

Supporting Information

Hydrangea-like δ -MnO₂ anchored on GNS as a high-performance supercapacitor electrode material

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Experimental data

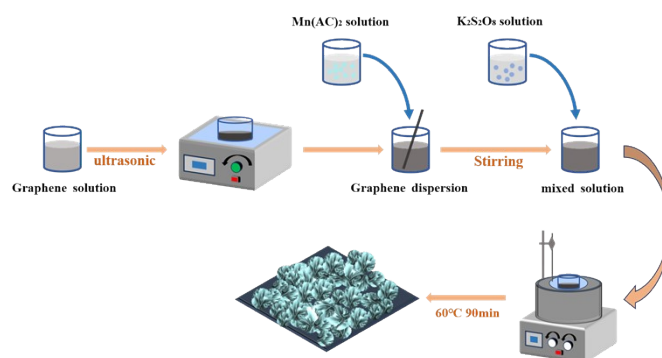


Figure 1. Schematic synthesis of δ -MnO₂/GNS

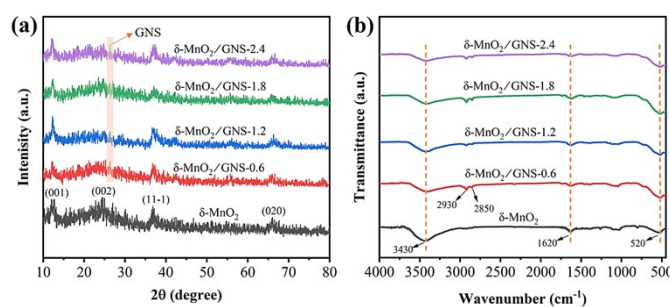


Figure 2. (a) XRD plots of δ -MnO₂ and composites, (b) FTIR plots of δ -MnO₂ and composites

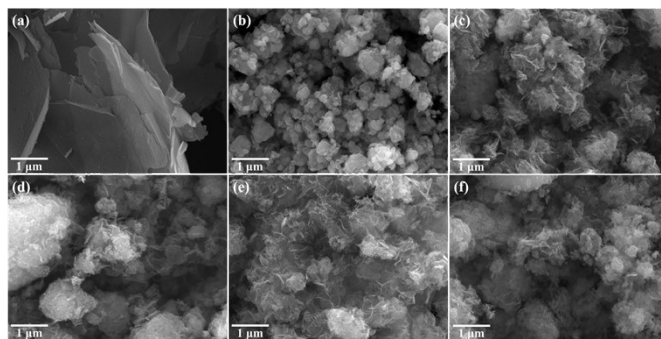


Figure 3. SEM image (a) GNS, (b) δ -MnO₂, (c) δ -MnO₂/GNS-0.6, (d) δ -MnO₂/GNS-1.2, (e) δ -MnO₂/GNS-1.8, (f) δ -MnO₂/GNS-2.4

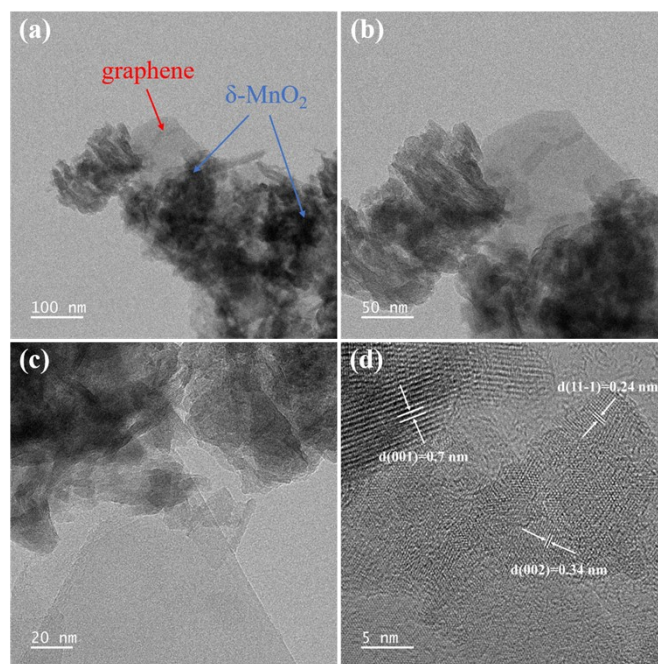


Figure 4. TEM image of δ -MnO₂/GNS-1.8. (a) 200 nm (b) 100 nm , (c) 20 nm, and (d) 5 nm

