalline wafer with near-intrinsic properties for ultralow-detection-limit X-ray detection

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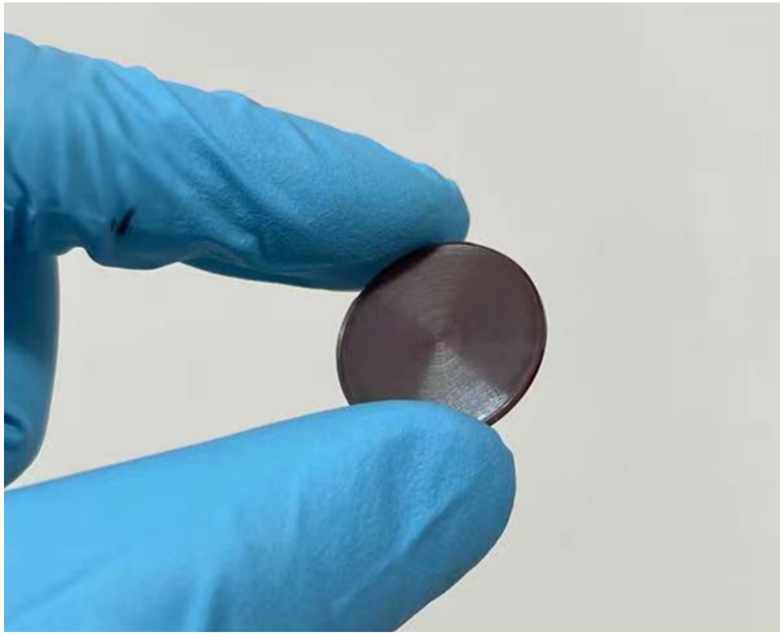

Figure S1. Photograph of the $Cs_3Bi_2I_9$ wafer.

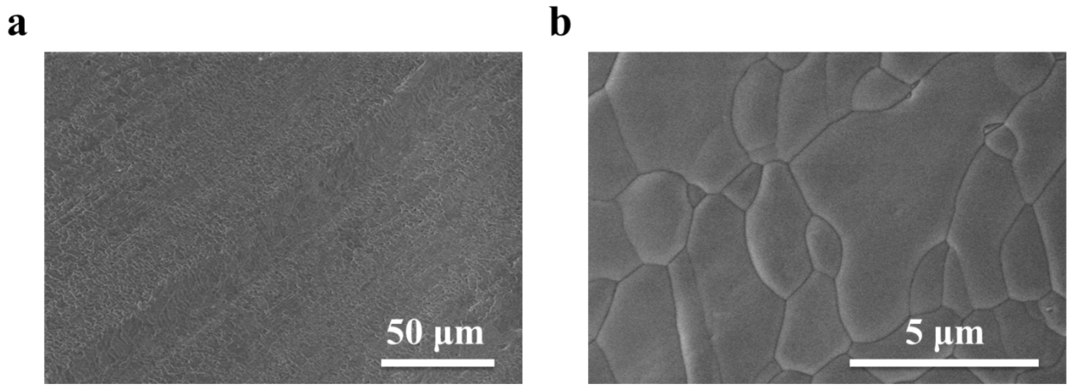

Figure S2. (a) and magnified (b) plan-view SEM image of the $Cs_3Bi_2I_9$ wafer.

