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

Supporting Information

$FAPb_{1-x}Sn_xI_3$ mixed metal halide perovskite with improved light harvesting and stability for efficient planar heterojunction solar cells

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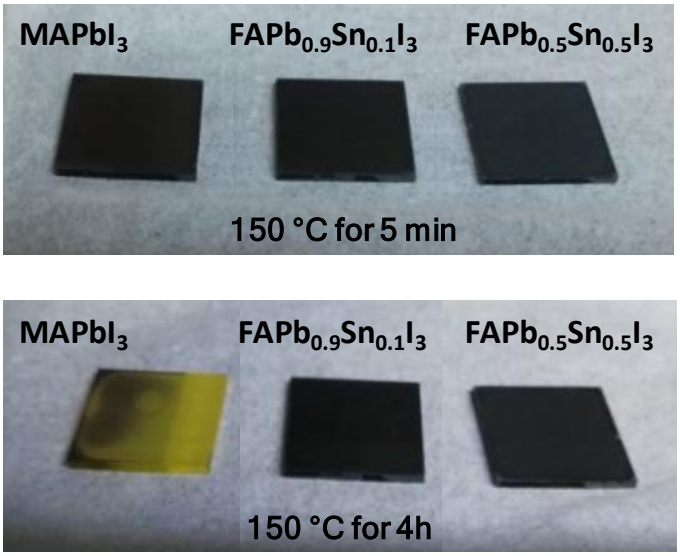


Figure S1. Images of $MAPbI_3$, $FAPb_{0.9}Sn_{0.1}I_3$ and $FAPb_{0.5}Sn_{0.5}I_3$ films annealed under different conditions.

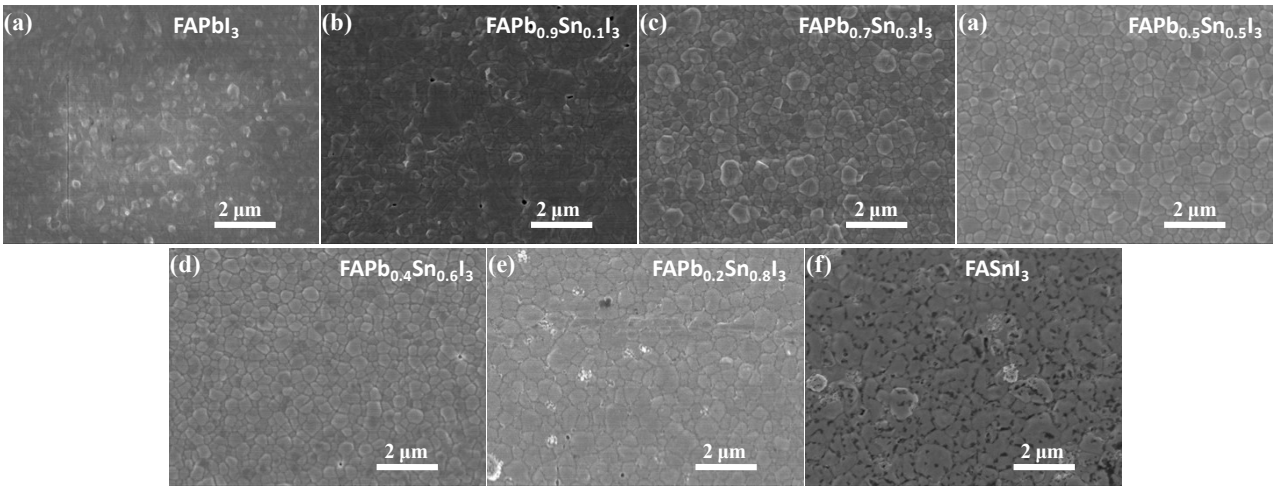


Figure S2. Low magnification SEM images of $FAPb_{1-x}Sn_xI_3$ films on ITO-coated substrates

