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

Supporting Information

CH_3NH_2 Gas Induced (110) Preferred Cesium-Containing Perovskite Film with Reduced PbI_6 Octahedron Distortion and Enhanced Moisture Stability

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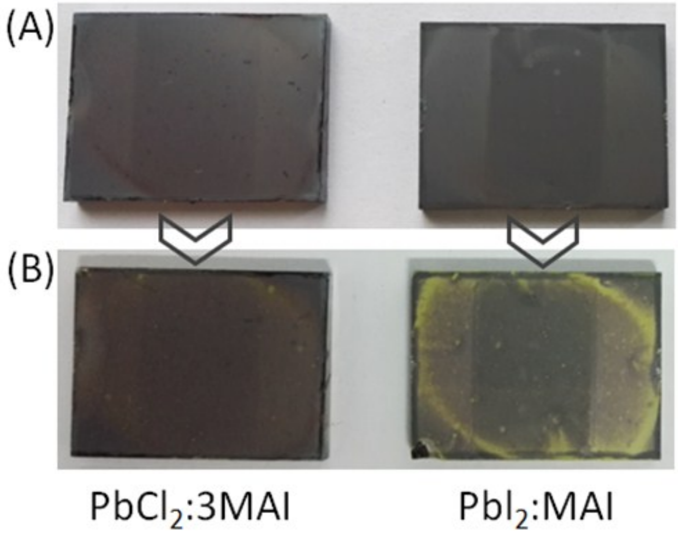

Figure S1. (A) Fresh $MAPbI_3$ films prepared from the $PbCl_2$: 3MAI and PbI_2: MAI recipes. (B) The $MAPbI_3$ films exposed in air under a humidity of 40% for 2 days.

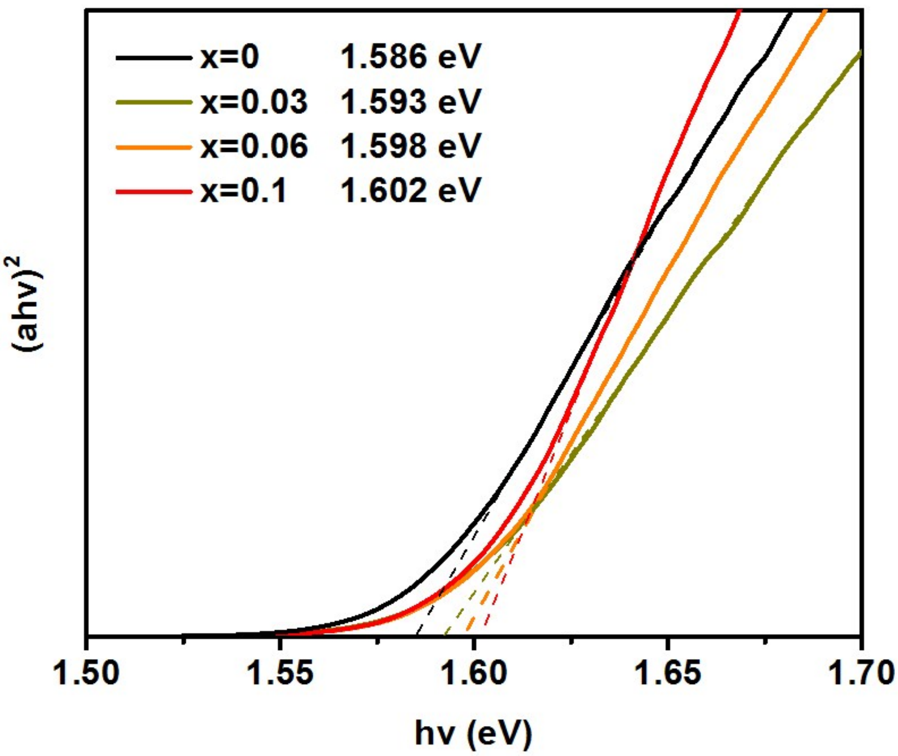

Figure S2. UV-Vis absorbance of $Cs_xMA_{1-x}PbI_3$ perovskite films, where x is varied from 0 to 0.1.

