Indoleacetic acid-mediated suppression of oxidation and crystallization in tin perovskite LEDs

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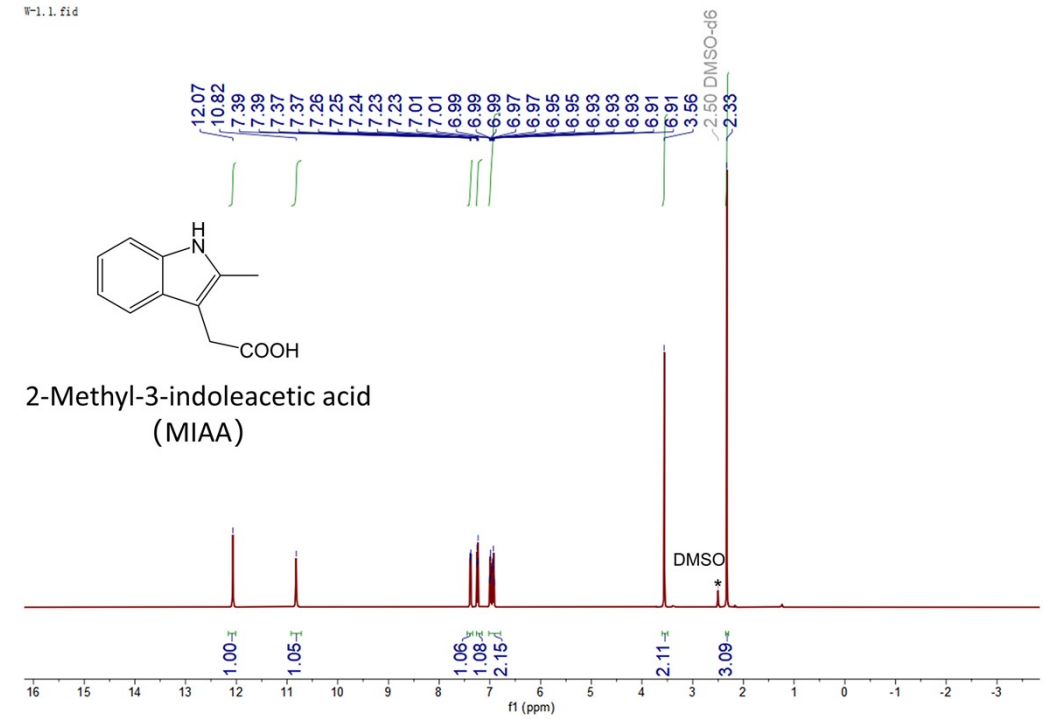

Fig. S1. Molecular structure and ^{1}H NMR spectra of MIAA in DMSO-d_6 solution.

