Supplementary Information (SI) for Sustainable Energy & Fuels.

Supplementary material

Ammonium Formate-Engineered MA-free Perovskite Ink for Solar Cells and Optoelectronic Devices

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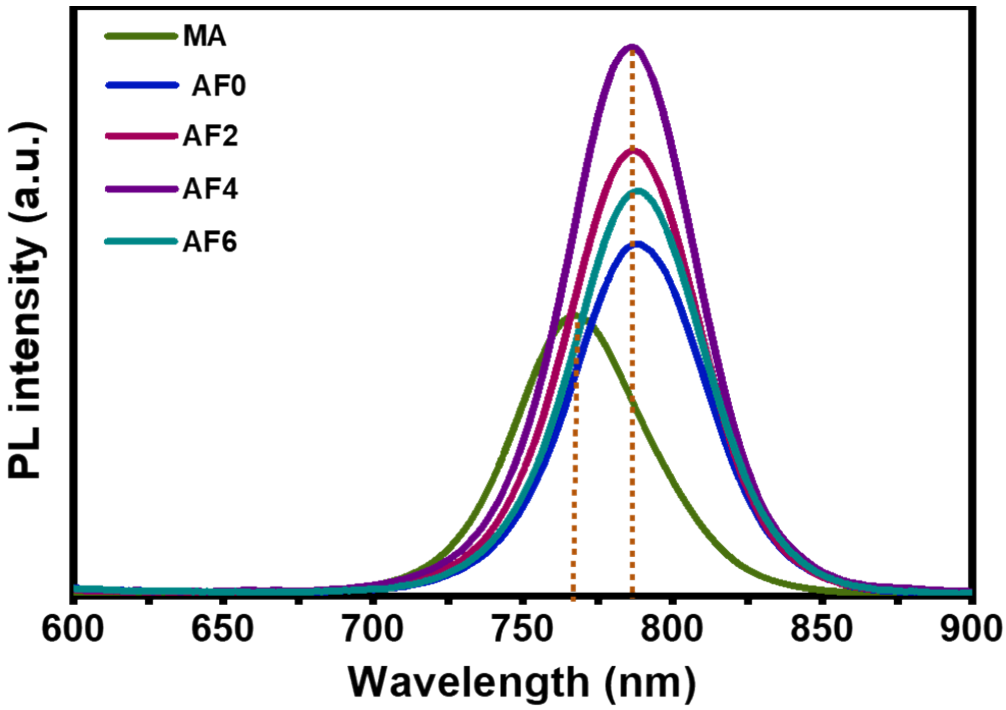

Fig. S1. PL spectrum for perovskite films with and without MA in presence of NH_4Fo at different concentration.

