Electronic Supplementary Information

Highly conducting reduced graphene synthesis *via* low temperature chemically assisted exfoliation and energy storage application

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Electrochemical characterization:

Saturated calomel electrode (SCE), Pt wire, and HQ-AC coated Pt foil were used as reference, counter, and working electrode, respectively. For electrochemical measurements, platinum (Pt) foils were coated with RG (active material). For fabrication purpose, first Pt foils were cleaned in acetone by sonication for half an hour and dried in air. After that 1 ml N-methyl-2-pyrrolidone (NMP), 1 mg poly(vinylidene fluoride) (PVDF) binder and 6 mg RG were added. The solution mixture was stirred for 6 hr to enhance the homogeneity of the solution. A 100 μl of aliquot was drop cast and spreaded on the electrode in 1 cm^2 area and dried at 100 °C for 8 hr in hot air oven. The mass of active material deposited on each electrode was 0.6 mg. Cyclic voltammetry (CV) experiments were performed in the potential range of -0.1 to 0.7 V versus SCE at various scan rates (5, 10, 20, 50 and 100 mV/s). Galvanostatic charge/discharge experiments were performed with in the cyclic potential range of -0.1 to 0.7 versus SCE at different current densities (1, 2, 5 and 10 A/g). Electrochemical Impedance Spectroscopy (EIS) date has been collected at potential of 0 V bias over frequency range of 0.01-10^5 Hz at amplitude of 0.01 V. By using eqn (1) capacitance values were calculated from cyclic voltammograms, where C, I, E and ν represents capacitance, current, potential and scan rate. The numerator of this equation was calculated by integrating the area of cyclic voltammogram. Capacitance values for galvanostatic charge/discharge curves were calculated by using eqn (2), where t is the time taken to complete charge/discharge process. Specific capacitance values were calculated by dividing calculated capacitance by weight of material deposited on electrodes.

$$C = \int (I.dE)/(2*E*\nu) \quad (1)$$

$$C = (I*t)/(2*E) \quad (2)$$

Preparation of sample for electrical conductivity measurement:

For electrical conductivity measurement, RG pellets were made by applying 4 tons force on 6 mm circular diameter pellet. Thereafter pellets were cut in rectangular shape of dimensions. For example, dimensions were (thickness (0.2 cm), width (0.42 cm). Probe spacing was fixed at 0.1 cm. Electrical Conductivity was calculated using formula as follows. (*Nat. chem.*, 2009, **1**, 403.)

Conductivity (S/cm) =

$$\frac{\text{probe spacing (cm)} \times \text{current (A)}}{\text{Voltage (V)} \times \text{width of film (cm)} \times \text{film thickness (cm)}}$$
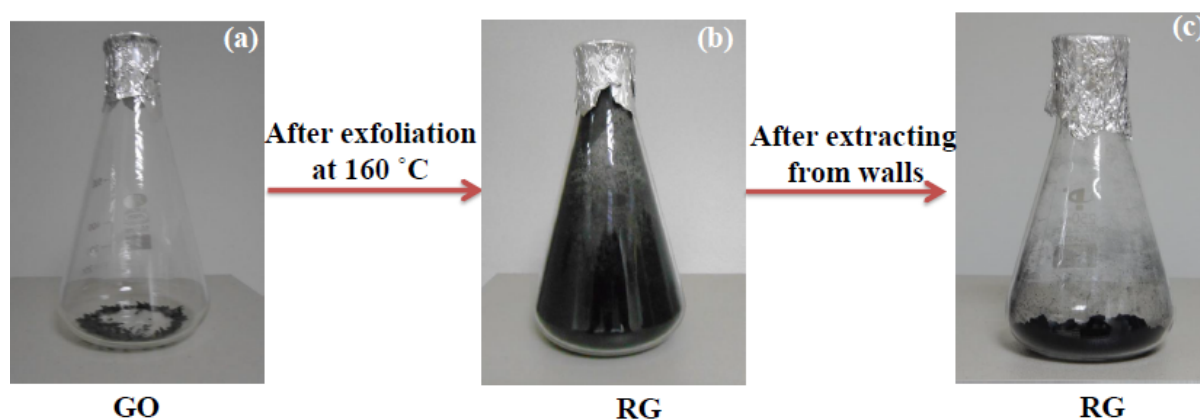

