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

The role of interface between electron transport layer and perovskite in halogen migration and stabilizing perovskite solar cells with Cs4SnO4

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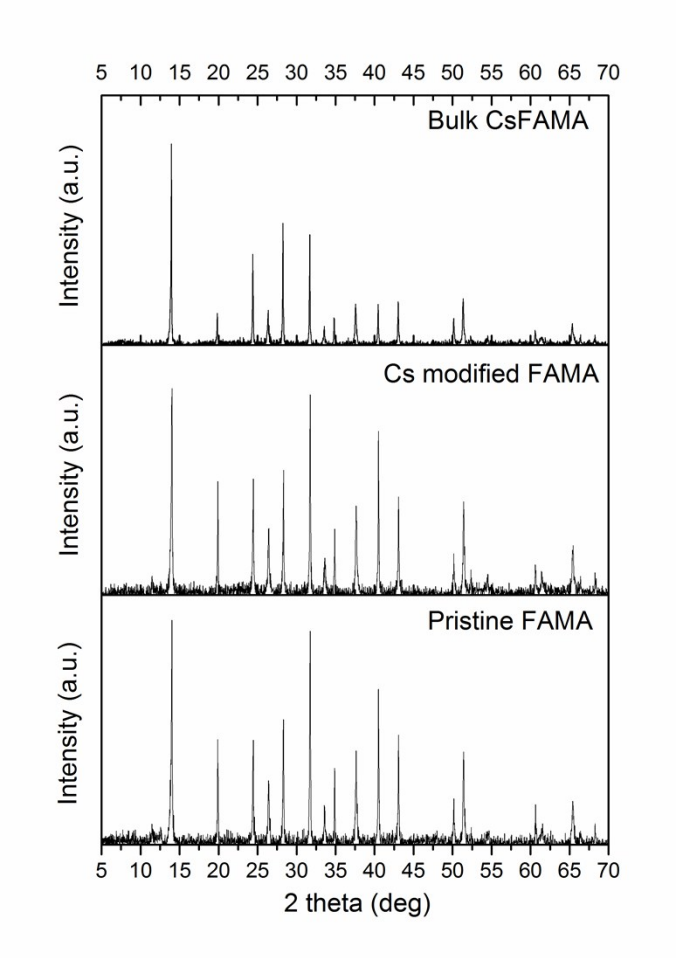

Figure S1. XRD of Pristine FAMA, Cs modified FAMA and bulk CsFAMA.

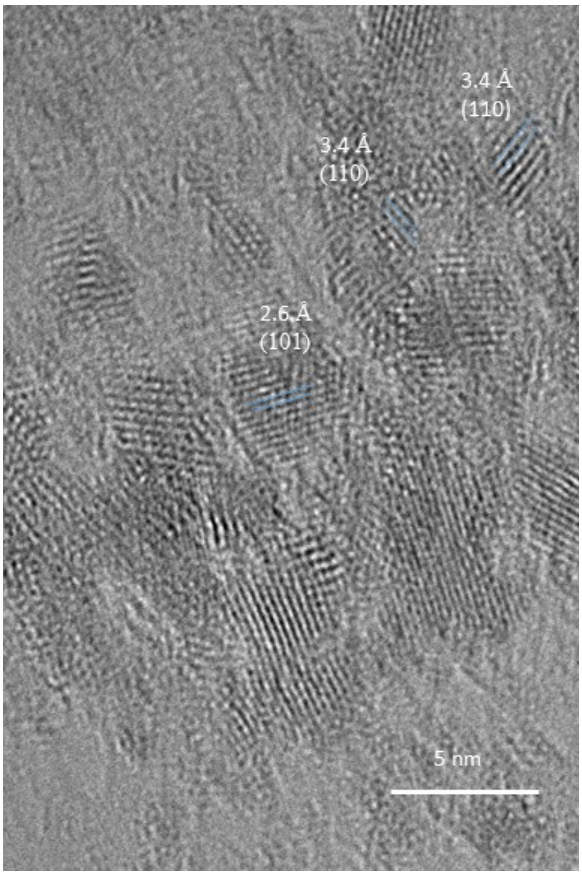

Figure S2. TEM image of SnO_2 nanoparticles.