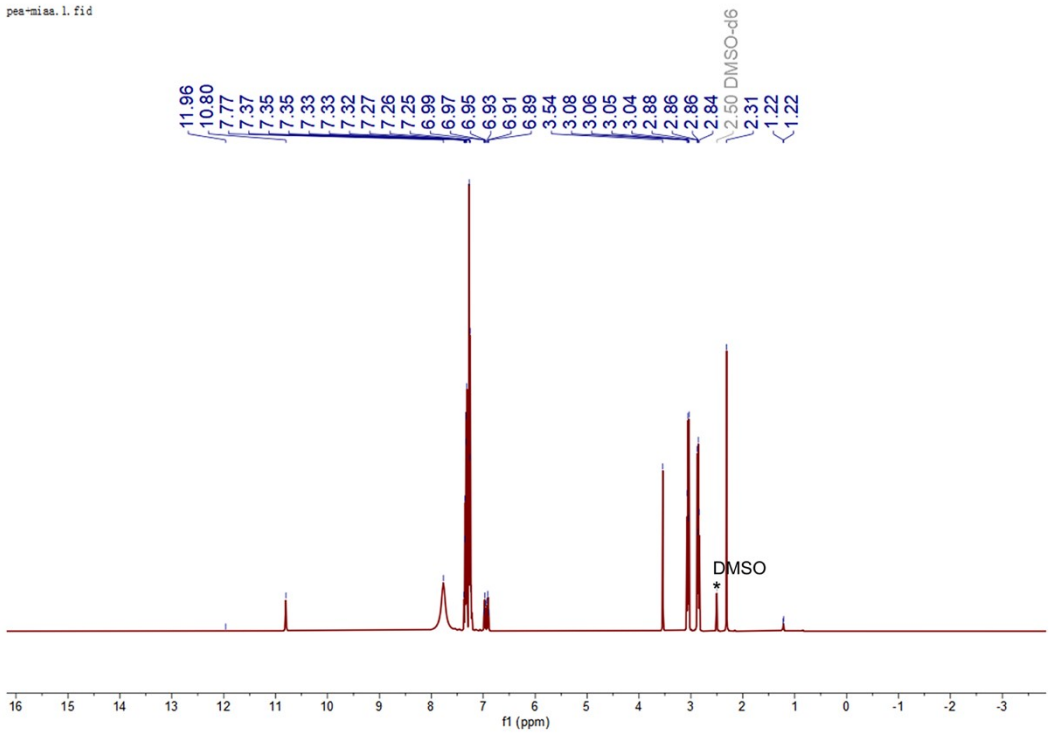

Fig. S2. ^{1}H NMR spectra of MIAA + PEAI in DMSO-d_6 solution. (Since Fig. 2 is the ^{1}H NMR spectrum of the mixture of two organic substances, MIAA and PEAI, no integration was performed on this hydrogen spectrum.)

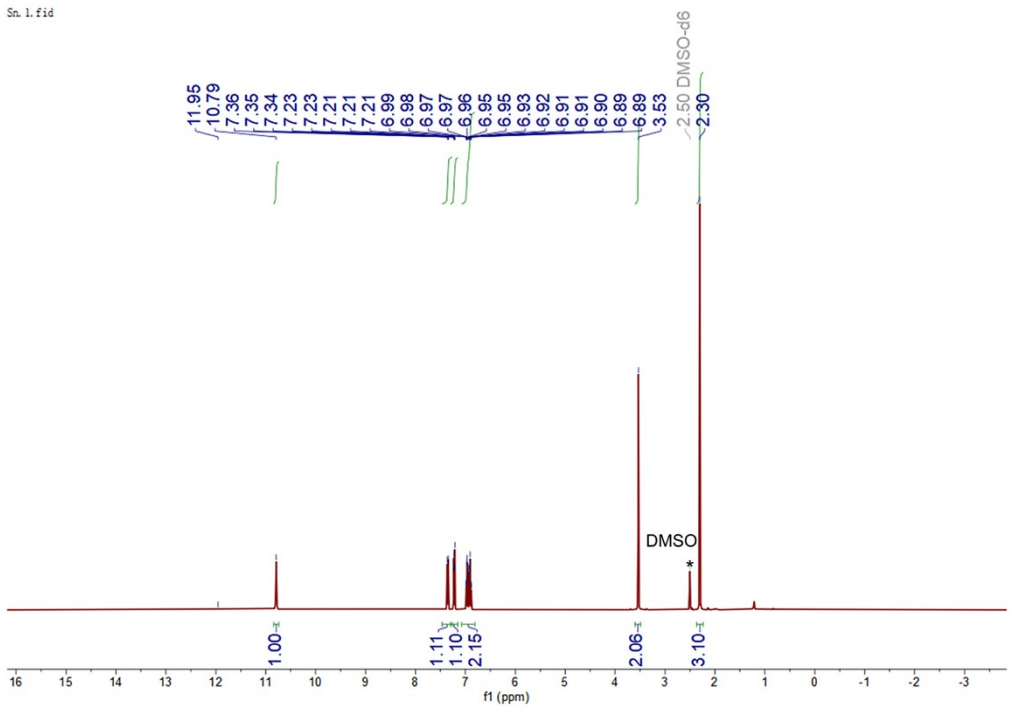

Fig. S3. ^{1}H NMR spectra of MIAA + SnI_2 in DMSO-d_6 solution.