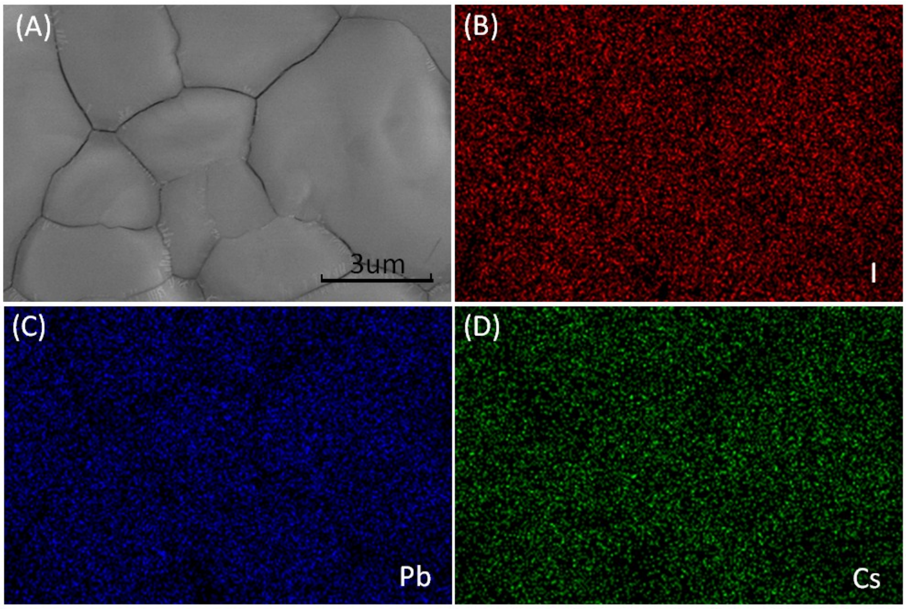

Figure S3. Top surface SEM image of $Cs_{0.1}MA_{0.9}PbI_3$ film (A) and its corresponding EDS maps for iodine (B), lead (C), and cesium (D).

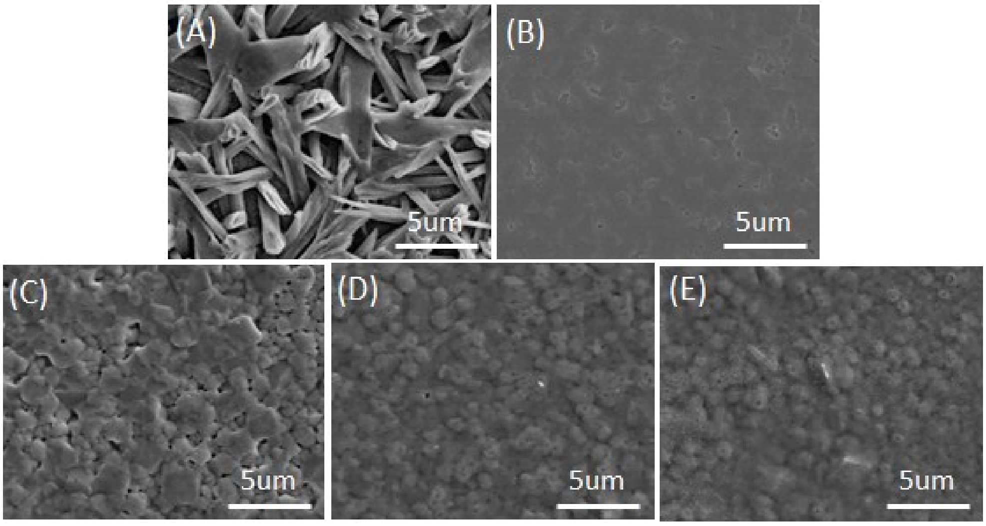

Figure S4. SEM images of $Cs_{0.1}MA_{0.9}PbI_3$ perovskite films with different soaking time in MA gas: 0 s (A), 2 s (B), 6 s (C), 10 s (D), 20 s (E).

