Electronic Supplementary Information

Iodide/triiodide redox shuttle-based additives for high-performance perovskite solar cells by simultaneously passivating the cation and anion defects

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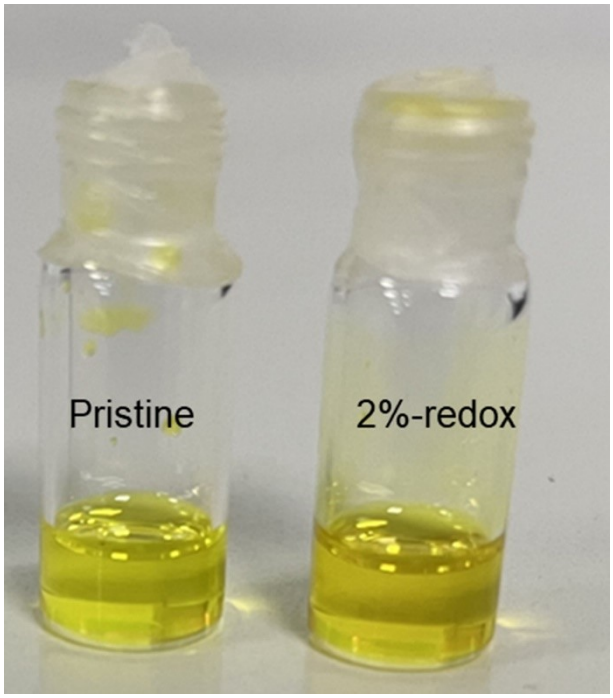

Fig. S1 Digital photographs of perovskite precursor solutions without and with redox additive (2%).

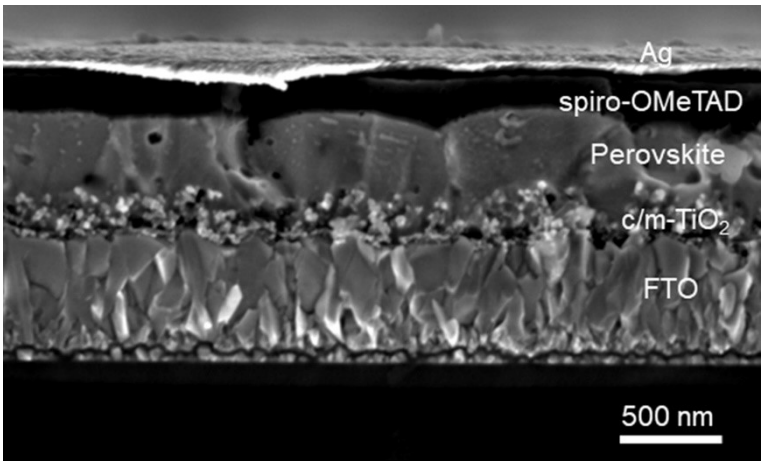

Fig. S2 Cross-sectional SEM image of the 2%-redox additive modified PSC.

