SUPPORTING INFORMATION

Regulated Crystallization of Efficient and Stable Tin-based Perovskite Solar Cells via Self-sealing Polymer

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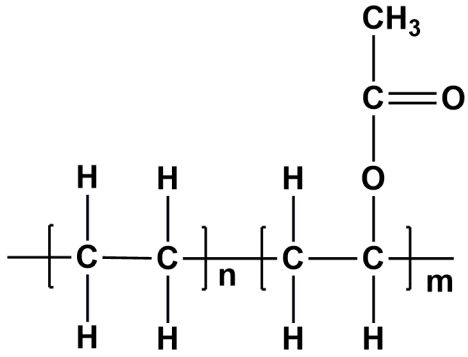

Figure S1. Molecular structure of EVA.

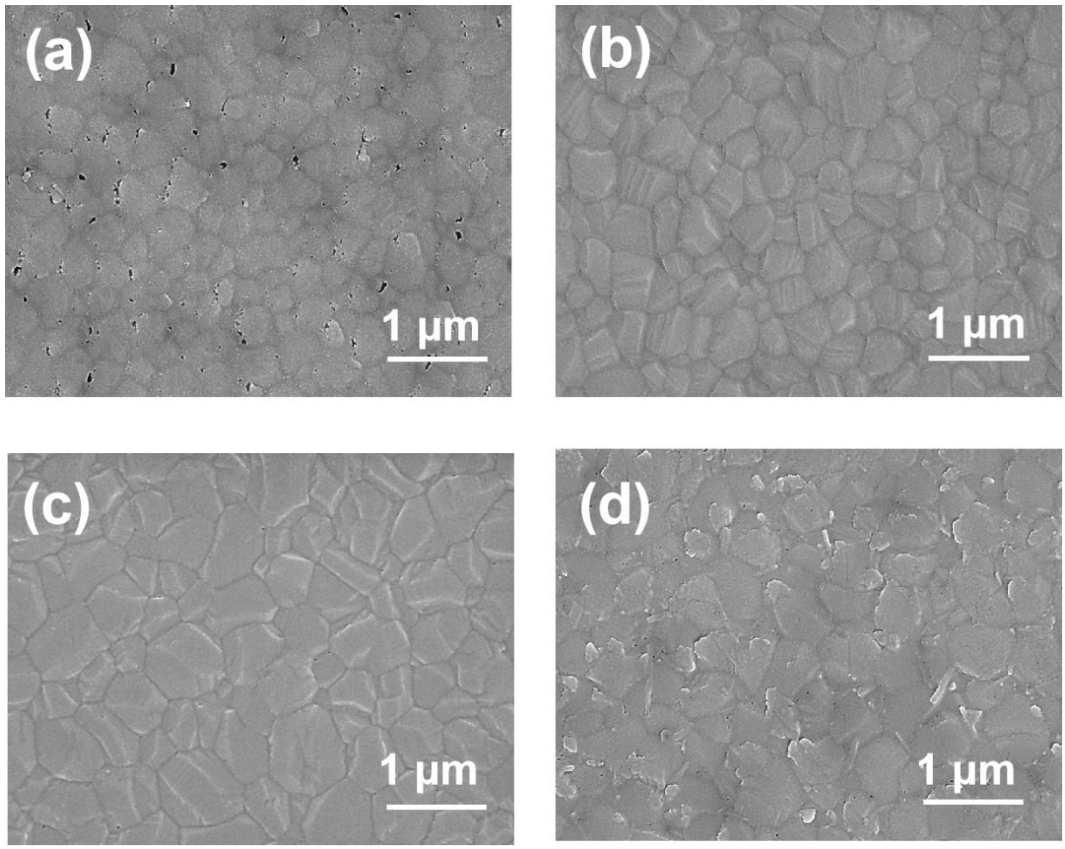

Figure S2. SEM images of perovskite films treated by EVA with different concentrations: (a) 0 mg/mL, (b) 1 mg/mL, (c) 2 mg/mL and (d) 5 mg/mL.