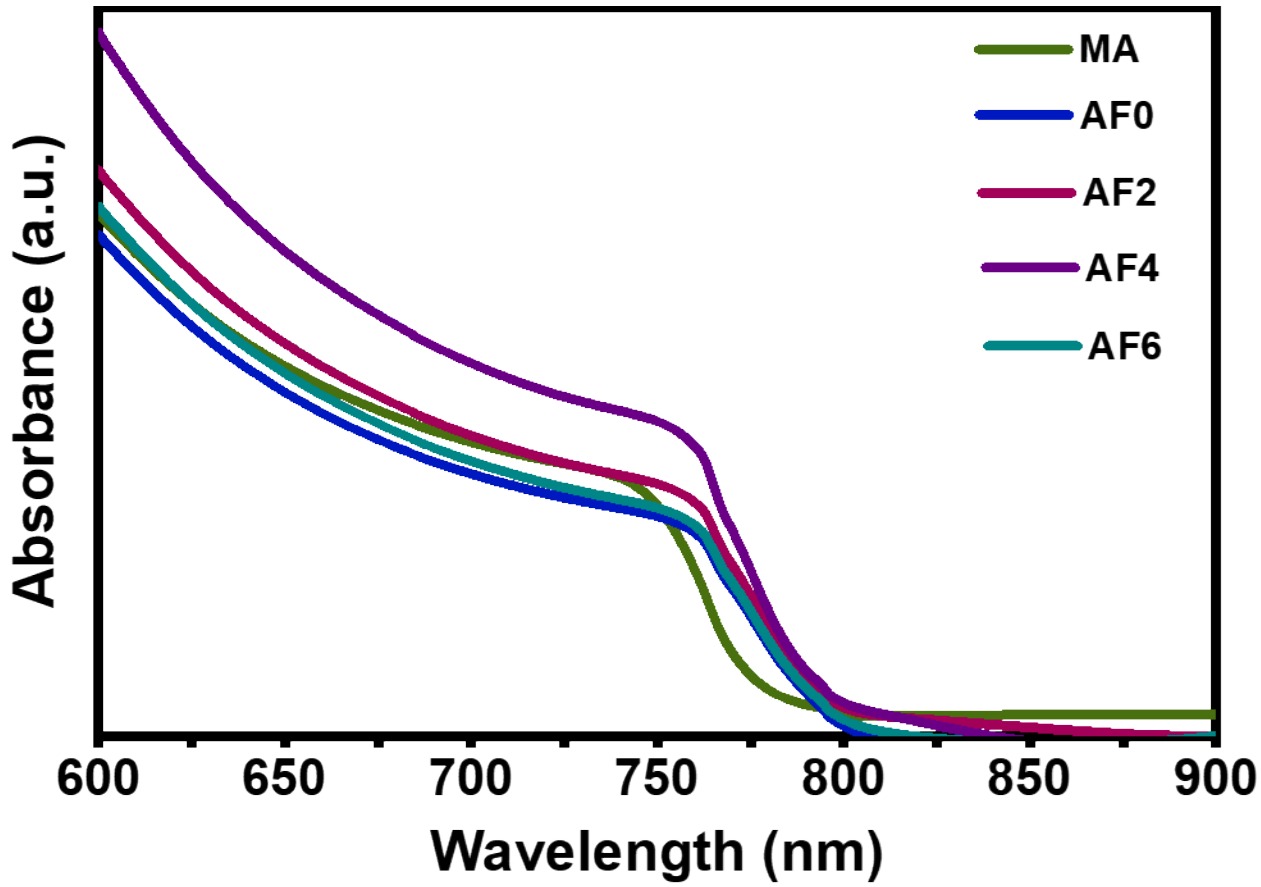

Fig. S2. UV–Vis absorption for perovskite films with and without MA in presence of NH_4Fo at different concentration.