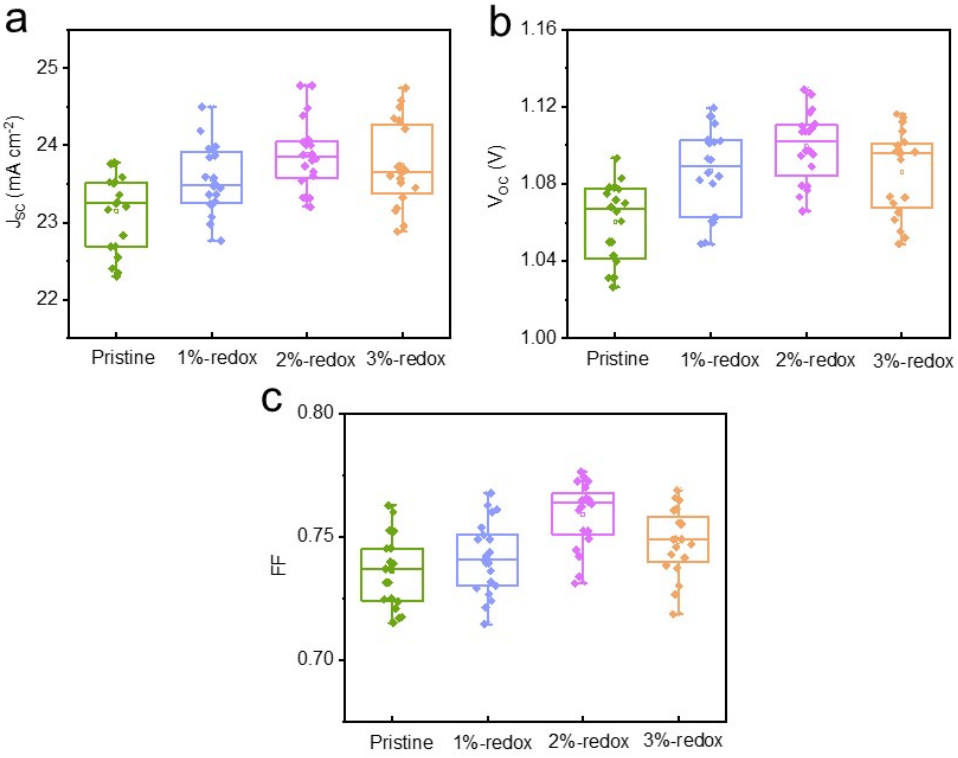

Fig. S3 The parameter distributions of 20 cells without and with different amounts of redox additive: (a) J_{sc}, (b) V_{oc} and (c) FF.

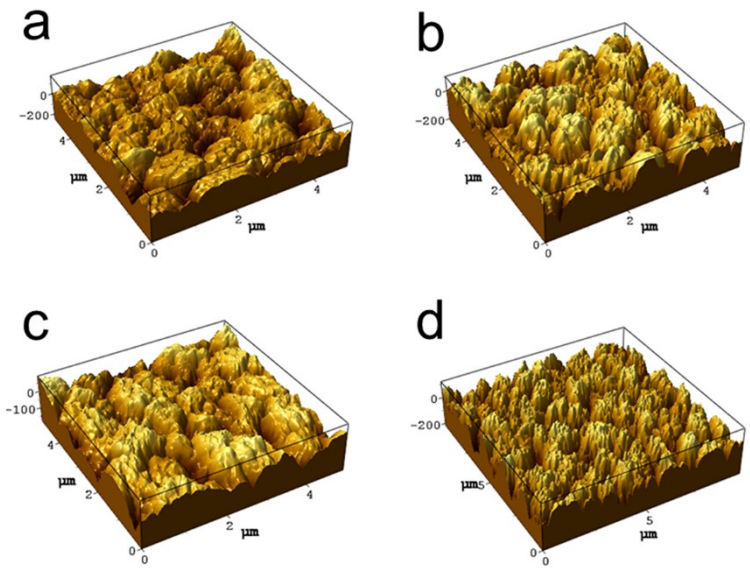

Fig. S4 3D-AFM models of (a) pristine, (b) 1%-redox, (c) 2%-redox and (d) 3%-redox films.

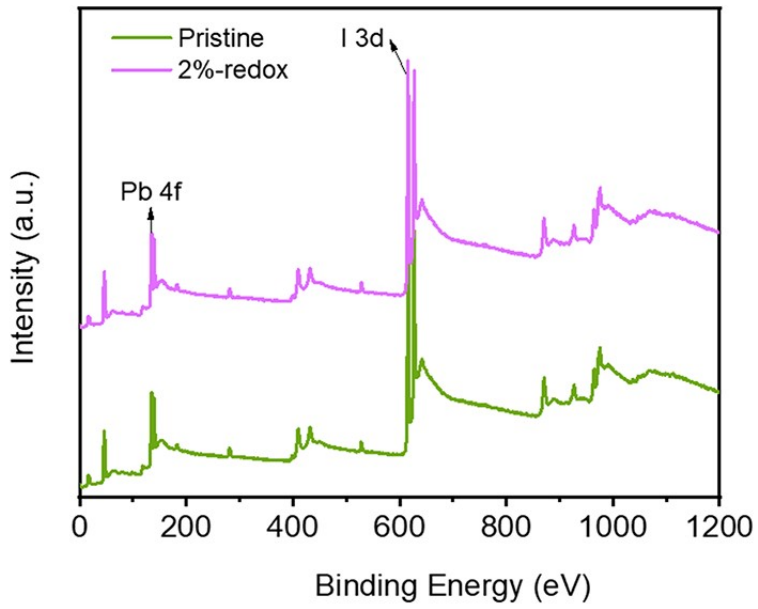

Fig. S5 XPS survey spectra of the pristine and 2%-redox films.