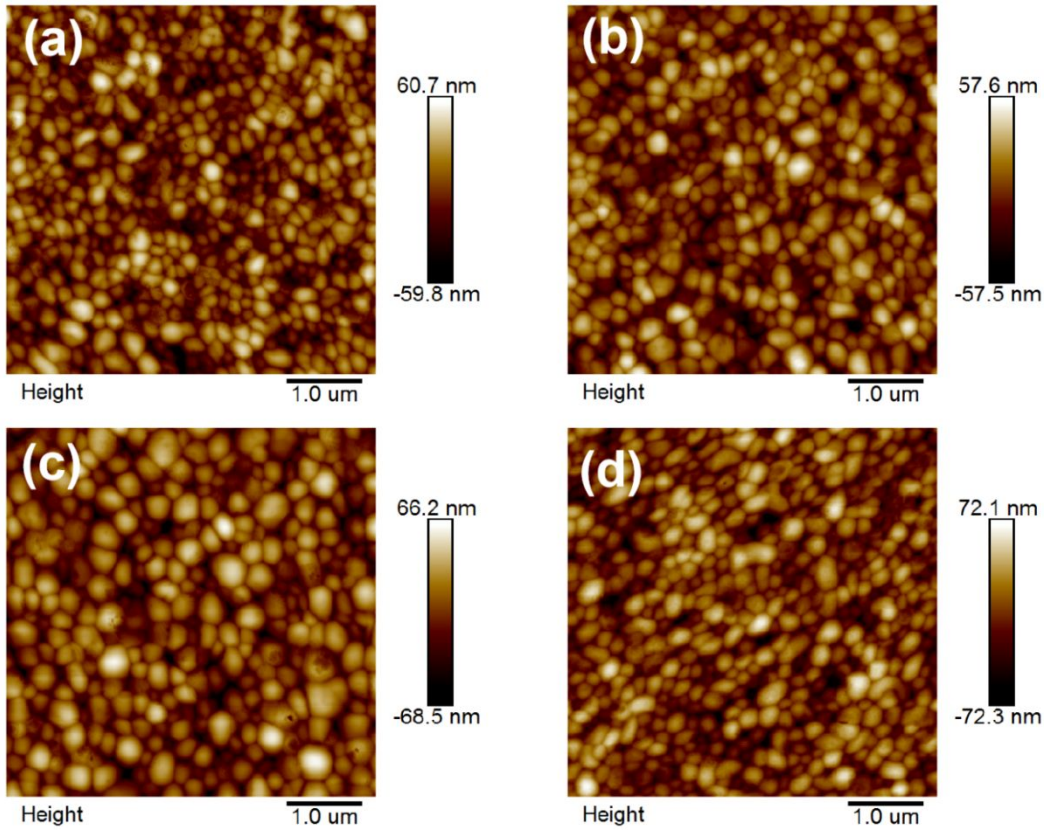

Figure S3. AFM height images of perovskite films treated by EVA with different concentrations: (a) 0 mg/mL, (b) 1 mg/mL, (c) 2 mg/mL and (d) 5 mg/mL.