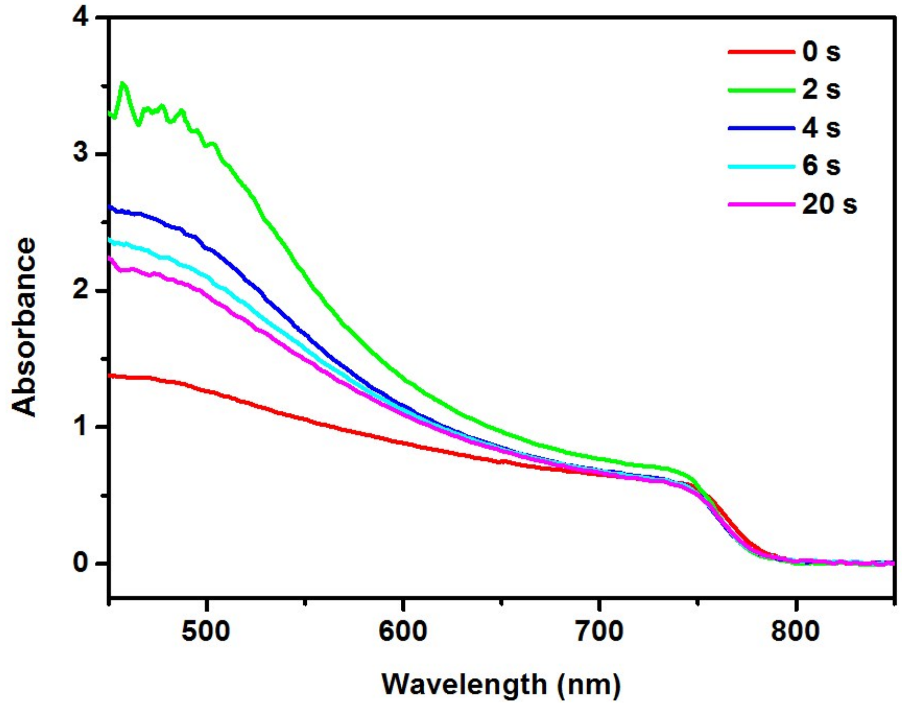

Figure S5. UV-Vis absorbance spectra of $Cs_{0.1}MA_{0.9}PbI_3$ perovskite films with different treating time in MA gas from 0 s to 20 s.

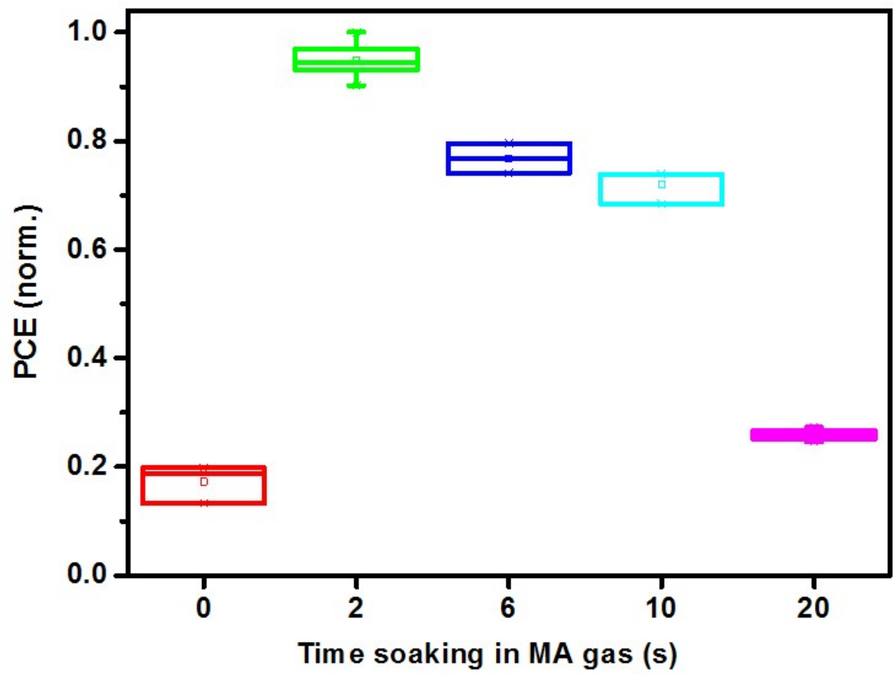

Figure S6. The efficiency distribution of the $Cs_{0.1}MA_{0.9}PbI_3$ perovskite solar cells fabricated by treating the perovskite films in MA gas from 0 s to 20 s.