In order to examine the effect of the interficial Cs_4SnO_4 and Cs^+ on the morphology of perovskite, SEM images of pristine FAMA, Cs_4SnO_4 modified FAMA and bulk CsFAMA are shown in Figure S2. Pristine FAMA and Cs_4SnO_4-modified FAMA exhibit larger grain sizes compared with bulk CsFAMA, while the large grain size is beneficial for the crystallinity and device performance.

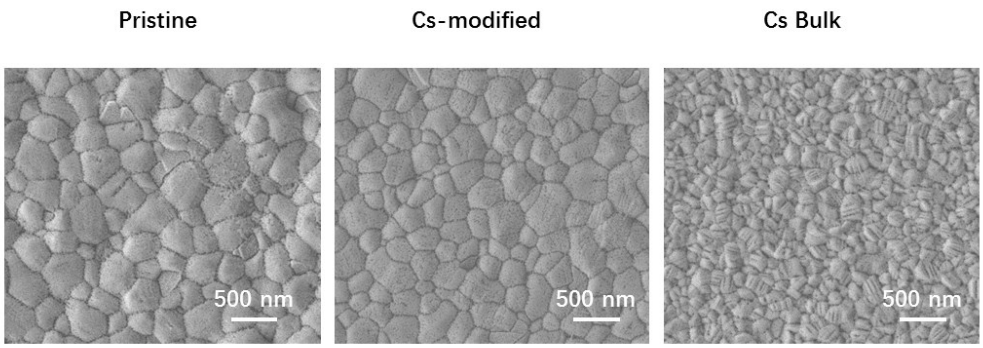

Figure S3. SEM images of pristine FAMA, Cs modified FAMA and bulk CsFAMA.

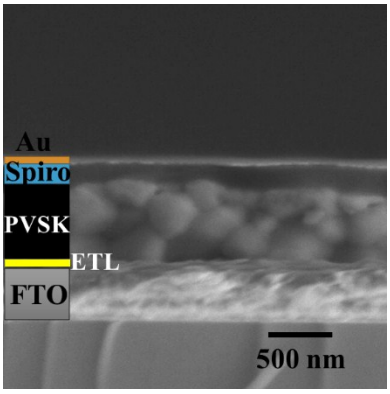

Figure S4. SEM image of a cross section of a complete Cs-modified device.

The depth profiles of Br^+ for prisitne CsFAMA and Cs_4SnO_4-modified device before and after 15 h photoaging are shown in Figure S5. Loss of Br- occurred at the interface of perovskite/ETL. Compare to the loss of Br-, the decrease of I in the control device is more severe (Figure 7), this means I ions are the species most likely to release from perovskite.