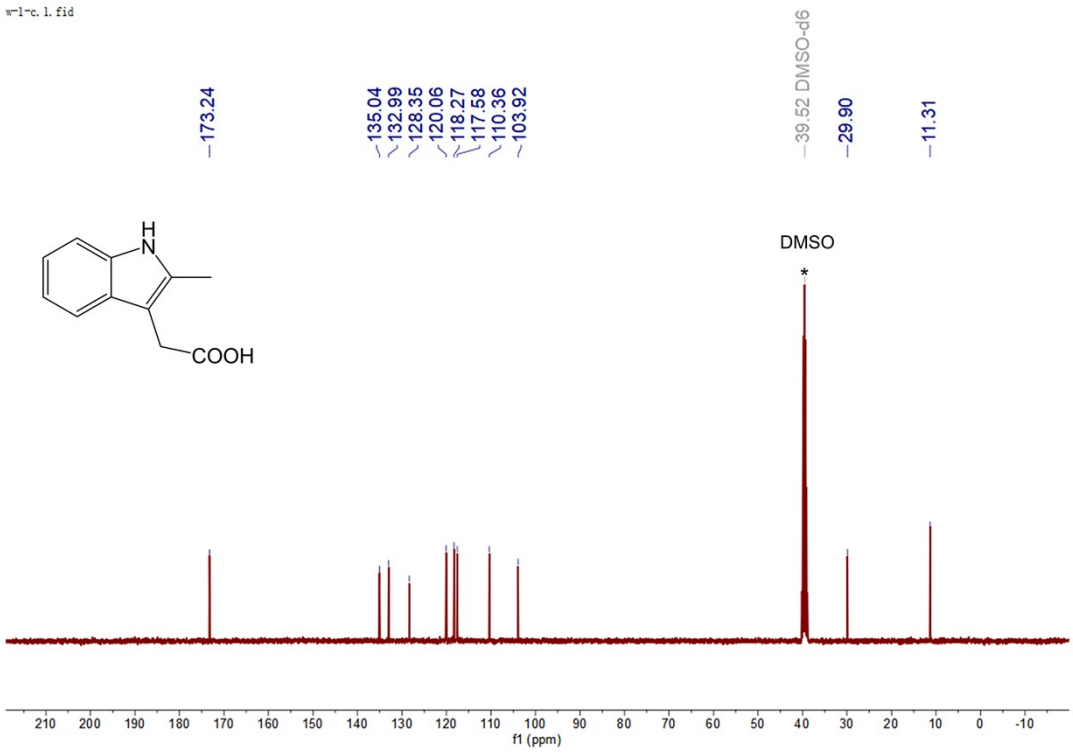

Fig. S4. ^{13}C NMR spectra of MIAA in DMSO-d_6 solution.

