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Supporting Information

Magnetic Field-Induced Fabrication of Fe_3O_4/Graphene Nanocomposites for Enhanced Electrode Performance in Lithium-Ion Batteries

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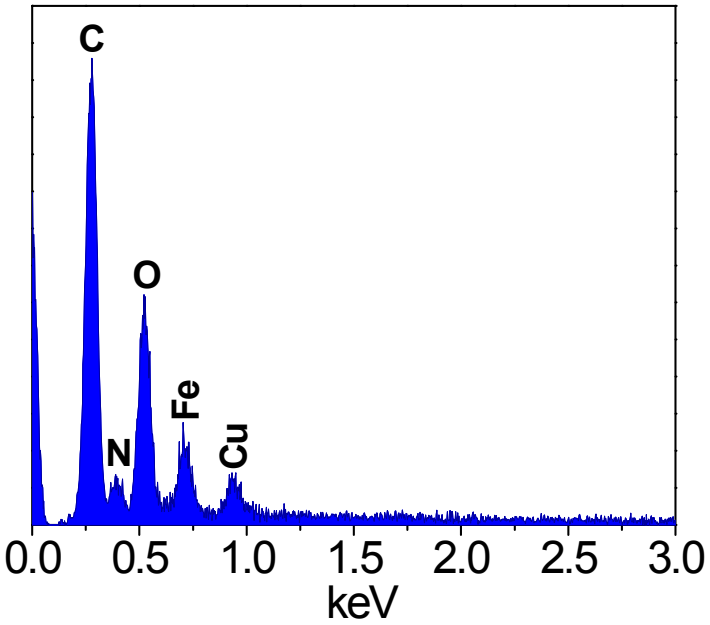

Figure S1. Energy dispersive X-ray pattern of Fe_3O_4/RGO nanocomposite

Table S1. Energy-dispersive X-ray element ratio of Fe_3O_4/RGO nanocomposite.

Element	[wt.%]	[Norm. wt.%]	[Norm. at.%]	Error in wt.% (1 Sigma)
Carbon	55.06902	37.49147	51.49212	6.054995
Nitrogen	15.57113	10.60096	12.48524	2.033584
Oxygen	41.67968	28.37589	29.25724	4.697456
Iron	26.95122	18.34863	5.419899	1.234481
Copper	7.613091	5.183059	1.345505	1.00074
Sum	146.8841	100	100	

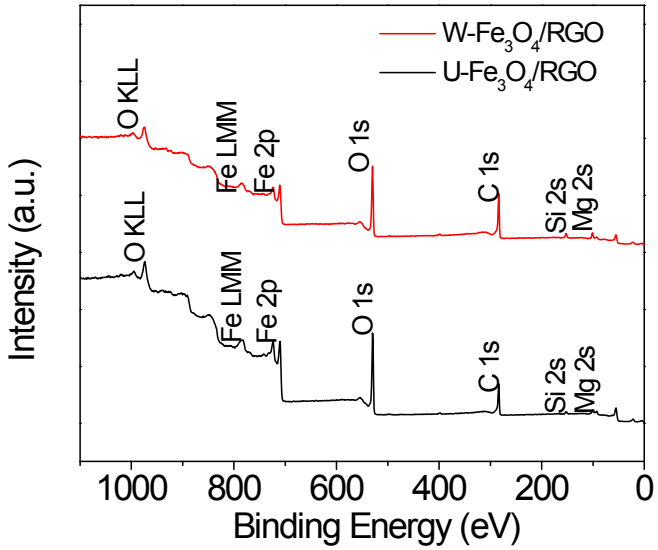

Figure S2. XPS survey scans of wrinkled and unwrinkled Fe_3O_4/RGO anodes.

Table S2. Atomic concentrations of wrinkled and unwrinkled Fe_3O_4/RGO anodes from XPS survey scans.

