

Supporting Information

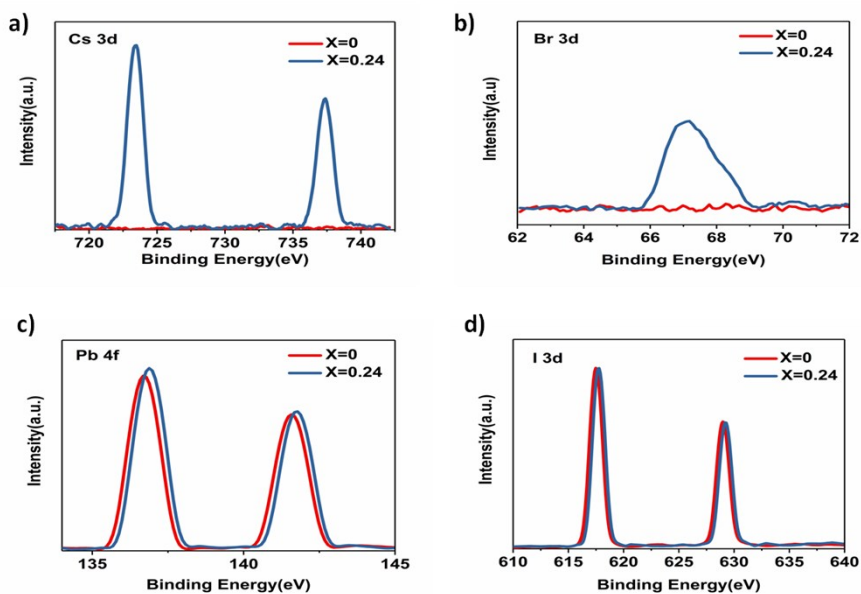


Fig. S1 XPS spectra of the perovskite films with $x=0$ and $x=0.24$ for (a) Cs 3d, (b) Br 3d, (c) Pb 4f, (d) I 3d.

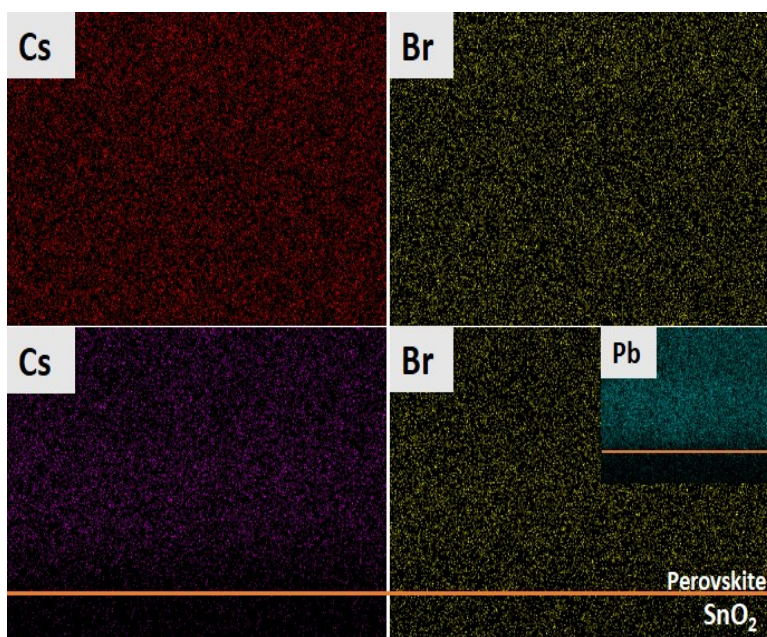


Fig.S2 EDS mapping of Cs_xFA_{1-x}PbI_{3-x}Br_x perovskite film from surface and cross-section