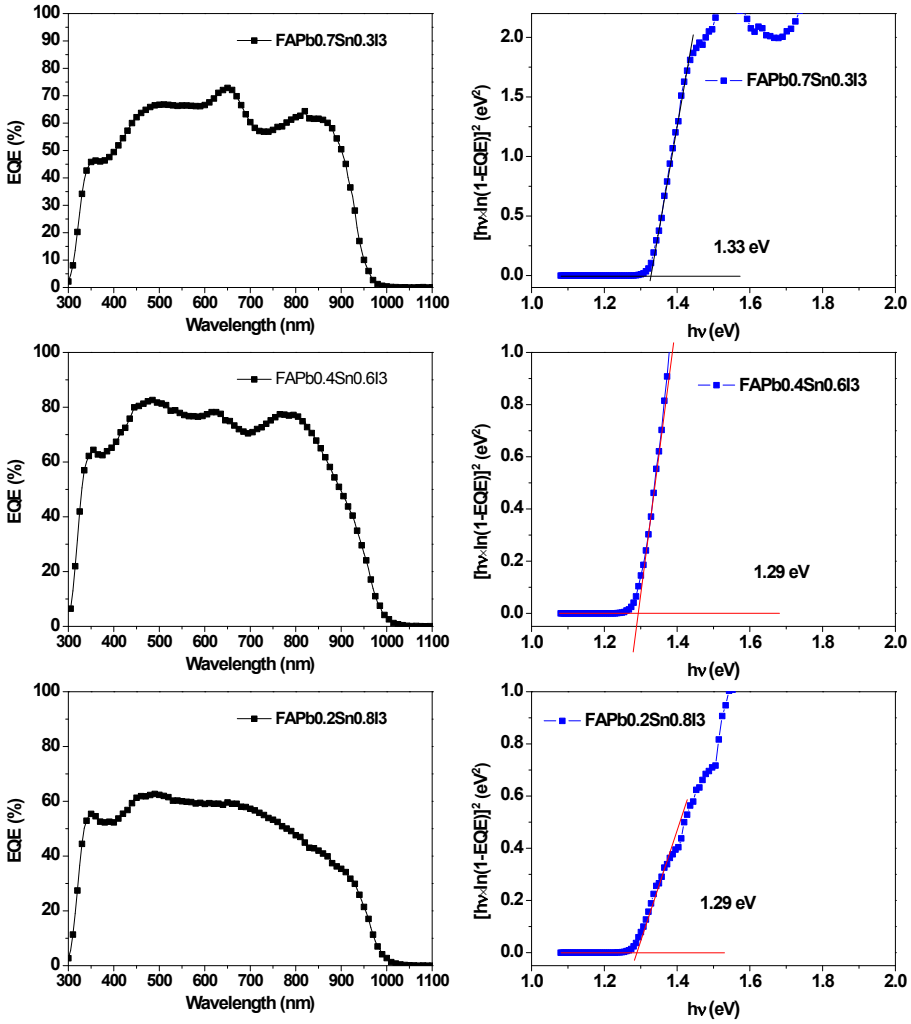


Figure S3. External quantum efficiency (EQE) of $FAPb_{1-x}Sn_xI_3$ perovskite solar cells with x = 0.3, 0.6 and 0.8.

Table S1 Photovoltaic parameters of $FAPb_{1-x}Sn_xI_3$ perovskite solar cells with increasing Sn contents.

Devices		J_{sc} (mA·cm^{-2})	V_{oc} (mV)	*FF* (%)	PCE (%)
$FAPbI_3$	Average	15.56±1.77	866±18	45.9±3.5	6.19±0.89
	Best	18.10	856	49.4	7.65
$FAPb_{0.9}Sn_{0.1}I_3$	Average	18.57±1.20	580±38	30.1±1.7	3.26±0.49
	Best	21.22	631	30.9	4.13
$FAPb_{0.7}Sn_{0.3}I_3$	Average	20.89±1.61	634±24	43.1±5.3	5.85±1.15
	Best	22.77	654	50.1	7.47
$FAPb_{0.5}Sn_{0.5}I_3$	Average	26.29±1.88	686±23	51.5±2.7	9.35±0.94
	Best	28.37	695	54.6	10.76
$FAPb_{0.4}Sn_{0.6}I_3$	Average	24.73±0.88	601±22	50.9±1.6	7.57±0.40
	Best	26.03	603	52.3	8.21
$FAPb_{0.2}Sn_{0.8}I_3$	Average	14.59±2.73	429±75	45.0±4.5	2.87±0.88
	Best	17.81	471	50.2	4.21
$FASnI_3$	Average	8.36±2.40	200±66	30.2±5.0	0.58±0.44
	Best	14.42	308	40.5	1.80