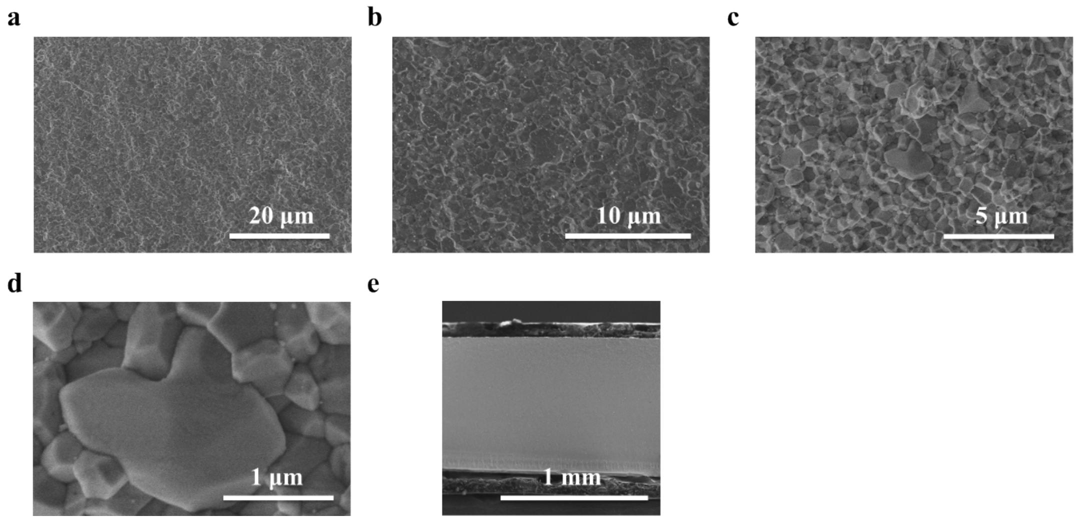

Figure S3. (a-e) Cross-sectional SEM images of the $Cs_3Bi_2I_9$ wafer with different magnification.

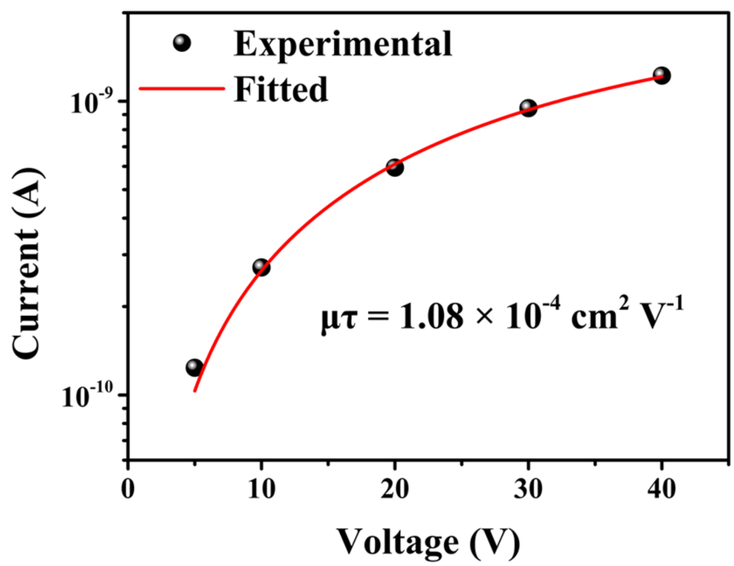

Figure S4. The fitted response current under X-ray illumination to determine the $\mu\tau$ product.

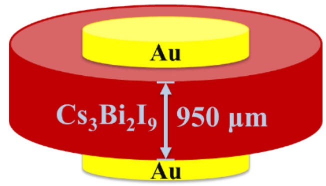

Figure S5. Schematic of the $Cs_3Bi_2I_9$ polycrystalline-based X-ray detector structure.