Fig. S1: Pictures of GO sample as prepared (a), after treating at 160°C for 14 min (Reduced graphene) (b), after extraction from the walls of conical flask (Reduced graphene) (c).
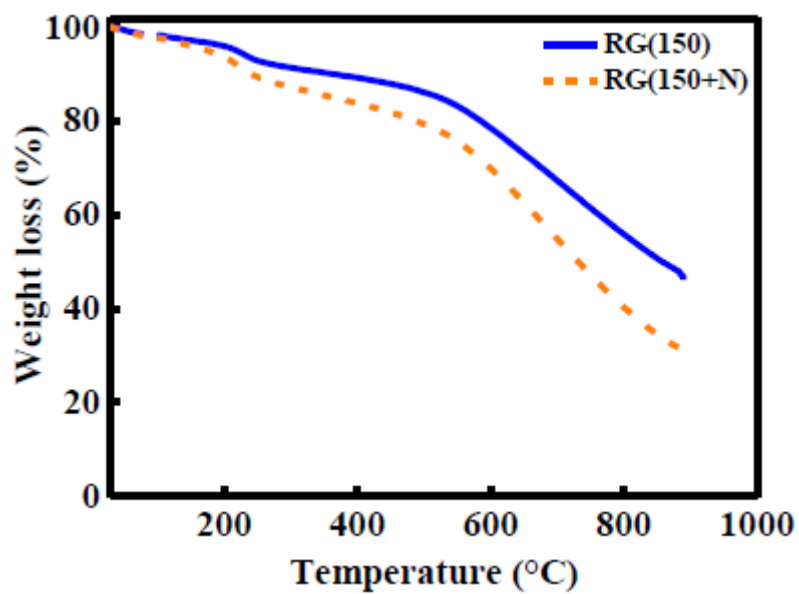
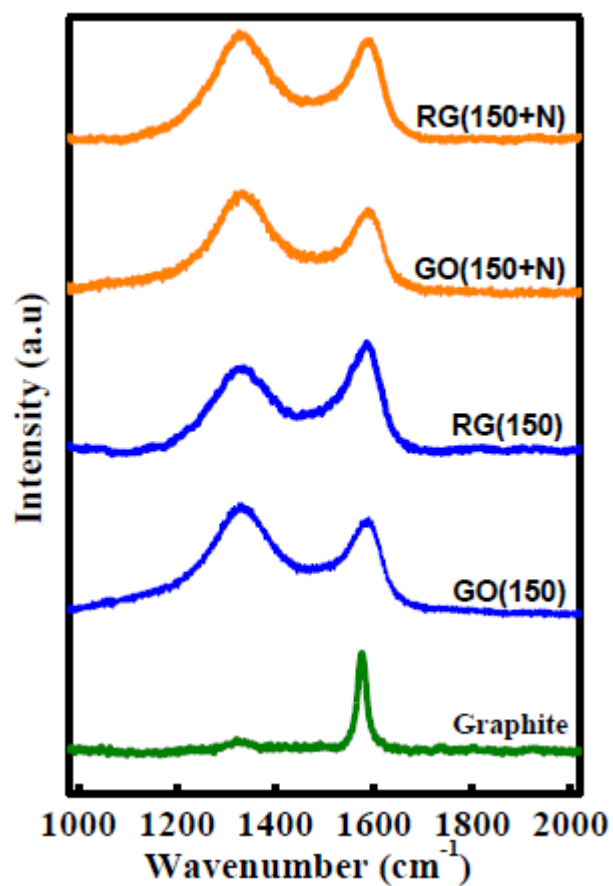**Fig. S2:** TGA traces have been shown for RG (150) and RG (150+N).

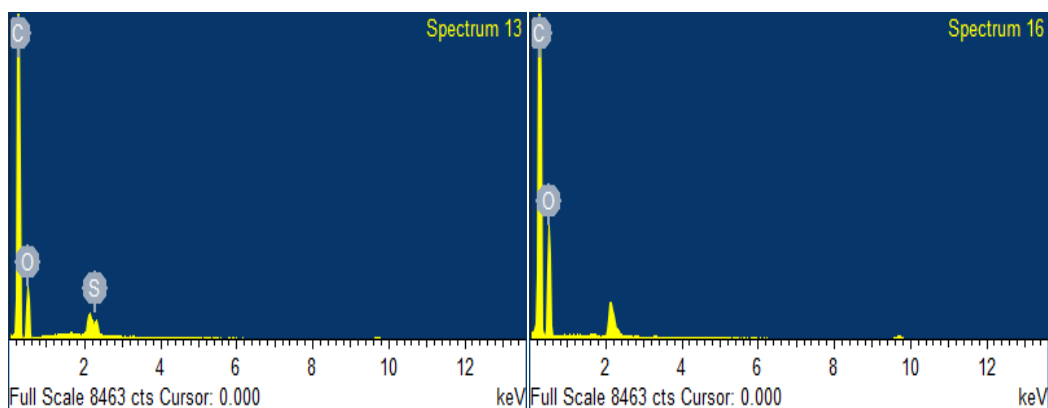**Fig. S3**: Raman spectra have been shown for pristine graphite, RGs and GOs.

