Supporting Information

Construction of ultrathin MnO_2 decorated graphene/carbon nanotube nanocomposites as efficient sulfur host for high-performance lithium-sulfur batteries

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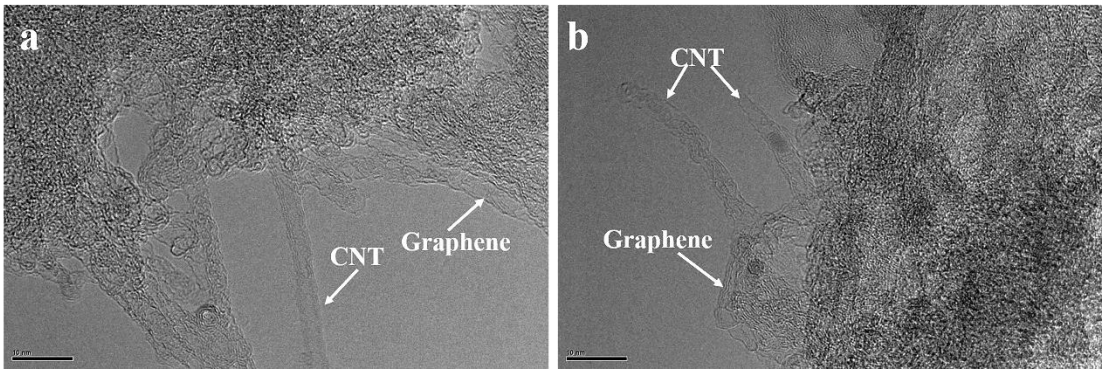

Fig. S1 HRTEM images of G/CNT hybrids with structure details

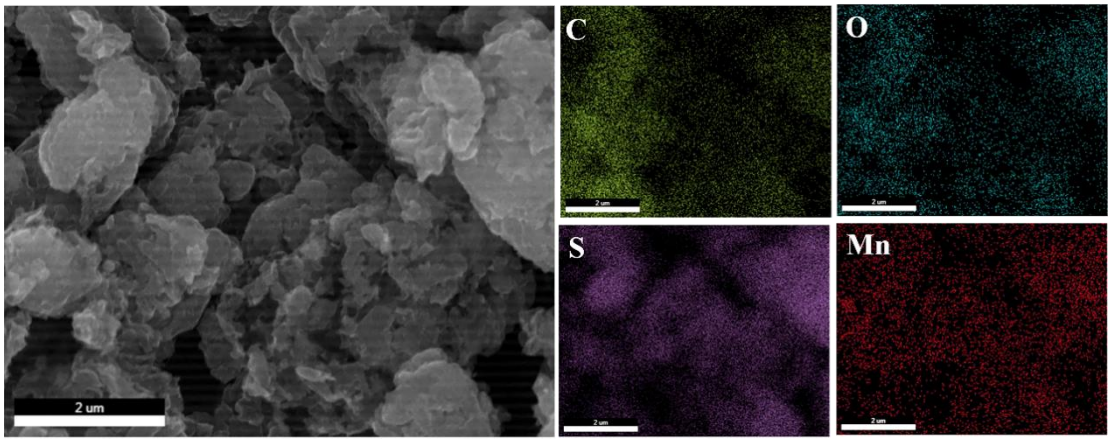

Fig. S2 SEM image of G/CNT@MnO_2@S composite and the corresponding EDX elemental mapping of C (green), O (blue), S (purple) and Mn (red).

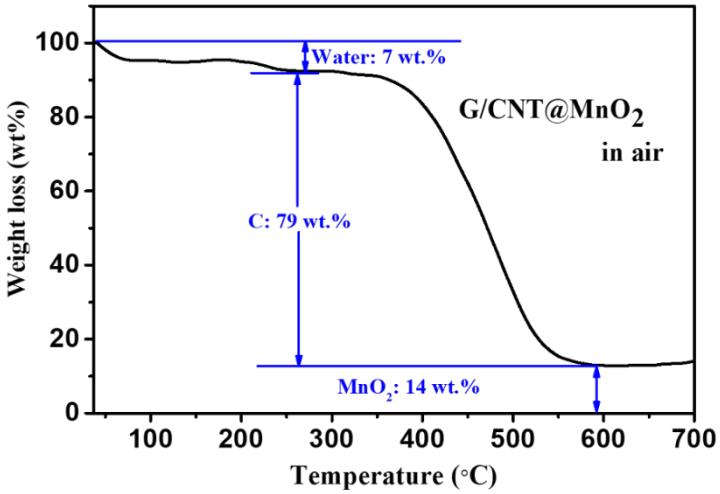

Fig. S3 TGA curves of G/CNT@MnO_2 in air atmosphere with 10 °C min^{-1}.

