

Supporting Information

Surface reinforcement of perovskite films with heteroatom-modulated carbon nanosheets for heat- resistant solar cells

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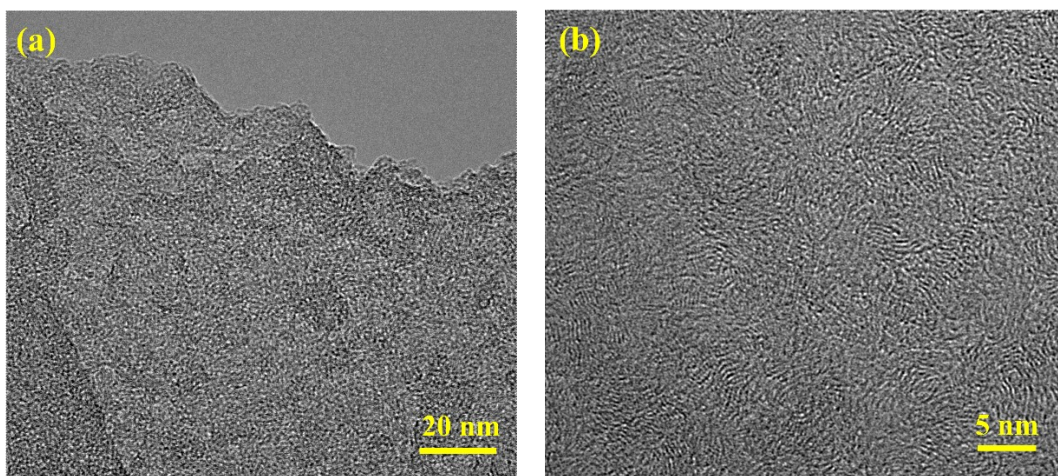


Fig. S1 (a-b) TEM images of G-DC.

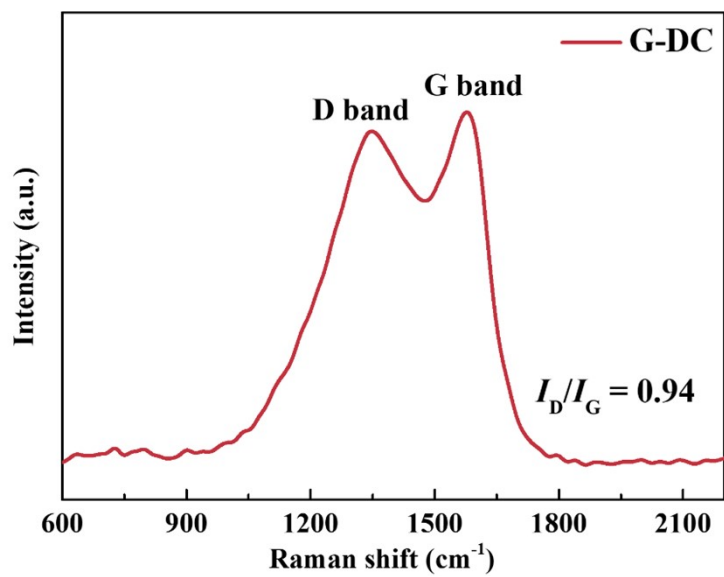


Fig. S2 The Raman spectrum of G-DC.

