

Supporting Information

**Soy Protein Enables Stable Perovskite Solar Cells by Defects
Passivation and Ion Migration Suppression**

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Figure S1. SP solution in DMSO.

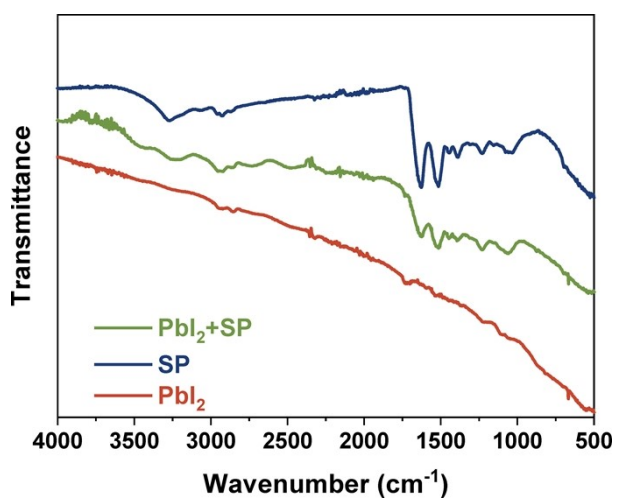


Figure S2. FTIR spectra of SP, PbI₂ and a mixture of SP+PbI₂.

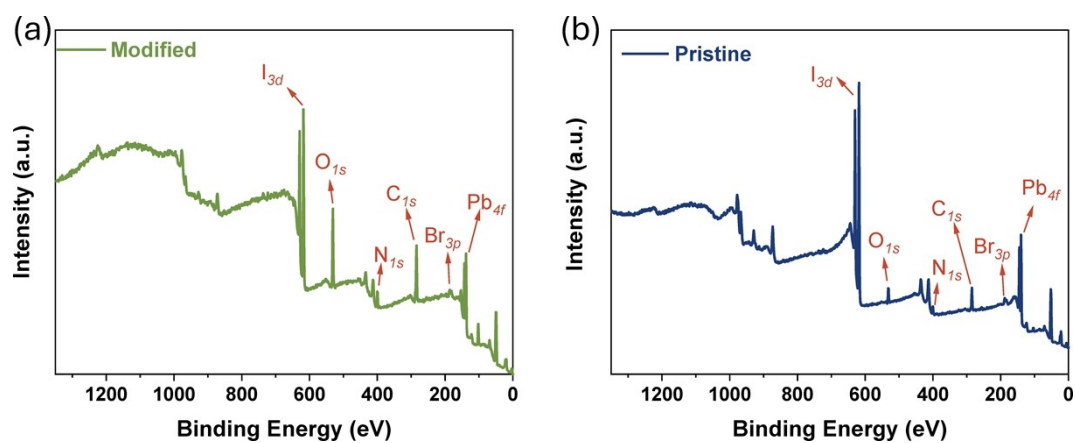


Figure S3. XPS spectrum of perovskite film (a) with and (b) without SP modification.

