Supporting Information

Defect Passivation of SnO_2 Doped with 2-FN for High-Performance Perovskite Detectors

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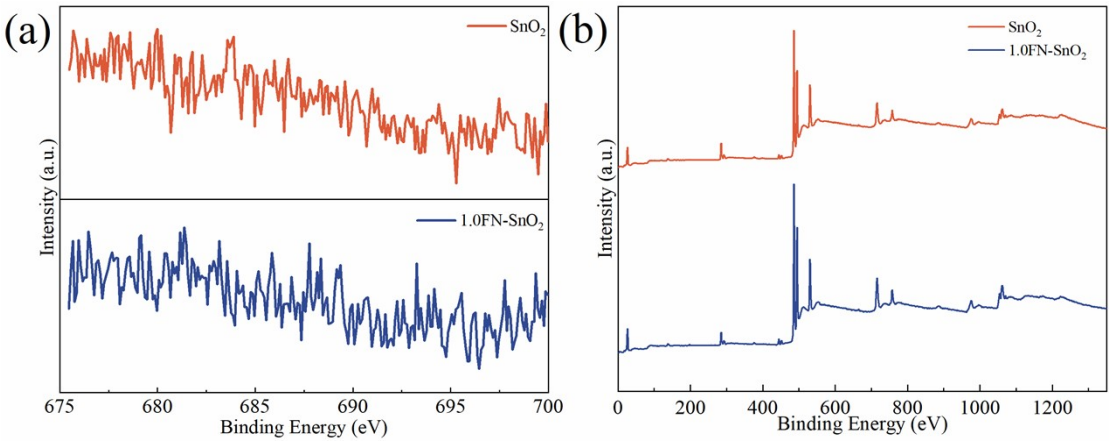

Fig. S1 (a). F 1s orbital XPS spectra. (b). Full XPS spectrum of SnO_2 and 1.0 FN-SnO_2.

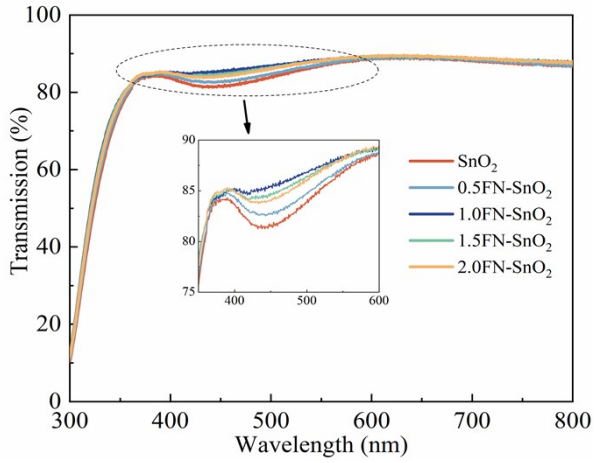

Fig. S2 Transmission spectra of SnO_2 and FN-SnO_2.