Element	[Atomic Conc.%]	[Atomic Conc.%]
O 1s	24.861	30.124
C 1s	44.069	32.671
N 1s	0.861	0.688
Co 2p	1.455	0
Fe 2p	7.948	14.996
Si 2p	9.040	9.350
Mg 2s	11.766	12.170
	Wrinkled sample	Unwrinkled sample

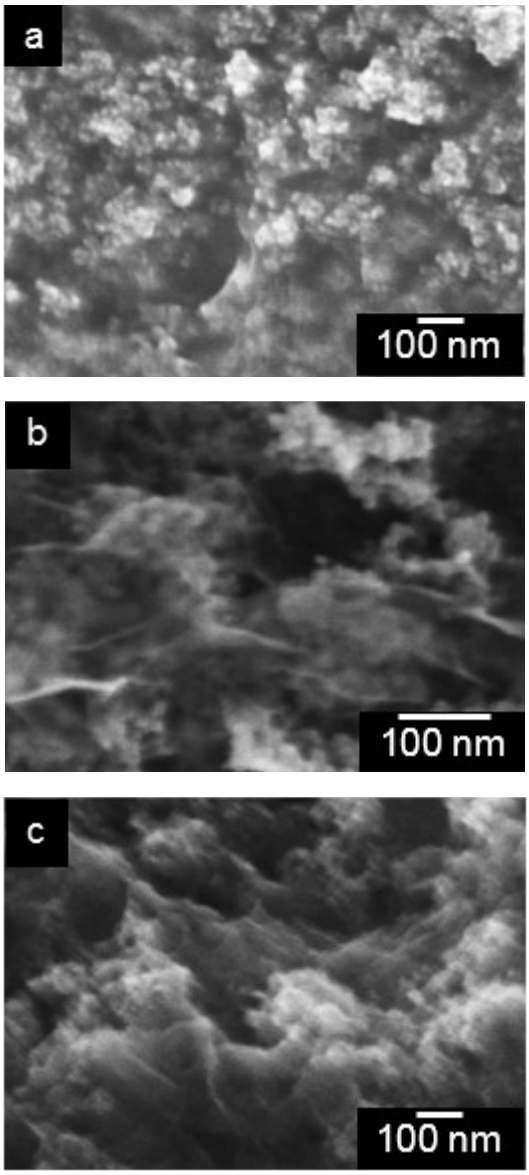

Figure S3. FESEM images of Fe_3O_4/RGO anode materials: (a) synthesized without exposure to magnet field; (b) synthesized with exposure to magnetic field and centrifugation treatment; and (c)) synthesized with exposure to magnetic field without centrifugation treatment

In order to further verify the successful fabrication of wrinkled structure under the magnetic field, we lowered the weight ratio of Fe_3O_4 in the composite from 83.03 wt% (amount used throughout the study) to 57.5 wt%. The weight ratio of new 57.5 wt% Fe_3O_4/RGO nanocomposite is shown in the TGA curve in Figure S4.The difference between the true weight ratio 57.5% and 59.5wt% of TGA curves could be explained by the slight weight gain based on the oxidation of Fe_3O_4 in air to Fe_2O_3.

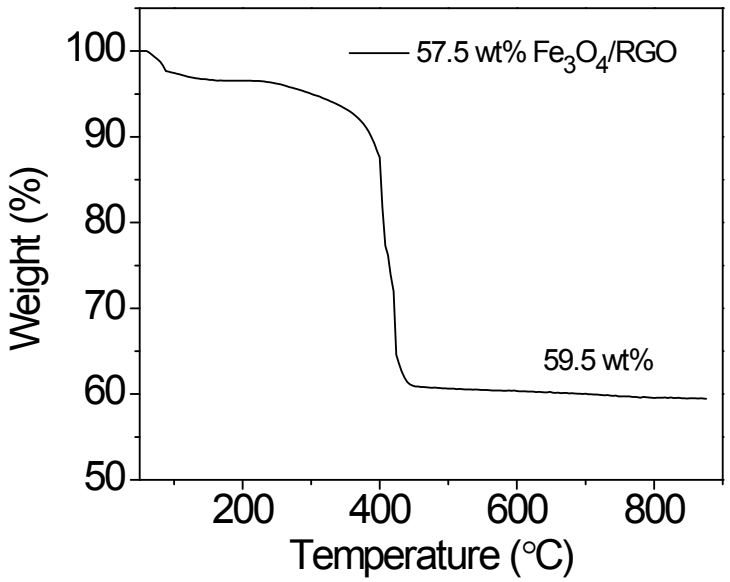

Figure S4. TGA curve of 57.5% Fe_3O_4/RGO nanocomposites under an air flow at a temperature ramp of 5 °C/min

