Solvent engineering of $MAPbI_3$ perovskite thick film for direct X-ray detector

Wei Qian[a,b]; Weitao Qiu[a]; Shanshan Yu[a,c]; Duan Huang[a]; Renbo Lei[b]; Xianzhen Huang[a]; Shuang Xiao[a]; Xinwei Wang*[b]; Shihe Yang*[a,c]

[a] *Guangdong Provincial Key Lab of Nano-Micro Materials Research, School of Chemical Biology and Biotechnology, Shenzhen Graduate School, Peking University, Shenzhen, Guangdong 518055, China.*

[b] *School of Advanced Materials, Shenzhen Graduate School, Peking University, Shenzhen 518055, China;*

[c] *Institute of Biomedical Engineering, Shenzhen Bay Laboratory, Shenzhen, Guangdong 518107, China*

Email: wangxw@pkusz.edu.cn

Email: chsyang@pku.edu.cn

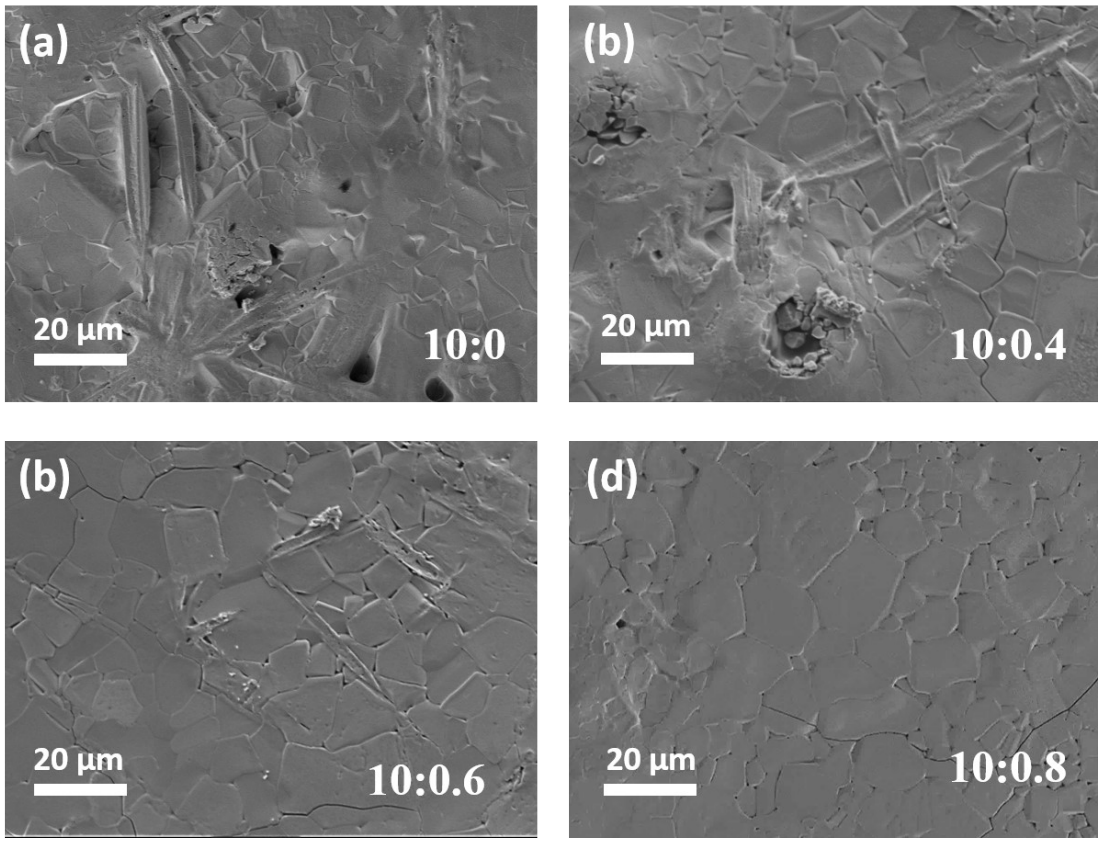

Figure. S1 Top-view SEM images of perovskite films prepared from precursor solution with different mixing radio of DMSO and ethylene glycol.