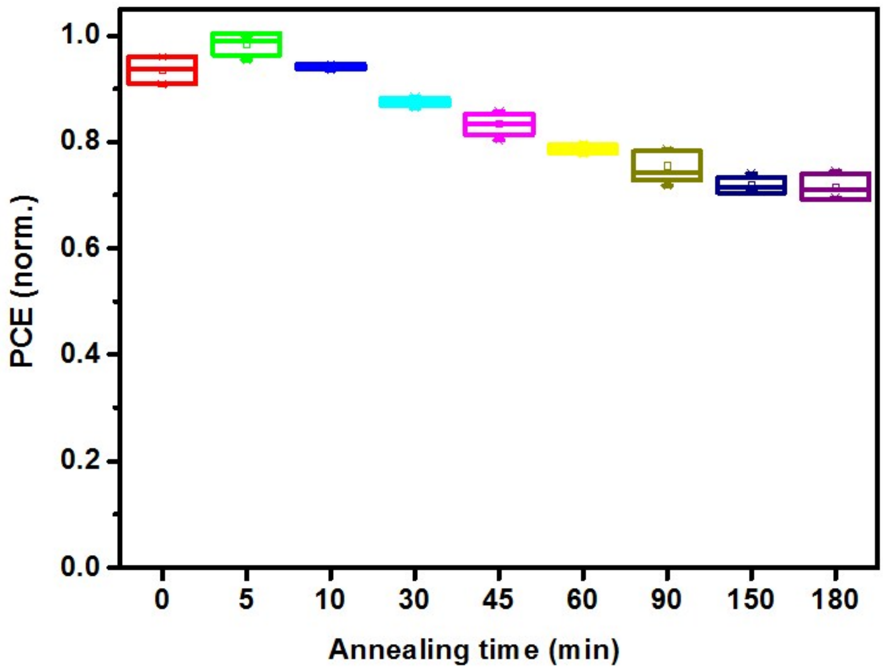

Figure S7. The efficiency distribution of the $Cs_{0.1}MA_{0.9}PbI_3$ perovskite solar cells fabricated with different annealing time at 100℃ from 0 min to 180 min.

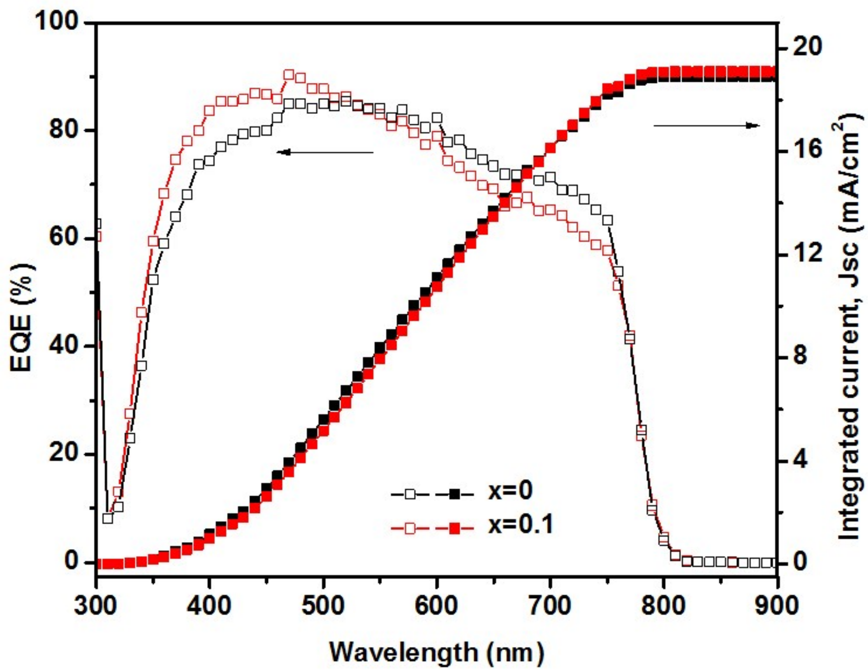

Figure S8. External quantum efficiency (EQE) and integrated current (J_{sc}) of $Cs_xMA_{1-x}PbI_3$ (x=0, 0.1) solar cells.