Figures S5 shows the morphology of unwrinkled and wrinkled 57.5 wt % Fe_3O_4/RGO anode sample. Even though the wrinkled features in the sample [see the panel (b)] are not obvious when compared to the surface of the unwrinkled sample [see the panel (a)], we still observed improved cycling performance for the wrinkled sample as shown in Figure S6. Cycling performance was conducted at 0.2C current rate (137mA/g based on 688 mA/g theoretical specific capacity). This result confirms that better capacity retention is achieved even when a partially wrinkled structure is formed.

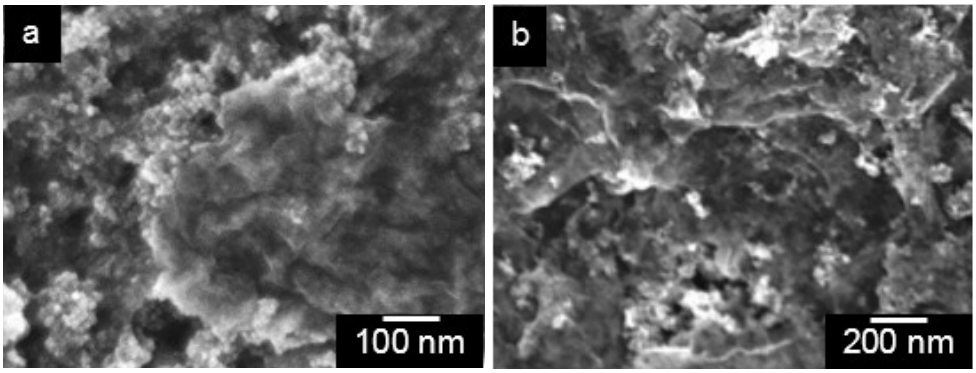

Figure S5. FESEM images of the 57.5 wt % Fe_3O_4/RGO anode material: (a) synthesized without exposure to magnetic field; (b) synthesized with exposure to magnet field and without centrifugation treatment.

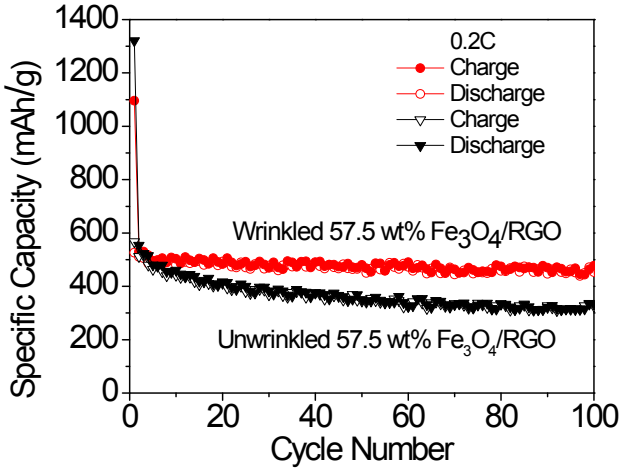

Figure S6. Cycling performance of wrinkled and unwrinkled 57.5wt % Fe_3O_4/RGO electrodes at a cycling rate of 0.2C with a cutoff voltage window of 3.0 - 0.001 V.

Using the Scherrer equation, we calculated the crystallite size from XRD data in the paper. Scherrer formula provides a lower bound on the particle size. The calculated crystallite size may appear small compared to the size determined from other methods.

$$D_p = \frac{0.94\lambda}{\beta_{1/2}\cos\theta}$$

Where Dp = Average crystallite size

$\beta_{1/2}$ = The line broadening at half the maximum intensity (FWHM)

θ = Bragg angle

λ = X-ray wavelength =1.5418 Å in our paper

Peak Position(2θ)/Degrees	Peak FWHM($\beta_{1/2}$)/Degrees	Fe_3O_4 Particle Size/nm
42.77 (400)	0.97	9.20
35.092 (311)	0.827	10.54
62.22 (440)	1.08	8.98