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

Supporting information

A Strategy for Improving Performance of Polycrystalline Perovskite Red Light-Emitting Diodes by Modifying the Growth of Perovskite Crystal

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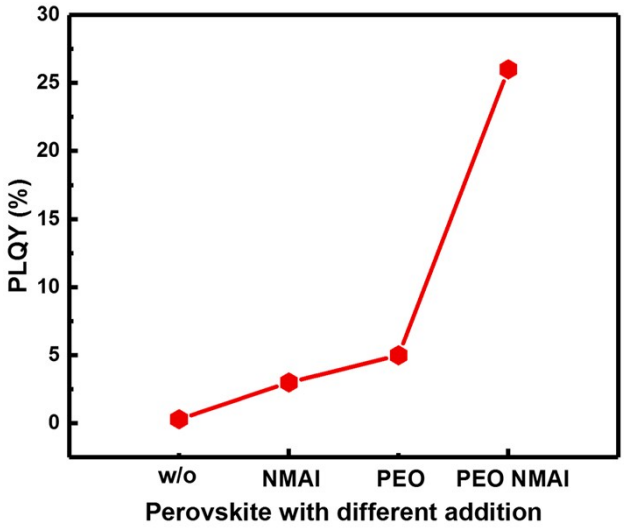


Figure S1 PLQY of $Cs_{0.8}FA_{0.2}PbI_3$ perovskite films processed with different additions.

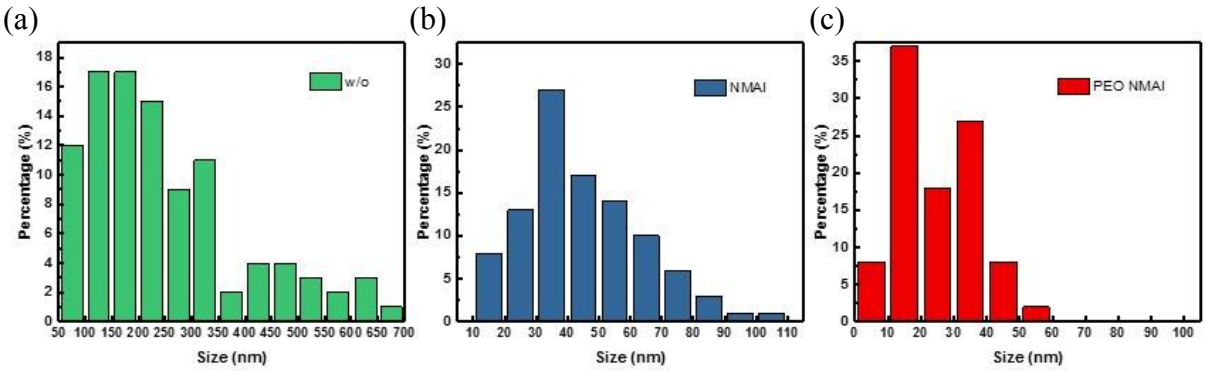


Figure S2. Histograms of grain size distributions of $Cs_{0.8}FA_{0.2}PbI_3$ films processed a) with no-addition; b) with containing NMAI; c) with containing PEO and NMAI.

