Electronic Supplementary Information

Novel π-conjugated iron oxide/ reduced graphene oxide nanocomposites for high performance electrochemical supercapacitors

Gourav Bhattacharya[a], Ganeshlenin Kandasamy[b], Navneet Soin[c], Ravi Kant Upadhyay[a], Sujit Deshmukh[a], Dipak Maity[b] , James McLaughlin[d] and Susanta Sinha Roy[a*]

[a]Department of Physics, School of Natural Sciences, Shiv Nadar University, Gautam Buddha Nagar 201314, Uttar Pradesh, India.

[b]Nanomaterials Lab, Department of Mechanical Engineering, School of Engineering, Shiv Nadar University, Gautam Buddha Nagar 201314, Uttar Pradesh, India

[c]Institute for Materials Research and Innovation (IMRI), University of Bolton, Deane Road, Bolton, BL3 5AB, United Kingdom.

[d]Nanotechnology and Integrated Bioengineering Centre, Jordanstown Campus, University of Ulster, Newtownabbey, BT37 OQB, Northern Ireland, United Kingdom.

*E-mail: susanta.roy@snu.edu.in

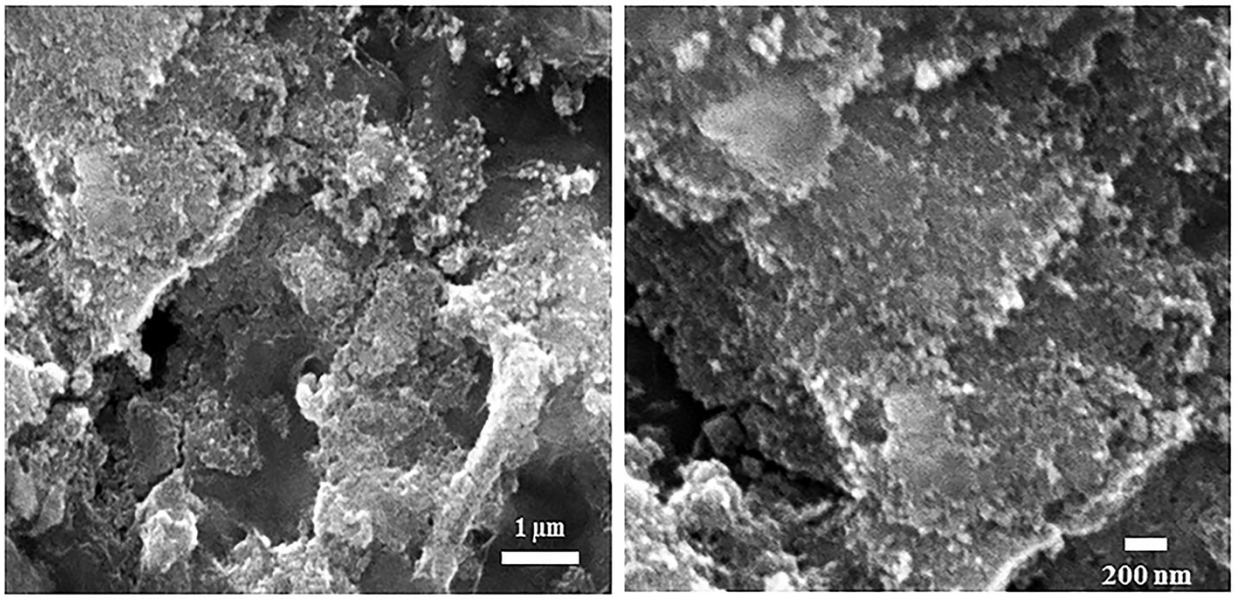

Fig. S1. SEM images of ATA-Fe_3O_4:RGO=1:1 samples at two different points and at two different resolutions.

