Supporting Informations

Eco-Friendly Synthesis of α-Fe_2O_3/rGO Nanocomposite and its Application in High-Performance Asymmetric Supercapacitors

Sabiar Rahaman[a§], Azam Raza[b§], Aadil Rahid Lone[a§], Mohammad Muaz[b], SM Hasan Zaidi[b], Mohammad Asif Adeeb[b], Farasha Sama[b], Kavita Pandey[a*], Absar Ahmad[b*]*

[a]*Centre for Nano and Soft Matter Sciences (CeNS), Shivanapura, Bangalore 562162, INDIA*

[b]*Interdisciplinary Nanotechnology Centre, Aligarh Muslim University, Aligarh 202002, INDIA*

* Corresponding Authors: farashasamachem@gmail.com, kavitapandey@cens.res.in , aahmad786in@gmail.com

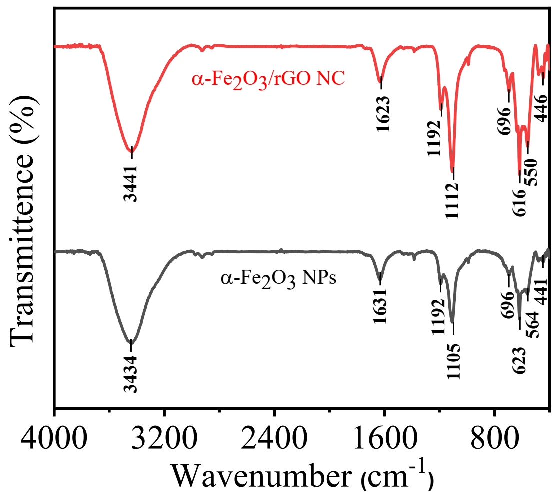

Fig. S1 Full range FTIR diagram of α-Fe_2O_3 NPs and α-Fe_2O_3/rGO NC.

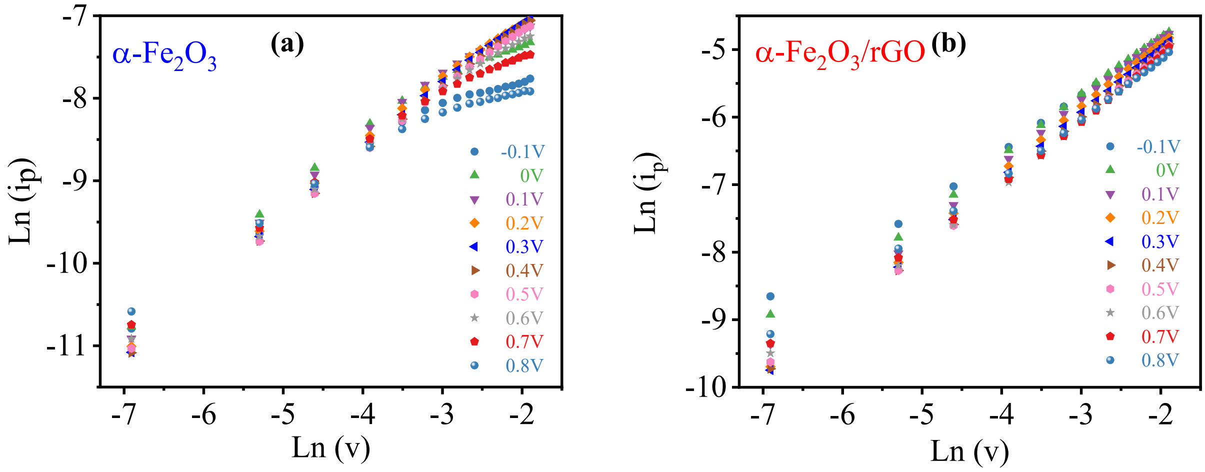

Fig. S2 log *i(V)* versus log (*v*) plot to calculate b values for **(a)** α-Fe_2O_3 NPs and **(b)** α-Fe_2O_3/rGO NC.