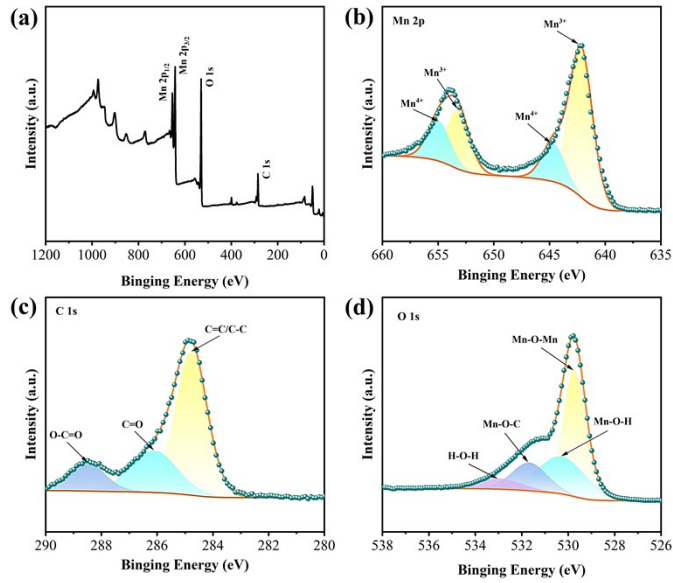


Figure 5. XPS spectra of δ -MnO₂/GNS-1.8 composite. (a) full spectrum, (b) Mn 2p spectrum, (c) Mn 3s spectrum, and (d) O 1s spectrum

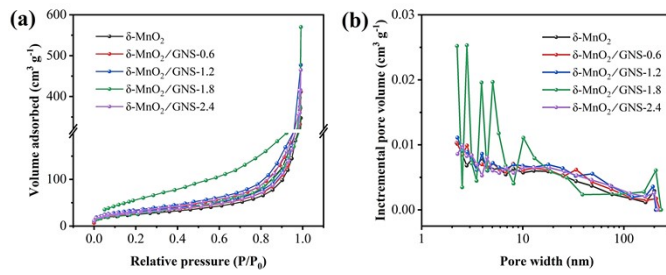


Figure 6. BET spectra of the synthesized materials. (a) Nitrogen adsorption/desorption isotherms, (b) pore size distribution

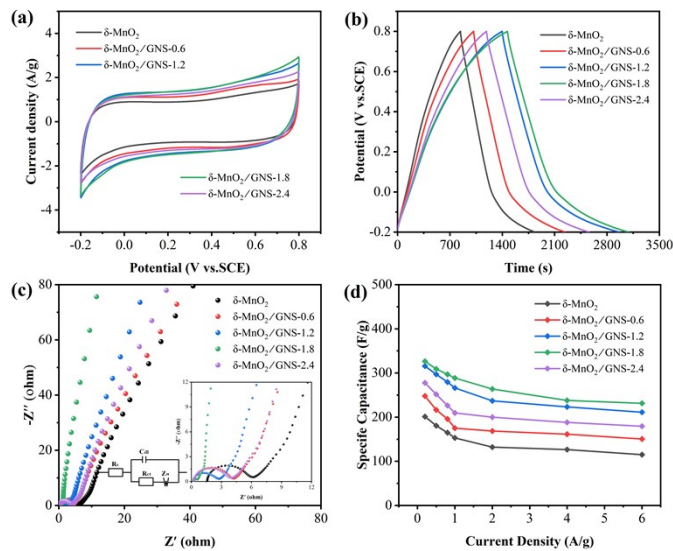


Figure 7. Electrochemical performance plots. (a) CV plot, (b) GCD plot, (c) EIS plot, (d) multiplicity performance plot

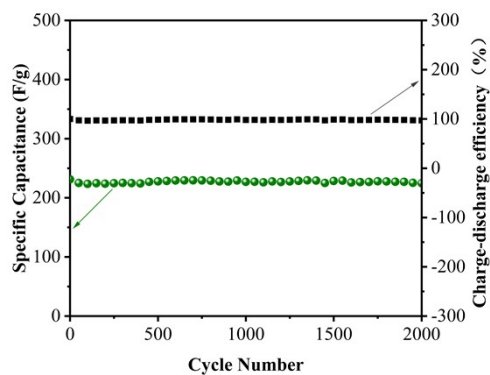


Figure 8. δ -MnO₂/GNS-1.8 at 6 A/g 2000 cycles

Table 1. Experimental results for the same type of electrode material

Electrode material	Potentiometric window	Specific capacitance	Ref
CNT@CNT@MnO ₂	0-1.0 V	210 F/g 0.5 A/g	11
HRGO/MnO ₂	-0.2-0.8 V	270 F/g 0.5 A/g	34
3DHG-MnO ₂	-0.2-0.8 V	192.2 F/g 0.5 A/g	35
MnO ₂ /rGO	-0.2-1.0 V	255 F/g 0.5A/g	37
N-PCNs/MnO ₂	-0.1-0.9 V	295 F/g 0.5 A/g	41
δ -MnO ₂ /GNS	-0.2-0.8 V	309 F/g 0.5 A/g	This work
δ -MnO ₂ /GNS	-0.2-0.8 V	326.6 F/g 0.2 A/g	This Work