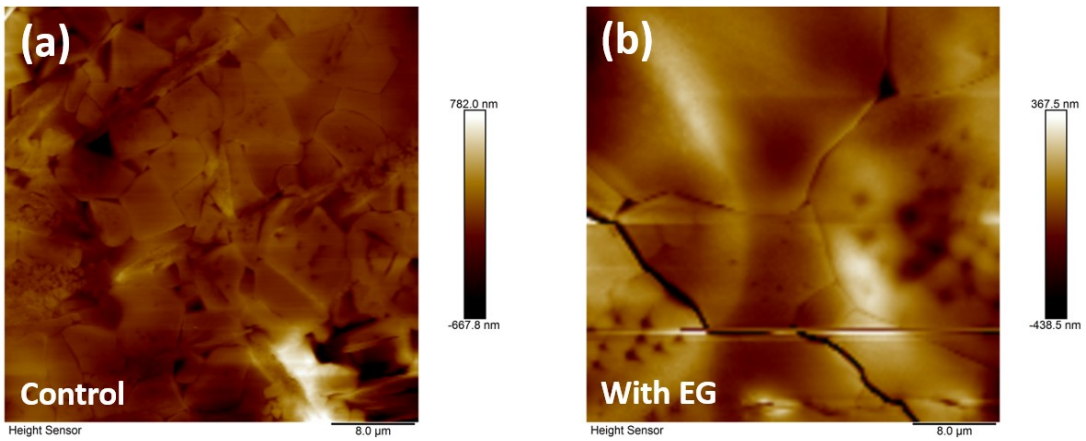

Figure.S2 The AFM images of the control (a) and experimental sample (b).

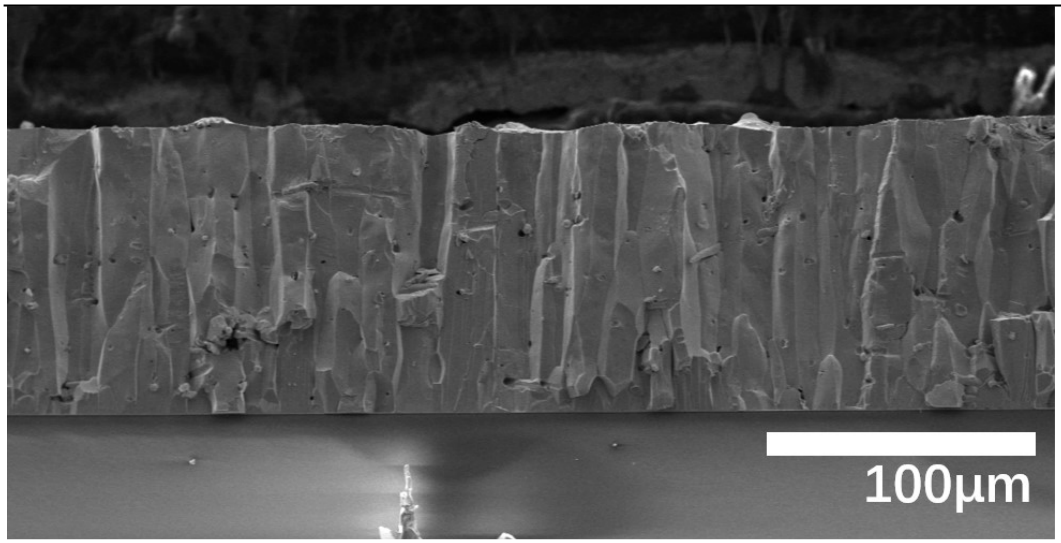

Figure.S3 The cross section SEM images of the 100μm perovskite films (experimental sample).

