Support Information

Bifunction Interfacial Modification Engineering with Biomimetic Perfluoro-copolymer-enabled High-Efficiency and Moisture-resistant Perovskite Solar Cells

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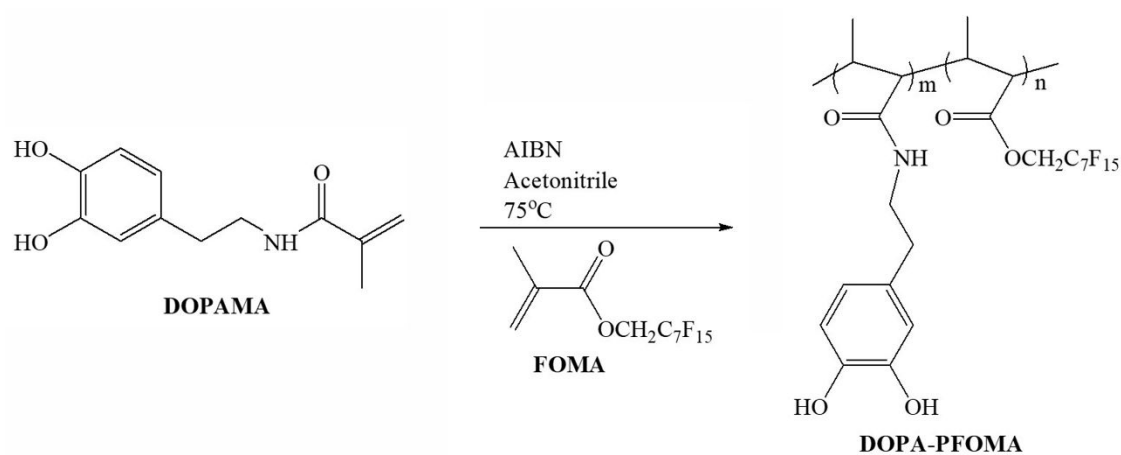
Contents

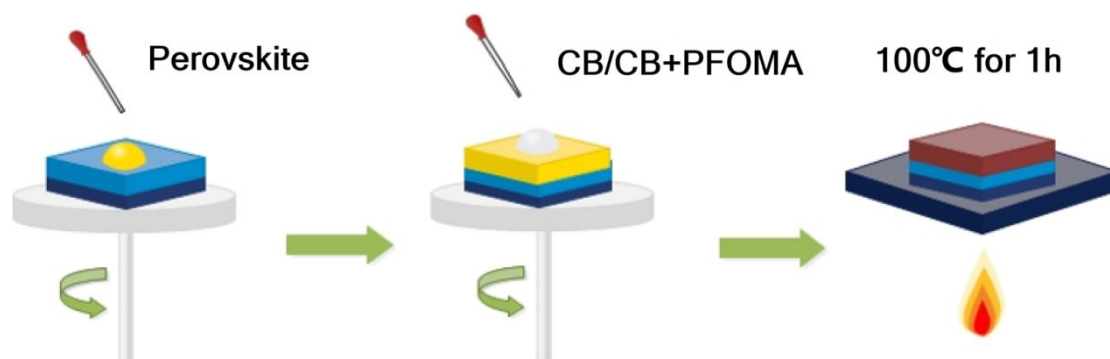**Figure S1.** The synthesis process of PFOMA.