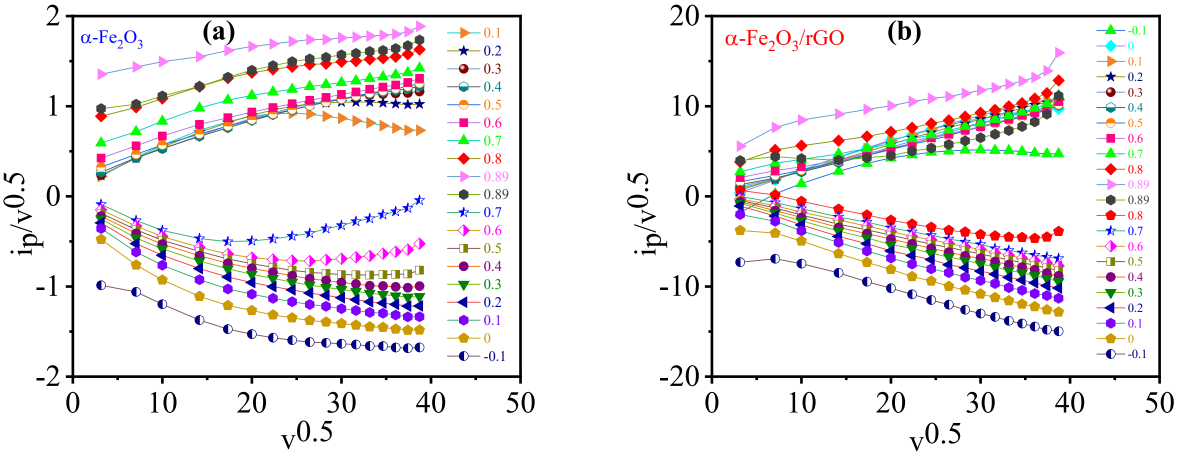

Fig. S3 Plotting of $\frac{(V)}{\square^{1/2}}$ *vs.* $v^{1/2}$ at different potentials for **(a)** α-Fe_2O_3 NPs and **(b)** α-Fe_2O_3/rGO NC.

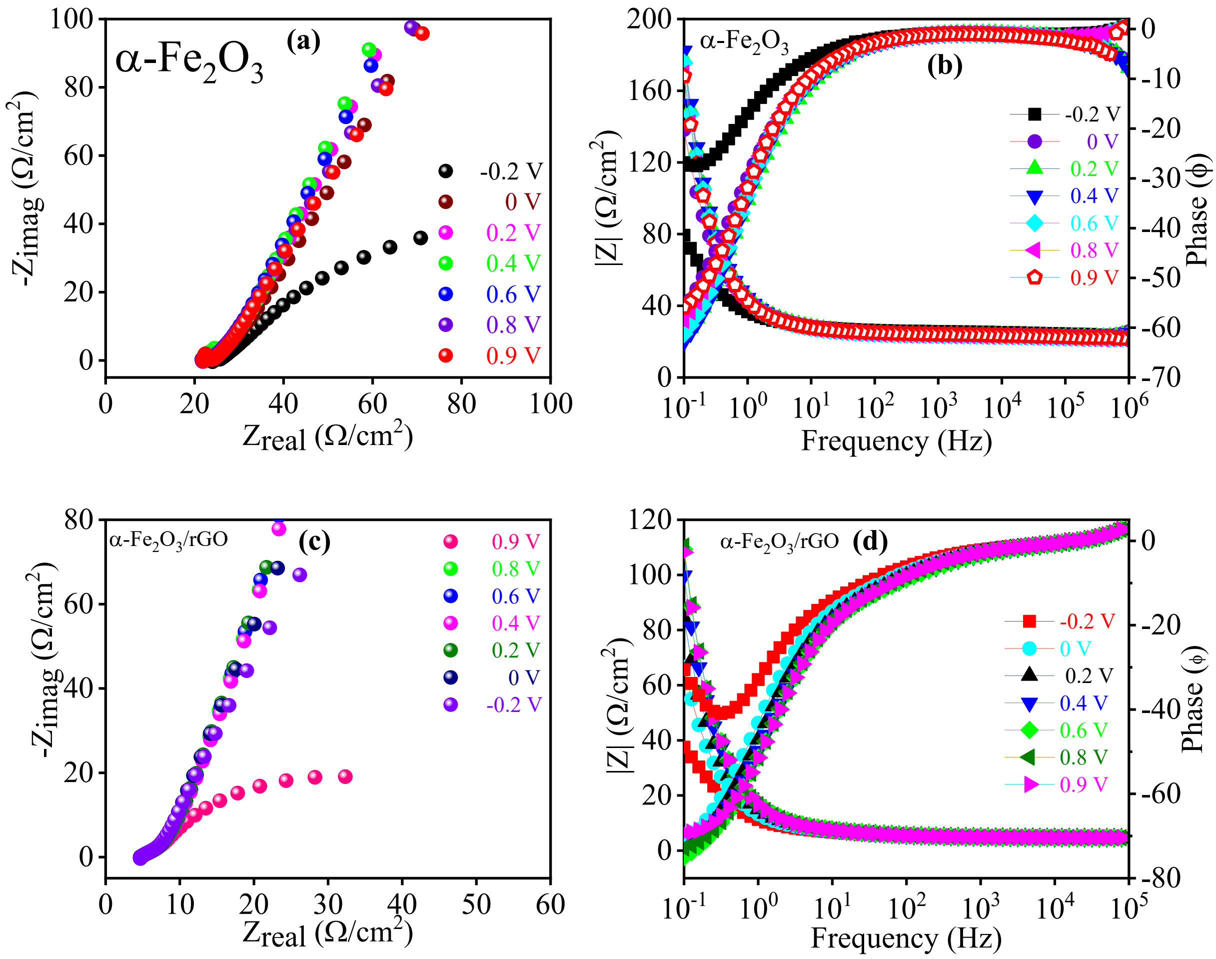

Fig. S4 Nyquist and Bode plots at different potentials for **(a-b)** α-Fe_2O_3 NPs and **(c-d)** α-Fe_2O_3/rGO NC.