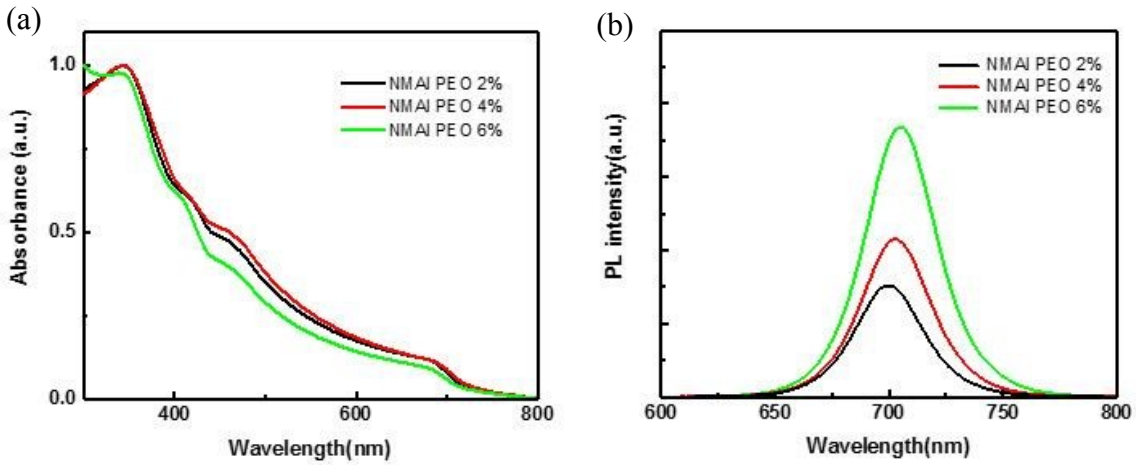


Figure S3. a) The photoluminescence (PL) spectra and b) UV–visible absorption spectra of $Cs_{0.8}FA_{0.2}PbI_3$ films processed with NMAI and PEO 2%, 4% and 6% (weight ratio) added.

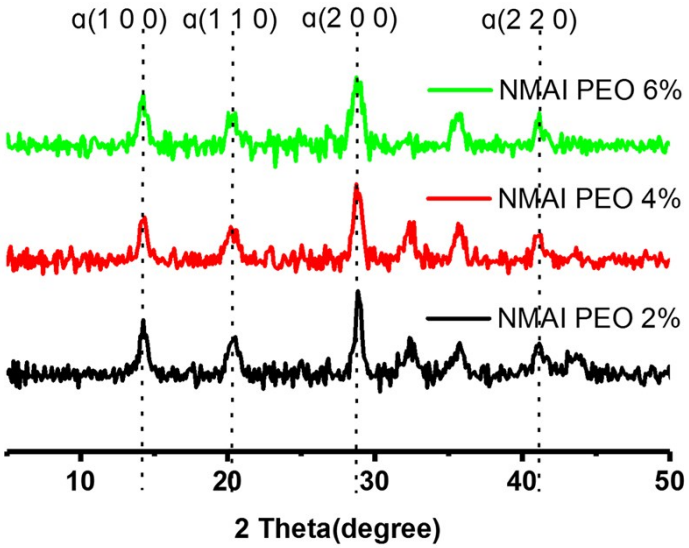
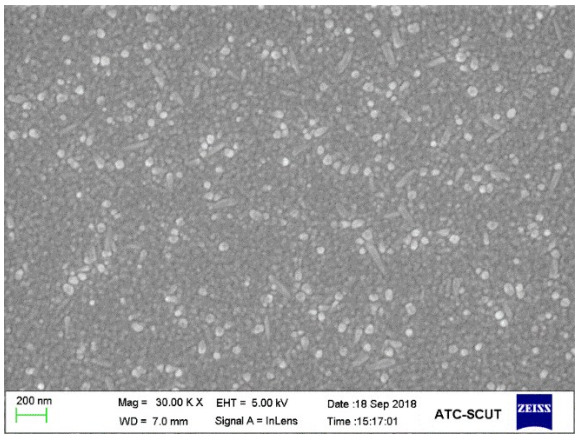
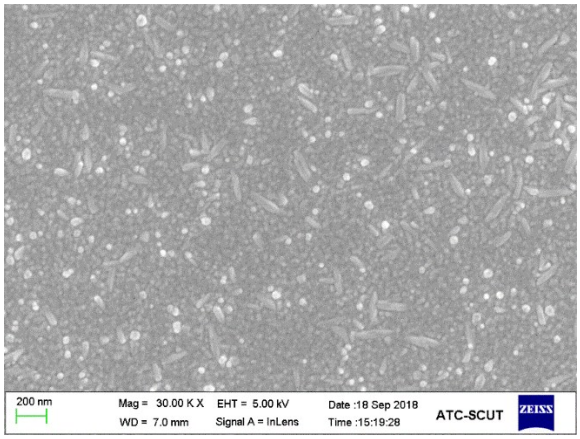


Figure S4 XRD patterns of glass/perovskite films processed with NMAI and PEO 2%, 4% and 6% (weight ratio) added.