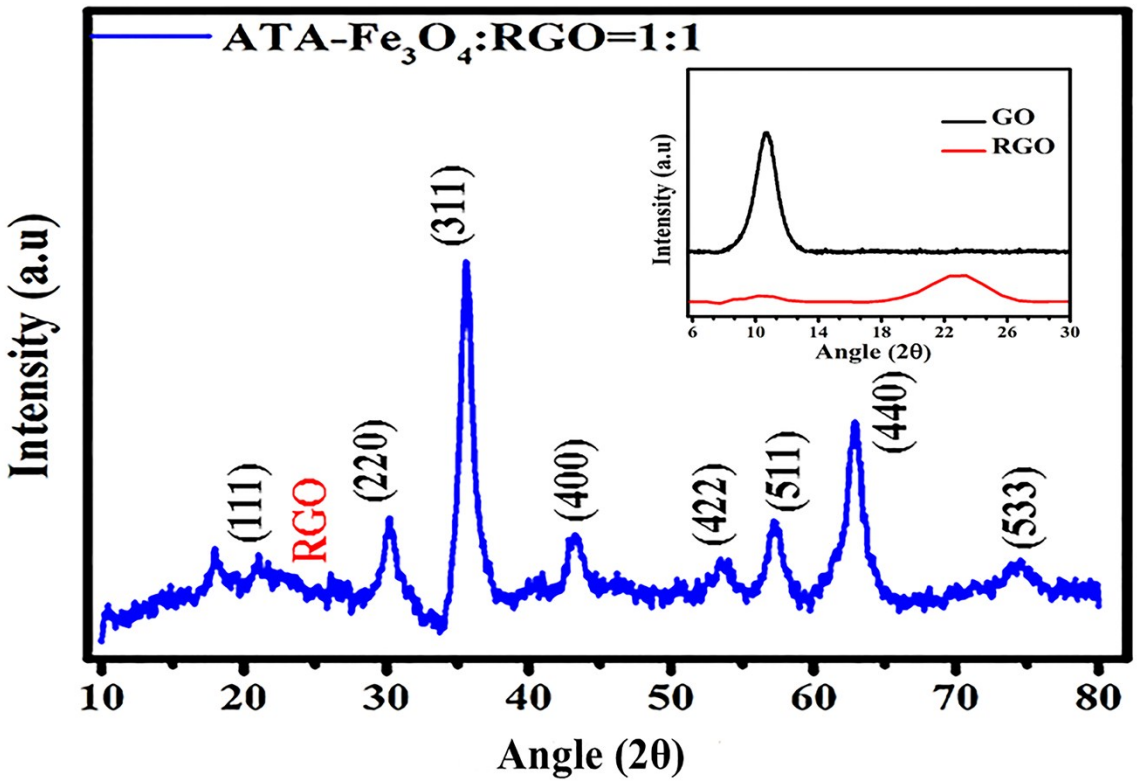

Fig. S2. XRD Spectra of ATA-Fe_3O_4/RGO nanocomposite (ATA-Fe_3O_4:RGO=1:1). Inset shows the XRD spectra of RGO.