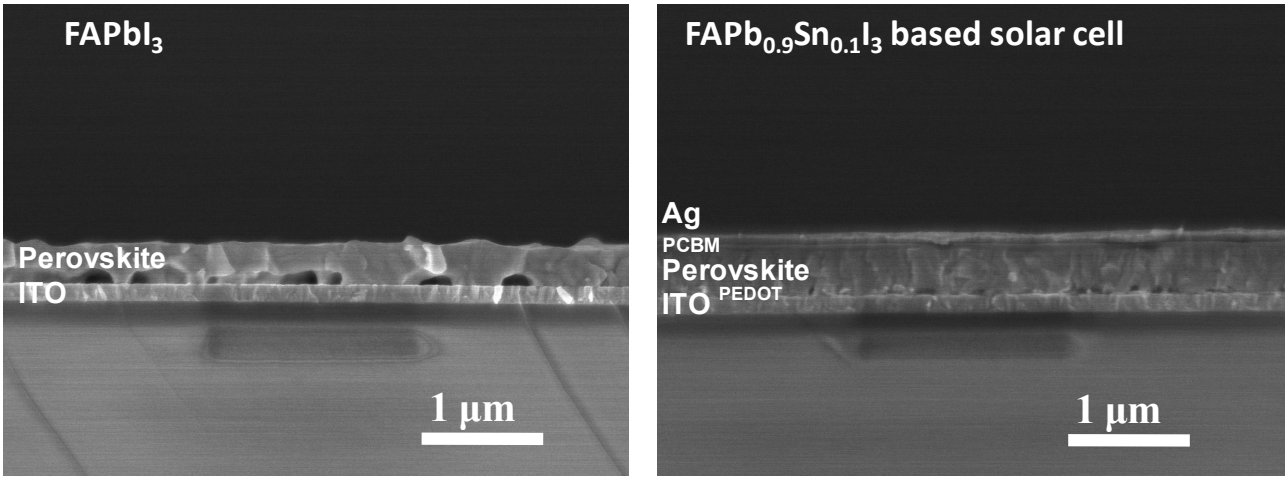
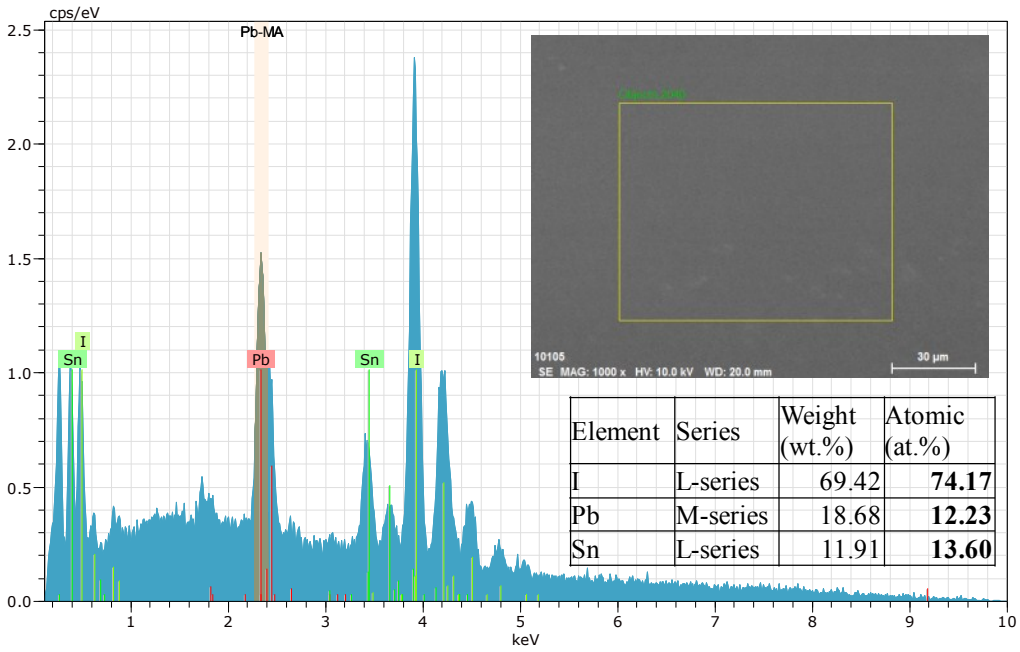