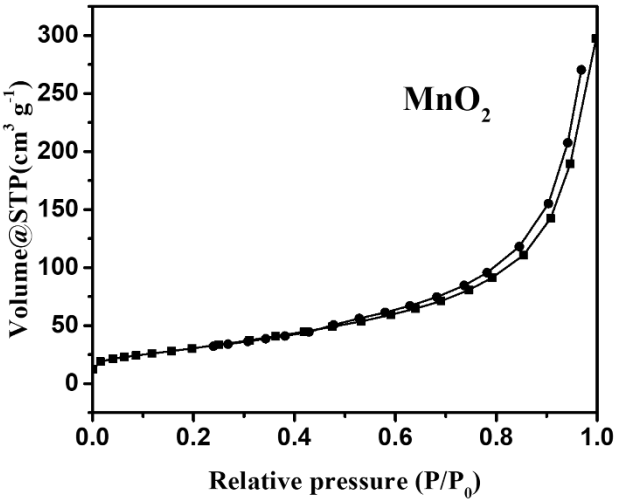

Fig. S4 N_2 adsorption/desorption isotherms for MnO_2.

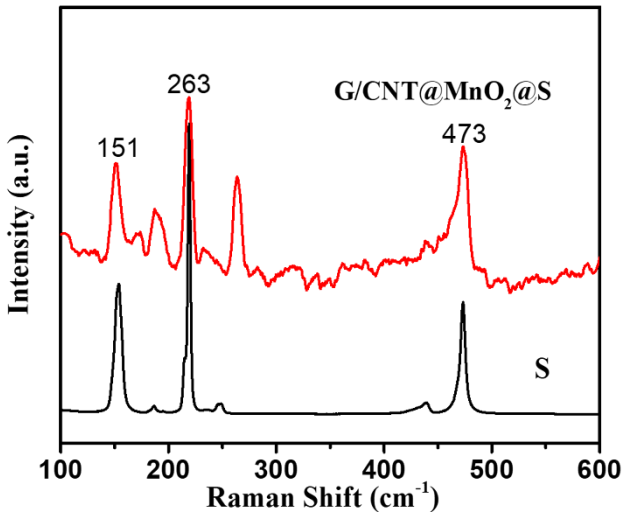

Fig. S5 Raman spectra of G/CNT@MnO_2@S.

