Supplementary Material

Hierarchical flower-like MoS_2/reduced graphene oxide nanohybrids supported on nickel foam as high-performance electrode material for supercapacitor applications

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1. General Characterizations

Powder X-ray diffraction (XRD) spectra has been recorded on Rigaku Miniflex 600 X-Ray Diffractometer at room temperature with Cu K_α radiation (λ = 1.540598 Å) in scattering range (2θ) from 5° to 70° at the scan rate of 1°/min. Raman spectroscopy measurement has been performed on Laser Raman Microscope with model LabRAM HR Evolution. High-Resolution Transmission Electron Microscope (HRTEM) measurements have been performed on Talos F200S (FEI Netherland) at point resolution 0.25 nm and line resolution 0.14 nm. Field Emission Scanning Electron Microscope (FESEM) images were collected on model JEOL JSM-7610FPlus. The investigation of N_2 adsorption/desorption isotherms have been conducted using a Quantachrome Autosorb Analyzer at 77 K. The specific surface area, pore volume, and pore size distribution of samples have been evaluated using Brunauer-Emmett-Teller (BET), t-plot and Barret-Joyner-Halenda (BJH) protocols, respectively. XPS has been collected on X-ray photoelectron spectrometer module ESCALAB 250 XI, Thermo scientific.

2. Electrochemical characterizations

The electrochemical testing was carried out using an electrochemical workstation (VMP-300, Biologic France) at an ambient temperature with 1 M Na_2SO_4 solution using cyclic

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voltammetry (CV), galvanostatic charge/discharge (GCD) and electrochemical impedance spectroscopy (EIS) techniques. CV measurements have been recorded in voltage window -0.6 to 0.6 V within scan rate (0.2 to 5 mV/s). GCD analysis has been accomplished at different current densities (30 to 150 mA/g) within a voltage window of -0.6 to 0.6 V. EIS studies have been conducted at 10 mV sinusoidal signal within frequency range (10 mHz to 100 kHz). The cycle stability was tested by repeating 10000 cycles at a fixed current density of 660 mA/g.

3. Additional morphological studies

Fig. S1 shows low-magnification FESEM pictures of Ni foam and Ni foam coated MG nanohybrids. Fig. S1 (a) clearly displays porous morphology of Ni foam with average pore diameter of about 200 µm. It can be seen from Fig. S1 (b-d) that MG nanohybrids have been successfully coated onto and within the pores of Ni foam, which facilitates fast electron transmission.

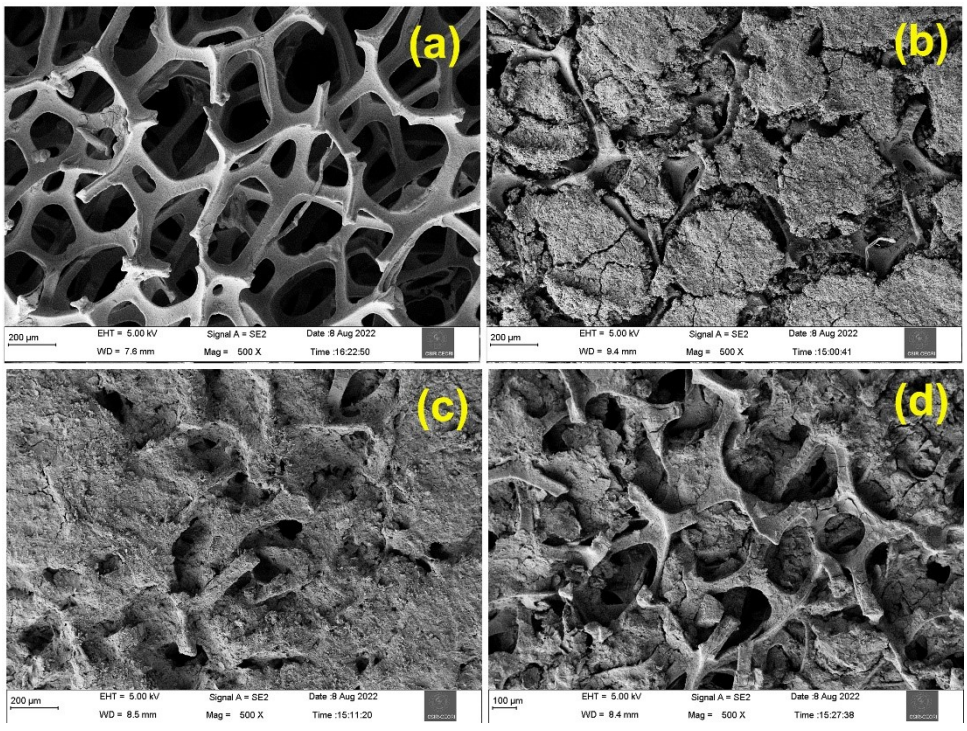

Fig. S1 FESEM images of (a) pure Ni foam, Ni foam coated (b) MG-0.5, (c) MG-1 and (d) MG-2 nanohybrid at lower magnification.

Table S1 Fitted parameters obtained after simulating EIS data

Sample	Model	R_s (Ω)	Q_2 ($F.s^{(a-1)}$)	n_2	R_{ct} (Ω)	Q_3 ($F.s^{(a-1)}$)	n_3	R_d (Ω)
MG-2	Model 1	2.741	0.04578	0.3139	1.466	1.411	0.9797	-
MG-1	Model 1	2.592	0.05007	0.3285	5.875	0.3287	0.86	-
MG-0.5	Model 1	4.832	0.01754	0.338	3.59	0.6298	0.8862	-
MS	Model 2	2.73	1.586e-3	0.4812	5.565	0.731	0.998	66

Table S2 Comparison of previously reported MoS_2 based supercapacitors and the findings of current work.

Electrode material	Electrolyte	Specific capacitance	Specific Energy (Wh/kg)	Specific Power (W/kg)	Cycle stability	Ref.
MoS_2/CC	1 M Na_2SO_4	2236.6 mF/cm^2 @ 10 mA/cm^2	-	-	86.1 % after 2000 cycles	[1]
MoS_2 nanostructure	1 M Na_2SO_4	92.85 F/g @ 0.5 mA/cm^2	7.25	186.5	93.8 % after 1000 cycles	[2]
MoS_2 nanosheet	1 M Na_2SO_4	129.2 F/g @ 1 A/g	-	-	85.1 % after 500 cycles	[3]
MoS_2@3DG	1 M $LiPF_6$ in EC/DMC/EMC with 10 wt % FEC	688 mAh/g @ 8 A/g	156	197	997 mAh/g after 700 cycles at 2 A/g	[4]
1T-MoS_2@rGO-H	DES	169.6 F/g @ 1A/g	31.2	1164	91 % after 20000 cycles	[5]
MoS_2-rGO/GCE	1 M Na_2SO_4	387.6 F/g @ 1.2 A/g	-	-	No loss upto 1000 cycles	[6]
2H/1 T-MoS_2@rGO	6 M KOH	275 F/g @ 1 A/g	55	3000	97 % after 5000 cycles	[7]
3D MoS_2/C@RGO	1 M Na_2SO_4	340.0 F/g @ 1 A/g	-	-	90 % after 1000 cycles	[8]
MoS_2/rGO	1 M KCl	850 F/g @1A/g	-	--	95.3 % after 10000 cycles	[9]
MG-2	1 M Na_2SO_4	2049.90 F/g	192.43	337.36	100 % after	**Present**

nanohybrid	@ 0.03 A/g	10000 cycles	**work**

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