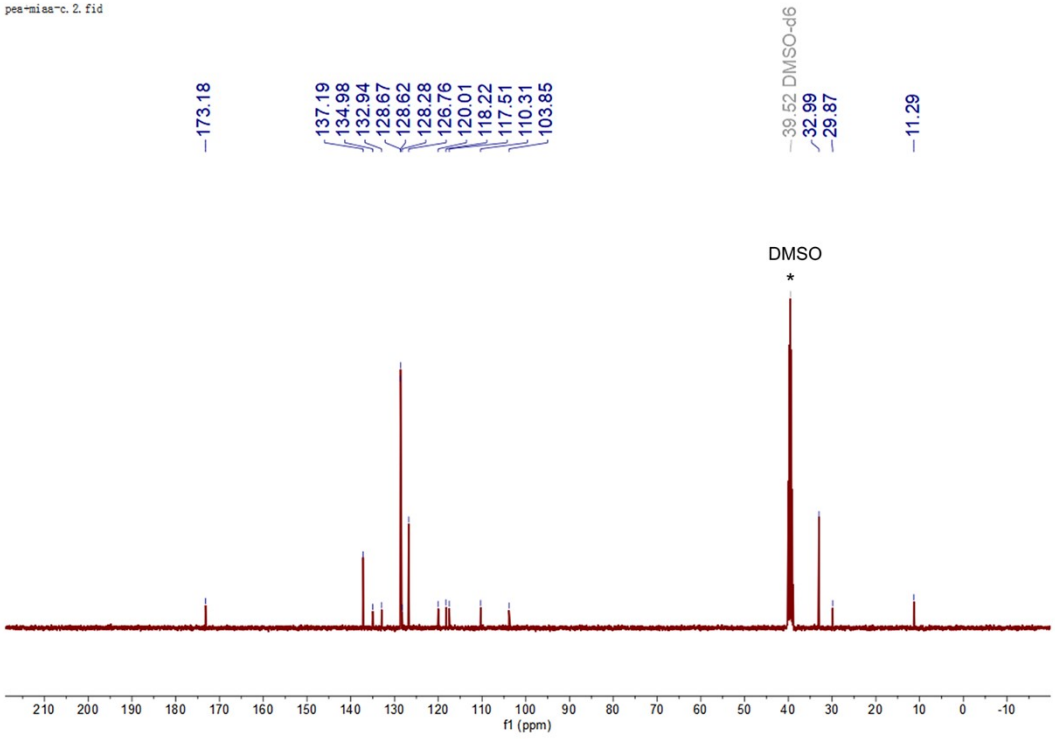

Fig. S5. ^{13}C NMR spectra of MIAA + PEAI in DMSO-d_6 solution.