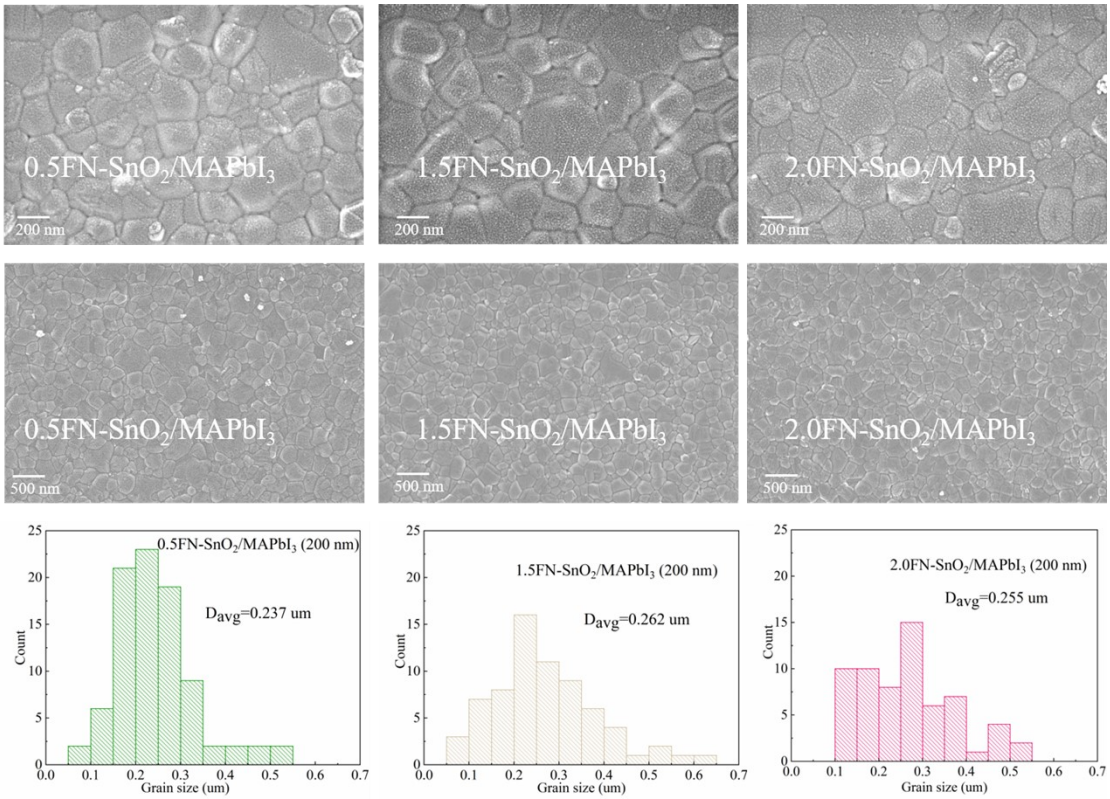

Fig. S3 SEM image of FN-SnO_2/$MAPbI_3$ and perovskite grain size statistics.

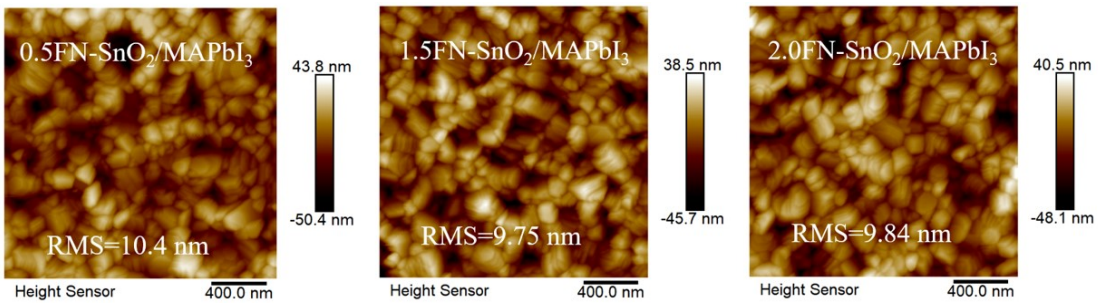

Fig. S4 AFM images of FN-SnO_2/$MAPbI_3$.

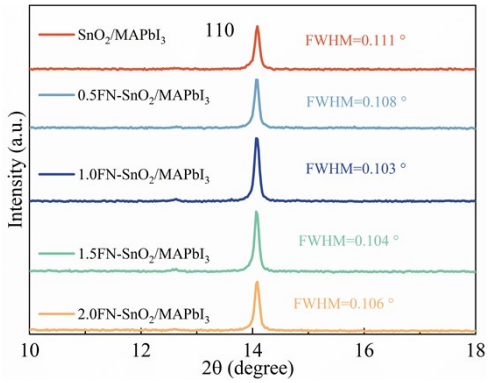

Fig. S5 The full width at half maximum of the (110) peak in the XRD spectrum of perovskite films deposited on SnO_2 films with different concentrations of 2-FN.