Figure S2. Schematic illustration of the fabrication process of PFOMA-modified PSCs.
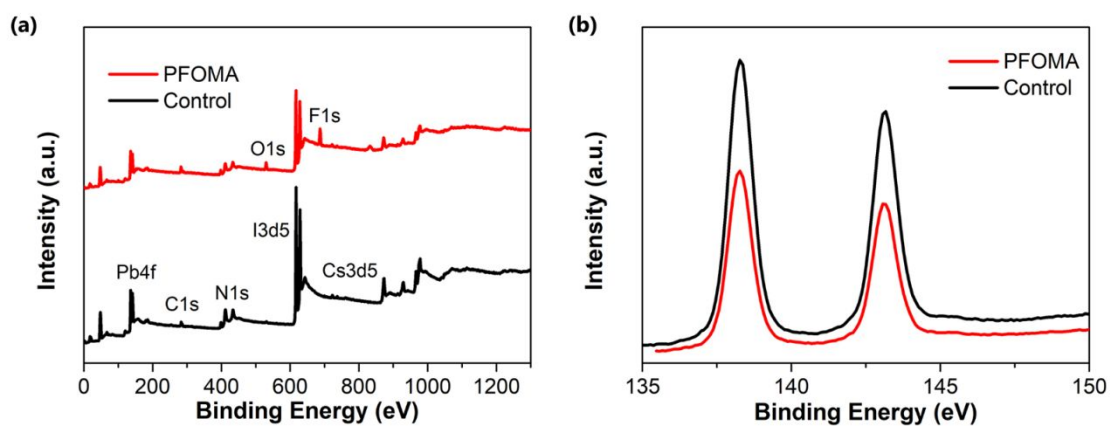

Figure S3. XPS spectra of control group and PFOMA-modified PSCs for **(a)** all elements and **(b)** lead.
