

NiFe₂O₄ nanoparticles decorated on 3D graphene capsule as an electrode for advanced energy storage applications

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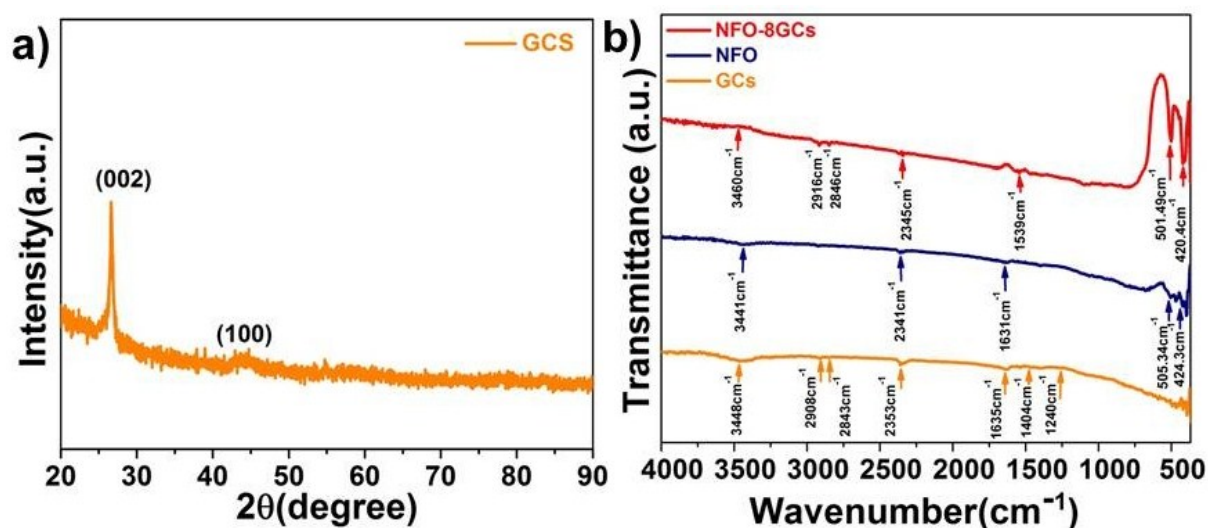


Fig.SI-I . Powder XRD patterns of (a) graphene capsules (GCs), and (b) FTIR spectra of GCs, NFO, and NFO–8GCs nanocomposite.

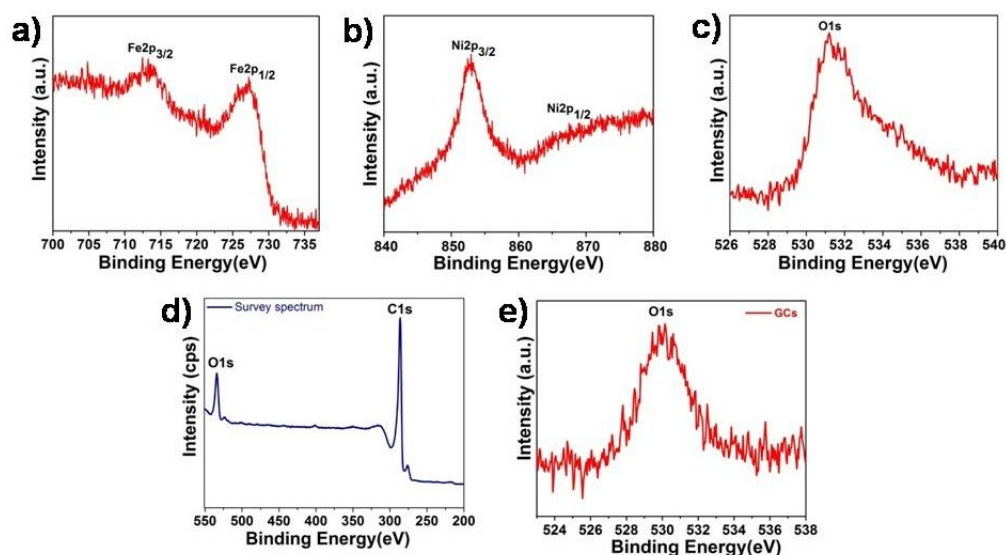


Fig.SI-II. (a) Fe 2p, (b) Ni 2p, (c) O 1s XPS spectra of NFO–8GCs nanocomposite and (d&e) XPS survey and O 1s spectra of GCs.