(a)



(b)



(c)

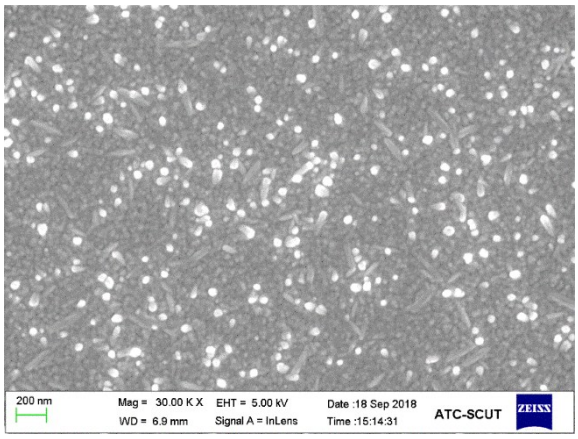


Figure S5. SEM images showing the surface morphology of $Cs_{0.8}FA_{0.2}PbI_3$ films processed a) with NMAI and PEO a)2%, b)4%, c)6% (weight ratio) added.

Table S1. Multi-exponential fitting parameters for the photoluminescence decay profiles shown in Figure 2c.

Device	τ_{avg}(ns)	τ_1(ns)	τ_2(ns)	τ_3(ns)
PEO	35.9	1.9	21.4	77.1
NMAI	5.7	1.1	3.8	13.7
PEO NMAI	71.6	7.0	37.8	120.9

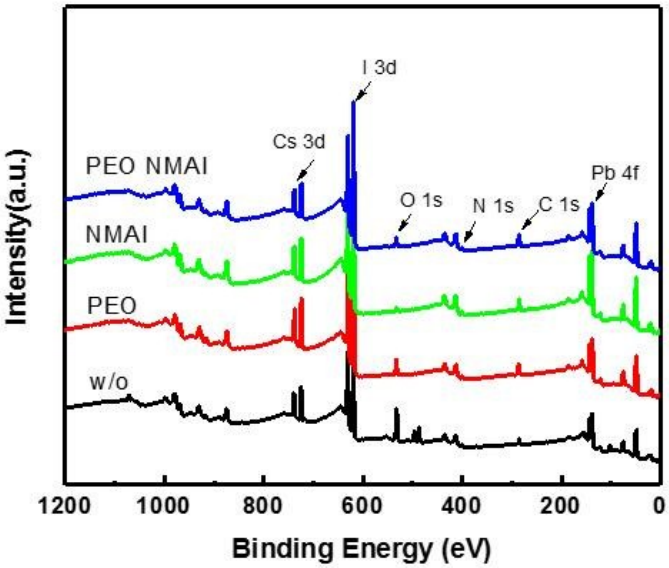
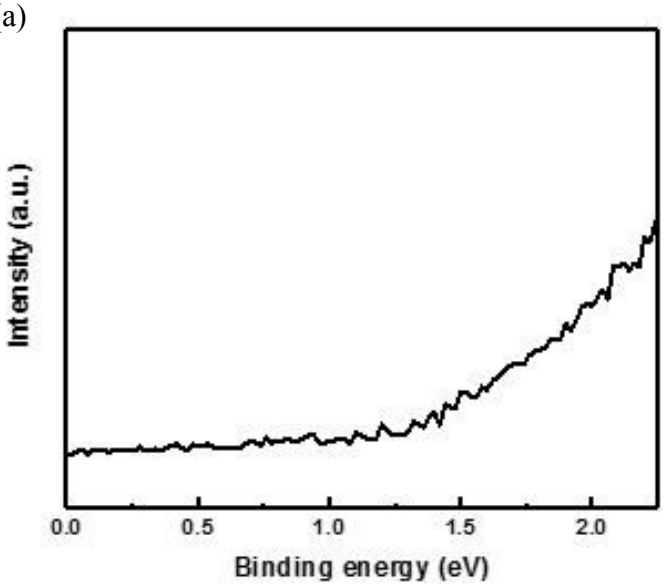


Figure S6. XPS survey spectra of $Cs_{0.8}FA_{0.2}PbI_3$ films with no-addition, containing PEO, containing NMAI, containing PEO and NMAI.