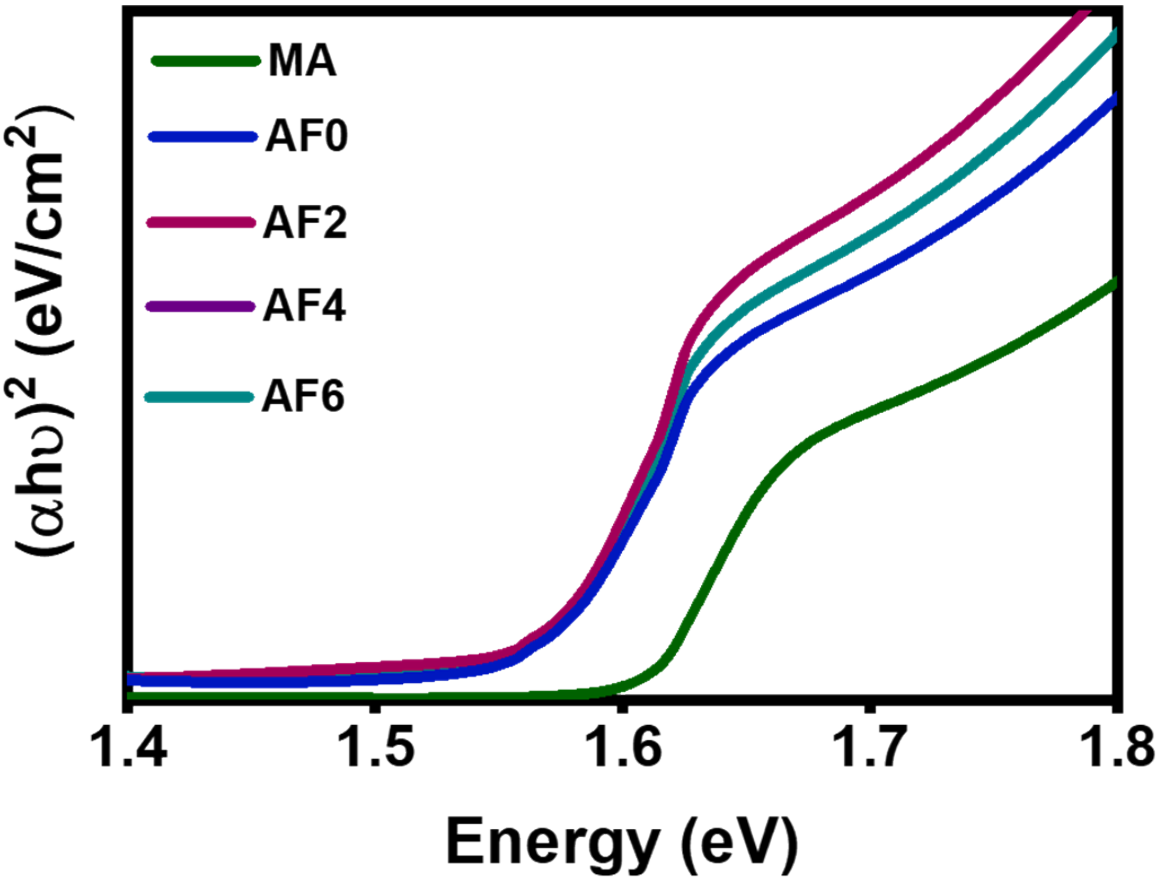

Fig. S3. Tauc plot for perovskite films with and without MA in presence of NH_4Fo at different concentration.

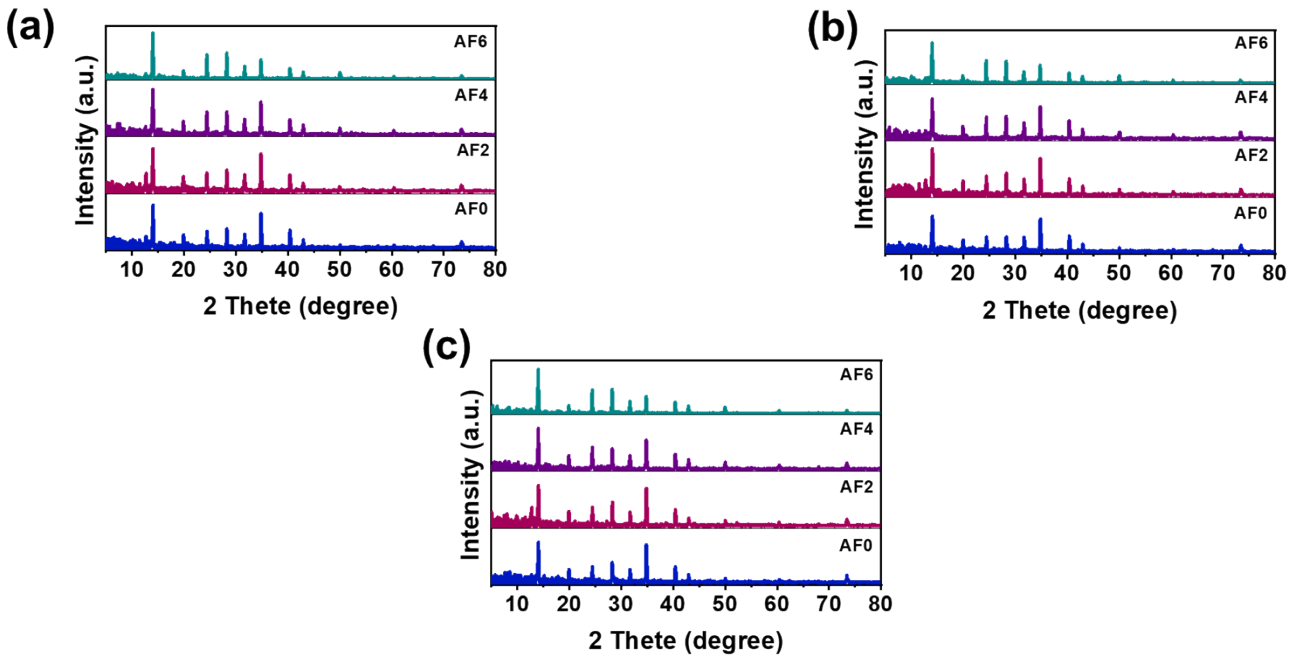

Fig. S4. XRD spectra of perovskite layers with and without NH_4Fo in different concentration at different days, (a) first day, (b) after 7 days and (c) after 14 days.