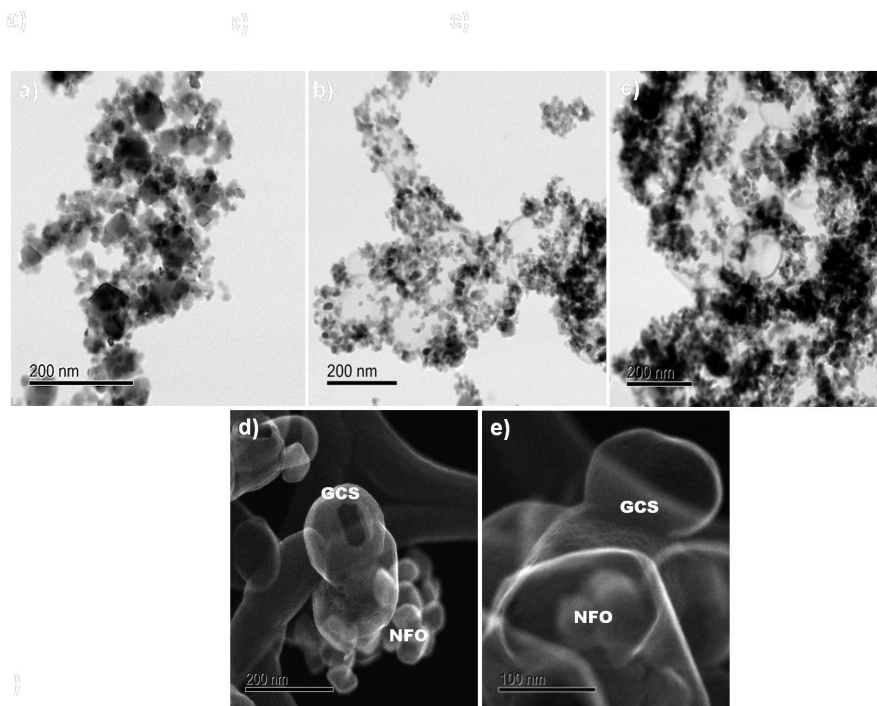


Fig. SI-III. (a-c) TEM images of NFO-GCs, (d&e) high magnification TEM images showing the presence of internal and external NFO in the GCs system.