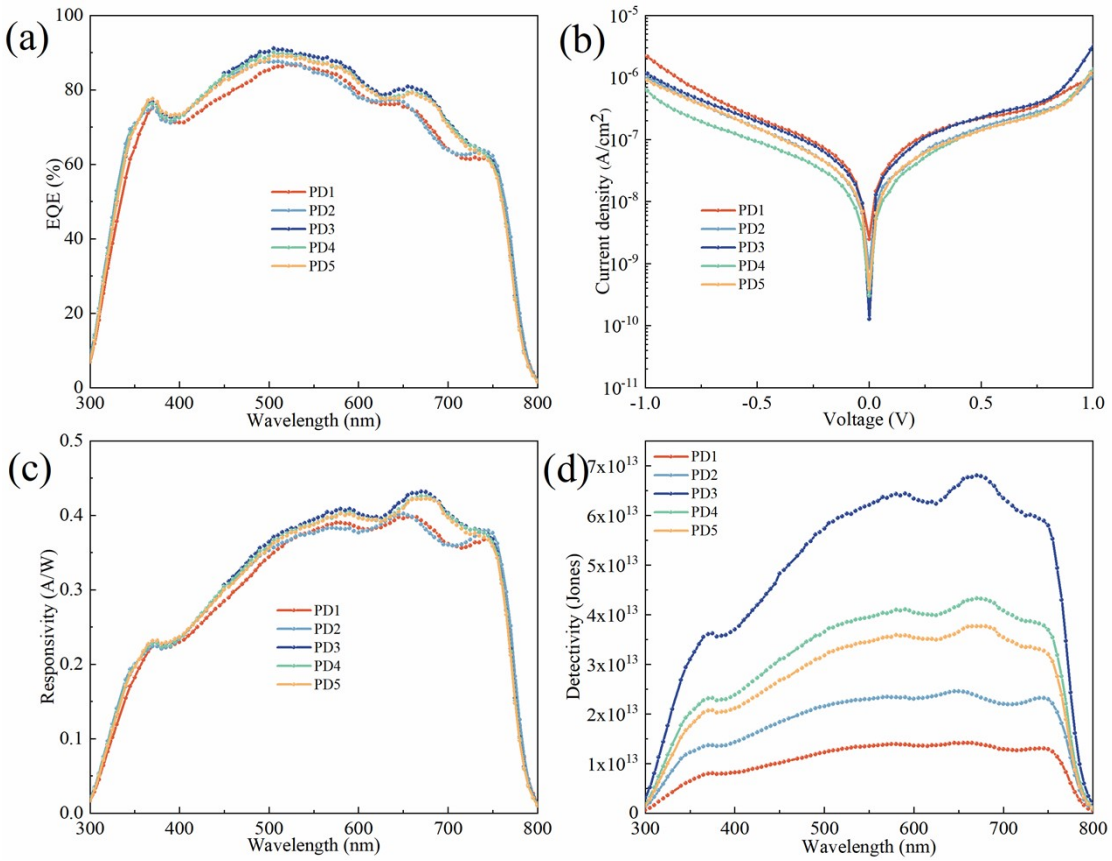

Fig. S6 (a) EQE response curves for PDs. (b) Dark current density profile of PDs. (c) Responsiveness curves for PDs. (d) Detection rate curves for PDs.

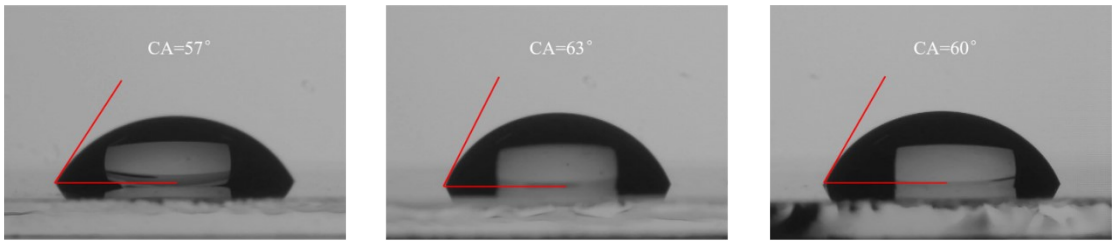

Fig. S7 Water contact angles of perovskite films deposited on different SnO_2 films.

Table. S1 Comparison of parameters with previously reported perovskite detectors.