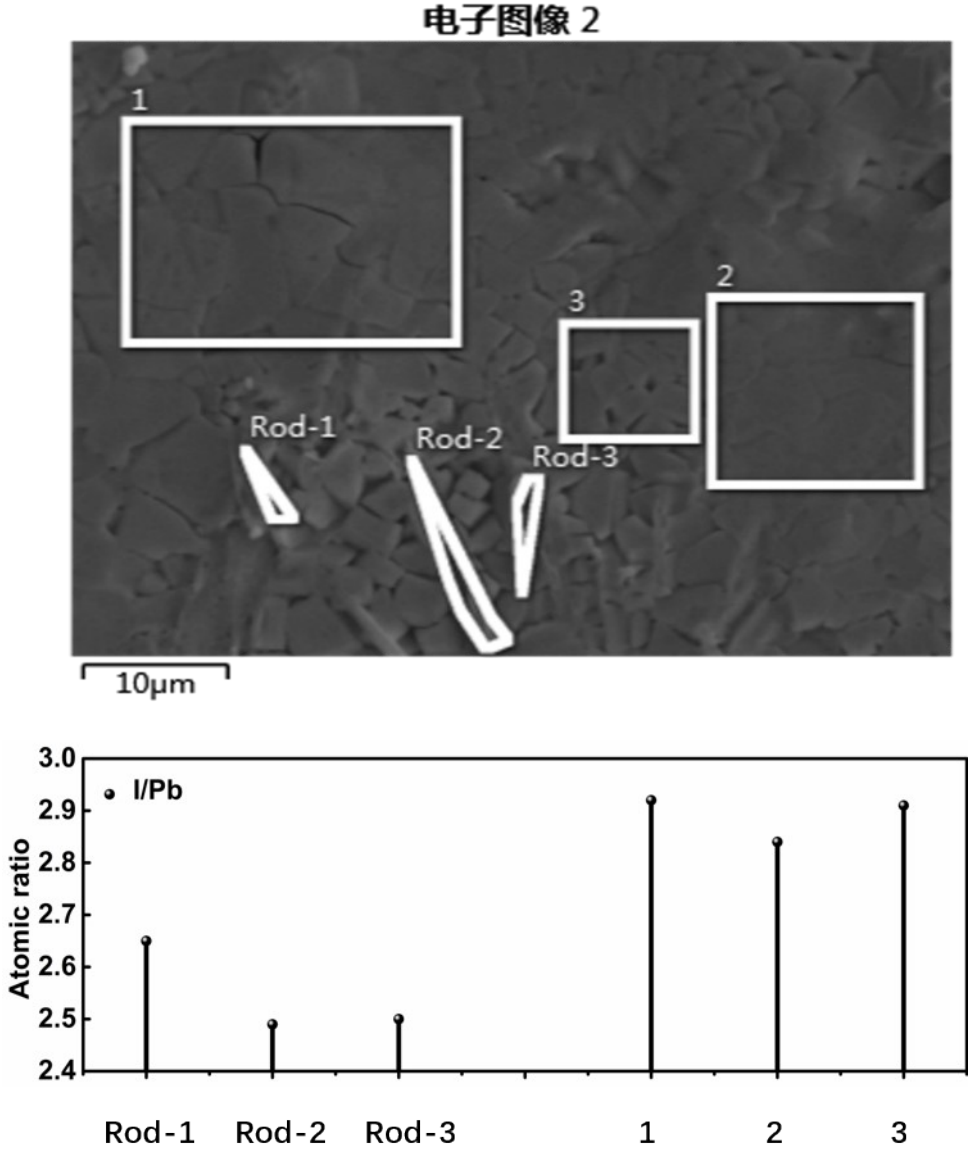

Figure. S4. EDS Analysis for different areas on the surface of perovskite films in the Control Group.