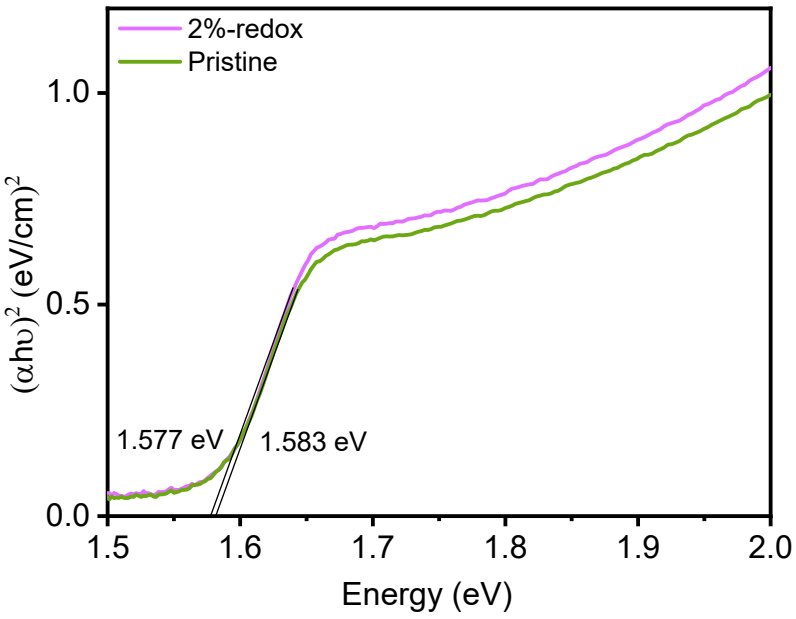

Fig. S6 Tauc plots of the pristine and 2%-redox films.

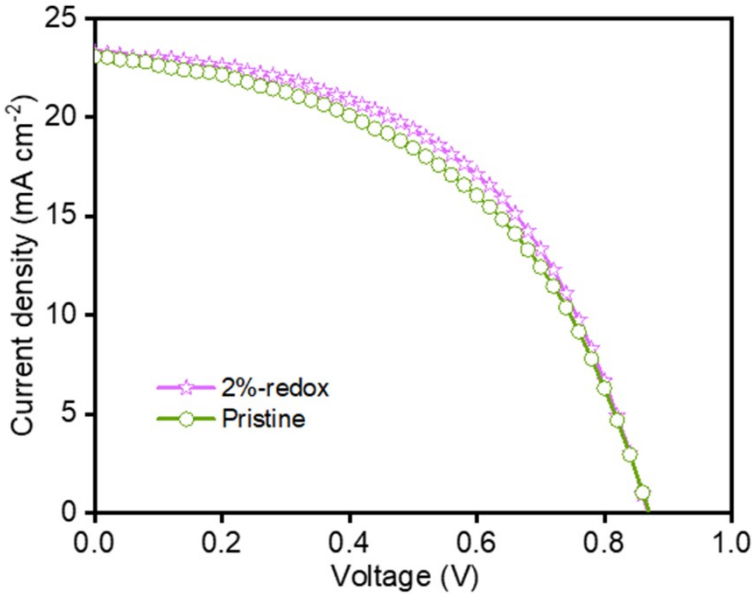

Fig. S7 *J-V* curves of carbon electrode-based pristine and 2%-redox cells.

Table S1 Photovoltaic parameters of $MAPbI_3$-based PSCs without and with different amounts of redox additive.

Perovskite	J_{sc} (mA cm^{-2})	V_{oc} (V)	FF	PCE (%)
Pristine	22.8	1.08	0.744	18.2
1%-redox	23.1	1.09	0.763	19.2
2%-redox	23.8	1.11	0.770	20.4
3%-redox	24.2	1.09	0.747	19.7

Table S2 Dynamic decay time parameters from TRPL measurements of the pristine and 2%-redox films deposited on the glass.

Perovskite	τ_1 (ns)	τ_1 ratio (%)	τ_2 (ns)	τ_2 ratio (%)	average τ (ns)
Pristine	3.04	9.78	54.04	90.22	49.0
2%-redox	0.67	5.98	72.26	94.12	68.0

Table S3 Photovoltaic parameters of carbon-based HTL-free $MAPbI_3$ and 2%-redox cells.

Perovskite	J_{sc} (mA cm^{-2})	V_{oc} (V)	FF	PCE (%)
Pristine	23.1	0.87	0.479	9.60
2%-redox	23.2	0.87	0.508	10.3