Figure S4. Cross-section Scanning Electron Micrograph (SEM) images of perovskite films



Element	Series	Weight (wt.%)	Atomic (at.%)
I	L-series	69.42	**74.17**
Pb	M-series	18.68	**12.23**
Sn	L-series	11.91	**13.60**

Figure S5. EDX analysis of $FASn_{0.5}Pb_{0.5}I_3$ perovskite film on glass substrate.

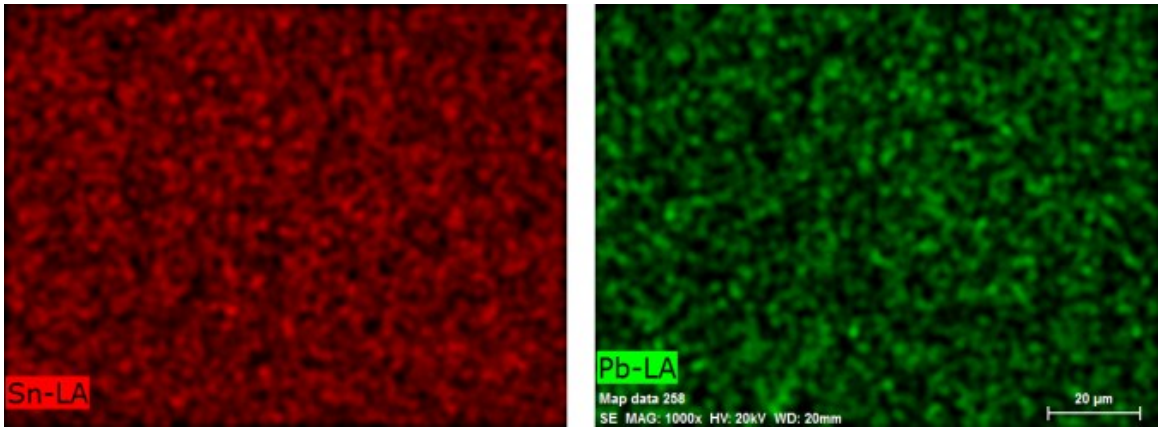


Figure S6. Elemental mapping images of $FASn_{0.5}Pb_{0.5}I_3$ perovskite film.