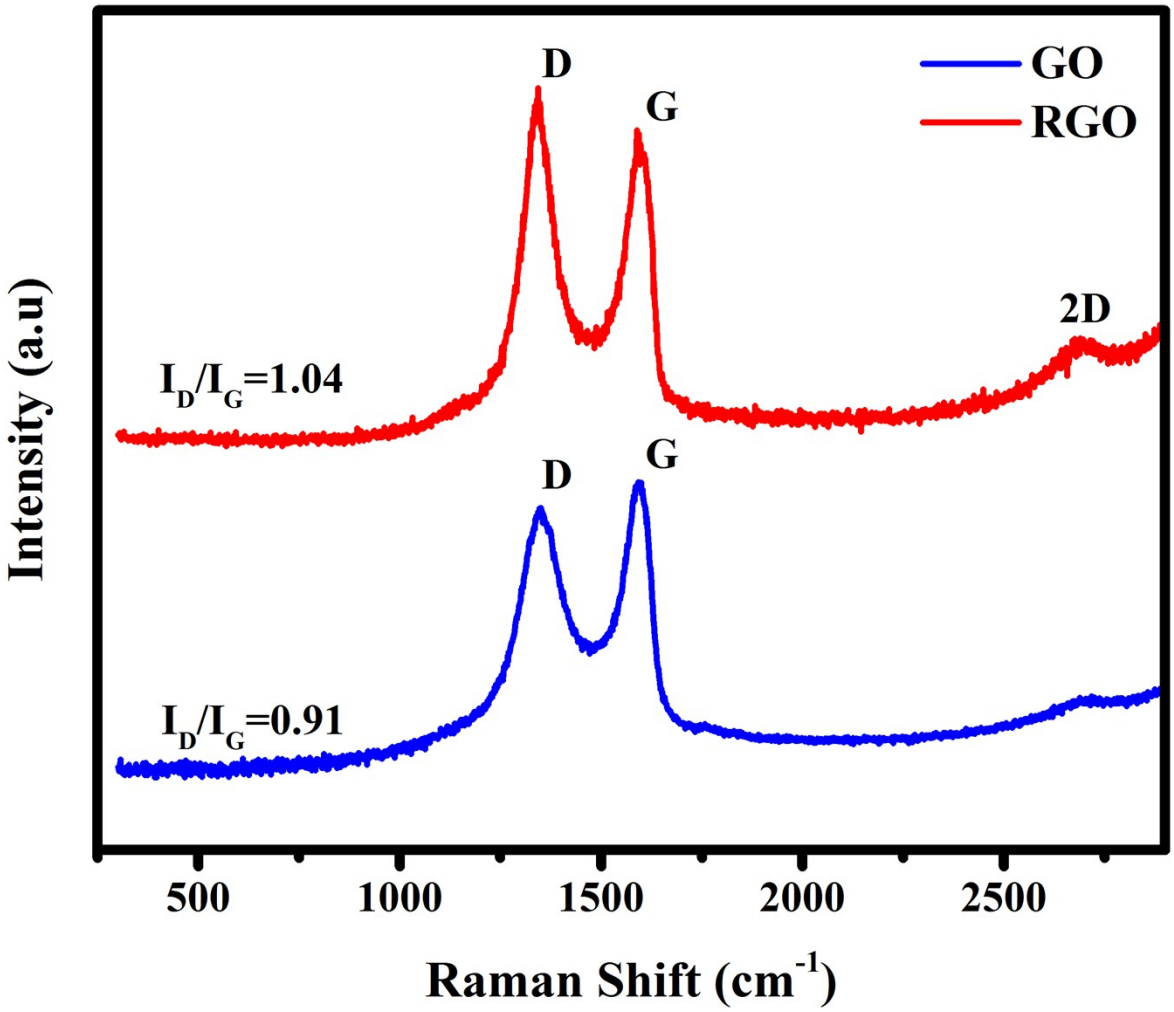

Fig. S3. Raman Spectra of GO and RGO

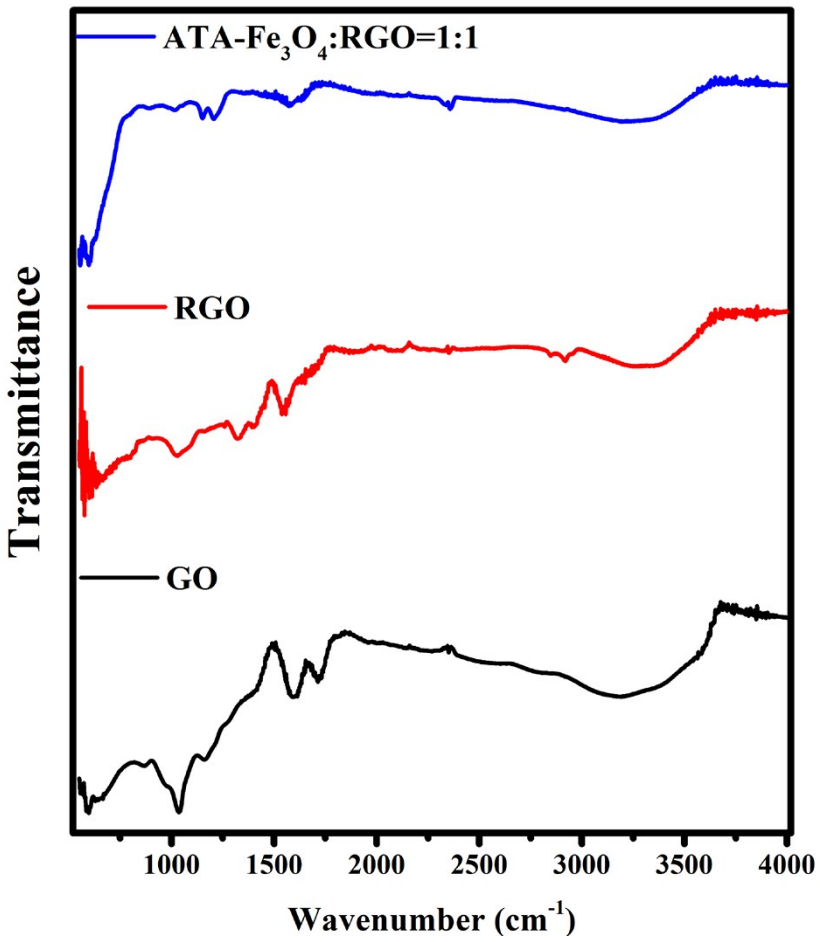

Fig. S4. FTIR Spectra of ATA-Fe_3O_4/RGO nanocomposite (ATA-Fe_3O_4:RGO=1:1)

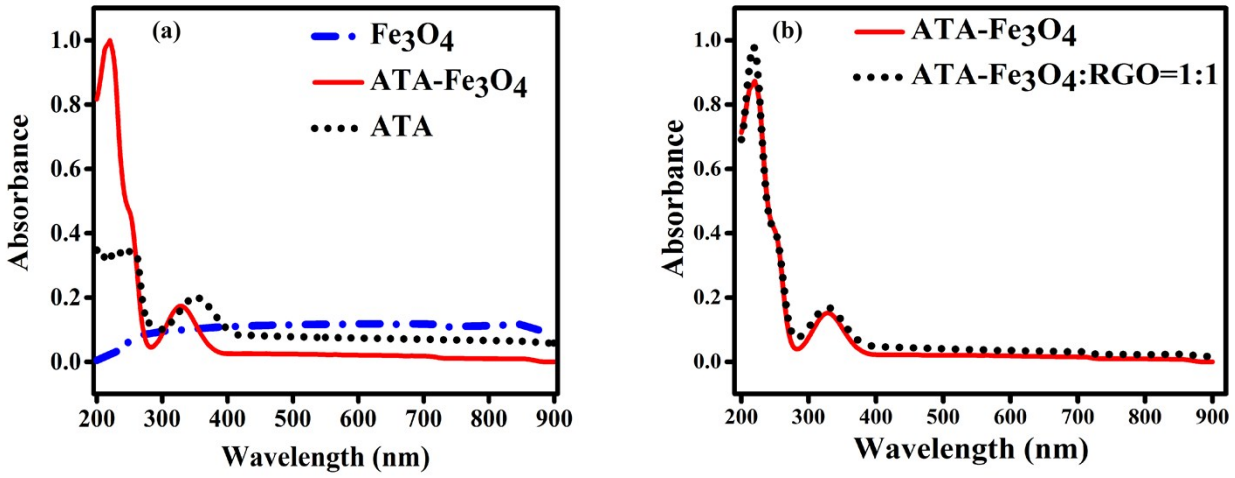

Fig. S5. UV-Visible spectra of (a). Fe_3O_4, ATA and ATA-Fe_3O_4 and (b). ATA-Fe_3O_4 andATA-Fe_3O_4:RGO=1:1.