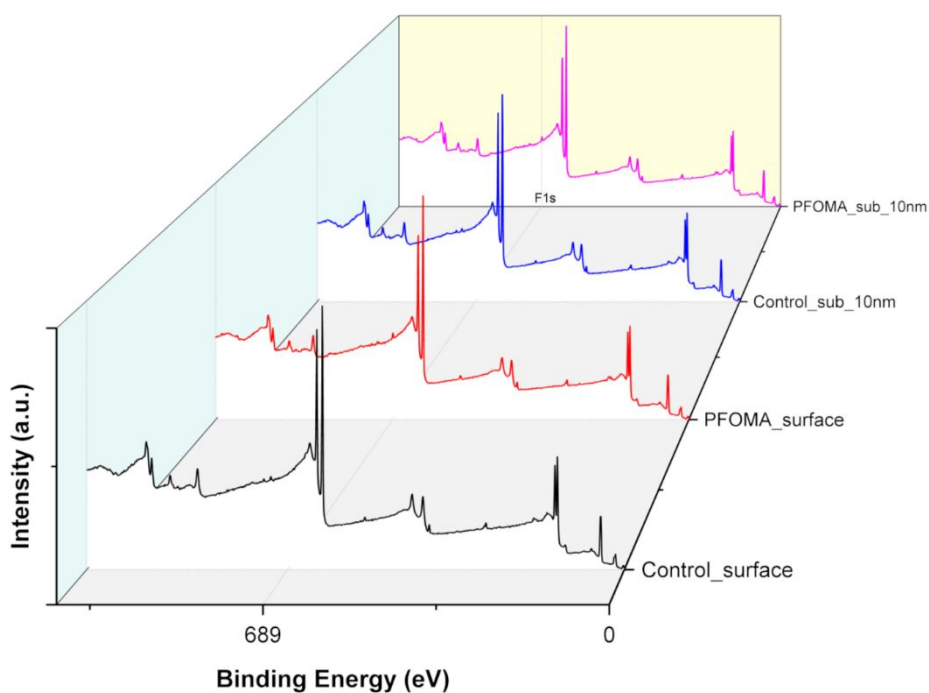
Figure S4. XPS image for perovskite film surface and 10 nm beneath in control group and PFOMA-modified group respectively. The F1s peak is shown at around 689 eV.
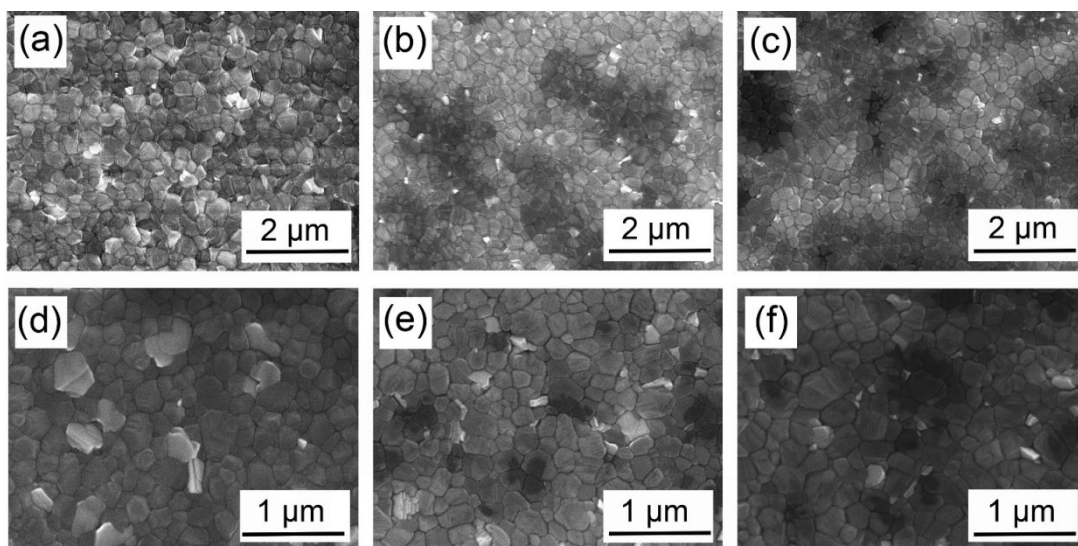