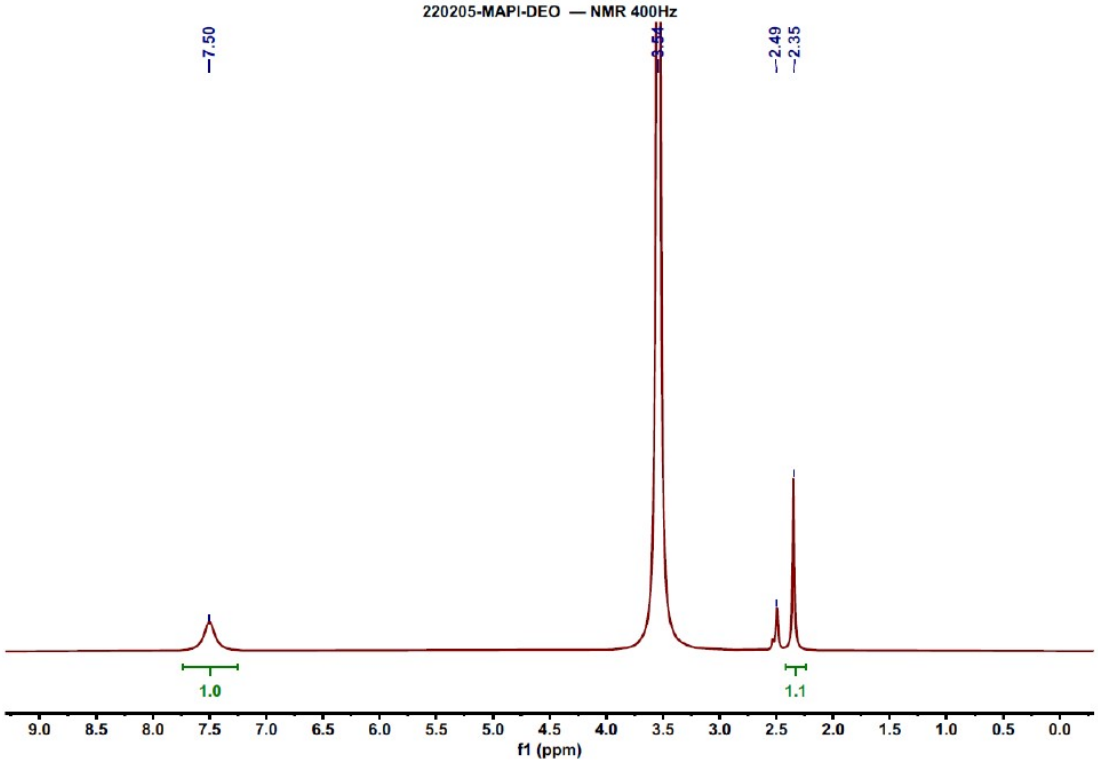

Figure.S5 The perovskite film of experimental group was dissolved in DMSO solvent for NMR analysis

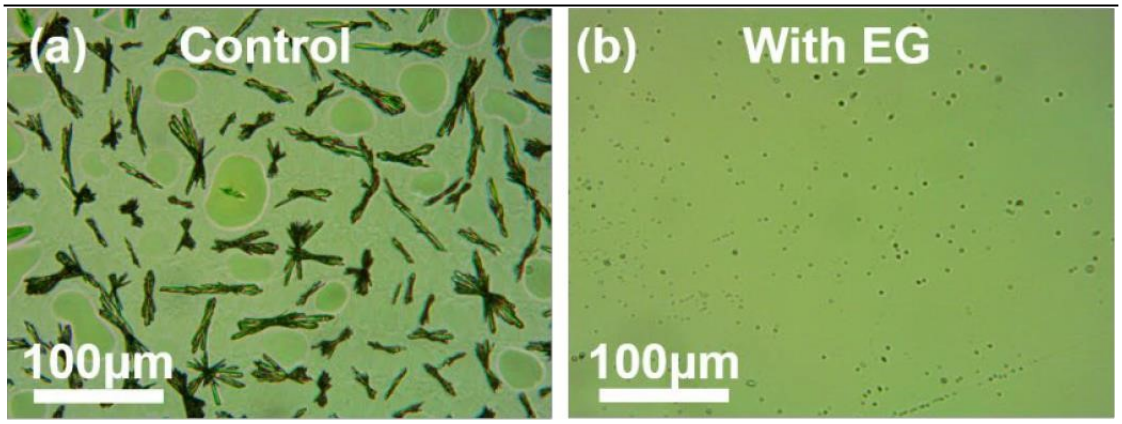

Figure.S6 In-situ optical microscopy images of the control and experimental wet films prepared by spin-coating method.