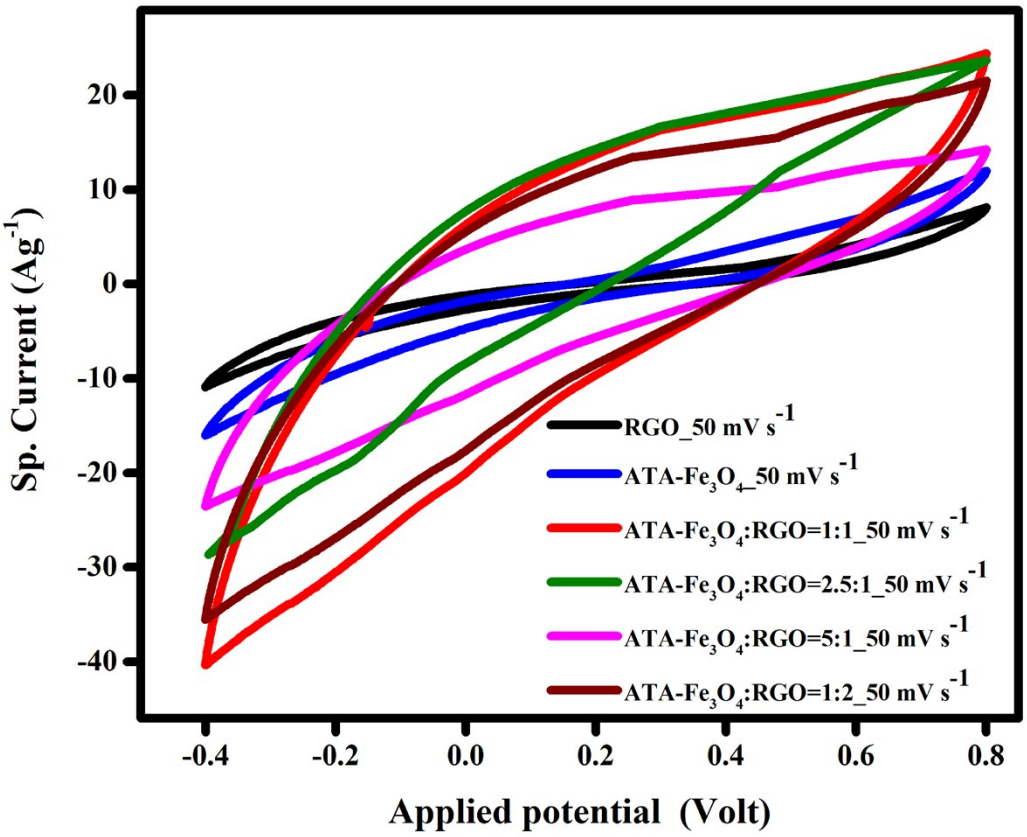

Fig. S6. Cyclic Voltammogram of ATA-Fe_3O_4, RGO and ATA-Fe_3O_4/RGO nanocomposites with different weight ratio (ATA-Fe_3O_4:RGO=1:2, ATA-Fe_3O_4:RGO=1:1, ATA-Fe_3O_4:RGO=2.5:1, ATA-Fe_3O_4:RGO=5:1) in 1M aqueous KOH at a scan rate 50 mV s^{-1}

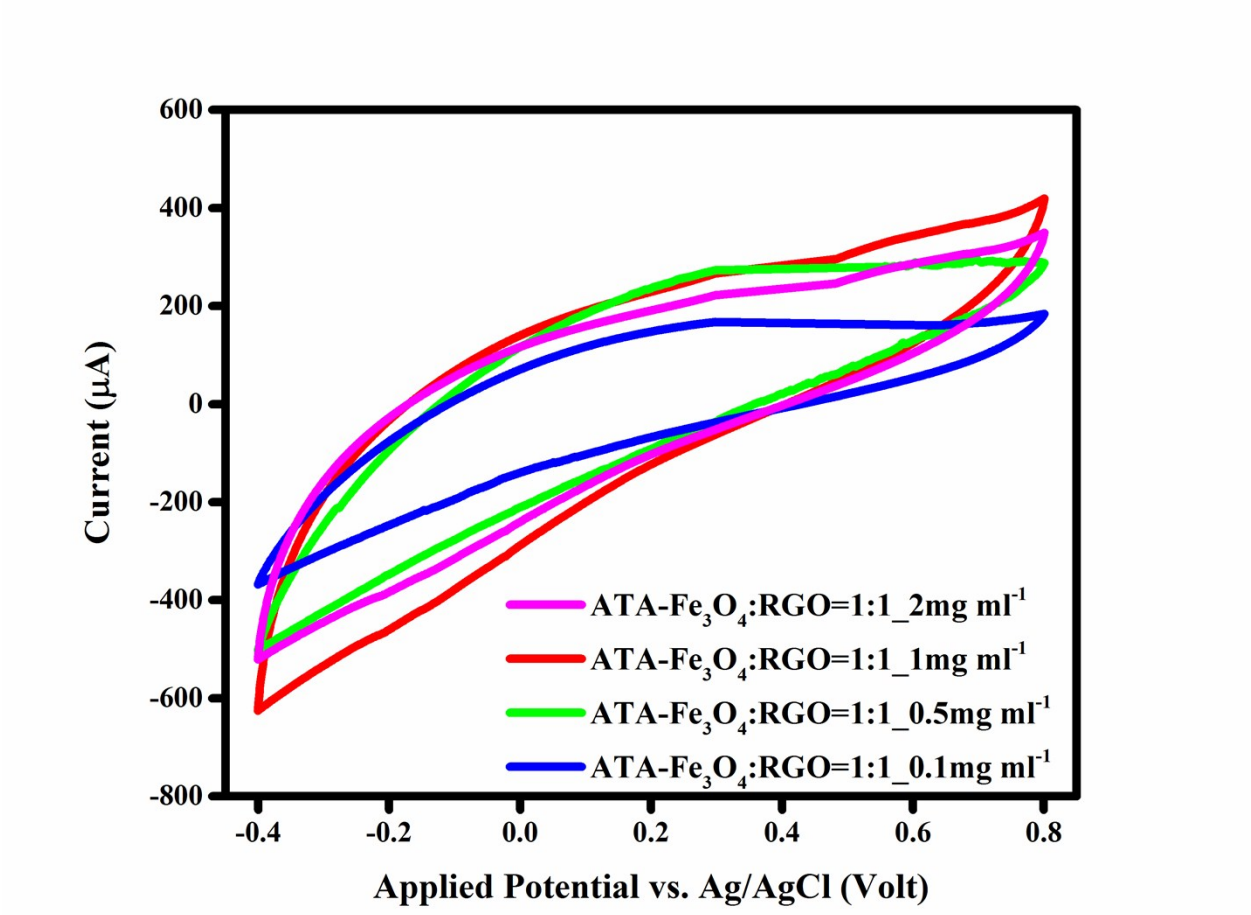

Fig. S7. Cyclic Voltammogram of ATA-Fe_3O_4/RGO nanocomposite (ATA-Fe_3O_4:RGO=1:1) with different nanocomposite concentrations (aqueous solution of 2 mg ml^{-1}, 1 mg ml^{-1}, 0.5 mg ml^{-1}, 0.1 mg ml^{-1}) at scan rate 50 mV s^{-1}