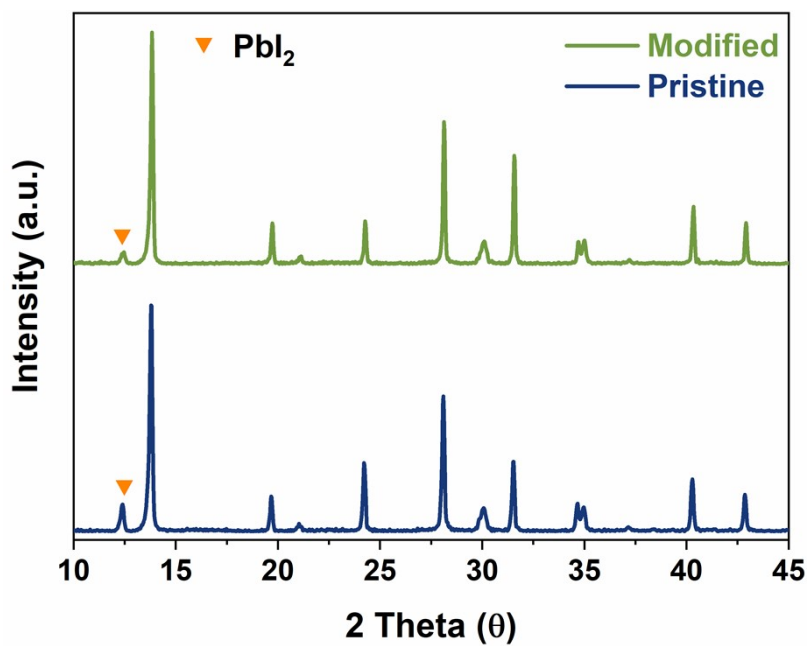


Figure S4. XRD results of pristine and modified perovskite film.

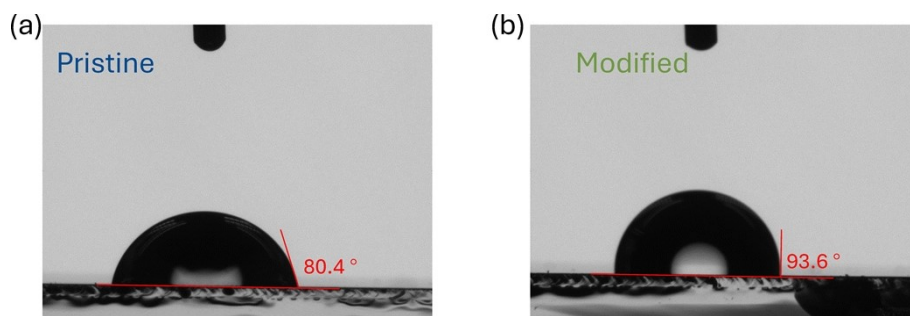


Figure S5. Water contact angles of (a) pristine and (b) modified perovskite films.

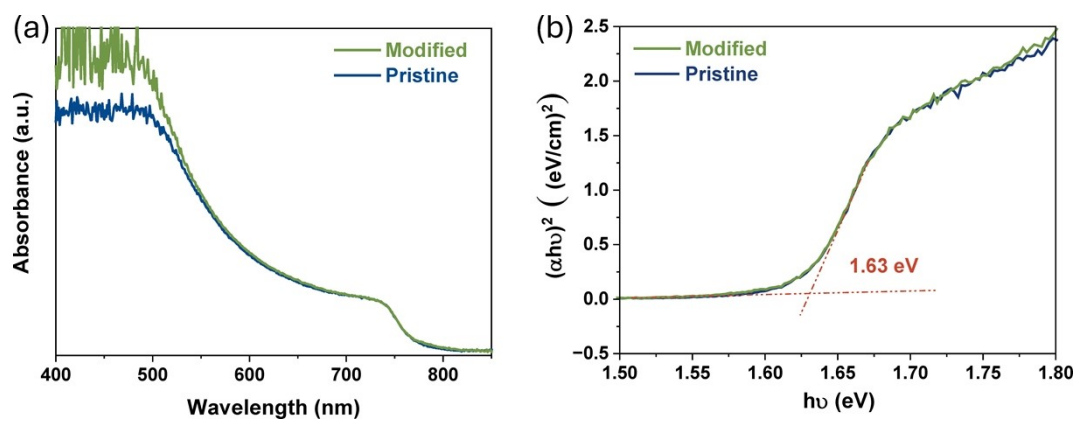


Figure S6. (a) UV-vis spectra and (b) Tauc plots of pristine and modified perovskite films.