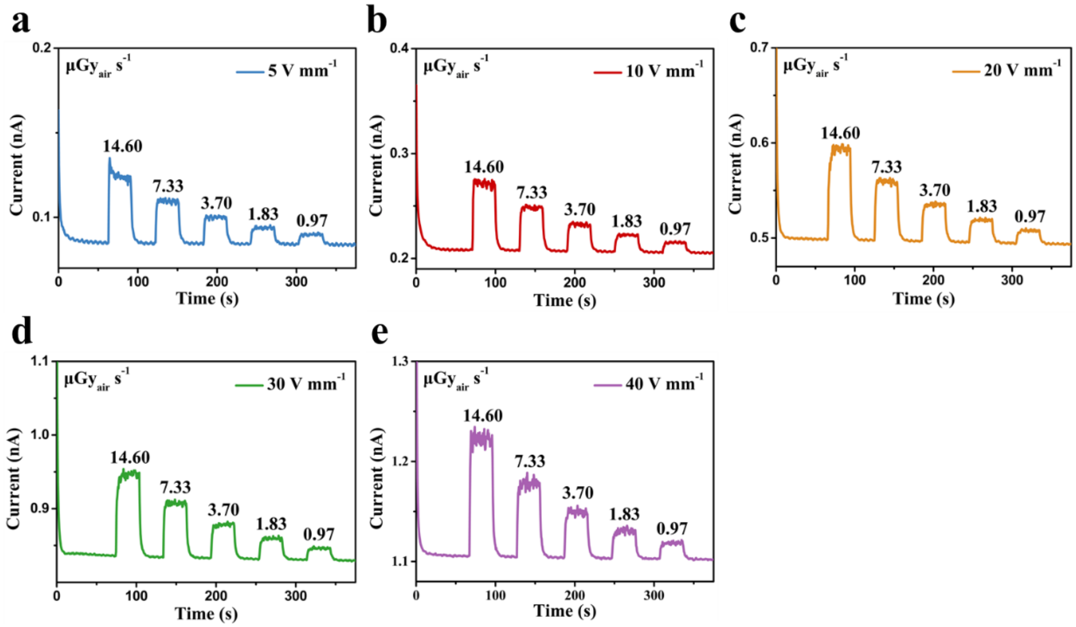

Figure S6. (a-e) ON/OFF photocurrent response of $Cs_3Bi_2I_9$ polycrystalline-based X-ray detector at different dose rates (0.97, 1.83, 3.70, 7.33 and 14.60 μGy$_{air}$ s^{-1}) and different electric field (5, 10, 20, 30, 40 V mm^{-1}).

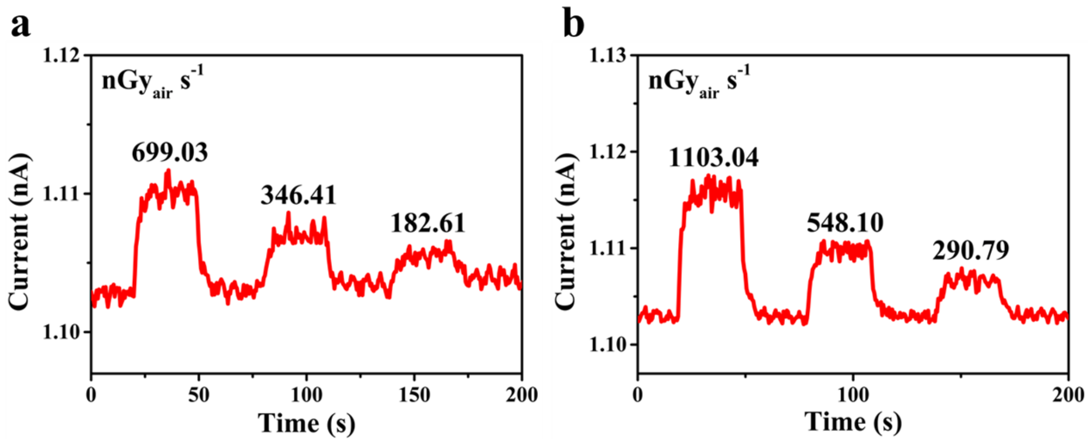

Figure S7. (a, b) I-T photocurrent response of the $Cs_3Bi_2I_9$ X-ray detector under 40 V mm^{-1} electric field and various dose rates.