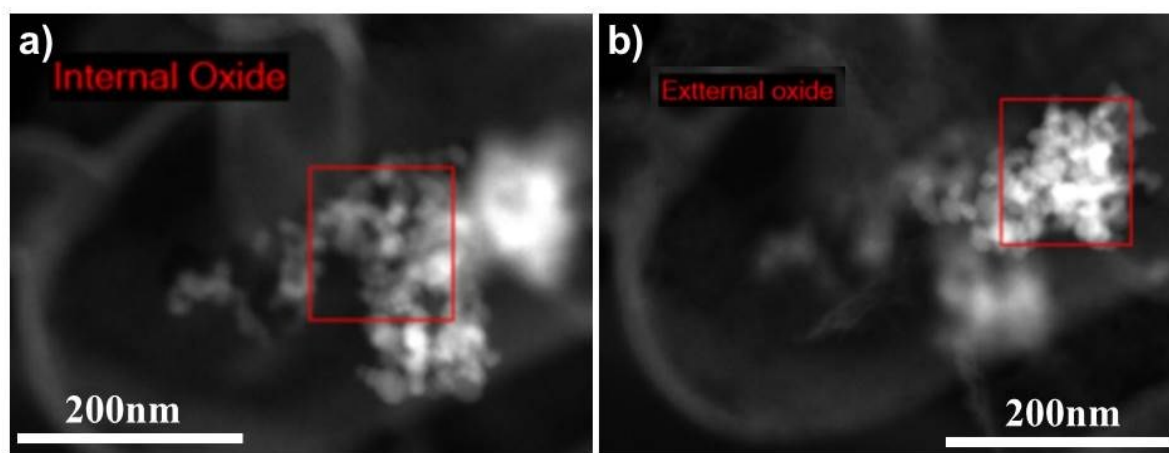


Fig. SI-IV. (a, b) TEM images of NFO-8GCs showing the presence of internal and external NFO.

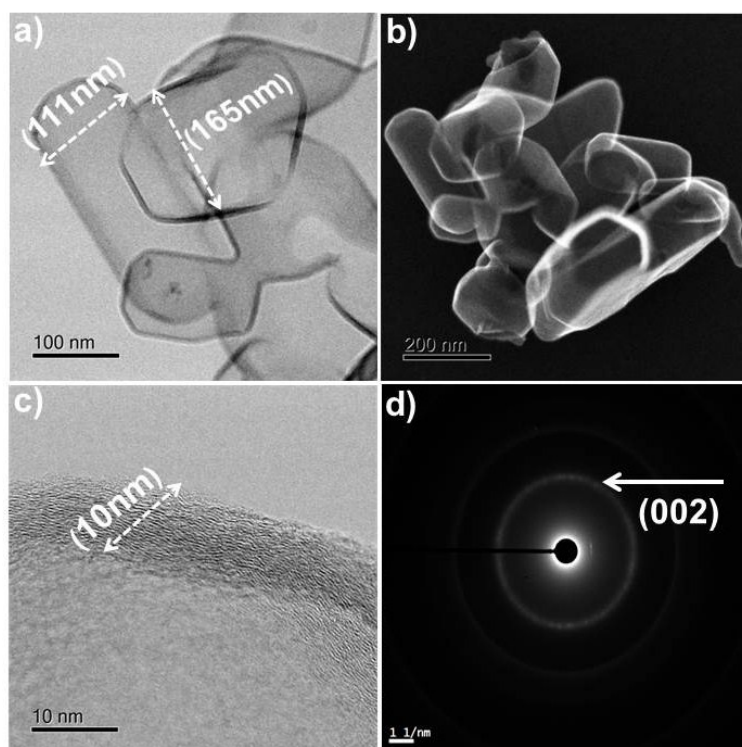


Fig.SI-V. (a, b) TEM images of GCs, c) HRTEM image of GCs, (d) corresponding SAED pattern.