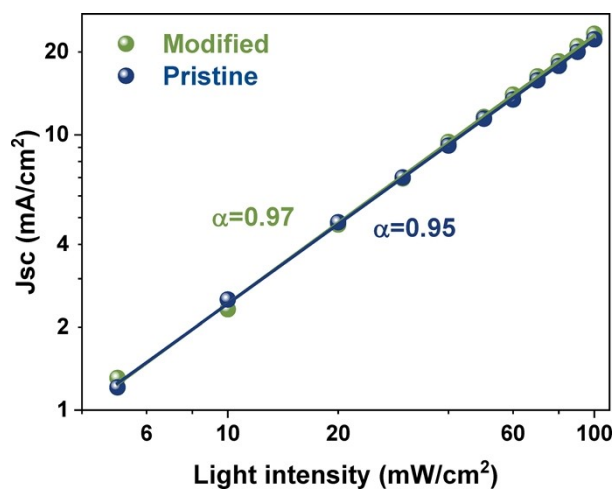


Figure S7. J_{sc} dependence on light intensity of pristine and modified PSCs.

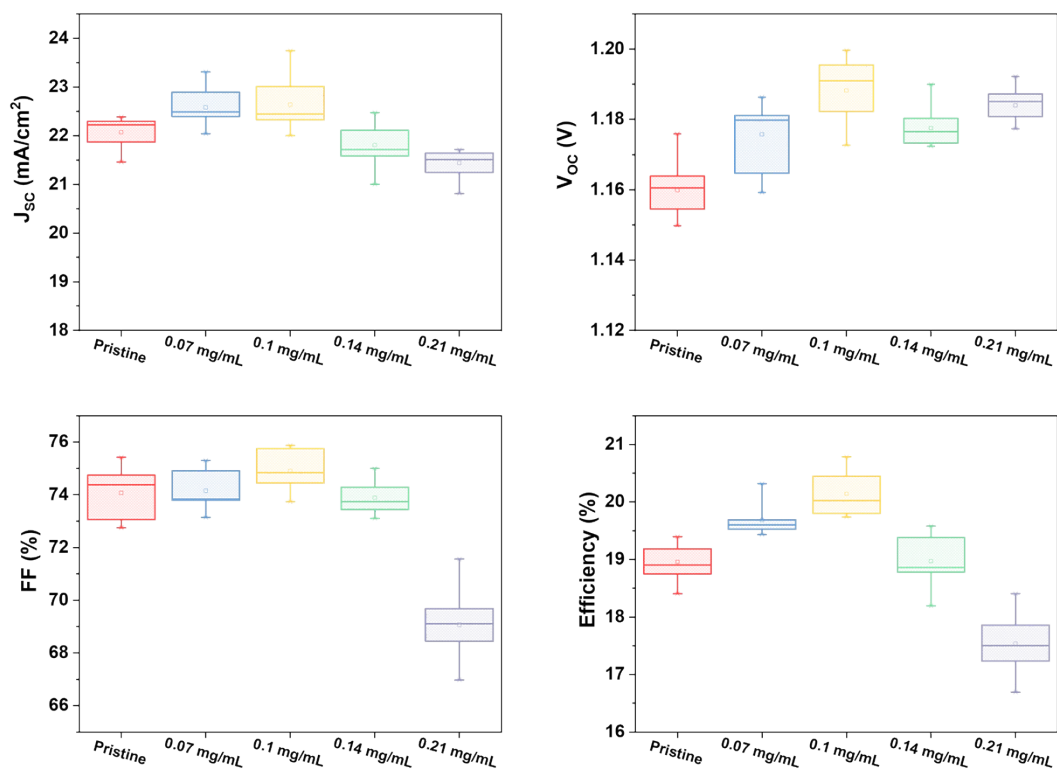


Figure S8. Statistical photovoltaic parameters of devices modified with different concentrations of SP.