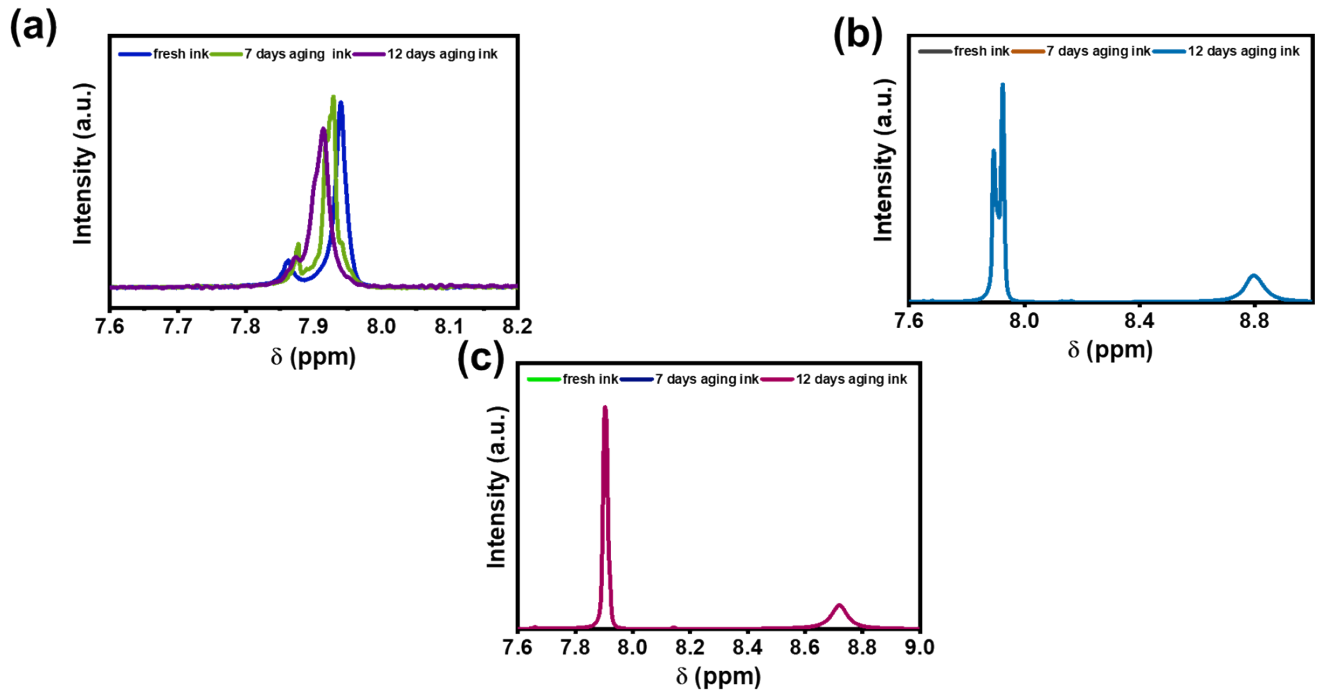

Fig. S5. ^{H} NMR spectra of perovskite layers with (a) MA, (b) without MA, and (c) without MA in presence of NH_4Fo 4% mol.