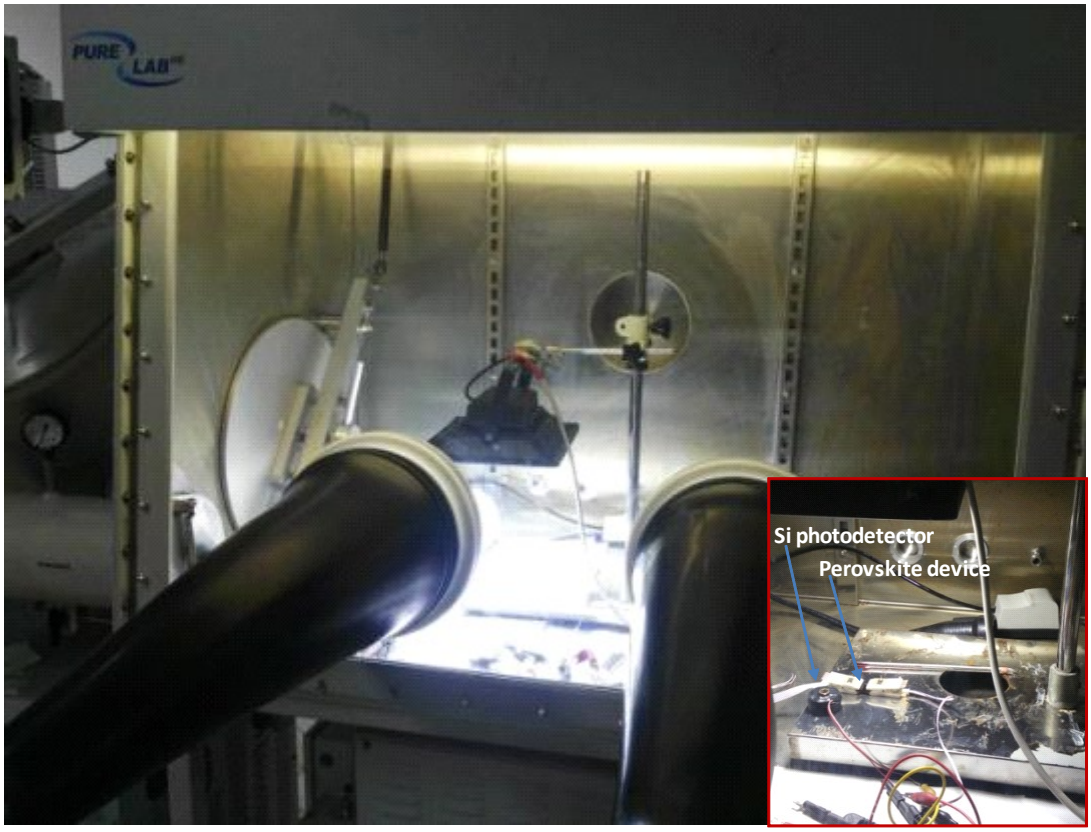


Figure S7. Stability measurement for perovskite solar cell.

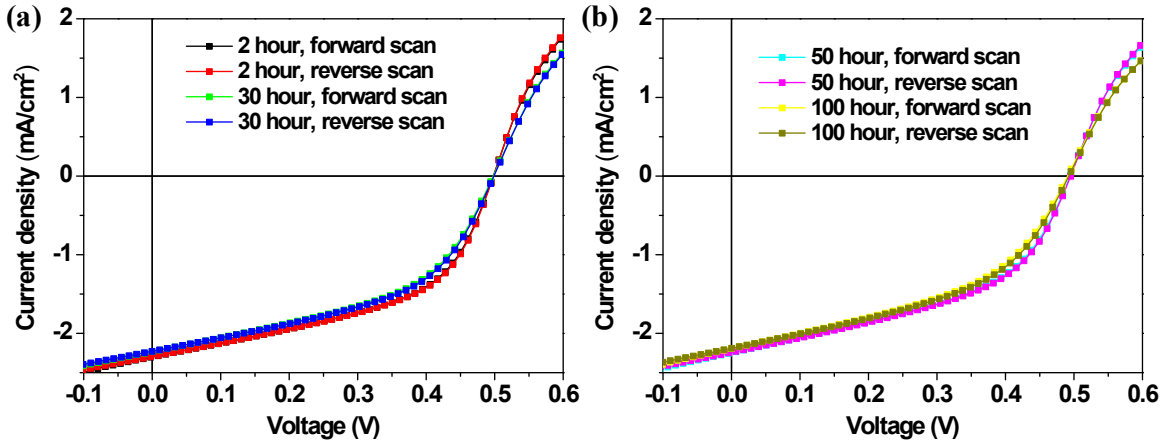


Figure S8. J-V curves of the perovskite solar cell measured under LED array light for different storage times.