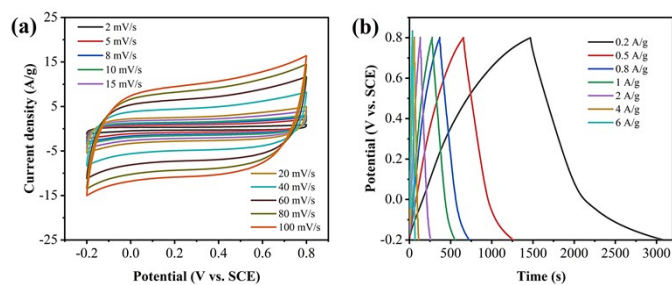


Figure 9. Electrochemical performance plots. (a) CV curves of δ -MnO₂/GNS-1.8 with different sweep speeds, (b) GCD curves of δ -MnO₂/GNS-1.8 with different current densities

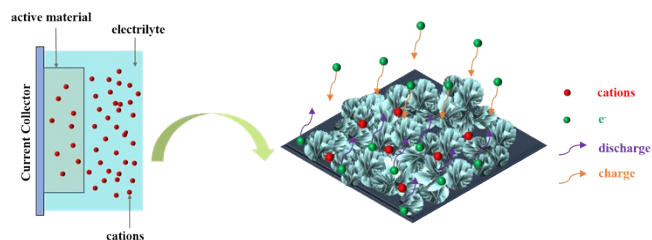


Figure 10. Electrochemical mechanism diagram of MnO₂/GNS-1.8

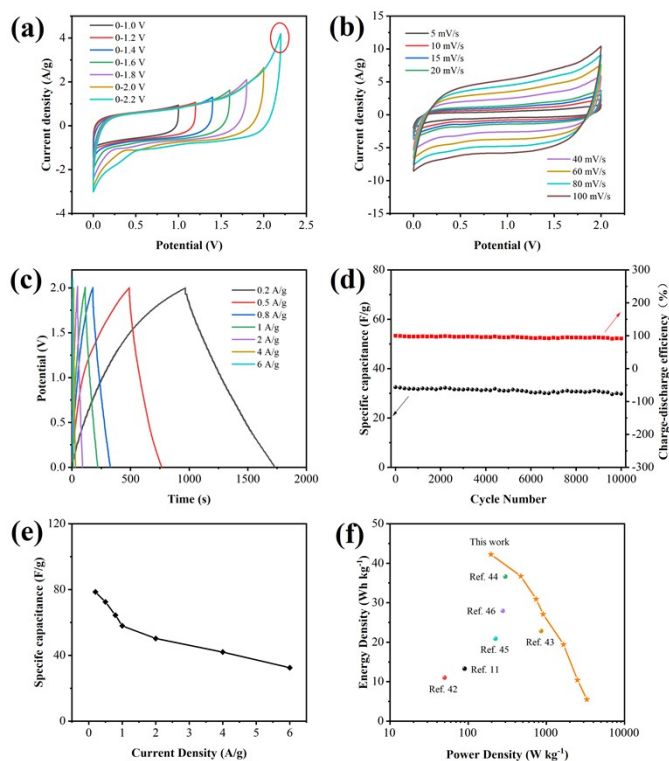


Figure 11. Performance diagram of δ -MnO₂/GNS//AC capacitor. (a) CV curves in different voltage windows at 10 mV/s scan rate, (b) CV curves at different scan rates, (c) GCD curves for different current densities, (d) 5000 consecutive charge/discharge cycles at 6 A/g current density, (e) Specific capacitance at different current densities, (f) Ragone diagram

Table 2. Table comparing the performance of δ -MnO₂/GNS//AC with other supercapacitor devices reported in the literature

Asymmetric supercapacitors	Working potential (V)	Energy Density (Wh/kg)	Power density (W/kg)	Ref
CNT@CNT/MnO ₂ /CNT@NCT	1.8	13.3	90	11
MnO ₂ @Carbon black//AC	1.6	11	50	42
GF/CNT/MnO ₂ //GF/CNT/Ppy	2.0	22.8	860	43
3D-MnO ₂ //AC	2.0	36.6	300	44
N-CNTs/MnO ₂ -2//N-CNTs	1.8	20.9	224	45
rGO/Mn ₃ O ₄ // rGO/Mn ₃ O ₄	0.8	27.92	277.8	46
δ -MnO ₂ /GNS//AC	2.0	42.2	196.8	This work