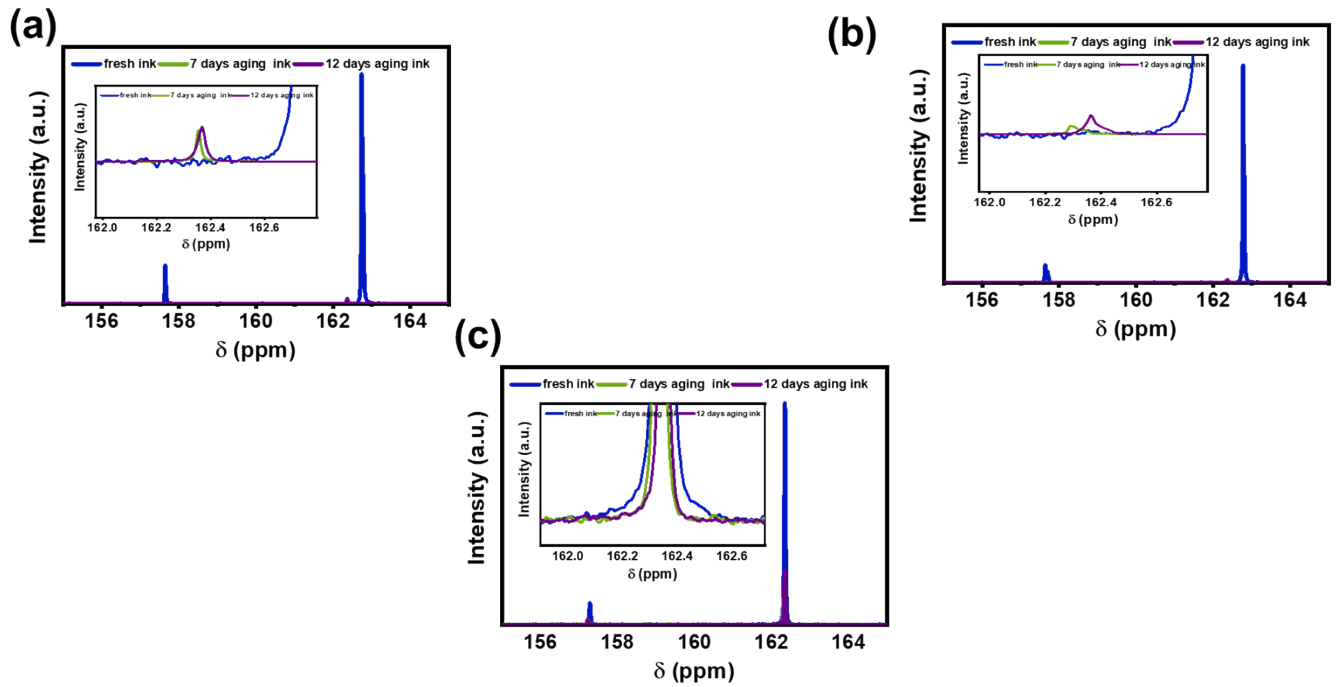

Fig. S6. ^{C} NMR spectra of perovskite layers with (a) MA, (b) without MA, and (c) without MA in presence of NH_4Fo 4% mol.

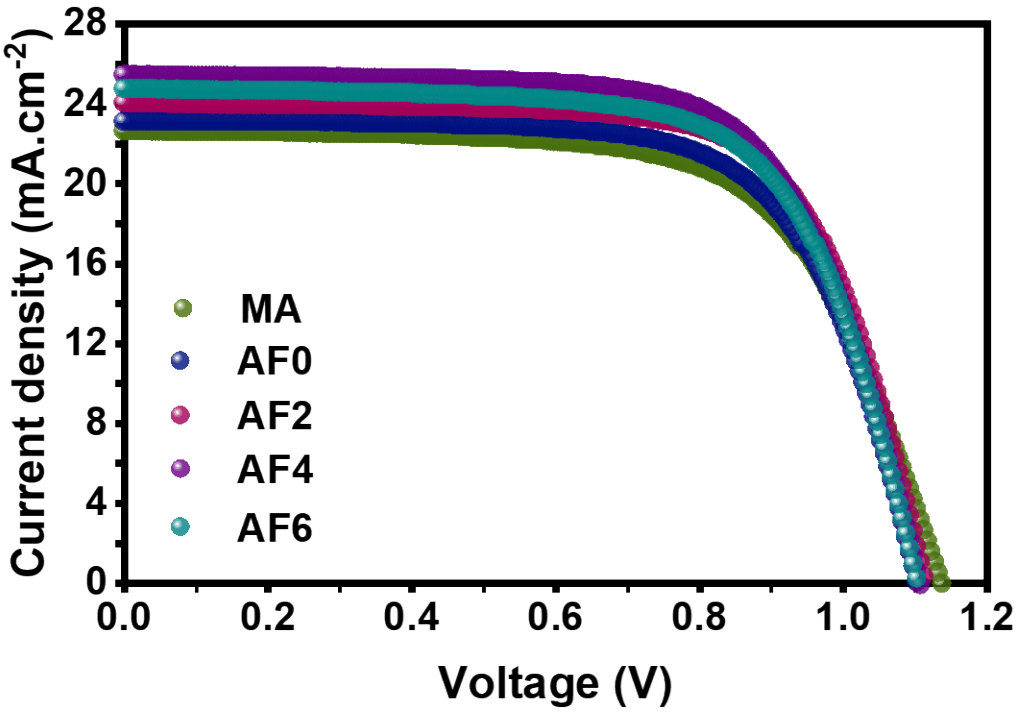

Fig. S7. J–V curves of the best performing PSCs based on MA and MA-free in presence of NH_4Fo at different concentration.