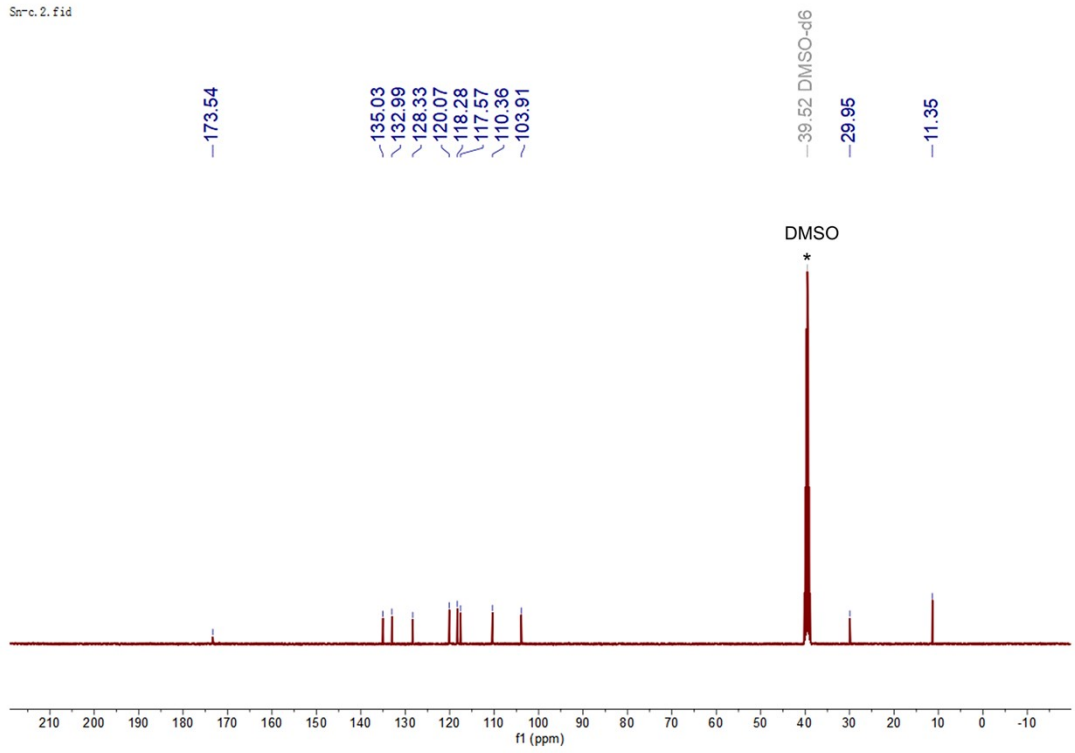

Fig. S6. ^{13}C NMR spectra of MIAA + SnI_2 in DMSO-d_6 solution.

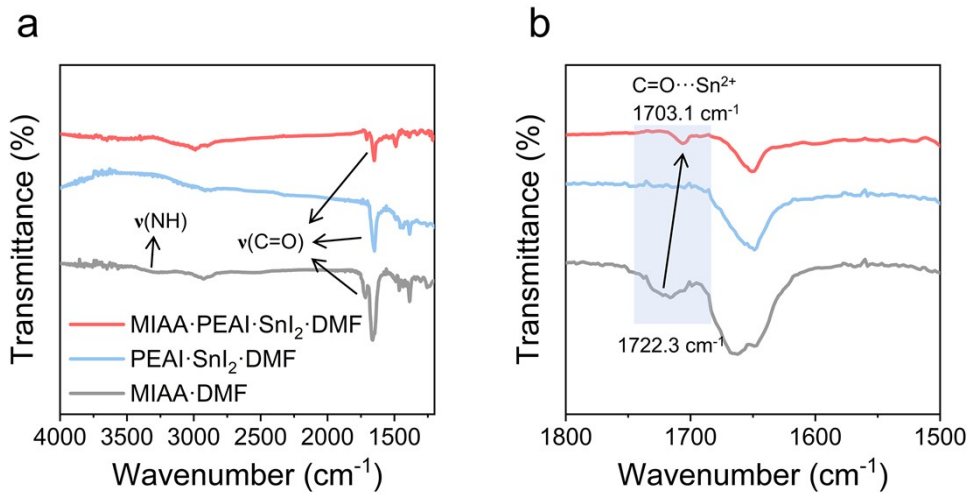

Fig. S7. (a) Full and (b) partial enlarged FTIR spectra of MIAA·DMF (powder), PEAI·SnI_2·DMF (powder), and MIAA·PEAI·SnI_2·DMF (powder).

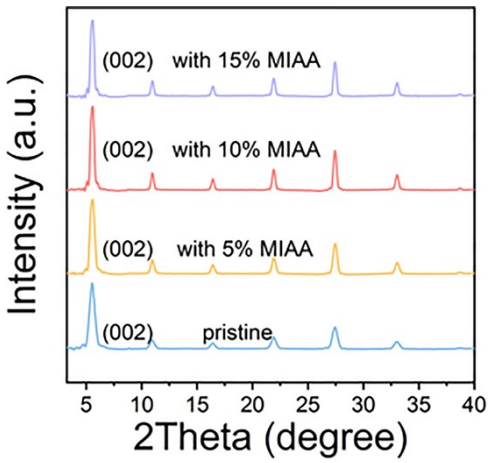

Fig. S8. XRD patterns of PEA_2SnI_4 of PEA_2SnI_4 perovskite films with different MIAA contents.