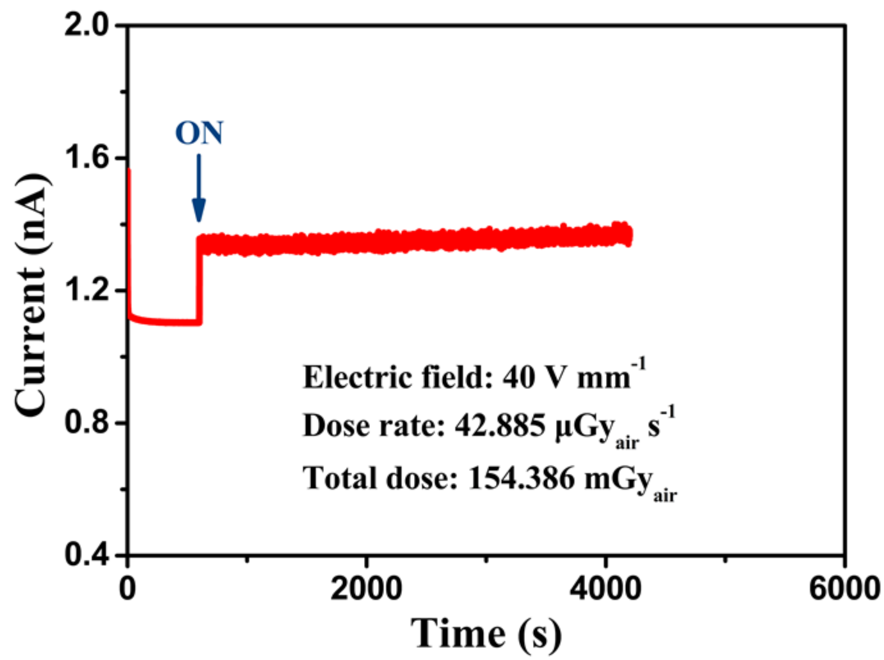

Figure S8. $Cs_3Bi_2I_9$ X-ray detector operational stability against continuous X-ray irradiation under a dose rate of 42.885 $\mu Gy_{air}\ s^{-1}$ with 40 V mm^{-1} electric field.

Table S1. The X-ray detection performance of the lead-free perovskite detectors.

Materials	Source	Electric Field	Sensitivity (μC Gy_{air}^{-1} cm^{-2})	Detection limit (nGy_{air} s^{-1})	Ref
$Cs_2AgBiBr_6$ Single Crystal	50 kV	/	105 (25 V mm^{-1})	59.7 (2.5 V mm^{-1})	1
$(BA)_2CsAgBiBr_7$ Single Crystal	70 keV	5 V mm^{-1}	4.2	/	2
$Cs_3Bi_2I_9$ Single Crystal	40 kV	50 V mm^{-1}	1652.3	130	3
$Cs_3Bi_2I_9$ Single Crystal	/	/	964 (120 V mm^{-1})	44.6 (60 V mm^{-1})	4
$Cs_3Bi_2I_9$ Single Crystal	80 kV	450 V cm^{-1}	111.9	/	5
$Cs_3Bi_2Br_9$ Single Crystal	50 kV	/	230.4 (200 V)	/	6
$Rb_3Bi_2I_9$ Single Crystal	50 kV	300 V mm^{-1}	159.7	8.32	7
$MA_3Bi_2I_9$ Single Crystal	40 kV	60 V mm^{-1}	1947	83	8
$FA_3Bi_2I_9$ Single Crystal	45 kV	/	598.1 (500 V)	200 (180 V)	9
$(NH_4)_3Bi_2I_9$ Single Crystal	50 keV	/	8.2×10^3	55	10
$(H_2MDAP)BiI_5$ Single Crystal	70 keV	5 V mm^{-1}	~1	/	11
$(DMEDA)BiI_5$ Single Crystal	50 kV	494 V mm^{-1}	72.5	/	12
$Cs_2AgBiBr_6$ Wafer	50 keV	0.5 V mm^{-1}	250	93.6	13
$Cs_3Bi_2Br_3I_6$	/	/	~2 (200 V)	10700 (50 V)	14
$MA_3Bi_2I_9$ Wafer	45 kV	2100 V cm^{-1}	563	9.3	15
$(F\text{-}PEA)_3BiI_6$ Wafer	120 kV	100 V mm^{-1}	118.6	30	16
Ba_2AgIO_6 Wafer	50 keV	5 V mm^{-1}	18.9	/	17
$Cs_3Bi_2I_9$ Wafer	40 kV	40 V mm^{-1}	230.46	61.25	This work

Remarks: kV: tube voltage; keV: energy of electron after acceleration voltage.

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