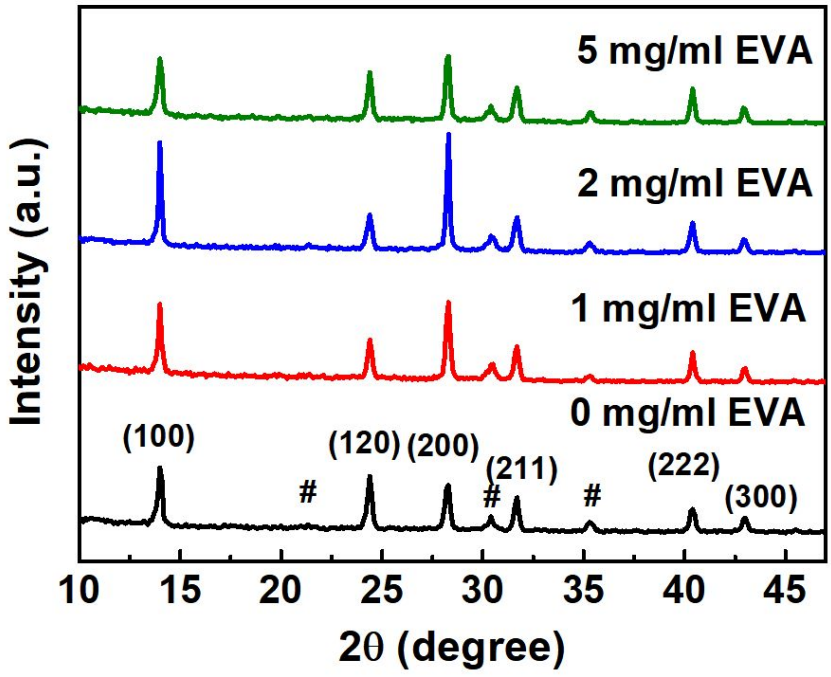

Figure S4. GIXRD patterns of perovskite films treated by EVA with different concentrations (0 mg/mL, 1 mg/mL, 2 mg/mL and 5 mg/mL).

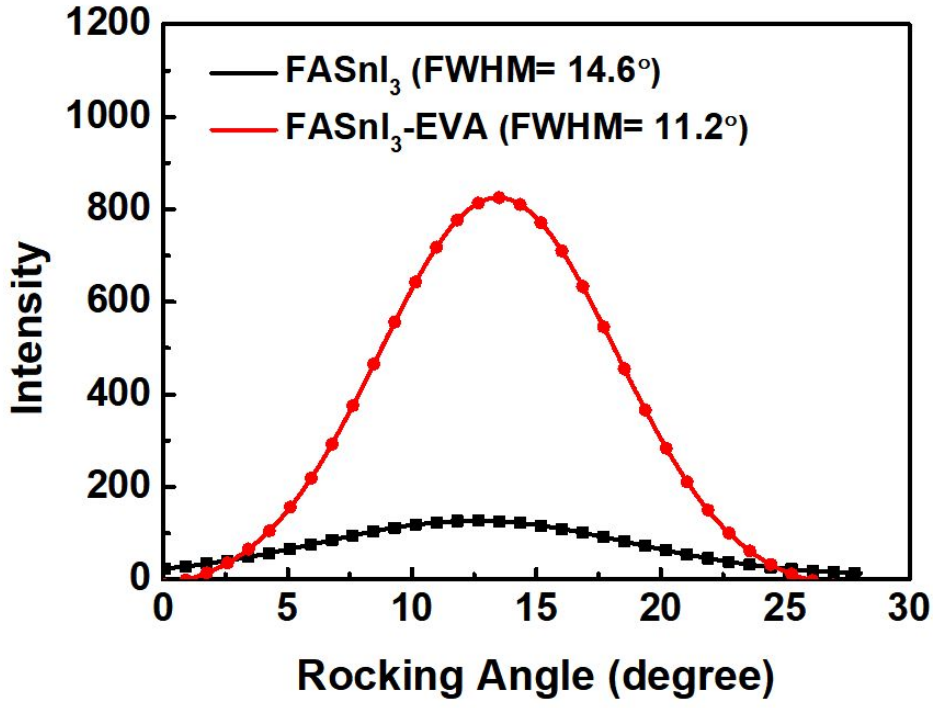

Figure S5. X-ray diffraction rocking curves of the (200) plane for the $FASnI_3$ and $FASnI_3$-EVA perovskite films, respectively.