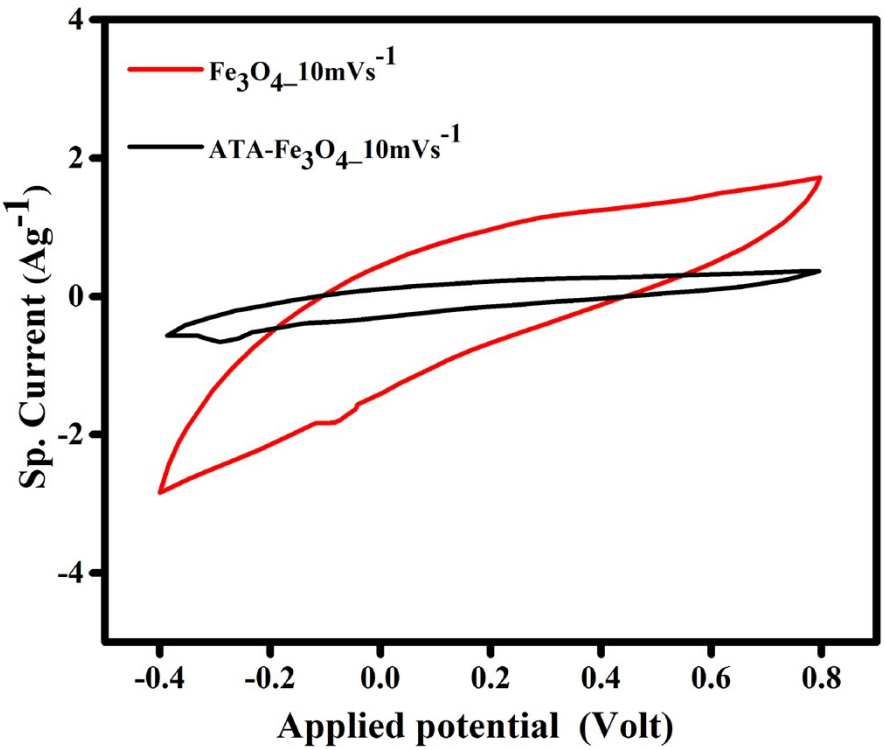

Fig. S8. Cyclic voltammetry of Fe_3O4 and ATA-Fe_3O_4 in 1M KOH solution and at a scan rate 10 mV s^{-1}.

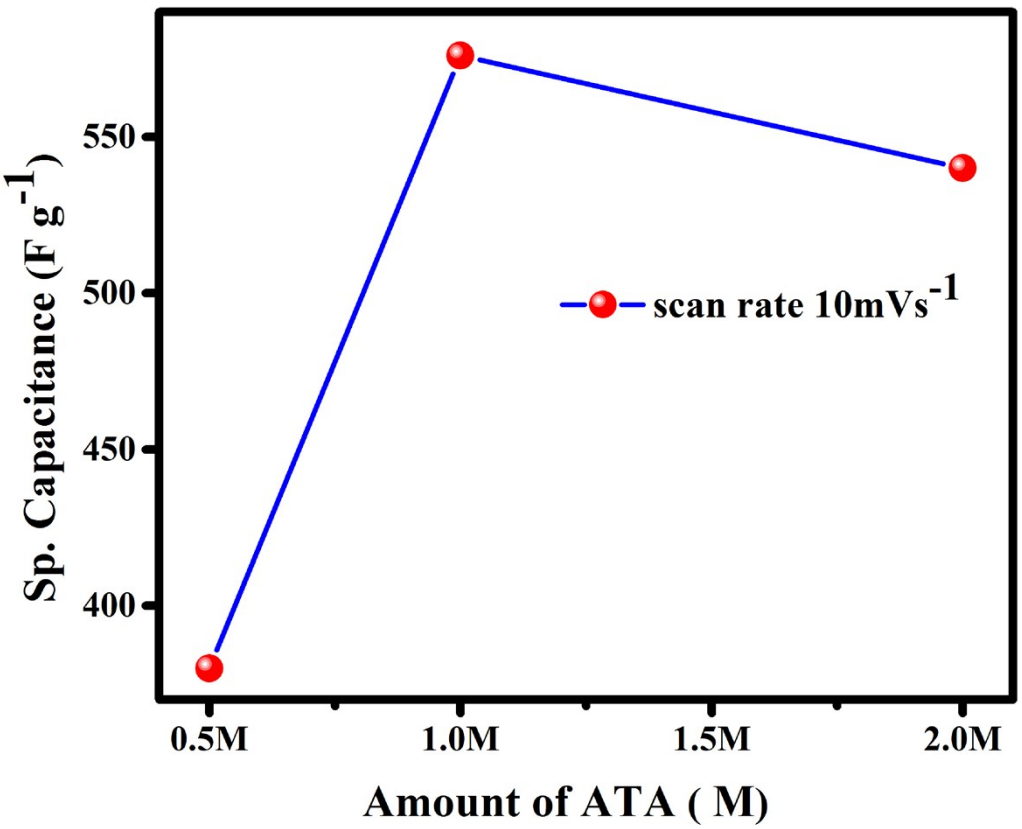

Fig. S9. Variation of specific capacitance of ATA-Fe_3O_4:RGO=1:1 samples with varying ATA amount at a scan rate 10 mV s^{-1}.