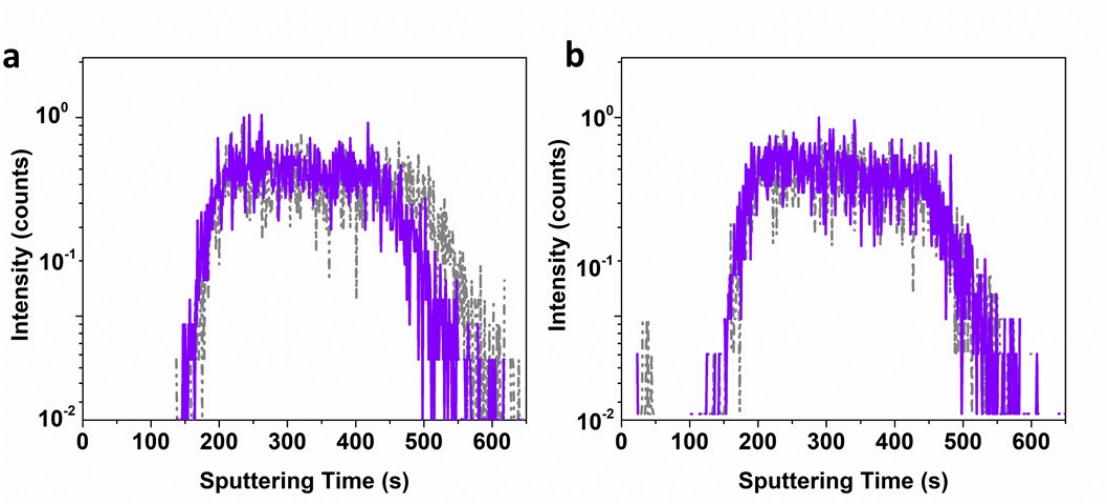

Figure S5. Normalized ToF- SIMS elemental depth profiles of Br^+ for a) Prisitne CsFAMA and b) Cs_4SnO_4-modified device. Grey line: before photoaging; purple line: after 15h photoaging.

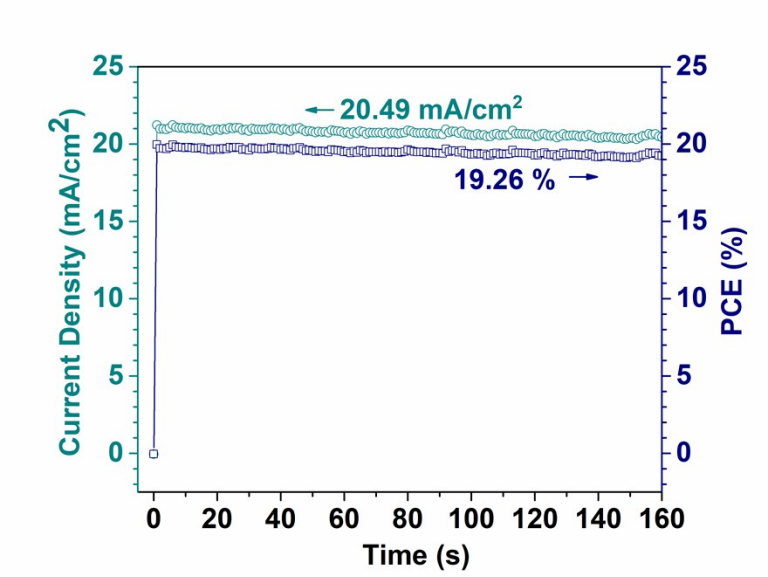

Figure S6. Stablized current density and PCE of Cs-modified device.

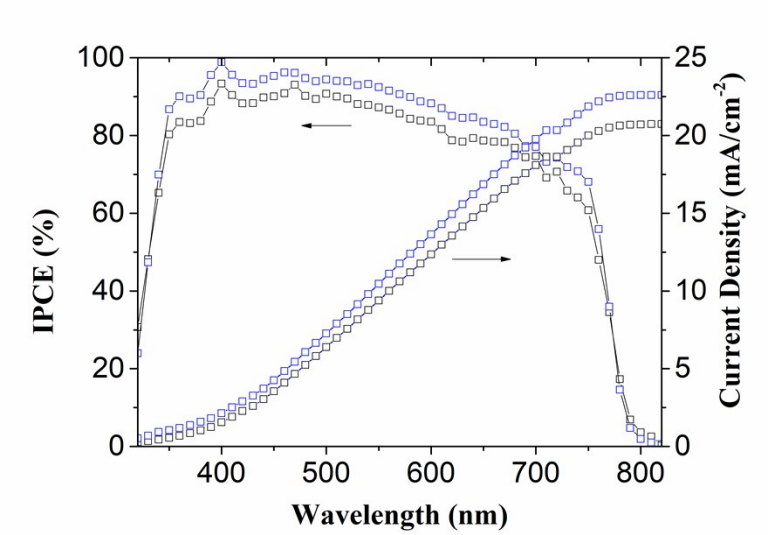

Figure S7. IPCE spectra and integrated current density of the pristine and Cs-modified device.