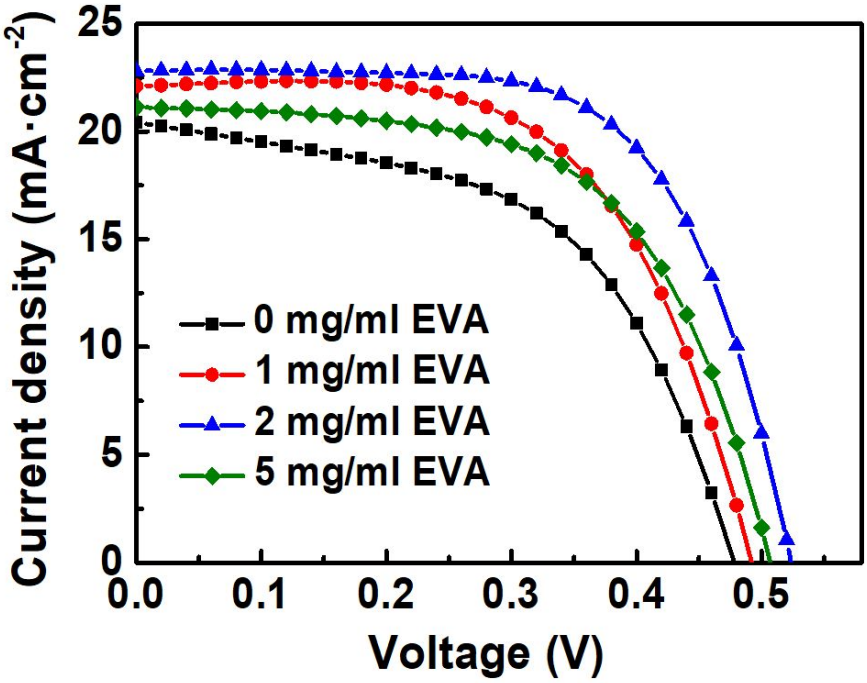

Figure S6. *J-V* curves of the PVSCs with different concentrations (0 mg/mL, 1 mg/mL, 2 mg/mL, 5 mg/mL) of EVA treatment.

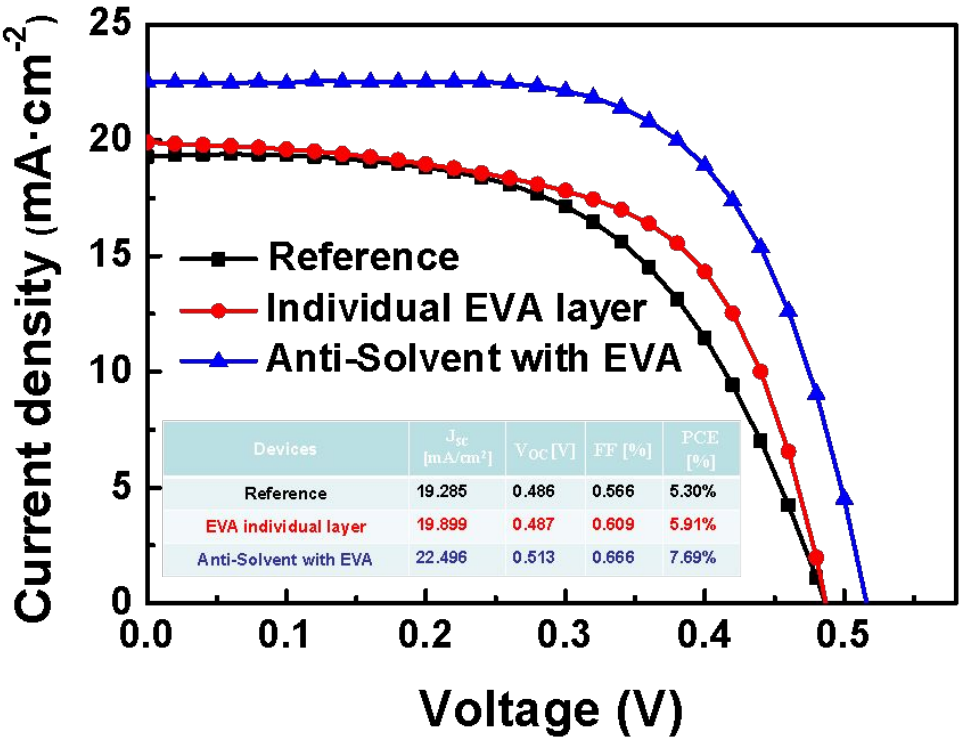

Figure S7. *J-V* curves of the PVSCs fabricated by conventional CB anti-solvent (reference), anti-solvent with EVA and spin-coating an individual EVA layer, respectively.