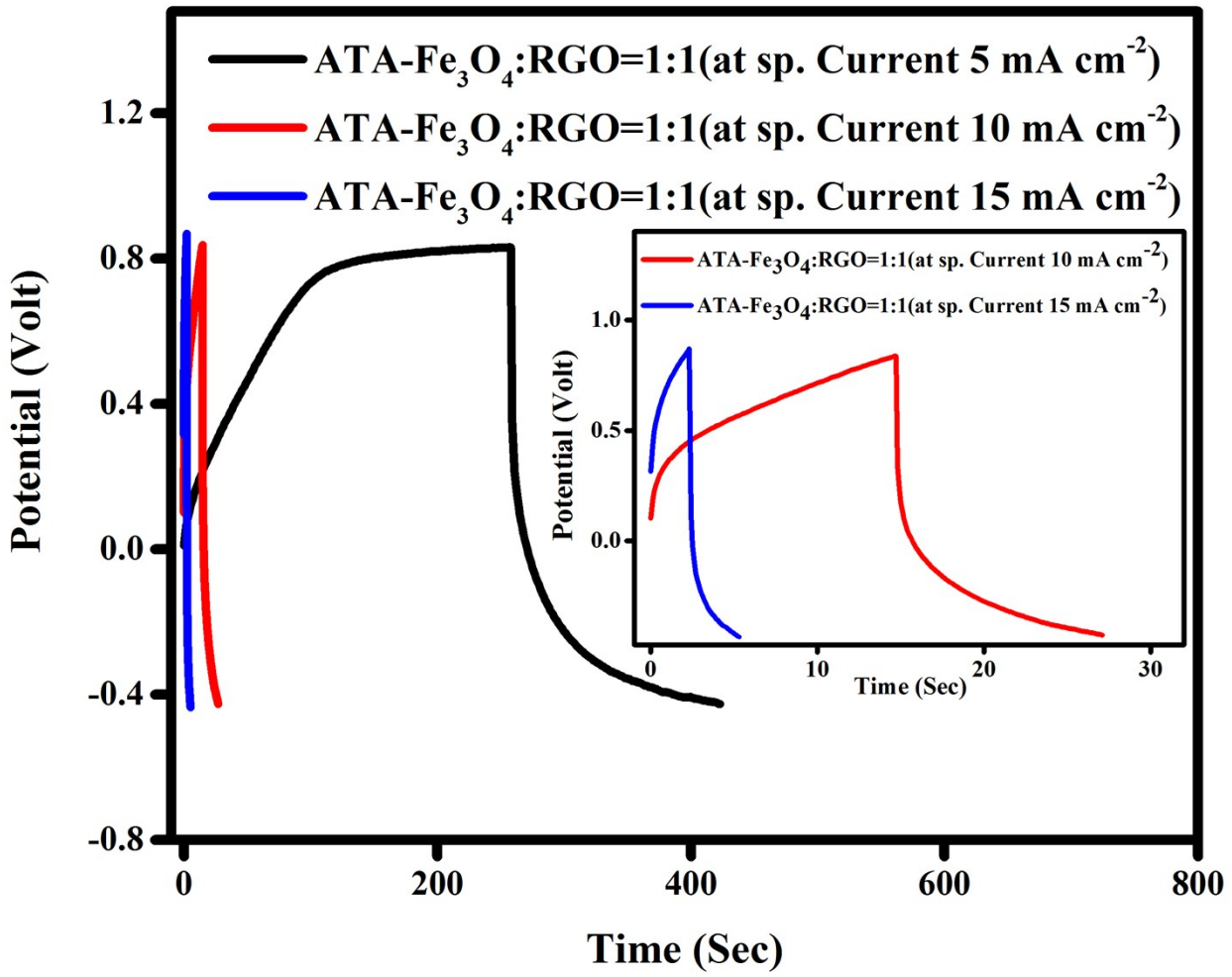

Fig. S10. Galvanostatic charge/discharge curve for areal capacitance of ATA-Fe_3O_4/RGO nanocomposite (ATA-Fe_3O_4:RGO=1:1) in 1M KOH solution at different specific current (5 mA cm^{-2}, 10 mA cm^{-2}, 15 mA cm^{-2}).