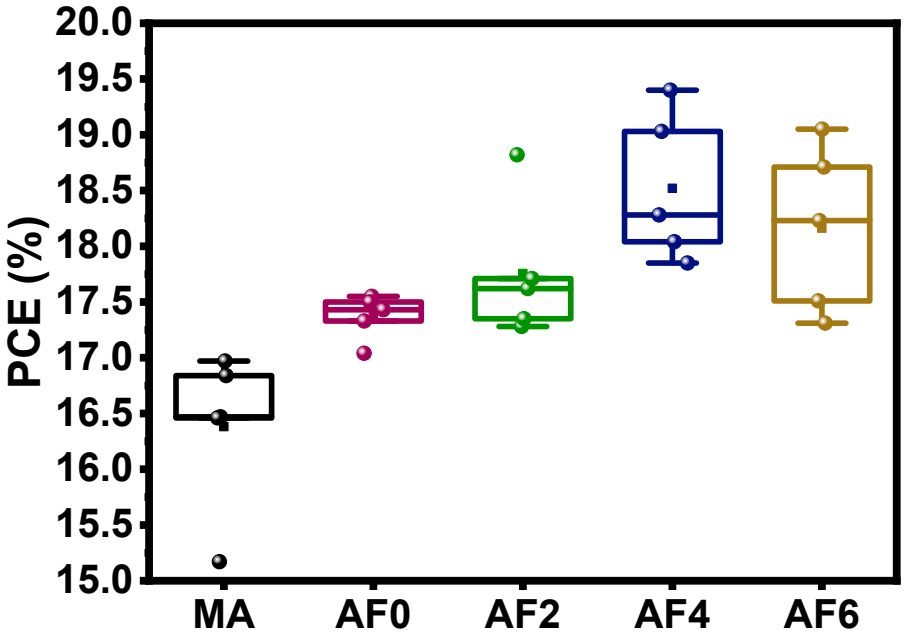

Fig. S8. Performance statistics of PSCs based on MA, MA-free and MA-free in presence of NH_4Fo at different concentration.