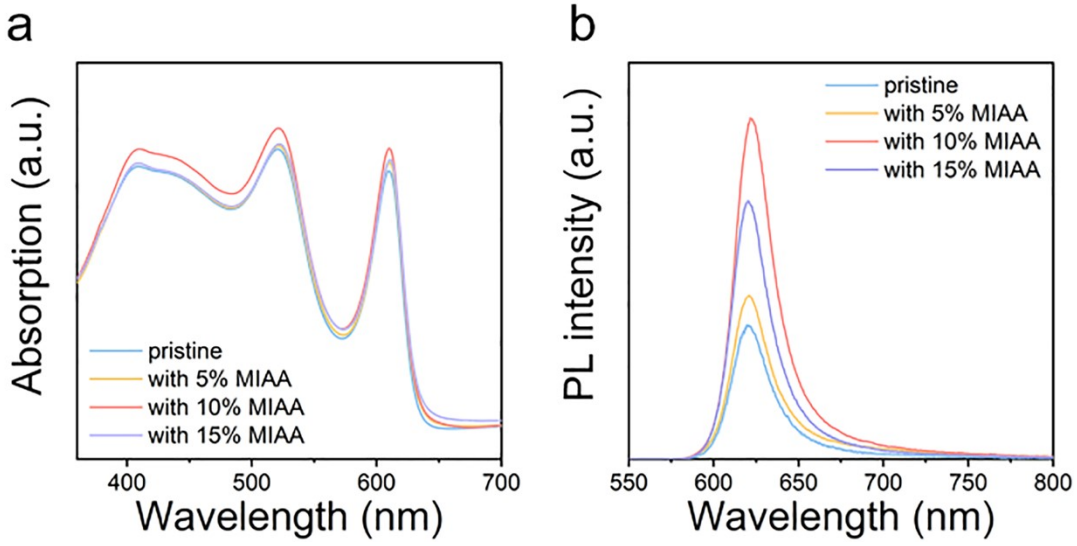

Fig. S9. (a) UV-Vis absorption spectra and (b) PL spectra of PEA_2SnI_4 perovskite films with different MIAA contents.

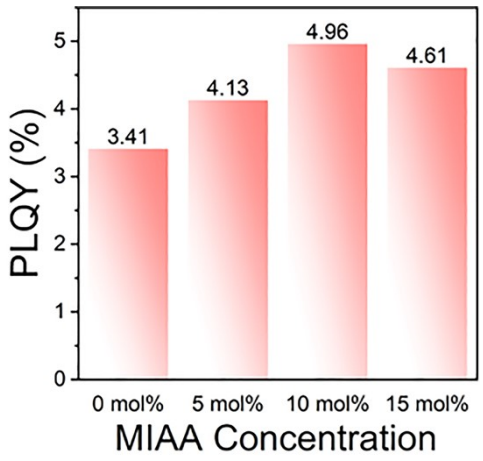

Fig. S10. PLQY of PEA_2SnI_4 perovskite films with different MIAA contents.