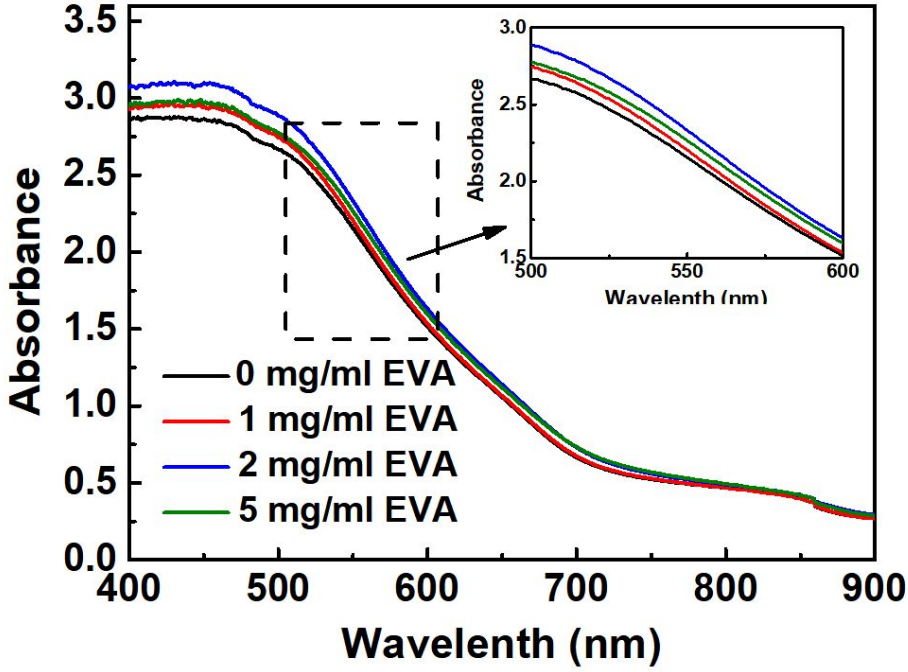

Figure S8. UV-vis absorption spectra of perovskite films that treated by EVA with different concentrations (0 mg/mL, 1 mg/mL, 2 mg/mL and 5 mg/mL).