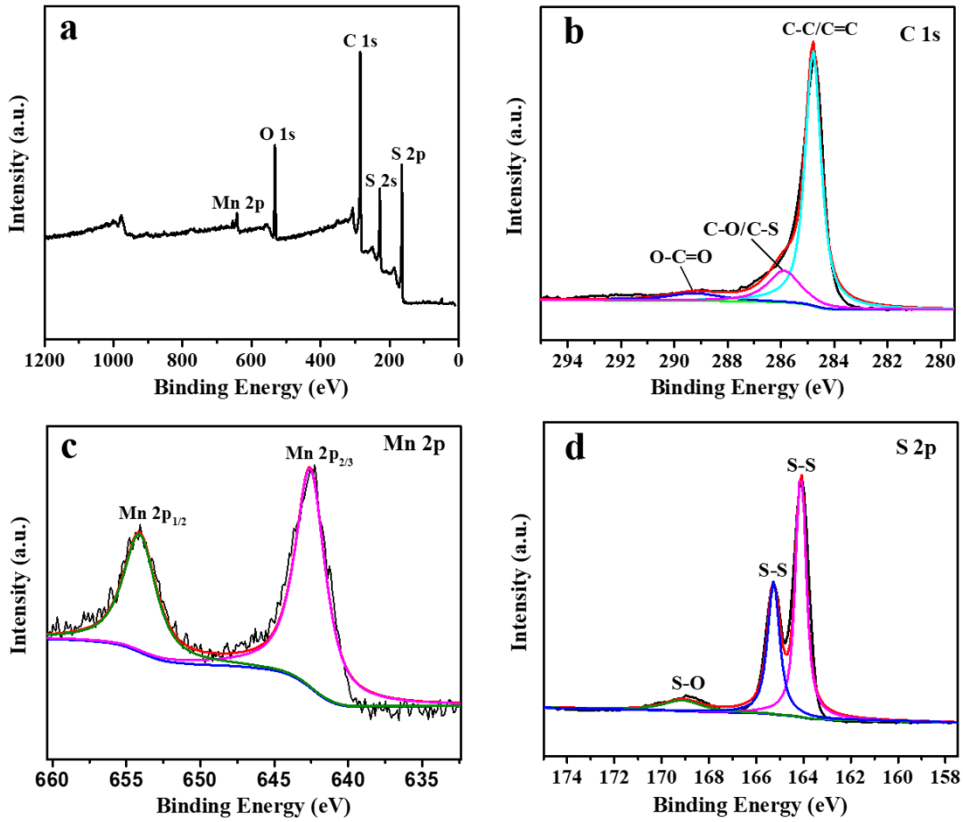

Fig. S6 XPS spectra of the G/CNT@MnO_2@S composite. (a) Full spectra, (b) C1s spectra, (c) Mn 2p spectra, (d) S 2p spectra.

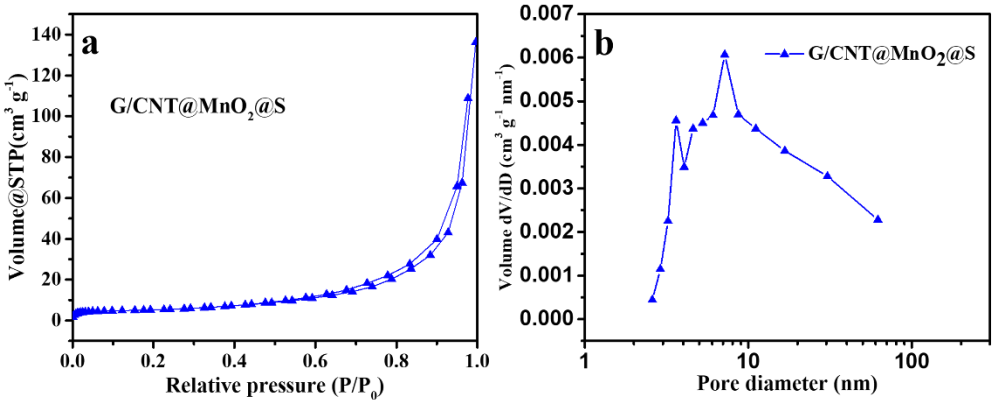

Fig. S7 (a) N_2 adsorption/desorption isotherms for G/CNT@MnO_2@S, (b) BJH pore size distribution for G/CNT@MnO_2@S.

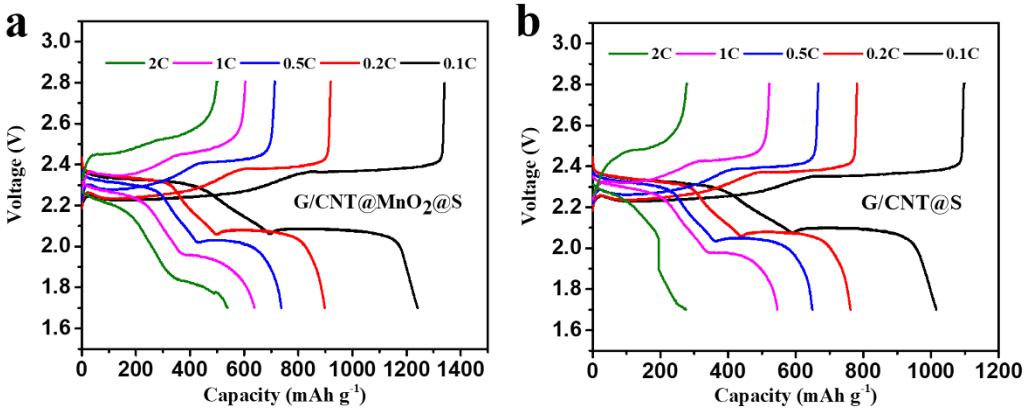

Fig. S8 Voltage profiles at various C rates of (a) G/CNT@MnO_2@S, and (b) G/CNT@S.