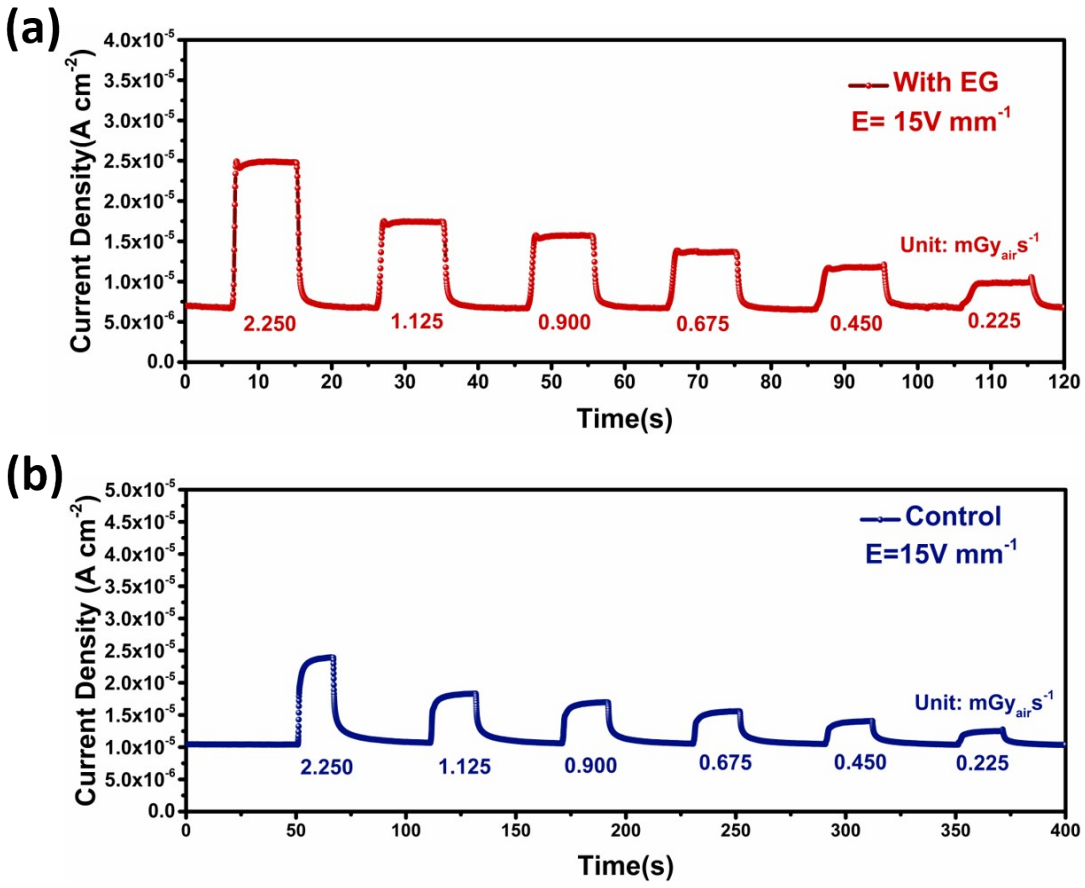

Figure. S7 (e) The X-ray response profiles of the control and experimental detectors with a varying dose rate ranging from 2.25 $mGy_{air}s^{-1}$ to 0.225 $mGy_{air}s^{-1}$.

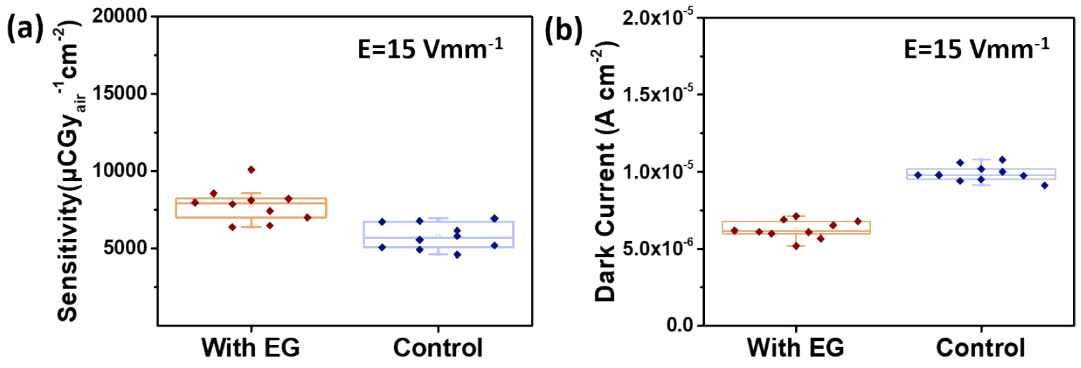

Figure. S8 (a) Box map of the sensitivity of 10 samples in experimental group and control group. (b) Box map of the dark current of 10 samples in experimental group and control group.