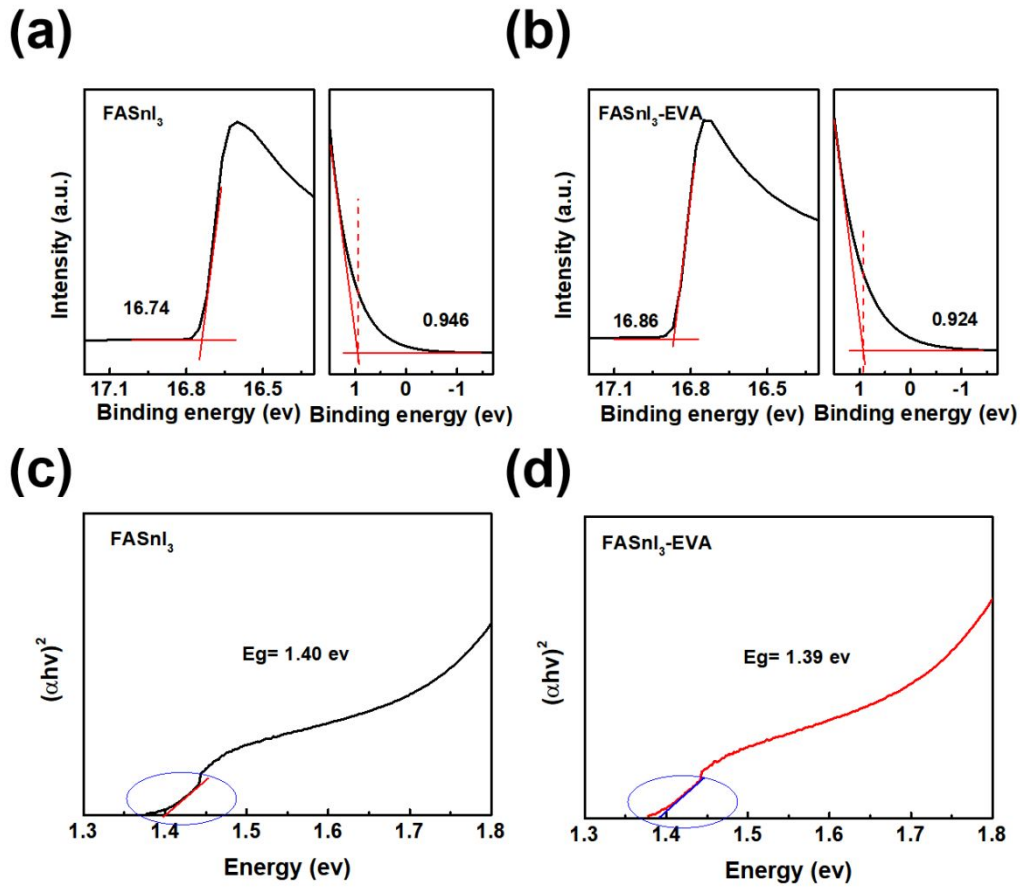

Figure S9. Ultraviolet photoelectron spectroscopy (UPS) of secondary electron cut off and valence band of the $FASnI_3$ films without (a) and with (b) EVA treatment. The relationship of $(\alpha h\upsilon)^2$ vs energy for the $FASnI_3$ films without (c) and with (d) EVA treatment.

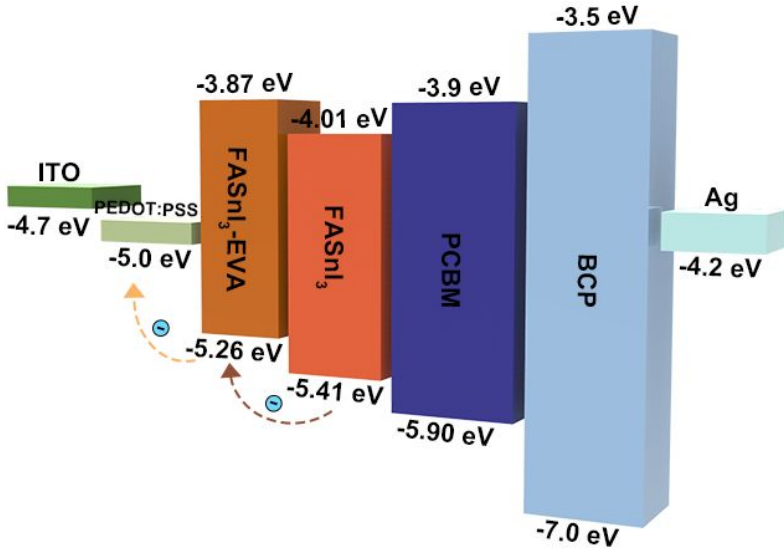

Figure S10. Schematic energy level diagram of materials used in the fabricated perovskite solar cells.