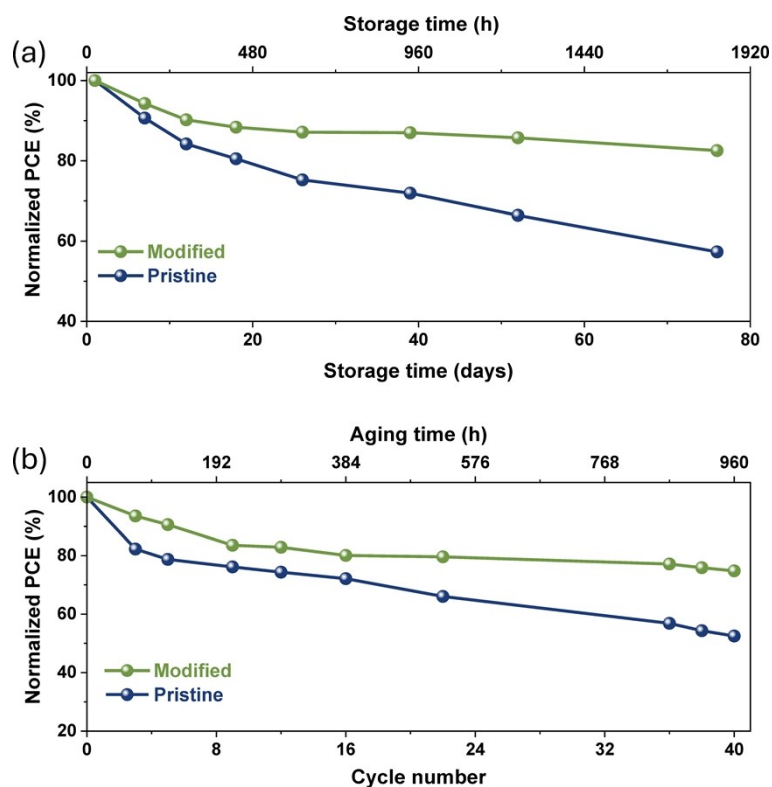


Figure S9. Performance decay of devices with the stability testing (a) at ~60 % RH in air and (b) in alternating cold (-20°C) and hot (85°C) environments for 12 hours each.

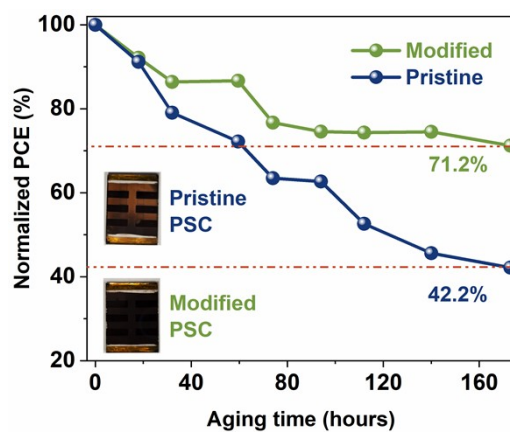


Figure S10. Photostability of PSCs under one sun illumination in air (Inset shows the photographs of devices after aging).

Table S1. Fitted TRPL parameters of pristine and modified perovskite films on ITO glass.

Perovskite film	A ₁	τ ₁ (ns)	A ₂	τ ₂ (ns)	A ₃	τ ₃ (ns)	τ _{ave} (ns)
Pristine	0.087	11.17	0.697	57.10	0.206	116.43	105.11
Modified	0.268	47.37	0.612	122.66	0.120	354.54	191.03

Table S2. The fitting parameters of each circuit element for the EIS response in Figure 5c.

	R _s (Ω)	R _{rec} (Ω)	C _{rec} (F)
Pristine	30.88	2661	3.1×10 ⁻⁹
Modified	42.01	3229	4.6×10 ⁻⁹

Table S3. Photovoltaic parameters of champion PSCs.

PSCs	V _{oc} (V)	J _{sc} (mA/cm ²)	FF (%)	PCE (%)	HI (%)
Pristine-R	1.176	22.17	74.38	19.39	7.94
Pristine-F	1.168	22.19	68.84	17.85	
Modified-R	1.195	23.15	75.12	20.79	4.18
Modified-F	1.187	23.02	72.87	19.92	