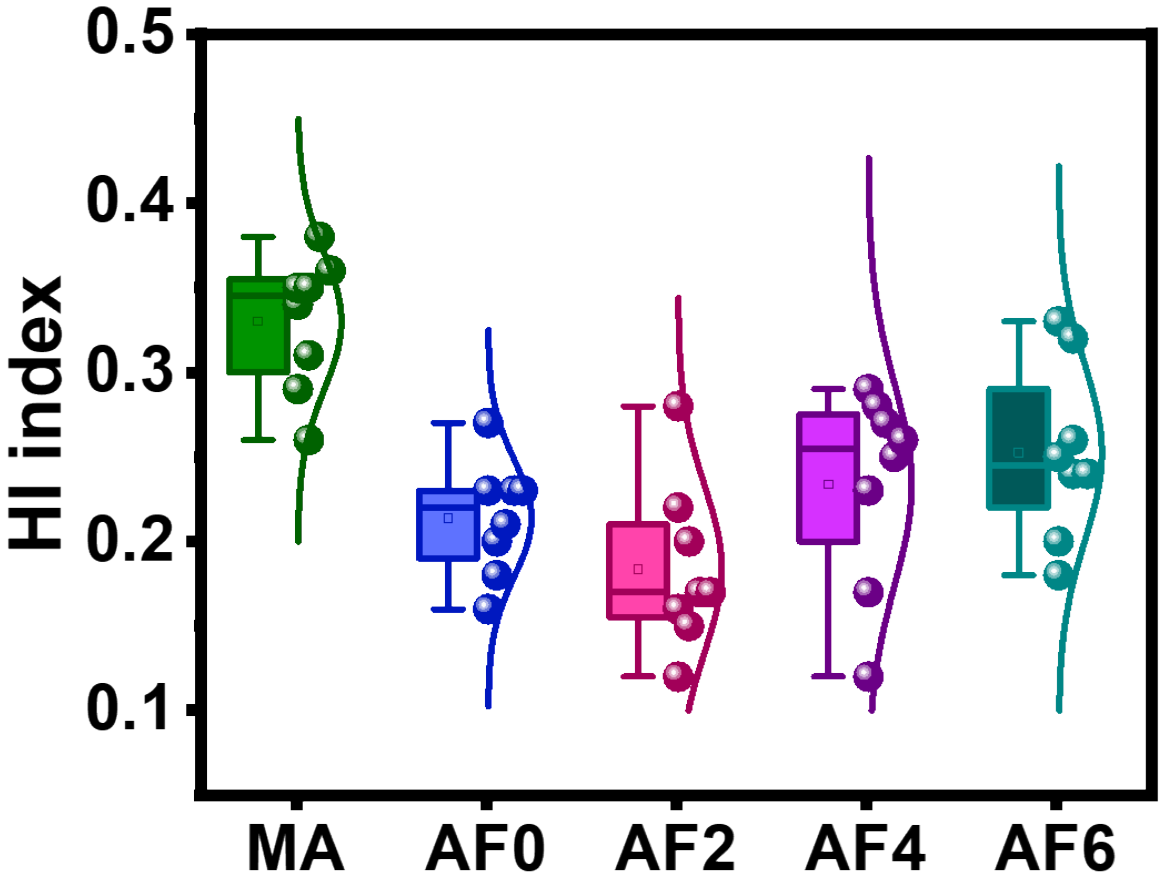

Fig. S9. HI index distribution of the PSCs based on MA and MA-free in presence of NH_4Fo at different concentration.

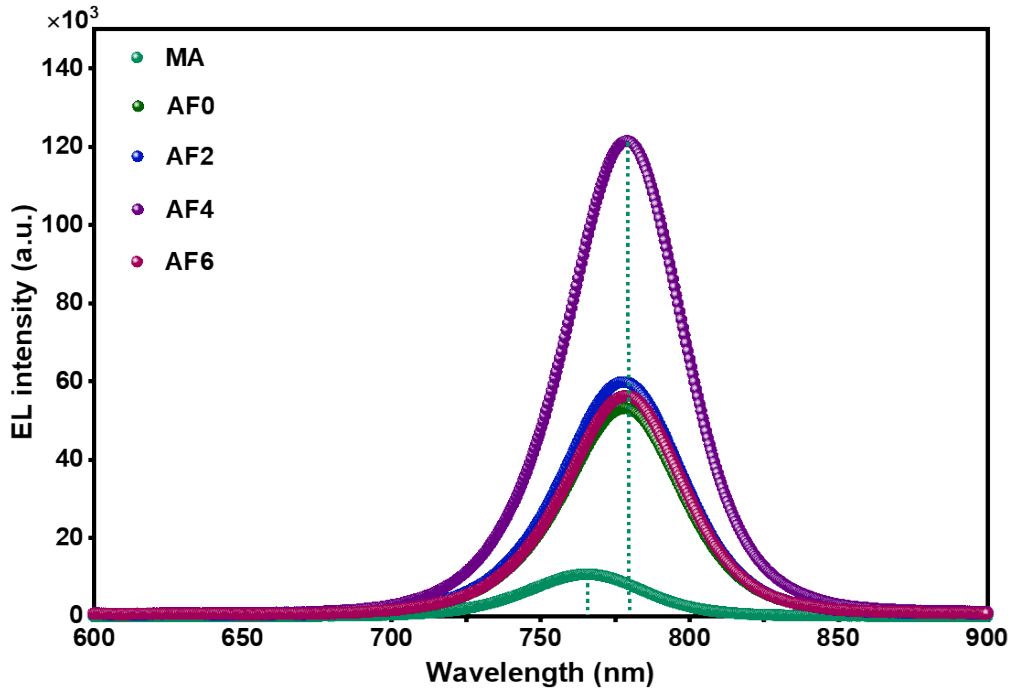

Fig. S10. EL spectra of the best performing PSCs based on MA and MA-free in presence of NH_4Fo at different concentration.