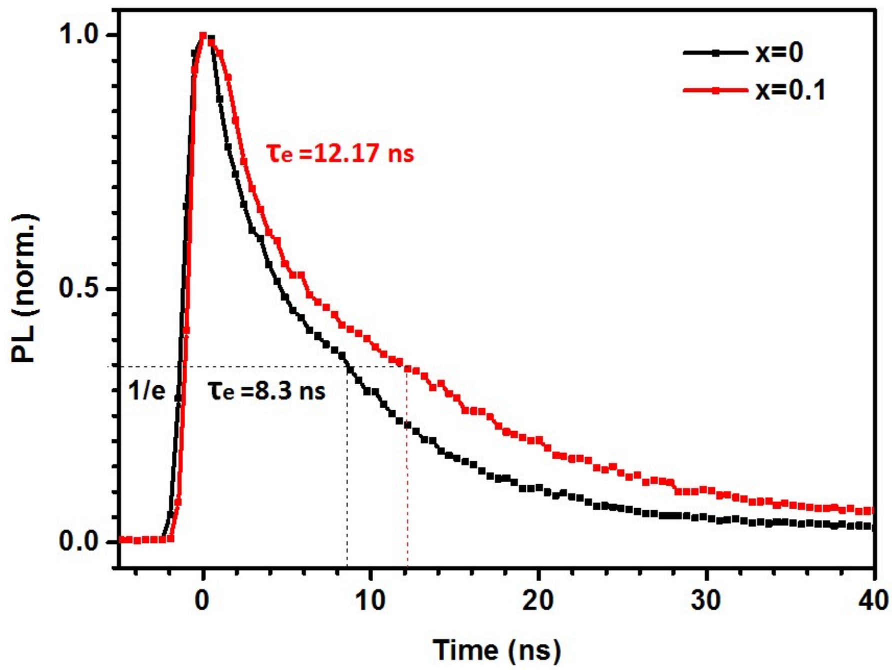

Figure S9. Time-resolved PL measurements, with lifetimes τ_e quoted as the time taken to reach 1/e of the initial intensity for $Cs_xMA_{1-x}PbI_3$ (x=0, 0.1) solar cells.

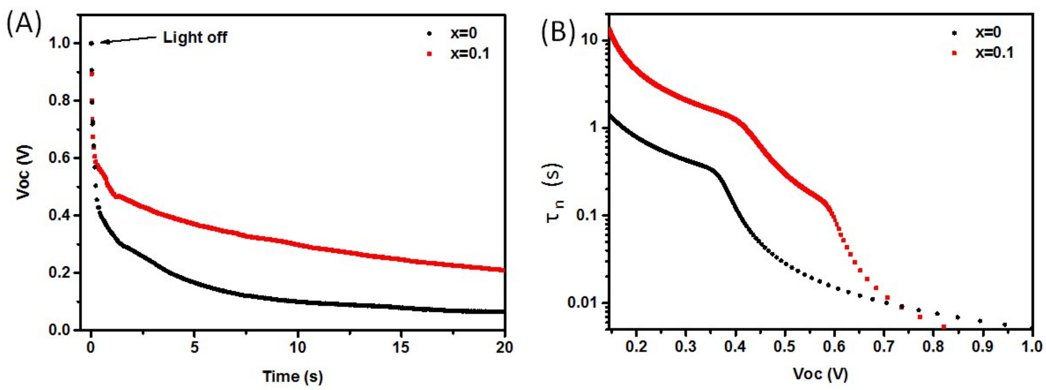

Figure S10. (A) V_{oc} decay curves and (B) Electron lifetime τ_n extracted from $V_{oc}(t)$ as a function of V_{oc} of $Cs_xMA_{1-x}PbI_3$ (x=0, 0.1) solar cells.

The OCVD technique is a method that consists of turning off the illumination in a steady state and monitoring the subsequent decay of voltage, Voc. The response time is obtained by the reciprocal of the derivative of the decay curve normalized by the thermal voltage:

$$\tau_n = -\frac{k_B T}{e}\left(\frac{dV_{oc}}{dt}\right)^{-1}$$

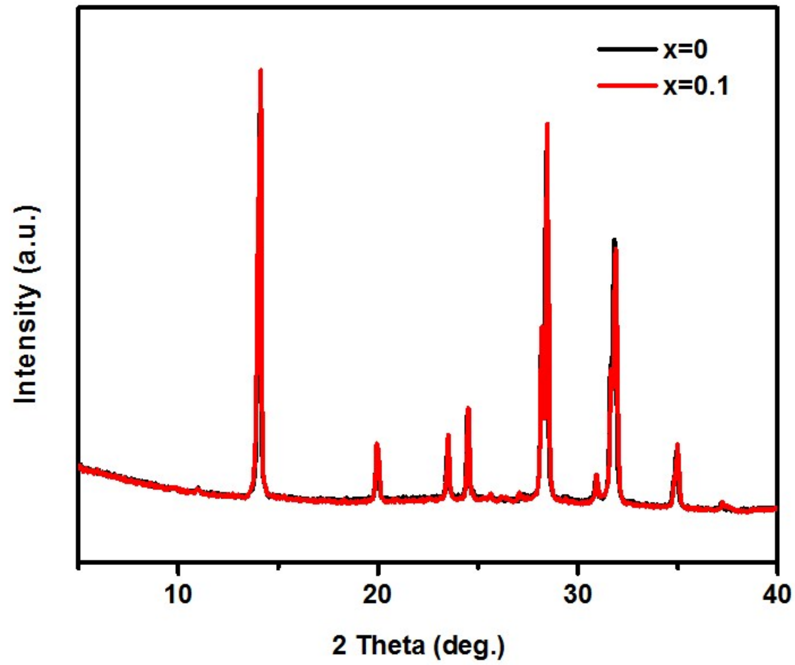

Figure S11. XRD patterns of $Cs_xMA_{1-x}PbI_3$ (x=0, 0.1) powder.