Device structure	R (A/W)	D* (Jones)	Bias (V)	Detection wavelength (nm)	Testing Equipment/Calibration Standards	Refs
ITO/SnO_2(PEAl)/$MAPbI_3$/ PTAA/Au	0.40	2.5×10^{12}	-0.5	300-850	Zolix SCS600 spectral response test system	[1]
FTO/TiO_2(ALD)/$MAPbI_3$/ Spiro-OMeTAD/Au	0.238	1.1×10^{13}	0	300-800	Si detector S10–14010, Enlitech	[2]
ITO/VOx(Li)/$MAPbI_3$/$PC_{61}BM$/BCP/Ag	0.47	7.4×10^{11}	-0.1	300-800	Enlitech, QE-R 3018	[3]
ITO/PEDOT:PSS/$MAPbI_3$(ODT)/$PC_{70}BM$/Al	0.366	1.4×10^{12}	-0.1	350-850	Silicon Reference Cell Calibration	[4]
ITO/SnO_2/$MAPbI_3$/ Spiro-OMeTAD(RbI)/MoO_3/Cu	0.43	3.7×10^{13}	0	300-800	Standard Monocrystalline Silicon Calibration	[5]
FTO/SnO_2/$CsPbI_2Br$(Lanthanide ions)/ Spiro-OMeTAD/Ag	0.12	4.6×10^{12}	0	300-700	Crowntech Qtest Station 1000 AD	[6]
ITO/SnO_2(2-FN)/$MAPbI_3$/ Spiro-OMeTAD/MoO_3/Cu	0.431	6.8×10^{13}	0	300-800	Standard Monocrystalline Silicon Calibration	This work

Table. S2 Performance parameters of PDs.

Devices	EQE_{max}	J_d (A cm^{-2})	R_{max}(A/W)	D^*_{max} (Jones)
PD1	86.92%	2.47×10^{-9}	0.397	1.41×10^{13}
PD2	87.64%	8.38×10^{-10}	0.402	2.45×10^{13}
PD3	91.11%	1.26×10^{-10}	0.431	6.80×10^{13}
PD4	90.05%	3.03×10^{-10}	0.426	4.30×10^{13}
PD5	89.15%	3.93×10^{-10}	0.422	3.76×10^{13}

Table. S3 Average values and standard deviations of the performance parameters based on 10 PDs.

Devices	EQE_{avg}(%)	$J_{d\,avg}$ (A cm^{-2})	R_{avg}(A/W)	D^*_{avg} (Jones)
PD1	86.28±1.22	$5.41\times10^{-9}\pm3.13\times10^{-9}$	0.410±0.013	$1.41\times10^{13}\pm3.07\times10^{12}$
PD2	87.46±0.57	$1.52\times10^{-9}\pm4.24\times10^{-10}$	0.415±0.008	$1.95\times10^{13}\pm3.07\times10^{12}$
PD3	89.32±0.97	$2.55\times10^{-10}\pm1.06\times10^{-10}$	0.420±0.010	$5.09\times10^{13}\pm9.72\times10^{12}$
PD4	88.80±1.02	$7.10\times10^{-10}\pm3.00\times10^{-10}$	0.418±0.011	$3.09\times10^{13}\pm5.94\times10^{12}$
PD5	88.42±0.95	$9.32\times10^{-10}\pm3.52\times10^{-10}$	0.417±0.003	$2.63\times10^{13}\pm4.91\times10^{12}$

References

1. S. L. Wang, M. Y. Li, C. Y. Song, C. L. Zheng, J. T. Li, Z. Y. Li, Y. T. Zhang and J. Q. Yao, *Appl. Surf. Sci.*, 2023, **623**, 9.
2. B. T. Liu, Y. S. Huang, T. H. Wu, S. H. Wang, H. S. Su and I. R. Chen, *J. Taiwan Inst. Chem. Eng.*, 2023, **151**, 7.
3. M. Y. Long, L. H. Yang, D. M. An, J. L. Dai, Y. Y. Wang and X. Yao, *Opt. Mater.*, 2024, **147**, 8.
4. B. G. Kim, J. Y. Chun, Z. Yang, S. Kim, W. Jang and D. H. Wang, *J. Alloy. Compd.*, 2023, **969**, 13.
5. B. T. Liu, Y. Z. Zhang, Y. Y. Zuo and D. Rachmawati, *J. Alloy. Compd.*, 2022, **929**, 10.
6. Z. Y. Fang, N. Ding, W. Xu, T. Y. Wang, Y. Wang, L. Zi, J. H. Hu, S. Y. Lu, D. L. Zhou, X. Bai and H. W. Song, *J. Mater. Chem. C*, 2023, **11**, 5546-5546.