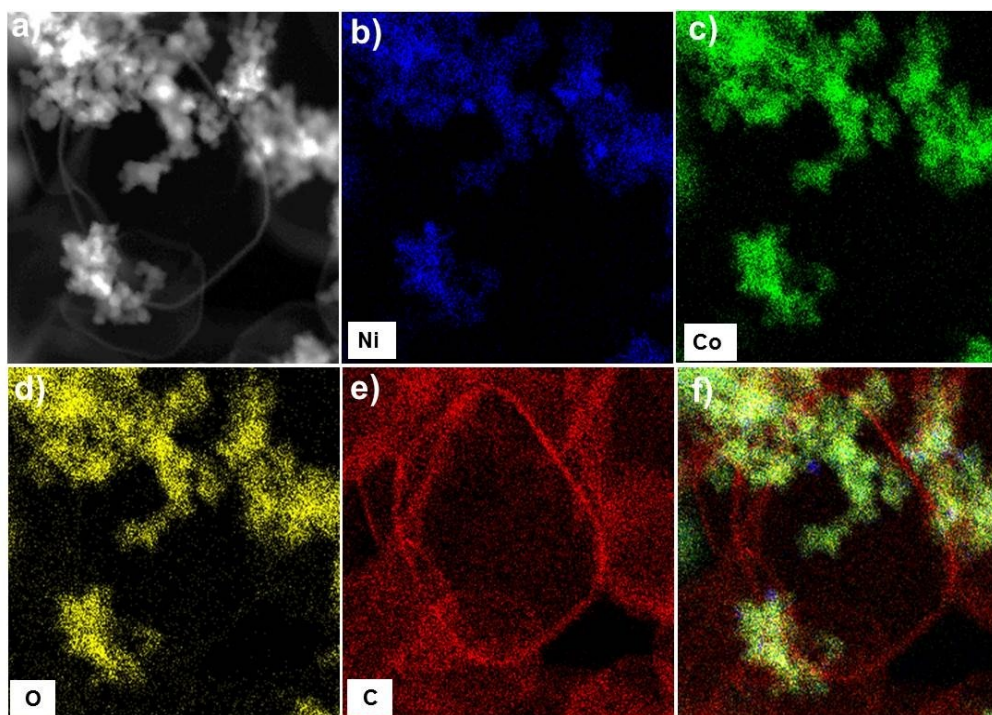


Fig. SI-VI (a) TEM image of the NFO-GCs and (b-e) corresponding elemental mapping and (f) the combined elemental mapping.

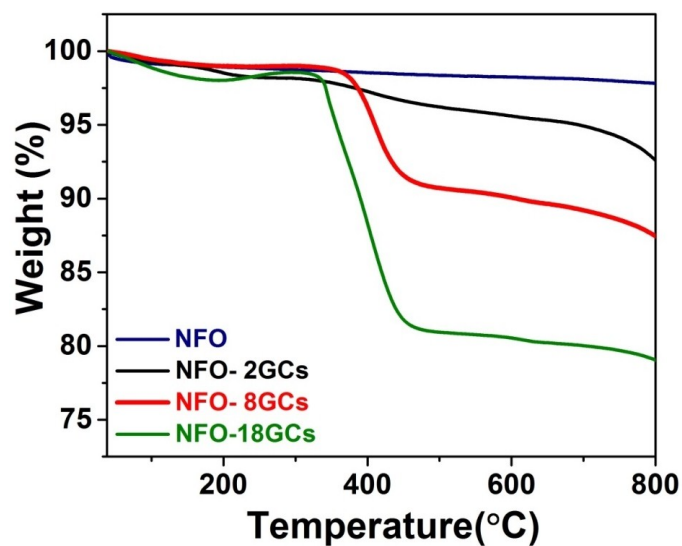


Fig. SI-VII. TGA analysis of the NFO– GCs nanocomposites with different ratios of GCs.