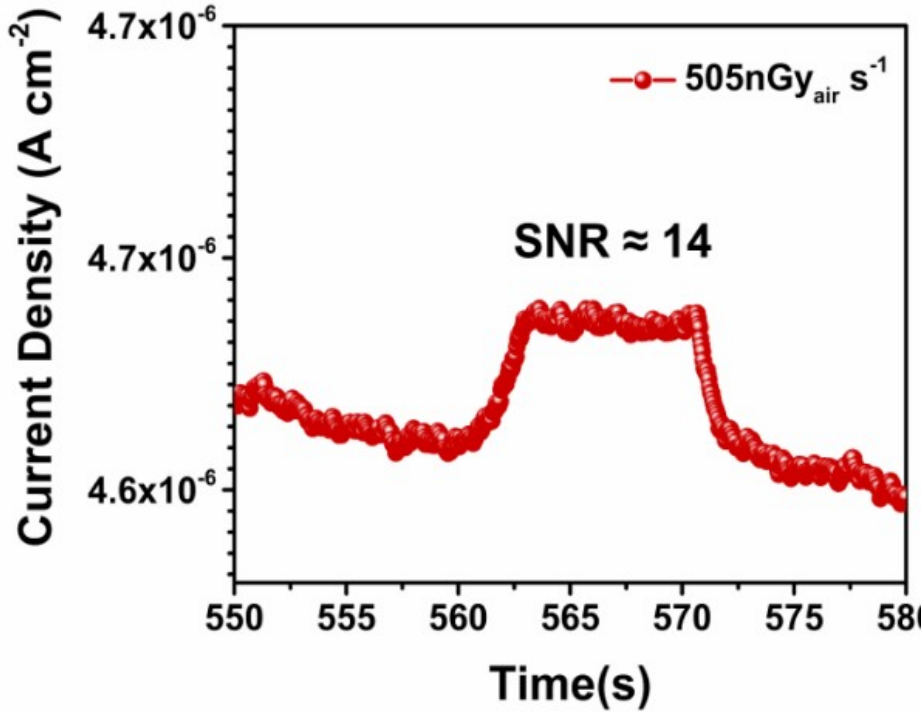

Figure.S9 The X-ray response of the double-layer perovskite detector at an ultralow dose of 550 $nGy_{air}s^{-1}$.

Table S1 Key parameters of the X-ray detectors made of perovskite materials

Device Structure	E_{ph} (keV)	E (V mm^{-1})	S (μCGy$_{air}^{-1}$cm^{-2})	LoD (nGy$_{air}$s^{-1})	Ref.
Au//$CsPbBr_3$/Au	50	20	918		[60]
Au//$RbCsPbBr_3$/Au	50	20	8097		[60]
Au/$(BA)_2EA_2Pb_3Br_{10}$/Au	70	5	6.8×10^3	5500	[61]
Au/$Cs_2AgBiBr_6$/Au	50	50	1974	45.7	[62]
Au/PEA-$Cs_2AgBiBr_6$/Au	50	23	288.8		[62]
Au/$(BA)_2CsA_gBiBr_7$/Au	70	5	4.2		[63]
Ag/$(H_2MDAP)BiI_5$/Ag	70	5	1		[64]
PEN/NiO_x/ $Cs_{0.1}FA_{0.75}MA_{0.15}PbBr_{0.5}I_{2.5}$/PCBM/ BCP/Au	70	27	33.5	12000	[38]
ITO/Pt/Polymer/$CsPbBr_3$/ W	70	45.5	1.2×10^4		[65]
ITO/TiO_2/Cs_2TeI_6 /PTAA/Au	60	50	0.24		[66]
FTO/$MAPbI_3$/C	60	15	7304	154	This work