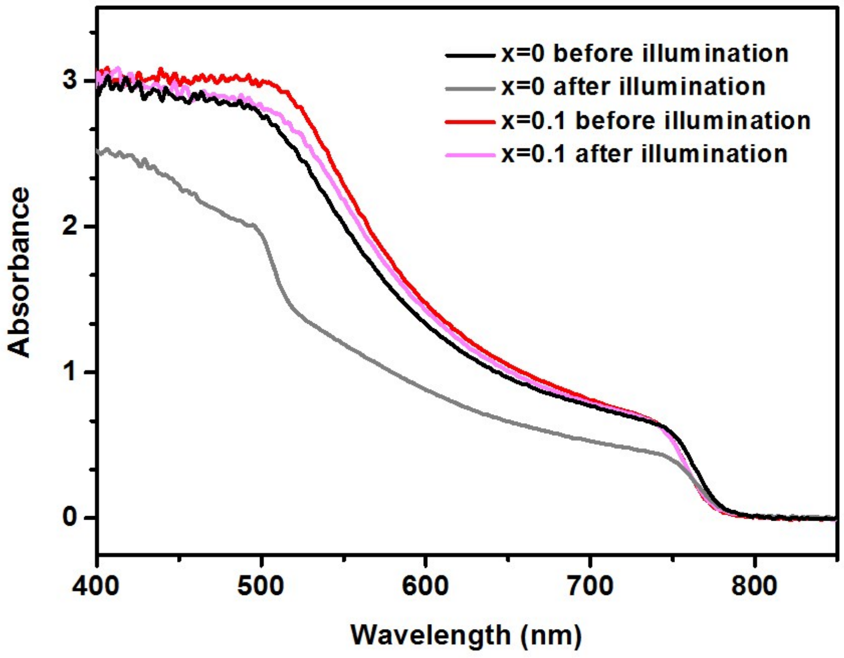

Figure S12. UV-Vis absorbance spectra of $Cs_xMA_{1-x}PbI_3$ (x=0, 0.1) perovskite films before and after one sun illumination for 3 h without any protection under a humidity of 40%.

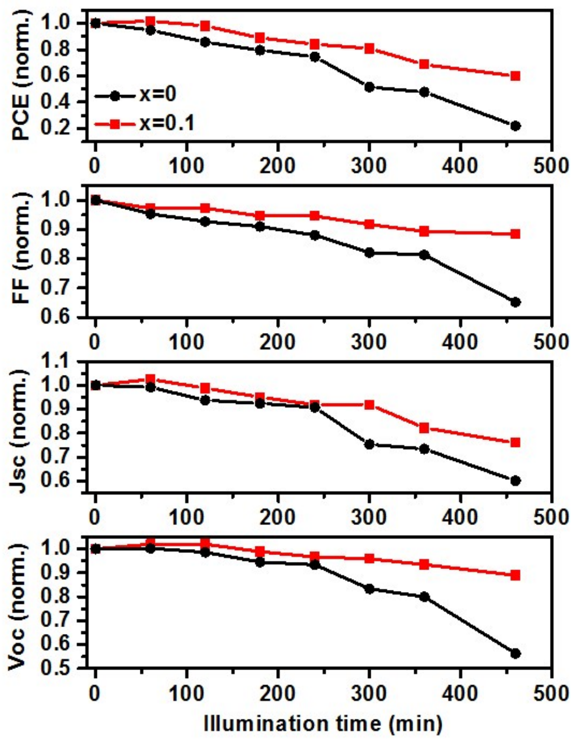

Figure S13. Comparison of the stability of CsxMA1-xPbI3 (x=0, 0.1) perovskite solar cells.

The unsealed solar cells were kept under continuous illumination in 40% humidity condition. It is worth noting that the devices were kept at an open circuit condition, which can highly accelerate the ions migration than the short circuit state.