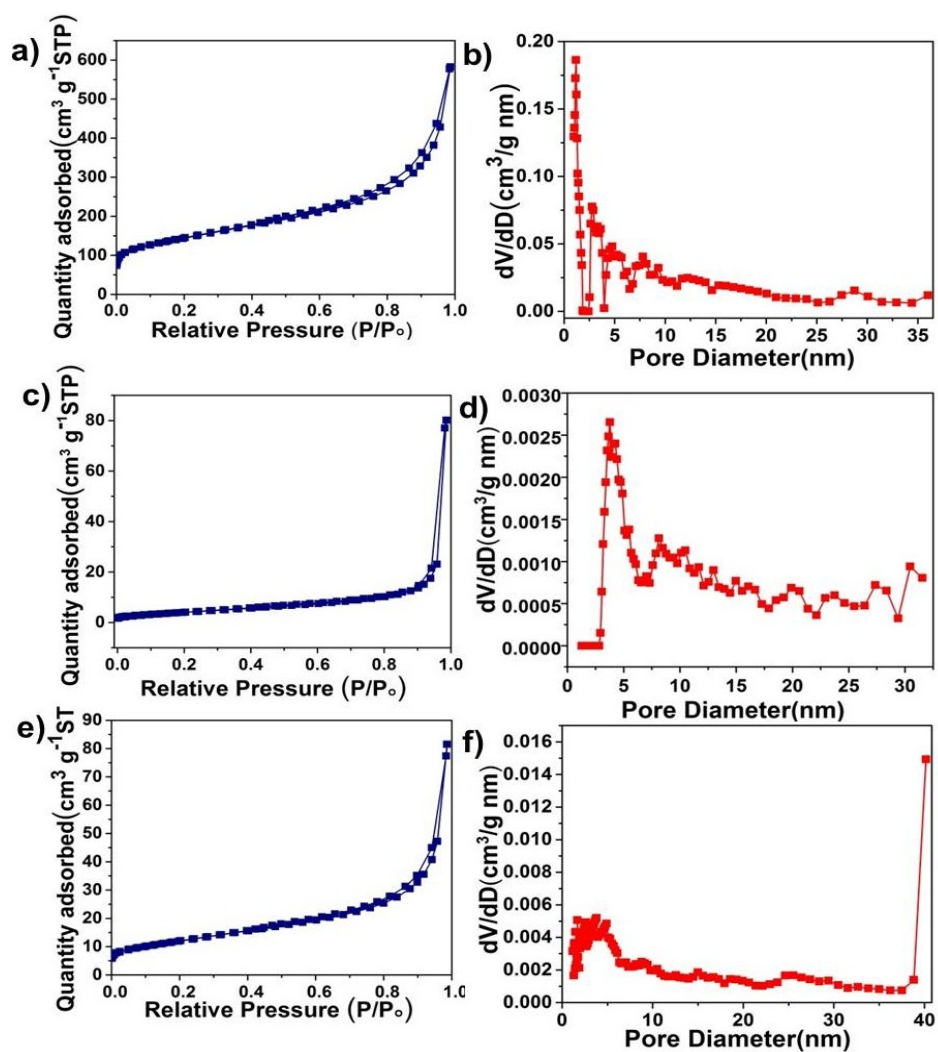


Fig.SI-VIII. (a, c, e) Nitrogen adsorption and desorption isotherms of the GCs, NFO, and NFO-8GCs composite, while (b, d, e) show the corresponding Barrett-Joyner-Halenda (BJH) pore size distributions.

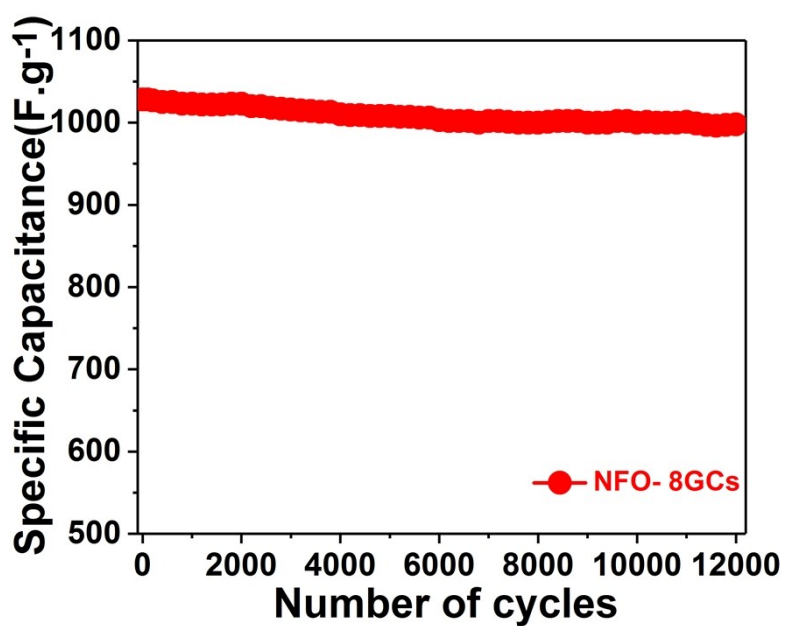


Fig. SI-IX cycling performance of NFO-GCs nanocomposites at 2 Ag^{-1} for 12000 cycles.