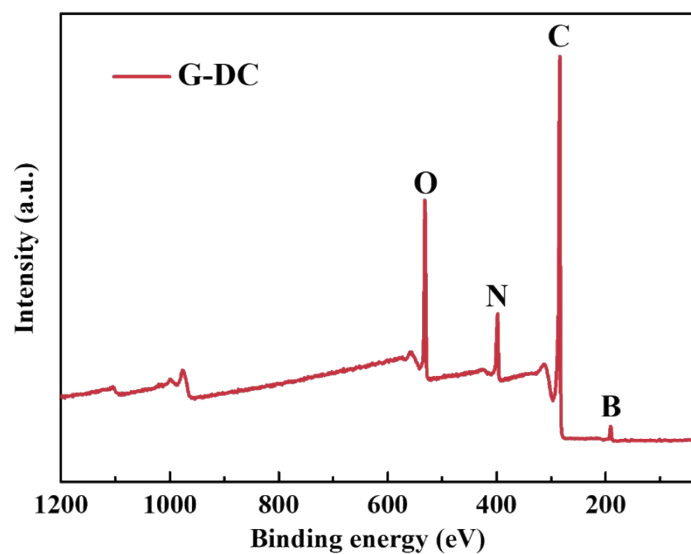


Fig. S3 The full XPS spectrum of G-DC.

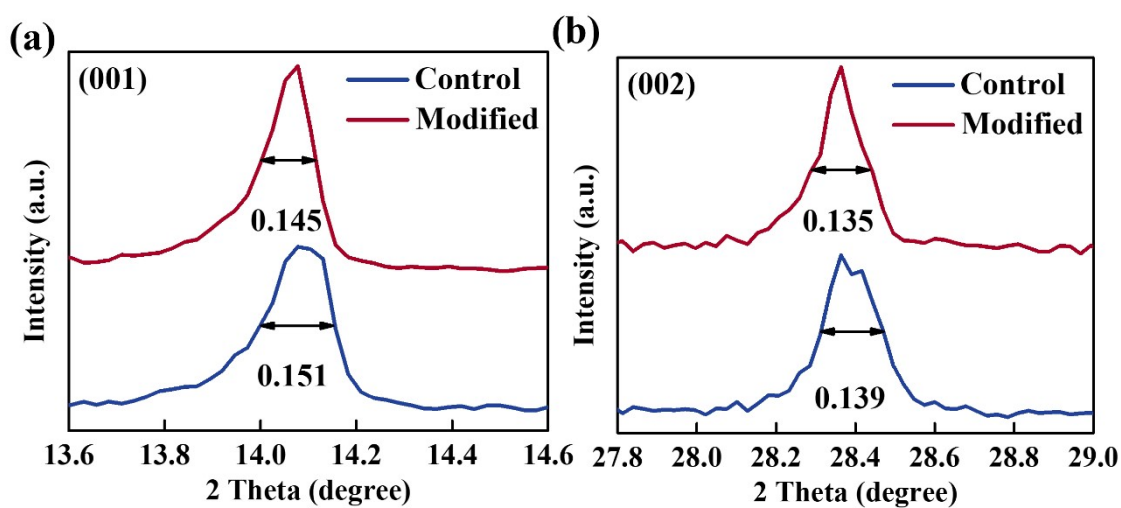


Fig. S4 (a-b) FWHM values of XRD (001) and (002) diffraction peak.

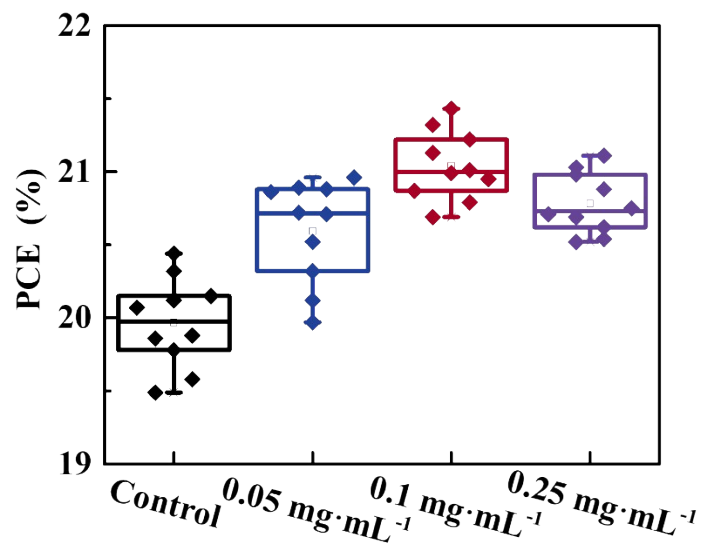


Fig. S5 PCE statistical distribution box diagram of G-DC modified devices with different concentrations.