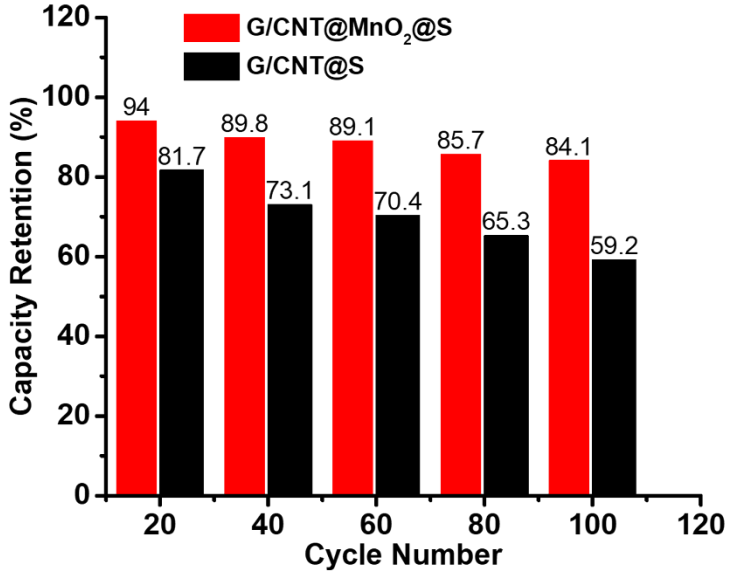

Fig. S9 Capacity retention of G/CNT@MnO_2@S, and G/CNT@S at 0.1C.

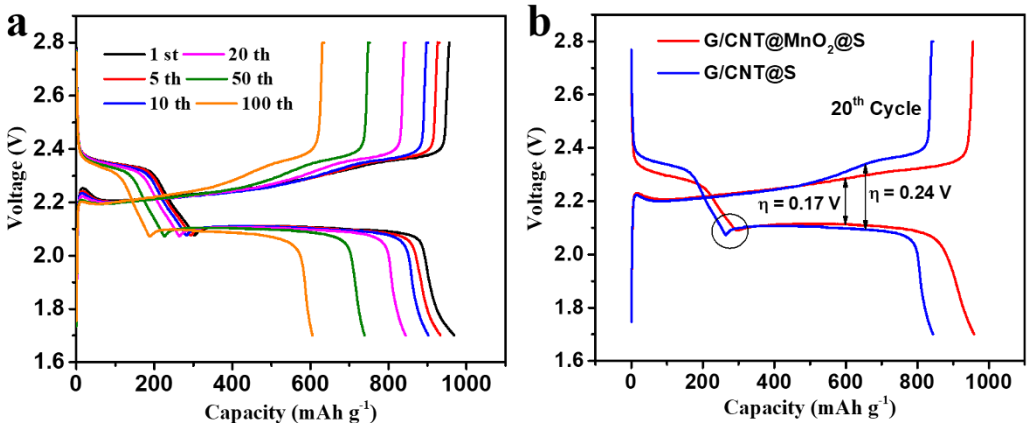

Fig. S10 (a) Voltage profiles of G/CNT@S at 0.1C, (b) Voltage profiles of G/CNT@MnO_2@S and G/CNT@S of the 20th cycle at 0.1C.

Table S1. Elemental analysis of the composites

Composite	Element Weight Percentage (%)		
	S	C	Mn
G/CNT@MnO_2@S	81.76	15.38	1.68
G/CNT@S	81.38	18.17	N/A

Table S2

The cycling performance comparison of this work with some other similar composites. [19, 23, 25, 37, 39, 42, 46-48]

Electrodes	Sulfur loading (mg cm^{-2})	Rate	Cycles	Initial capacity (mAh g^{-1})	Capacity retention	Ref.
MnO_2@HCB/S	0.7-1.0	0.6 C	60	1042	≈48%	19
		1.79C	200	503	≈20%	
S@MnO_2@GO	1.0	0.36 C	100	1160	≈58%	23
rGM-SA67	0.8	0.2 C	100	≈1200	≈75%	25
S–MnO_2@GN	1.0	0.2 C	100	1116	74%	37
MnO_2@HCF/S	3.5	0.2 C	100	1147	≈75%	39
		0.5 C	100	≈920	≈84%	
S@PEDOT/MnO_2	/	0.2C	100	1150	≈71.9%	42
		1.0C	200	685.6	52.5%	
S@MnO_2	1.1-1.3	0.06C	200	≈1200	≈63%	46
S-MnO_2@C	1.0	0.1C	50	≈1150	≈40%	47
		1.0C	100	≈700	≈51%	
CNFs/MnO_2	1.5	0.2C	100	≈1350	≈59%	48
G/CNT@MnO_2@S	1.5-2.0	0.1C	100	1015.1	84.1%	This work
		1.0C	200	758.1	77.9%	

HCB: Hollow Carbon Nanoboxes, rGM-SA: reduced graphene oxide/ultrathin MnO_2 nanosheets-S aerogel, GN: Graphene, HCF: Hollow Carbon Nanofibers, CNFs: carbon nanofibers.