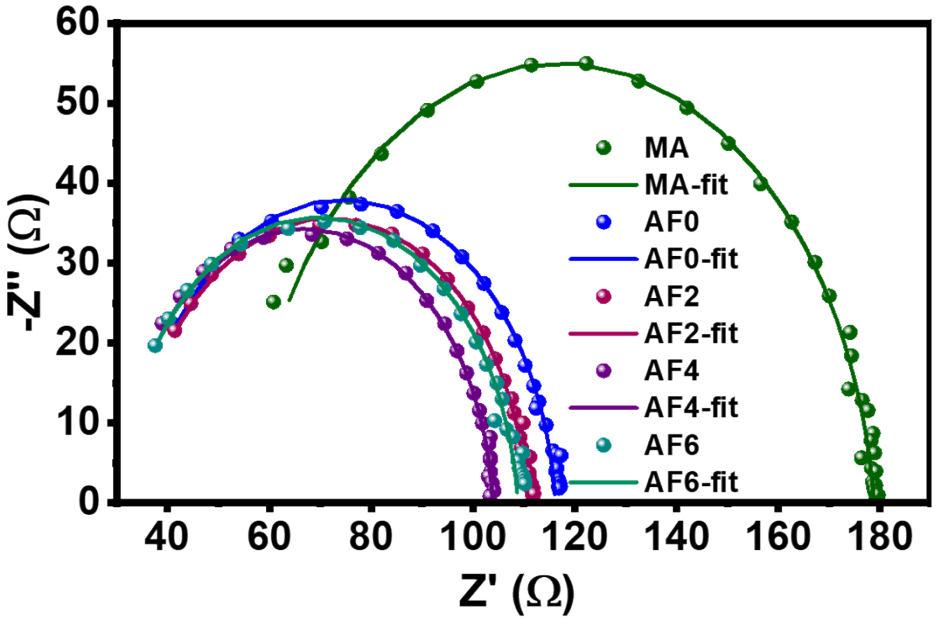

Fig. S11. Nyquist plots of the best performing PSCs based on MA and MA-free in presence of NH_4Fo at different concentration.

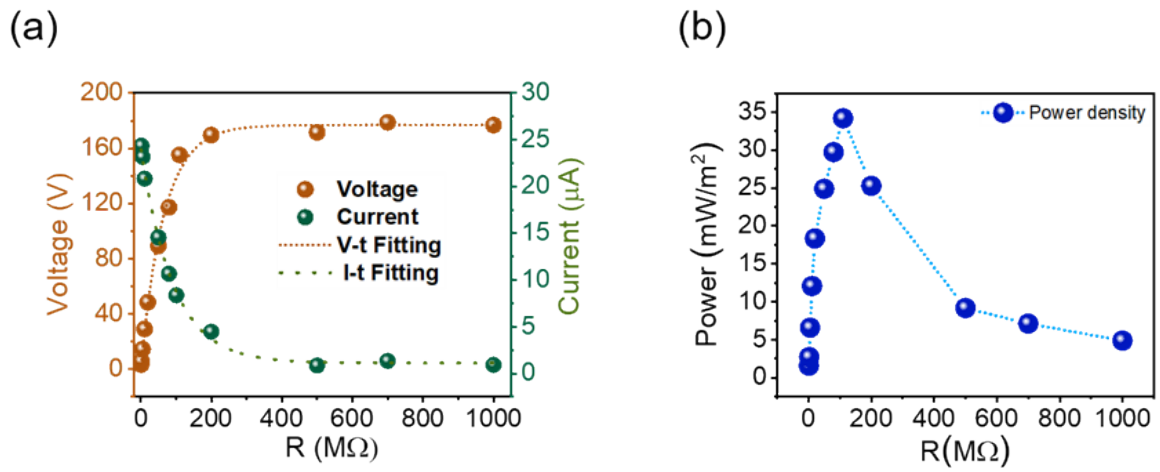

Fig. S12. (a) The current and voltage amplitude vs different load resistance and (b) The generated power density vs. load resistance for FTO/Kapton CS-TENG.

Table S1. Composition and molar amounts of precursors used for the preparation of perovskite solutions.

Perovskite Type	Precursor	Mass (mg)	Molar Mass (g/mol)	Amount (mmol)
$FA_{0.80}MA_{0.12}Cs_{0.08}Pb(I_{0.88}Br_{0.12})_3$	PbI_2	548.6	461.01	1.19
	$PbBr_2$	57.06	367.01	0.155
	FAI	178.94	171.91	1.041
	MABr	17.41	111.97	0.155
	CsI	27.02	259.81	0.104
	Solvent (DMF:DMSO)			780 µL:220 µL
$FA_{0.92}Cs_{0.08}Pb(I_{0.92}Br_{0.08})_3$	PbI_2	548.6	461.01	1.19
	$PbBr_2$	57.06	367.01	0.155
	FAI	205.59	171.91	1.196
	CsI	27.02	259.81	0.104
	Solvent (DMF:DMSO)			800 µL:200 µL

Table S2. Detailed composition of ammonium formate (AF) additive in perovskite precursor solutions with different concentrations.

Final Perovskite Composition	AF Amount (%mol)	Molar Mass of AF (g/mol)	Added AF (mg)	Sample Code
$FA_{0.92}Cs_{0.08}Pb(I_{0.92}Br_{0.08})_3$	0.00	63.06	0.00	AF0
	2.00	63.06	1.69	AF2
	4.00	63.06	3.38	AF4
	6.00	63.06	5.07	AF6