Table S1. The photovoltaic parameters and hysteresis effect index (H_i) of the CsFAMA devices.

Device	Scan direction	J_{SC} (mA/cm^2)	V_{OC} (V)	FF (%)	Eff. (%)	H_i
CsFAMA	R	21.30	1.15	0.70	17.07	0.083
	F	21.26	1.16	0.65	16.02	

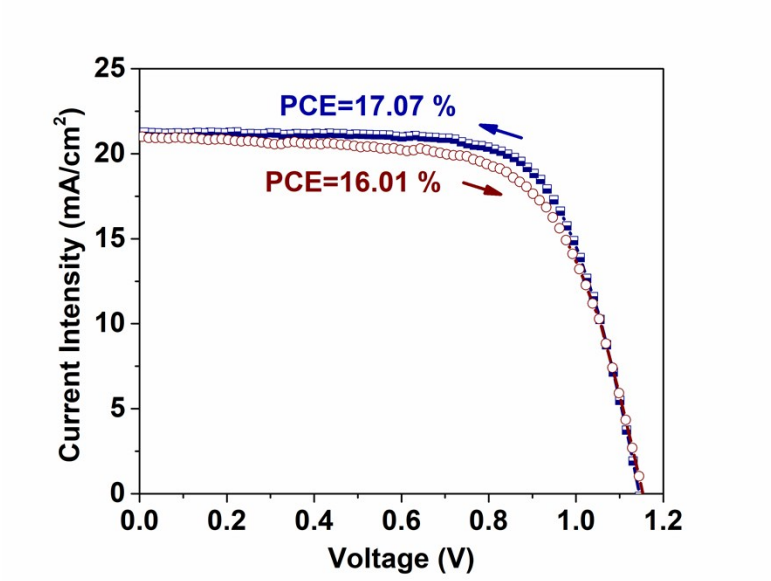

Figure S8. J-V Curves of CsFAMA performed with F/R scan.

Table S2. Complete photovoltaic parameters of pristine device.

		J_{SC}(mA/cm^2)	V_{OC}(V)	FF	Eff.(%)
Pristine reverse	1	21.85746	1.12875	0.679206	16.75712
	2	22.22868	1.12875	0.69716	17.49217
	3	22.69813	1.14445	0.69508	18.05599
	4	22.35994	1.12875	0.690885	17.4371
	5	22.52158	1.14445	0.672514	17.33393
Pristine forward	1	21.68932	1.1347	0.65501	16.12041
	2	22.11881	1.15045	0.66637	16.95675
	3	22.65756	1.15045	0.63056	16.43649
	4	22.28319	1.15045	0.63409	16.25538
	5	22.53003	1.15045	0.62316	16.15206

Table S3. Complete photovoltaic parameters of Cs_4SnO_4-modified device.

		J_{SC}(mA/cm^2)	V_{OC}(V)	FF	Eff.(%)
Cs_4SnO_4-modified reverse	1	22.6538	1.14445	0.71347	18.49752
	2	22.8016	1.16015	0.72003	19.04715
	3	22.82245	1.16015	0.706658	18.7105
	4	22.52173	1.16015	0.692653	18.09804
	5	22.81529	1.16015	0.726435	19.22814
Cs_4SnO_4 - modified forward	1	22.58385	1.15045	0.68654	17.83743
	2	22.79562	1.15045	0.68352	17.92542
	3	22.72954	1.16625	0.69654	18.46404
	4	22.43222	1.16625	0.69031	18.05963
	5	22.76402	1.15045	0.70022	18.33799