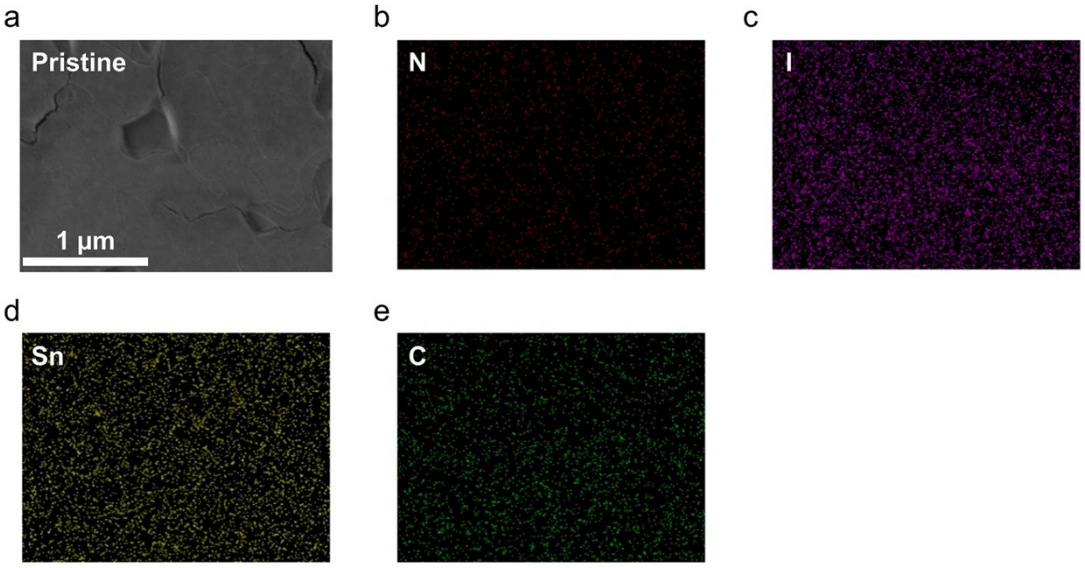

Fig. S11. (a) SEM image and (b-e) corresponding element mapping images of pristine PEA_2SnI_4 perovskite films.

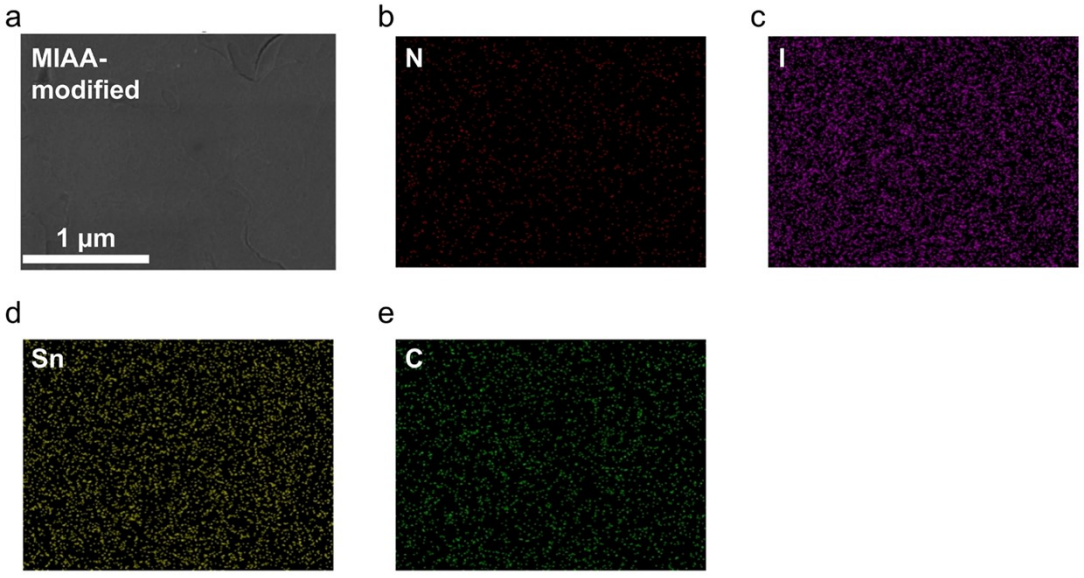

Fig. S12. (a) SEM image and (b-e) corresponding element mapping images of MIAA-modified PEA_2SnI_4 perovskite films.