(a)



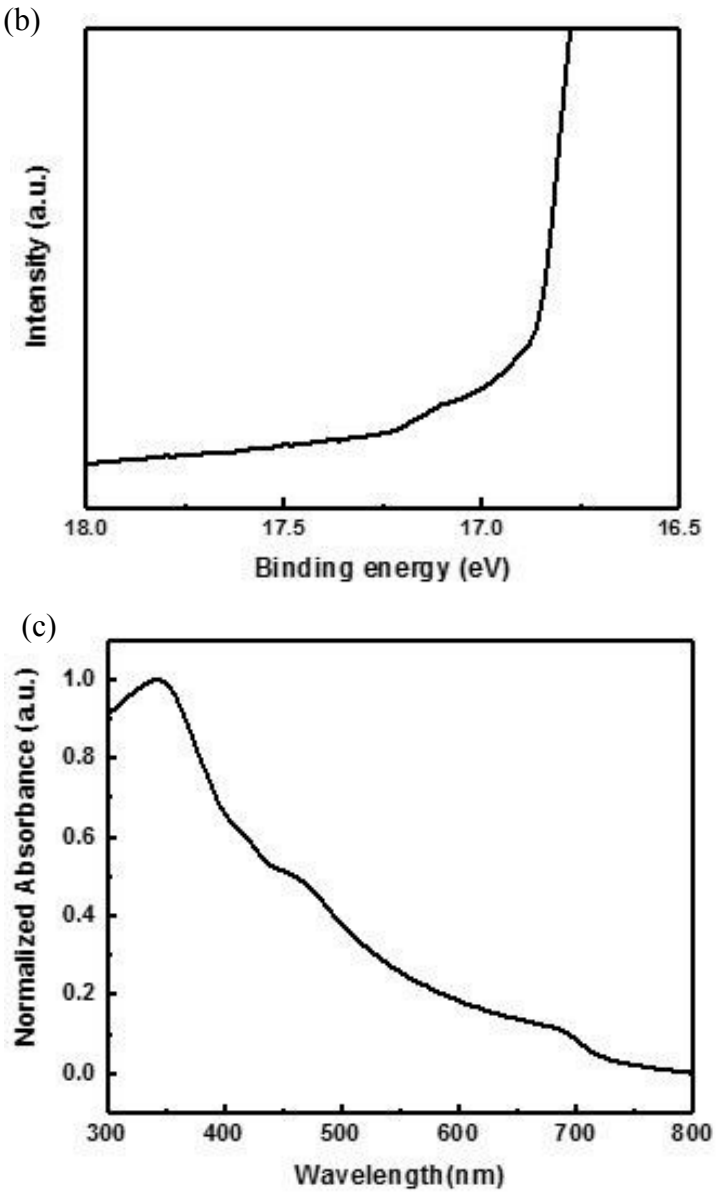


Figure S7. UPS spectrum of $Cs_{0.8}FA_{0.2}PbI_3$ film containing PEO and NMAI: a) offset between WF and IE, b) secondary cut-off, and c) Absorption spectra of the film.

VB and CB of the $Cs_{0.8}FA_{0.2}PbI_3$ film could be calculated via the valence band edge(16.91eV), the secondary electron cut-off edge(1.25eV) and the absorption edge (710nm), which is 5.56eV and 3.81eV, respectively.