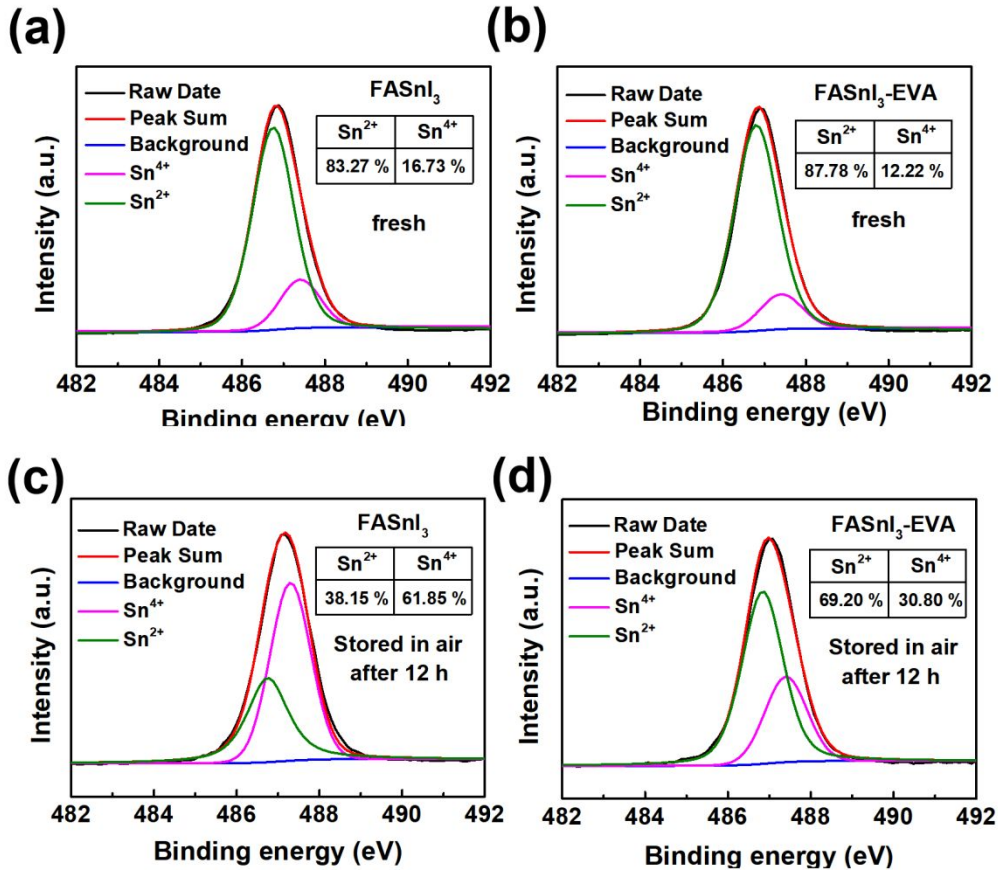

Figure S11. X-ray photoelectron spectra of the fresh $FASnI_3$ perovskite films without (a) or with (b) EVA treatment. X-ray photoelectron spectra of the ageing (stored in air for 12h) $FASnI_3$ perovskite films without (c) and with (d) EVA treatment

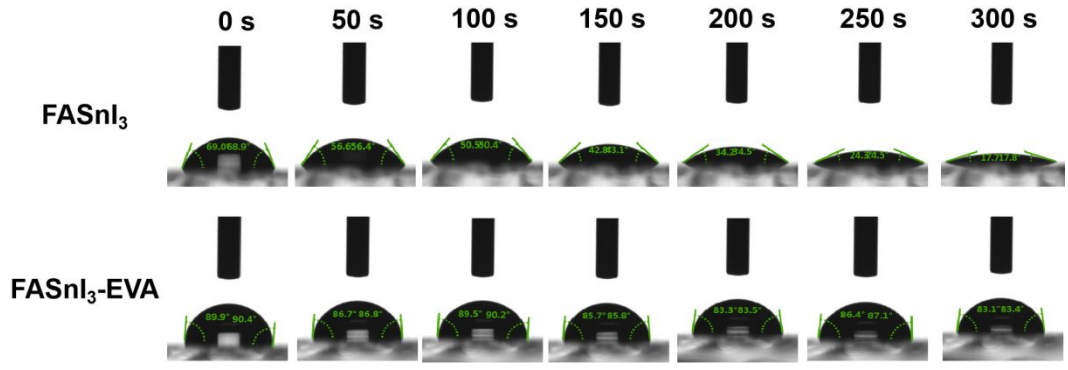

Figure S12. Contact angles of water droplets for $FASnI_3$ and $FASnI_3$-EVA perovskite films under different recording times (0-300 s).