Figure S5. (a)-(c) SEM images of perovskite films in **(a)** control groups, **(b)** 0.10 mg/mL PFOMA and **(c)** 0.15 mg/mL PFOMA-modified PSCs under the magnification of 50000x (2 μm). **(d)-(f)** SEM images of perovskite films in **(d)** control groups, **(e)** 0.10 mg/mL PFOMA and **(f)** 0.15 mg/mL PFOMA-modified PSCs under the magnification of 100000x (1 μm).
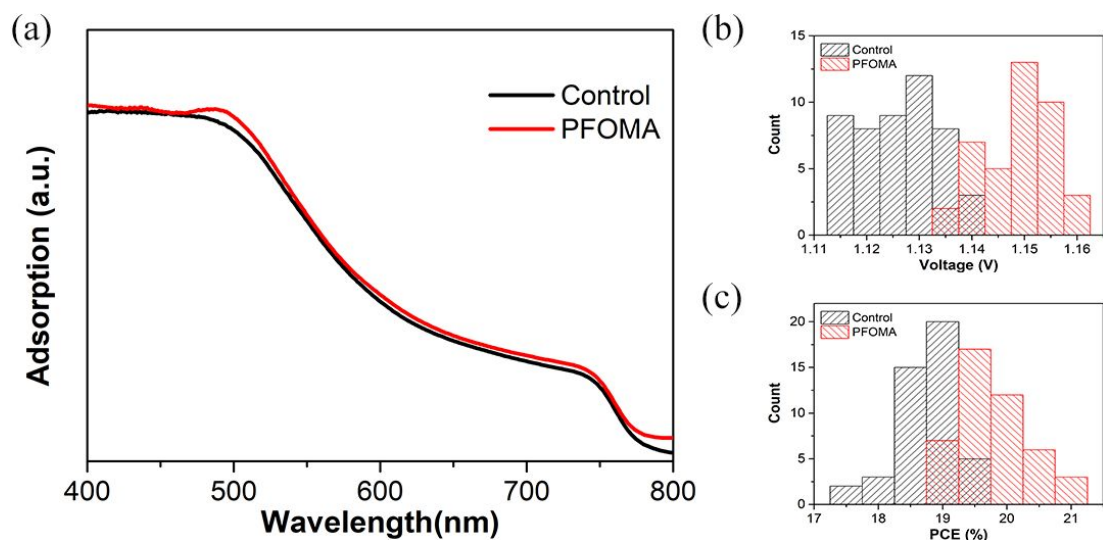
Figure S6. (a) UV-Vis spectra of perovskite films in control group devices and PFOMA-modified devices. Histogram of **(b)** V_{OC} distribution and **(c)** PCE distribution of control group devices and optimized PFOMA-modified devices.
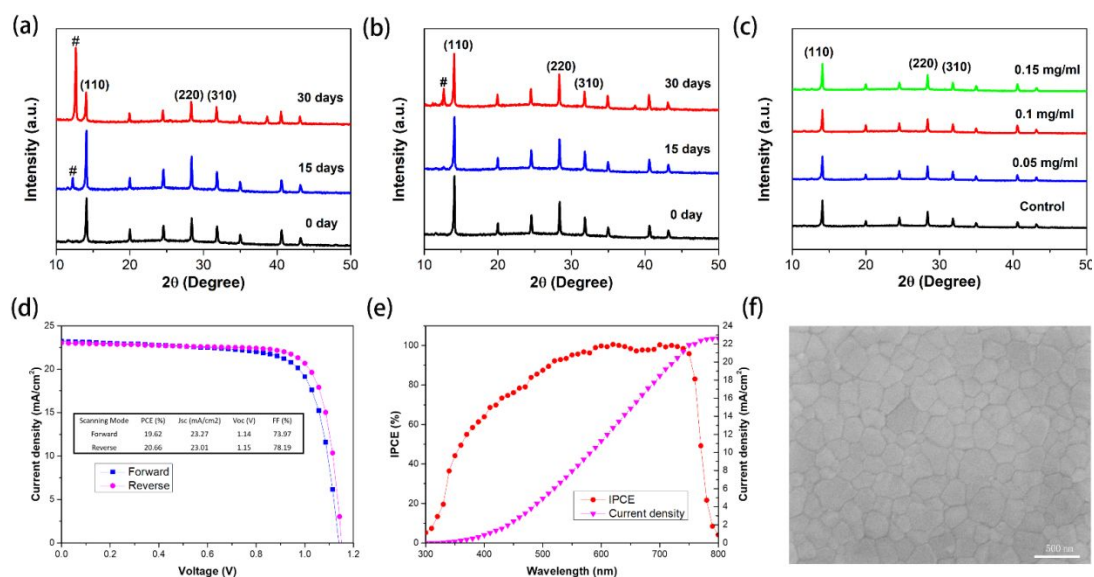

Figure S7. XRD patterns of perovskite films for **(a)** control group devices and **(b)** PFOMA-modified devices after 0 day, 15 days and 30days in storage under 70±5% relative humidity respectively. **(c)** XRD patterns of original perovskite films in control group devices and modified devices with different PFOMA concentrations in CB. **(d)** J-V curves of a champion PSC device in 0.1mg/mL-PFOMA-modified group under reverse and forward scanning (insert is the table for the performance parameters). **(e)** IPCE and integrated current density curves of the champion device. **(f)** SEM picture of the champion device perovskite film.

Table S1. Typical performance of PSC devices before and after PFOMA modification

	Scanning Mode	PCE (%)	J_{SC} (mA/cm^2)	V_{OC} (V)	FF (%)	Hysteresis index
Control	Forward	15.89	21.96	1.12	64.69	0.117
	Reverse	18.00	21.65	1.12	73.49	
PFOMA-PSCs	Forward	18.68	22.01	1.14	73.97	0.038
	Reverse	19.42	21.86	1.15	77.67	

Table S2. Parameters of TRPL spectra for the control and PFOMA-modified PSCs

	τ_1(ns)	τ_2(ns)
Control	23	98
PFOMA- PSCs	45	121