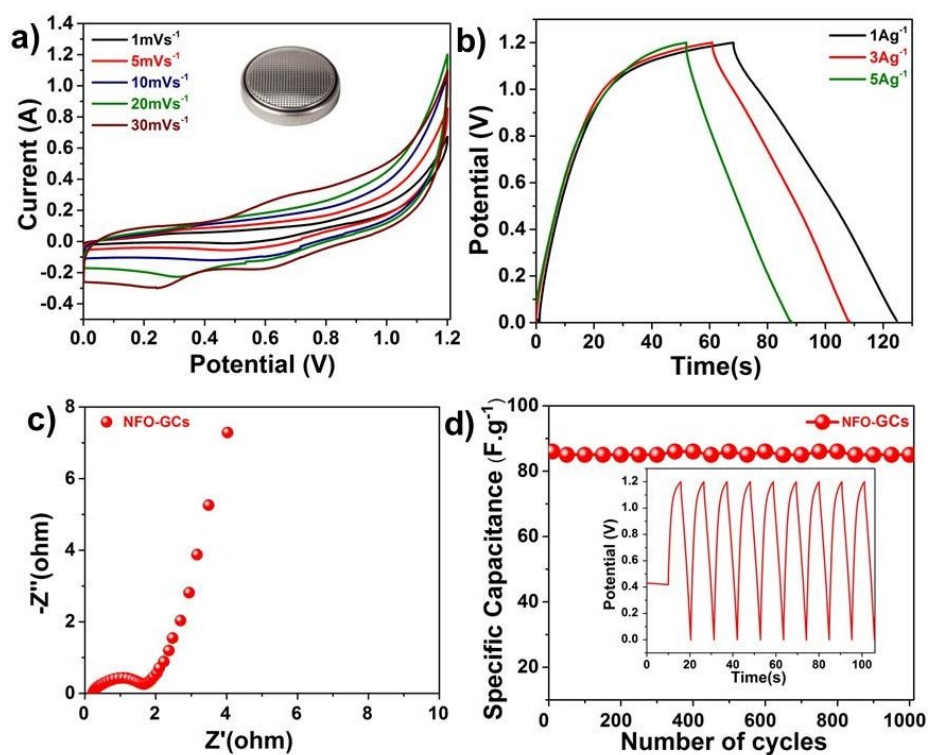


Fig. SI-X. a) CV curves, b) charge /discharge curves, c) Nyquist plot recorded between 1 Hz and 100 kHz, and d) cycling performance of the NFO-8GCs solid state device.

Table SI-1 BET surface area and pore size of GCs, NFO and NFO-GCs:

Samples	BET specific surface area (m ² g ⁻¹)	BJH pore volume (cc g ⁻¹)	Average pore size (nm)
GCs	509.99	3.68E-01	7.5
NFO	15.642	1.57E-02	10.7
NFO-8GCs	43.643	3.47E-02	7.6

Table SI -2 Solution Resistance (R_s), charge transfer resistance (R_{ct}), initial capacitance and capacitance retention of NFO and NFO-GCs:

Samples	R_s (Ω)	R_{ct} (Ω)	Capacitance F. g ⁻¹	Capacitance Retention %
NFO	4.7	4.18	720	88
NFO-2GCs	3.10	3.23	860	90
NFO-8GCs	0.92	1.42	1028	94
NFO-18GCs	0.54	1.39	945	92

Table SI-3 Electrochemical performance comparison of present system with different reported NFO system:

Electrode Material	Processing Technique	Specific capacitance (F g ⁻¹)	No. of Cycles	Capacitance Retention (%)	Reference No.
NFO– carbon textile	Hydrothermal	584	10000	93.5	20
NFO– carbon cloth	Hydrothermal	1135.5	3000	80	21
NFO	Chemical bath deposition	541	1050	—	23
NFO	Hydrothermal	1040	500	70	38
NFO– PANI	Polymerization	448	1000	80	39
NFO–DOT:PSS– rGO	One- step	1090	750	94	40
NFO– GCs	Hydrothermal	1028	10000	94	Present study