Table S1. The current density-voltage (*J-V*) parameters of the $FASnI_3$ based PVSCs treated by EVA with different concentrations (0 mg/mL, 1 mg/mL, 2 mg/mL and 5 mg/mL).

EVA concentration	V_{oc} (V)	J_{sc} (mA/cm^2)	FF (%)	PCE (%)
0 mg/mL	0.487	20.433	53.474	5.23%
1 mg/mL	0.492	22.104	59.738	6.50%
2 mg/mL	0.523	22.800	64.690	7.72%
5 mg/mL	0.507	21.130	59.387	6.36%

Table S2. The parameters of time-resolved photoluminescence (TRPL) mesurements for $FASnI_3$ films deposited on glass substrate without and with EVA treatment.

Sample	τ_1 (ns)	Ratio (%)	τ_2 (ns)	Ratio (%)	τ_{ave} (ns)
$FASnI_3$	0.123	53.39	1.635	46.61	1.53
$FASnI_3$-EVA	0.135	41.40	3.063	58.60	2.97

The average PL lifetime (τ_{ave}) values were obtained by the intensity average method, given by $\frac{\sum_{i=1}^{n} A_i \tau_i^2}{\sum_{i=1}^{n} A_i \tau_i}$.

Table S3. The band structure parameters of the $FASnI_3$ film without and with EVA treatment.

Sample	E_{cutoff} (eV)	E_{oneset} (eV)	HOMO (eV)	LUMO (eV)
$FASnI_3$	16.74	0.946	-5.406	-4.006
$FASnI_3$-EVA	16.86	0.924	-5.264	-3.874

The lowest unoccupied molecular orbital (LUMO) levels were calculated by the formula: $E_{LUMO} = - [E_g + 21.22 - (E_{cutoff}-E_{oneset})]$ eV. The optical bandgap was estimated from the onset position of the absorption spectra and calculated by the equation: $E_g = 1240/\lambda_{onset}$.

Table S4. The lifetimes of $FASnI_3$ based PVSCs stored in air without encapsulation.

Absorber	Structure	PCE	Storage environment	Lifetime (Keep the initial value)	Ref
$FASnI_3$ ($SnCl_2$+KHQSA)	Inverted	6.67%	Air (RH=20%) Air (RH=45%)	500 h (≈80%) 168 h (≈80%)	[1]
$FASnI_3$ (SnF_2)	Inverted	5.12%	N_2 glove box Air (RH=40%)	720 h (≈95%) 8 h (≈65%)	[2]
$FASnI_3$ (SnF_2+PEAI)	Inverted	9.0%	Air (RH=20%)	80 h (≈60%)	[2]
$FASnI_3$ (SnF_2+TMA)	Inverted	7.09%	N_2 glove box Air (RH=50%)	480 h (≈ 80%) 20 h (0%)	[3]
$FA_{0.75}MA_{0.25}SnI_3$	Inverted	3.31%	Air (Humidity unknown)	1 h (0%)	[4]
$FASnI_3$ (SnF_2+5-AVAI)	Inverted	7.0%	N_2 glove box Air (RH=50%)	1000 h (≈90%) 50 h (≈40%)	[5]
$FASnI_3$ (SnF_2+PPAI)	Inverted	9.61%	N_2 glove box Air (RH=60%)	1440 h (≈92%) 10 h (≈60%)	[6]
$FASnI_3$ (SnF_2+EVA)	**Inverted**	**7.72%**	**N_2 glove box** **Air (RH=60%)**	**800 h (90.1%)** **48 h (62.4%)**	**This work**

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