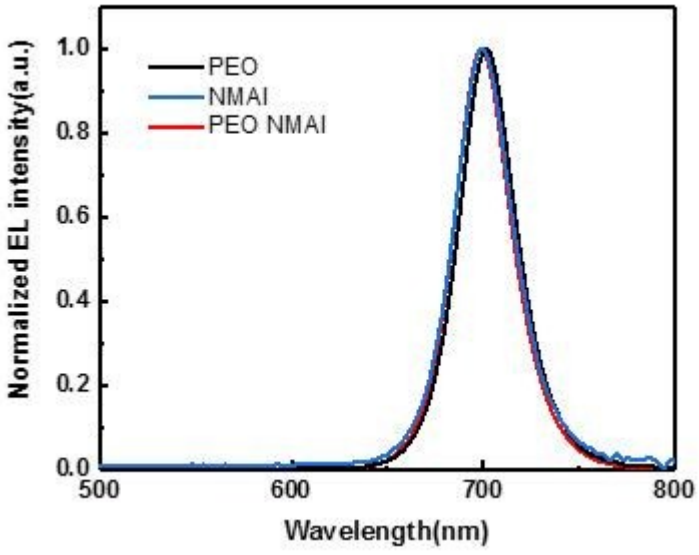


Figure S8. a) The Electroluminescence (EL) spectra of $Cs_{0.8}FA_{0.2}PbI_3$ films processed with different additions.

Table S2. Device performance with different additions.

Device	EL Peak (nm)	EL FWHM (nm)	Von(V)	max L (cd m^{-2})	Max EQE (%)
w/o	--	--	5.4	2	0.04
PEO	702	32	3.4	32	0.69
NMAI	700	32	3.6	14	0.08
PEO NMAI	698	32	2.9	176	2.6

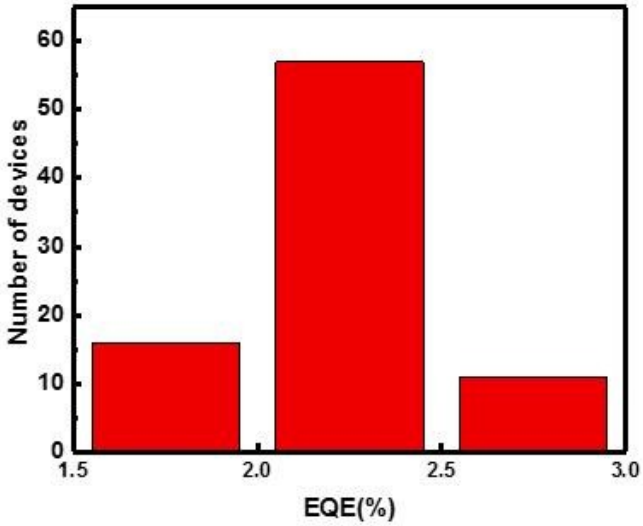


Figure S9. Histograms of peak EQEs for PeLED devices based on containing PEO and NMAI.

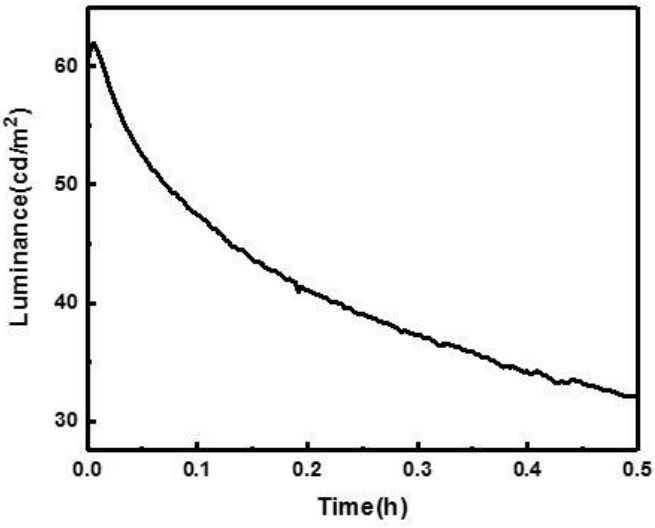


Figure S10. The stability of device based on containing PEO and NMAI.