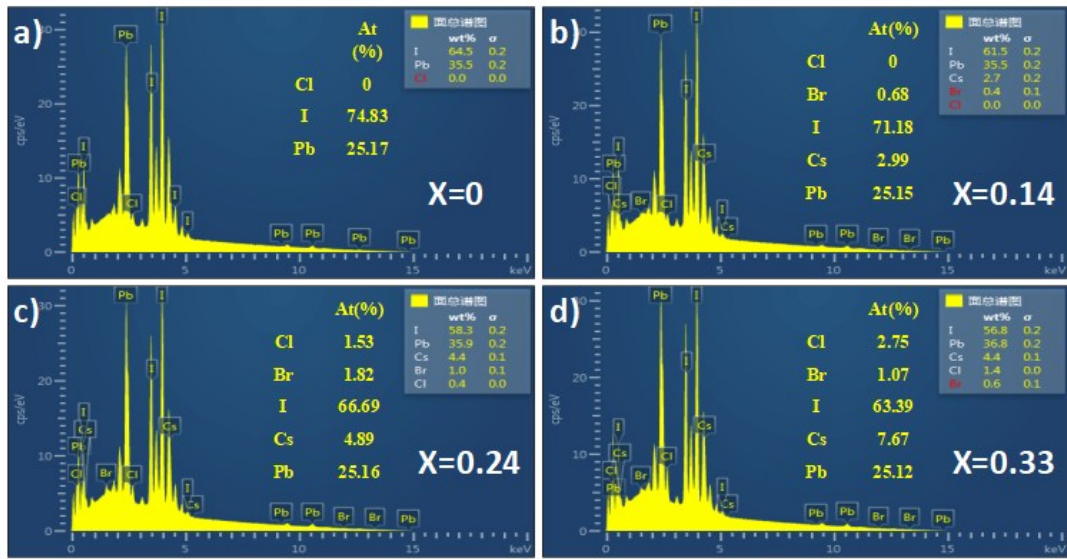


Fig. S3 The elements content of perovskite films with X=0, X=0.14, X=0.24 and x=0.33, which prepared by solid-vapor reaction in FAcI/FAI vapor.

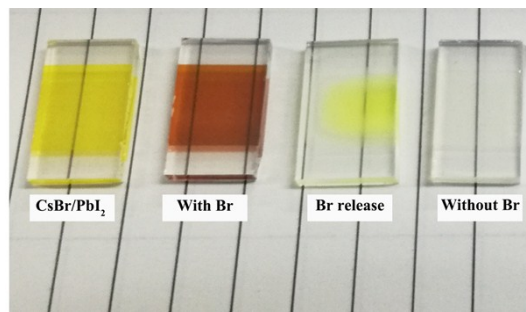


Fig. S4 The color evolution of CsBr/PbI₂ composite film reacted with pure FAcI gas.

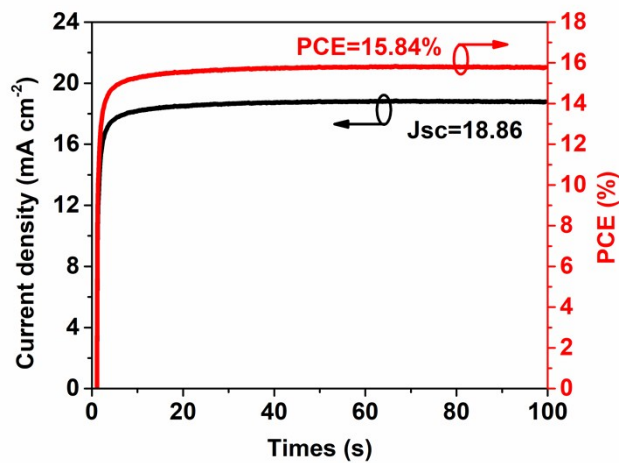


Fig. S5 Steady-state current of Cs_{0.24}FA_{0.76}PbI_{3-y}Br_y perovskite cell.

Table S1 Comparison of PL decay fitting parameters between different perovskite films.

Lifetime	X=0	X=0.14	X=0.24	X=0.33
τ 1(ns)	4.3	3.94	10.68	5.75
τ 2(ns)	33.57	273.01	306.5	257.72