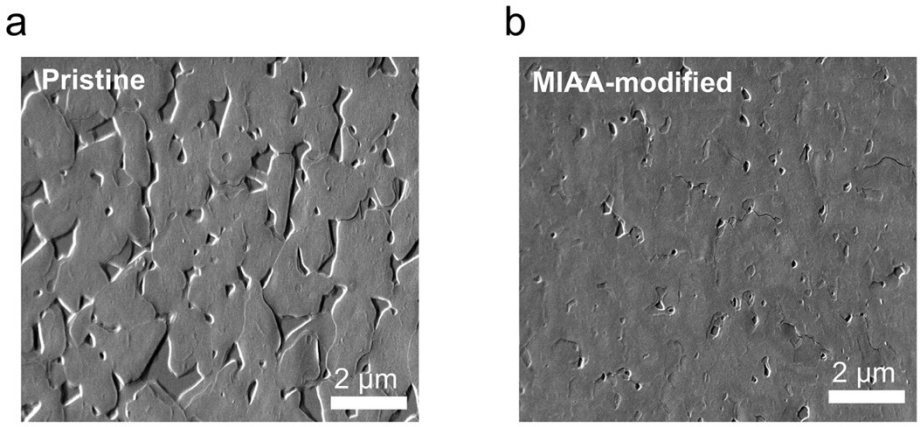

Fig. S13. SEM image of (a) pristine and (b) MIAA-modified PEA_2SnI_4 perovskite films at a 45° sample tilt angle.

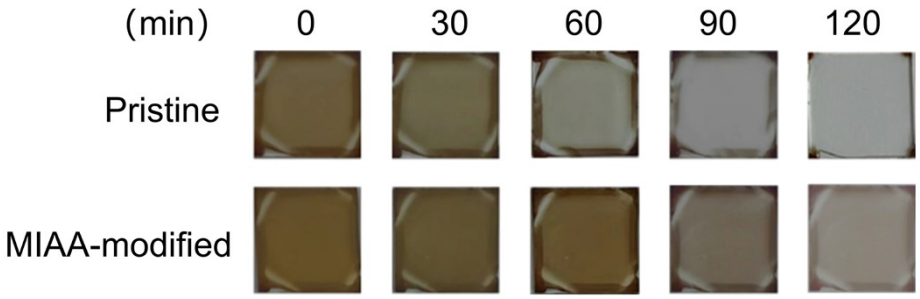

Fig. S14. Photos of pristine and MIAA-modified PEA_2SnI_4 film placing at air (20% RH, 25℃).

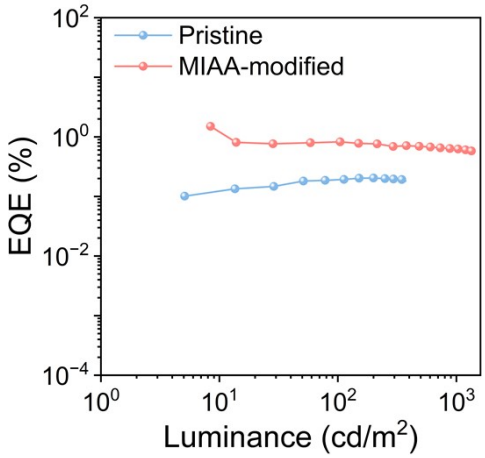

Fig. S15. EQE-Luminance curves of pristine and MIAA-modified PEA_2SnI_4 perovskite thin-film LED devices.

Table S1. TRPL fitting parameters of pristine and MIAA-modified PEA_2SnI_4 films.

Sample	τ_1 (ns)	A_1	τ_2 (ns)	A_2	τ_{avg} (ns)
Pristine	0.51	258.9	3.29	127.8	2.63
MIAA-modified	0.87	1184.3	5.87	132.8	3.02

Table S2. Summary of device performance for tin-based pure red PeLEDs with different additive.

Reference	additive	Max. Lum. (cd/m^2)	Max. EQE. (%)
ACS Photonics 2020, 7, 1915-1922	DSAS	132	0.7
Sci. Adv. 2020, 6, eabb0253	VA	~ 90	5.0
Adv. Funct. Mater. 2023, 33, 2301304.	DPPO-NH_2	451	3.5
Angew. Chem. 2023, 135, e202312728	GSH	382	9.32
Nature 2023, 622, 493-498.	CA	~ 800	20.3
J. Mater. Chem. C. 2023, 11, 9916-9924	NHD	50	0.9
J. Mater. Chem. C, 2024, 12, 14368–14375	N-MTU	509	2.35
Laser Photonics Rev. 2025, e00727.	γ acid	371	15.5
Adv. Funct. Mater. 2025, 2506504	TPP	195	10.1
Our work	**MIAA**	**1412**	**1.5**