Table S1: Room temperature phonon modes of α-Fe_2O_3 and α-Fe_2O_3/rGO

Raman peaks	reduced graphene oxide[1, 2]	α-Fe_2O_3 NPs	α-Fe_2O_3/rGO NC
$A_{1g}(1)$	…..	218	216
$E_g(1)$	…..	287	286
$E_g(2)$	…..	404	402
D	1344	1320	1319
G	1579	1574	1569

Table S2: Comparison of I_D/I_G ratio

Sample	ID/IG
reduced graphene oxide [3]	0.61
α-Fe2O3 NPs	0.82
α-Fe2O3/rGO NC	0.83

Table S3: Vibrations corresponding to the functional groups

Functional group	α-Fe_2O_3 NPs (cm^{-1})	α-Fe_2O_3/rGO NC (cm^{-1})
Fe-O[4, 5]	441 (Stretchingvibrations)	446 (Stretching vibrations)
Fe-O[4, 6]	564 (Stretchingvibrations)	550 (Stretching vibrations)
Fe-O[4, 6]	623	616
Fe-O[4, 6]	696	696
Fe-O-H[7]	1105	1112
C-OH[8]	1192	1192
C=C[9]	1631 (Bending vibrations)	1623 (Bending vibrations)
O-H[10]	3434	3441

Table S4: α-Fe_2O_3 NPs and α-Fe_2O_3/rGO NCs with corresponding absorption peaks and energy gap (eV)

Samples	Absorption peak (nm)	Absorption peak (nm) Ref[11, 12]	Direct bandgap (eV)	Indirect band gap (eV)
α-Fe_2O_3 NPs	450-550	500 - 700	1.65	2.007
α-Fe_2O_3/ rGO NC	450-575	574	1.63	1.93

Table S5: Summary of EIS parameter of α-Fe_2O_3 NPs and α-Fe_2O_3/rGO NCs

Sample	R_s (Ω)	R_{ct} (Ω)	α
α-Fe_2O_3 NPs	21.6	2.14	0.466
α-Fe_2O_3/rGO NCs	4.70	0.40	0.737

Table S6: Comparison of supercapacitor performance with the literatures

S. No.	Active Electrode Material	Potential Window	Electrolyte	Capacitance	Current Density/ Scan Rate	Capacitance Retention Rate (Stability)	
1	α-Fe_2O_3 thin film[13]	-1.5 to 0V	0.5 M Na_2SO_3	142 F/g	10 mA/cm^2	-	
2	Fe_2O_3@CC[14]	-1.2 to 0V	1 M $LiNO_3$	29 mF/cm^2	1mV/s	-	
3	rGO/Cu-MOF[15]	0 to 0.5V	1 M KCl	44.6 mF/cm^2	5 mV/s	69 % after 1000 cycles at 0.0125 mA/cm	
4	Co/Mn-MOFs@Rice Husks[16]	0 to 0.8V	2 M KCl	30.3 F/g	10 mV/s	39 % after 5000 cycles at 0.5 A/g	

5	$Co(OH)_2/Ni$[17]	-0.3 to 0.5V	2 M KOH	22.9 mF/cm^2	5 mV/s	92 % after 10000 cycles at 0.09 mA/cm$_2$	
6	γ-CD-MOF/GO/MG-600//γ-CD-MOF/GO/MG-600[18]	-0.2V to 0.8V	1 M H_2SO_4	111.3 F/g	1 A/g	90 % after 5000 cycles at 5 A/g	
7	$Cu_3(THQ)_2$-BPY[19]	−0.3 to −0.9 V	1 M KOH	66.1 F/g	10 mV/s	-	
8	TiO_2 nanotubes[20]	0 to 1V	0.5 M Na_2SO_4	23.2 mF/cm^2	2 mV/s	80 % after 5000 cycles at 1 mA/cm^2	
9	$NiCo_2O_4$[21]	-0.2 to 0.5V	2 M KOH	40.6 mF/cm^2	0.133 mA/cm^2	96 % after 10000 cycles at 0.533 mA/cm^2	
10	α-Fe_2O_3/rGO NC[22]	-0.2 to 1.9V	1 M Na_2SO_4	90.2 mF/cm^2	1 mV/s	112 %after 10000 cycles at 5 mA/cm^2	**This Work**

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