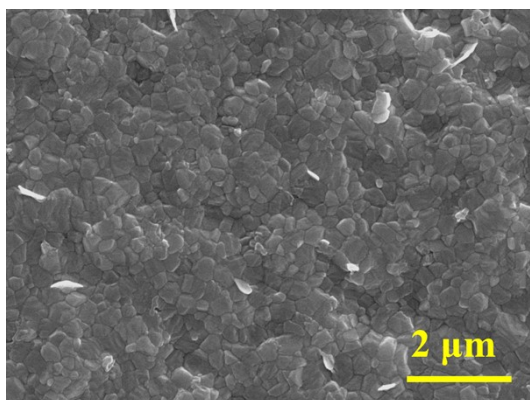


Fig. S6 SEM image of the perovskite film with 0.5 mg/mL G-DC modification.

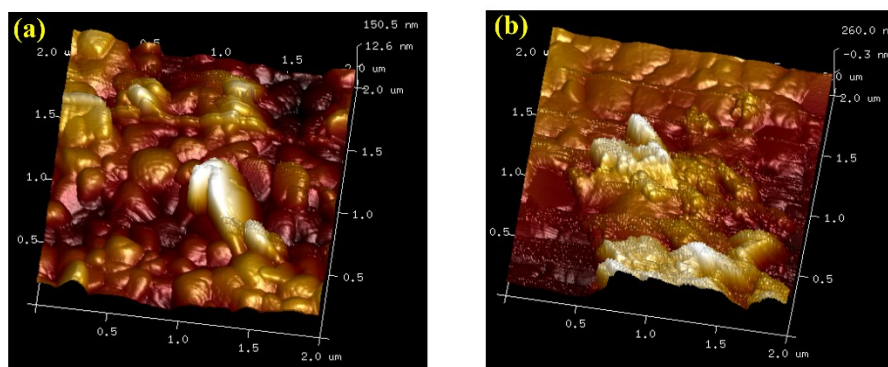


Fig. S7 AFM images of the perovskite film with 0.5 mg/mL G-DC modification.

(a) Curly and wrinkled G-DC; (b) Gathered G-DC

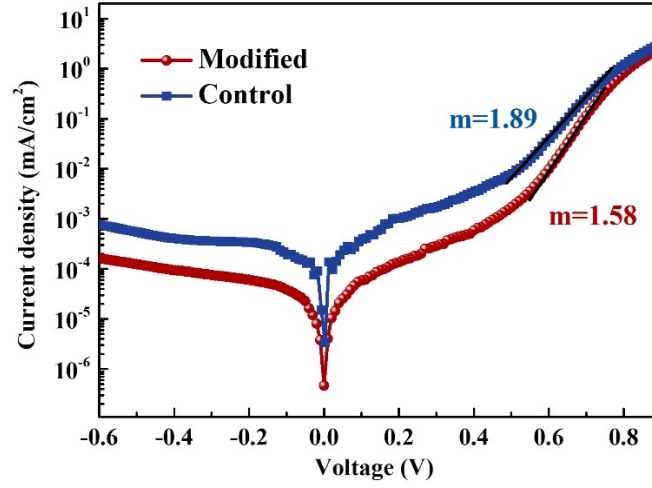


Fig. S8 Dark J - V curves of the PSCs with and without G-DC modification.