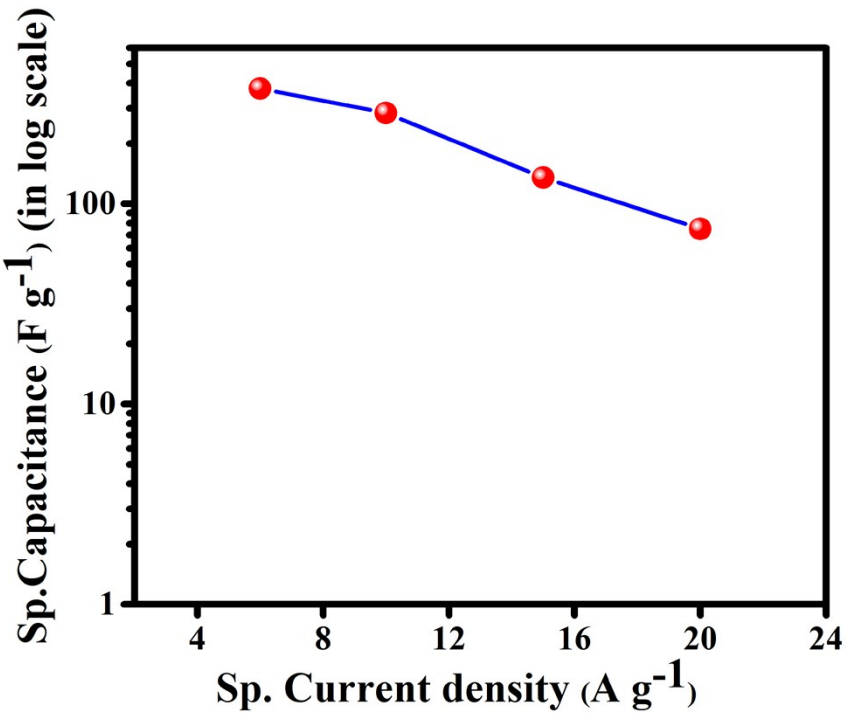

Fig. S11. Variation of sp. Capacitance with specific current density for ATA-Fe_3O_4:RGO=1:1 nanocomposites

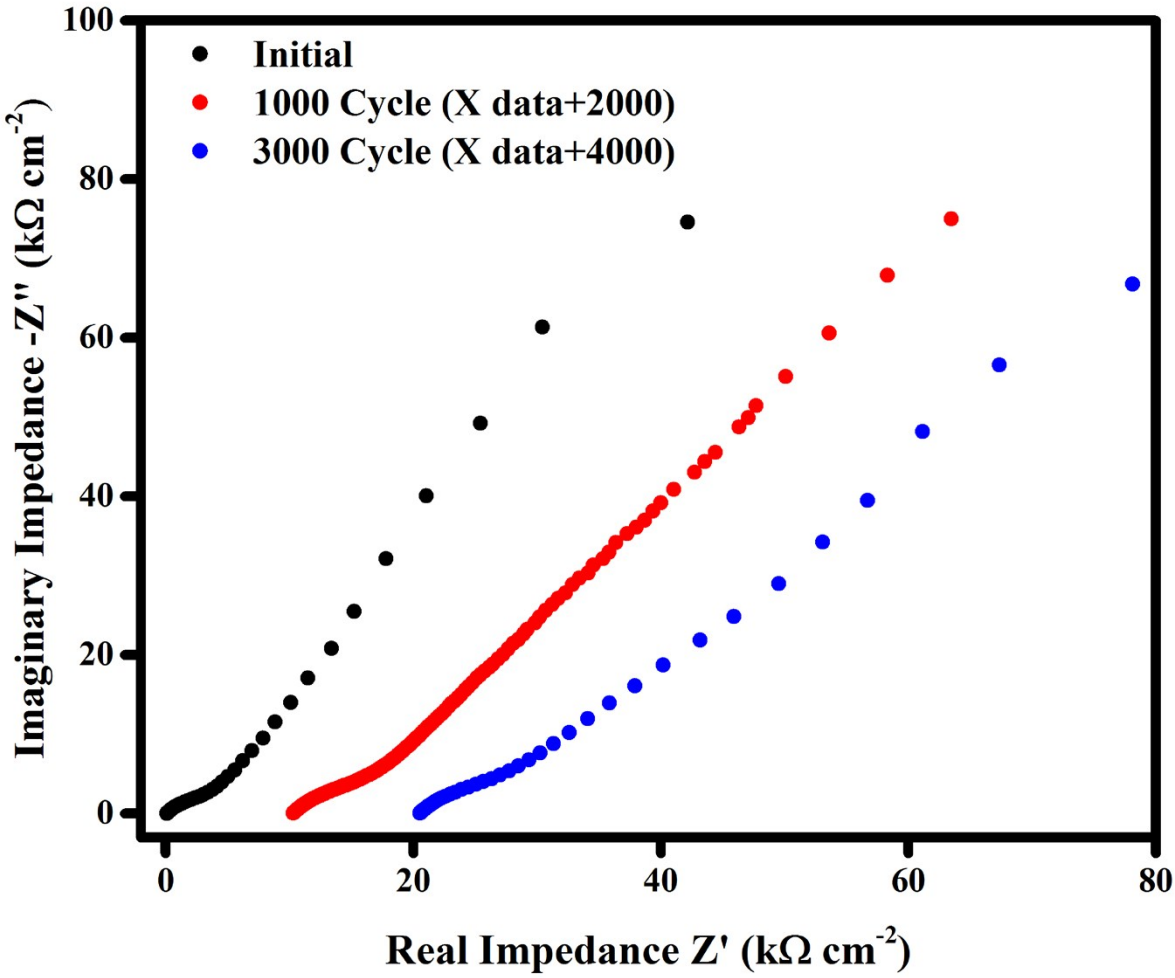

Fig. S12. Variation in Nyquist plot of experimental data for ATA-Fe_3O_4/RGO nanocomposite (ATA-Fe_3O_4:RGO=1:1) with charge-discharge cycle (The real part of the impedance value for 2nd and 3rd plots are shifted to show the variation distinctively)