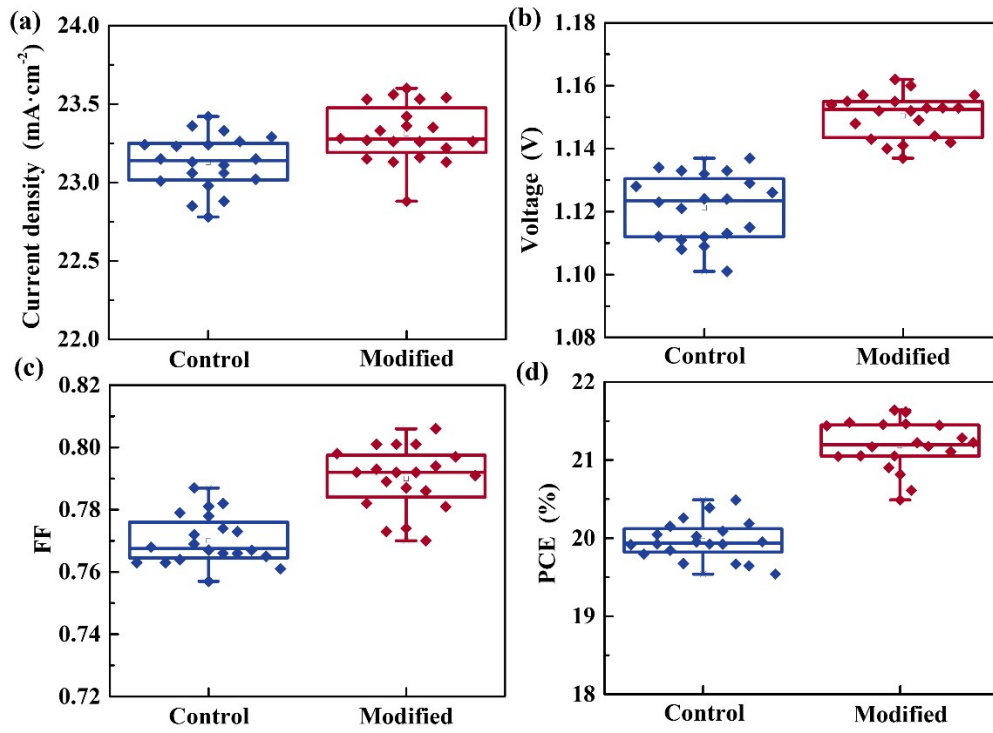


Fig. S9 Statistical distribution of photovoltaic parameters of different devices.

(a) J_{sc} (b) V_{oc} (c) FF (d) PCE

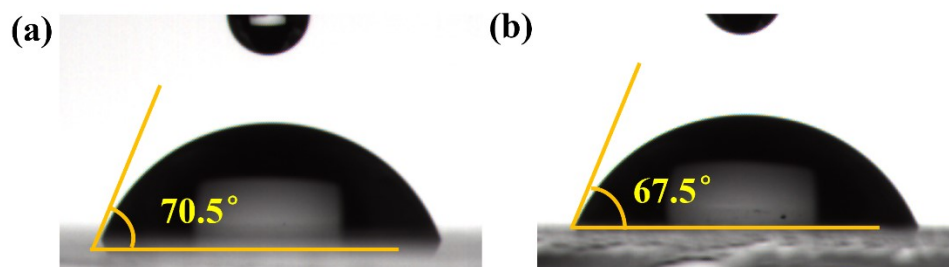


Fig. S10 Water contact angle of perovskite films (a) with and (b) without G-DC modification.

Table S1 Photovoltaic parameters of different PSCs

Devices	J_{SC} (mA/cm ²)	V_{OC} (V)	FF (%)	PCE (%)
Control	23.31	1.128	77.3	20.32
Modified	23.49	1.161	79.4	21.65

Table S2 Photovoltaic parameters of different PSCs under different scanning directions

Devices	Scan directions	J_{SC} (mA·cm ⁻²)	V_{OC} (V)	FF (%)	PCE (%)	Hysteresis index (%)
Control	Reverse scan	23.08	1.121	78.4	20.28	3.43%
	Forward scan	23.11	1.116	76.0	19.61	
Modified	Reverse scan	23.29	1.153	80.5	21.61	1.65%
	Forward scan	23.30	1.151	79.3	21.26	