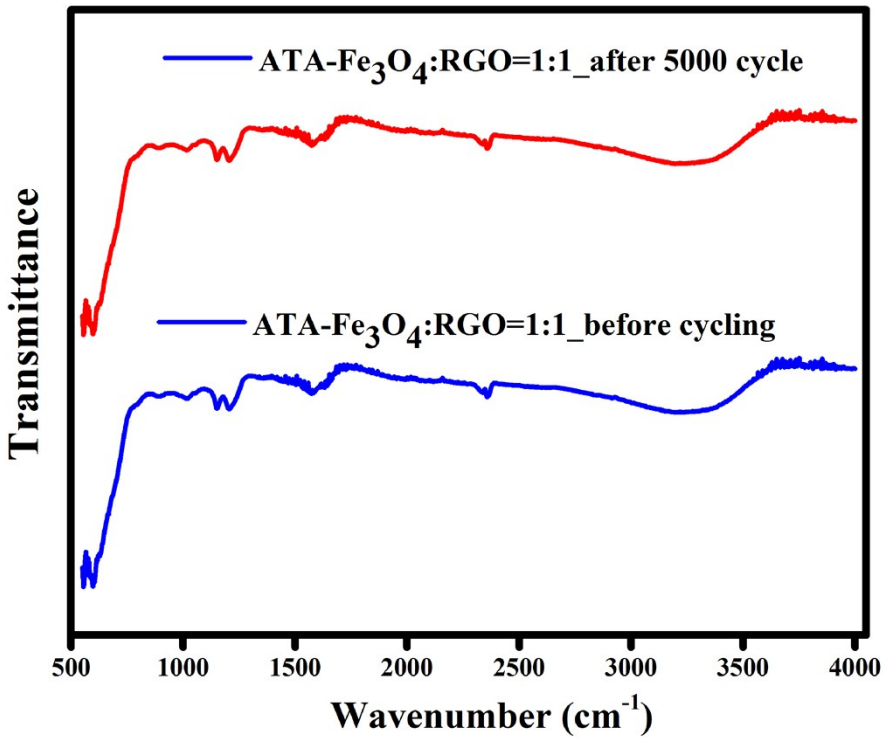

Fig. S13. FTIR Spectra of ATA-Fe_3O_4:RGO=1:1 sample before cycling and after 5000 cycles.

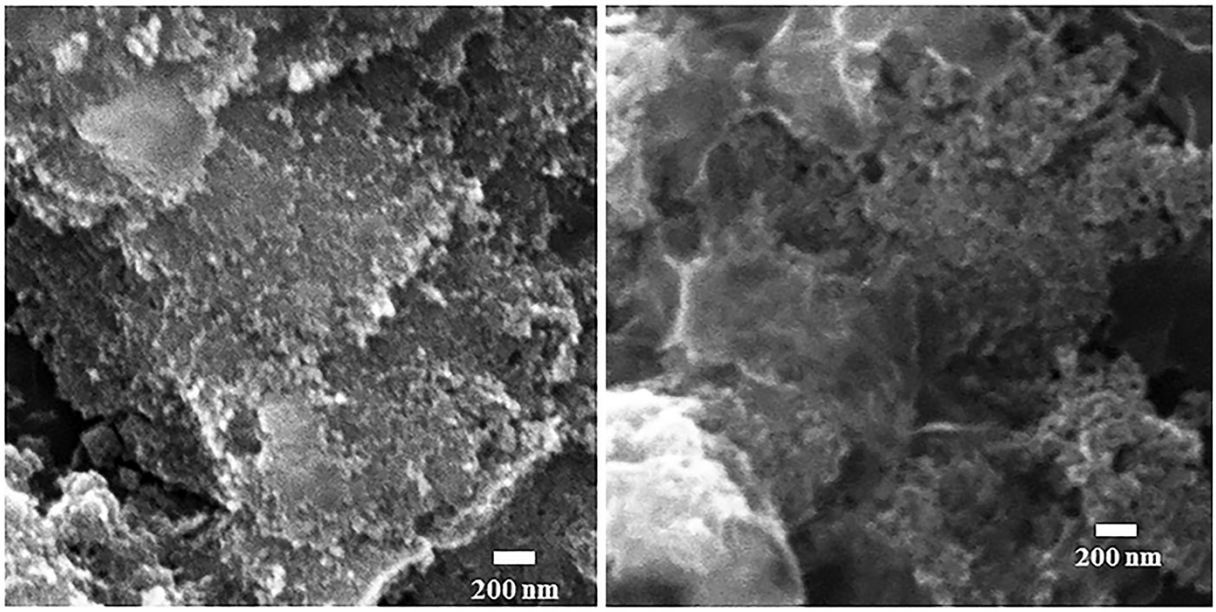

Fig. S14. SEM images of ATA-Fe_3O_4:RGO=1:1 samples. (a). Before cycling (b). After 5000 cycles.

Supplementary Table

Table S1. Variation of specific capacitance at different scan rate for Three samples (ATA-Fe_3O_4, RGO, ATA-Fe_3O_4:RGO=1:1)

Sp. Current ($Ampg^{-1}$)	**Scan Rate (Vs^{-1})**	**Sp. Capacitance ($F\ g^{-1}$)**	**Sample**	**Concentration (Amount of composite/ ml of water)**
3.76	0.2	9.40	ATA-Fe_3O_4	1mg ml^{-1}
3.27	0.1	16.35		
3.22	0.08	20.12		
3.17	0.05	31.70		
3.05	0.03	50.83		
2.64	0.01	132.00		
2.79	0.2	6.98	RGO	1mg ml^{-1}
2.07	0.1	10.35		
1.95	0.08	12.19		
1.73	0.05	17.32		
1.57	0.03	26.17		
1.20	0.01	60.00		
35.50	0.2	88.75	ATA-Fe_3O_4:RGO=1:1	1mg ml^{-1}
29.00	0.1	145.00		
26.52	0.08	165.75		
24.50	0.05	245.00		
18.54	0.03	309.00		
11.53	0.01	576.50		

Table S2. Different component of fitted parameters obtained from equivalent model electrical circuit fitting from Nyquist plot of impedance spectroscopy

R_1 (Ω)	R_2 (Ω)	C_1 (F g^{-1})	C_2 (F $g^{-1)}$	W (mho $g^{-1)}$
12.4	21	20	8.5	18.75