Fig. S4: Energy Dispersive X-ray Spectroscopy patterns of RG (150) (right) and RG (150+N) (left) respectively.
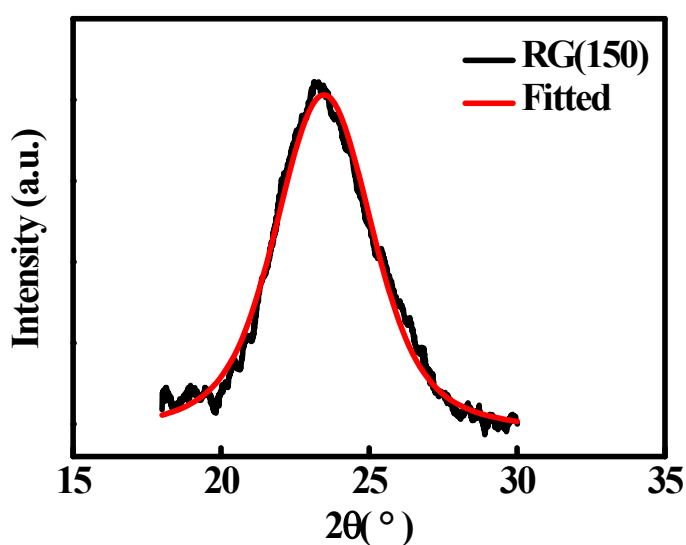
XRD Analysis using Scherrer Equation-

Fig. S5: Figure shows XRD peak fitting for RG (150) using Voigt equation.

Determination of d-

From Bragg's law

$n\lambda = 2d\sin\theta$

n is an integer

λ = wavelength of incident light

d = interlayer distance

θ = the angle between the incident ray and the scattering planes

Using, n = 1, λ = 1.54 Å, 2θ = 23.4°, θ = 11.7°

d = 1.54/(2×sin(11.7)) = 3.8 Å

Determination of L_c and N-

From Scherrer formula,

$L_c = (K\lambda) /(\beta \cos\Theta)$
L_c = Mean crystallite length along c-axis
K = dimensionless shape factor, typical value is 0.9 for L_c.
β = line broadening at full width half maxima in radian = 81×10^{-3}
β was determined by Voigt fitting
$\theta = 11.7° = 0.204$ radian
$\lambda = 0.154$ nm
Hence, $L_c = (0.90\times0.154)/(81\times10^{-3}\times\cos(0.204))$
$L_c = 17.2$ Å
N = Number of layers
N = 17.2/3.8 = ~ 5 layers

Determination of L_a –

$L_a = (K\lambda) /(\beta \cos\Theta)$
L_a = Mean crystallite length along a-axis
K = dimensionless shape factor, typical value is 1.84 for L_a.
β = line broadening at full width half maxima in radian = 40×10^{-3}
β was determined by Voigt fitting
$\theta = 21.7° = 0.378$ radian
$\lambda = 0.154$ nm
Hence, $L_a = (1.84\times0.154)/(40\times10^{-3}\times\cos(0.378))$
$L_c = 70$ Å
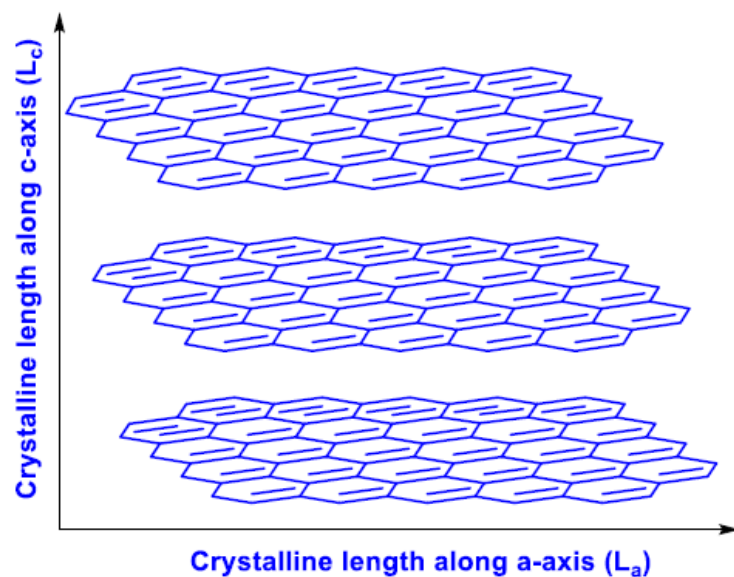
Table S1: Elemental Analysis of RGs and GOs.

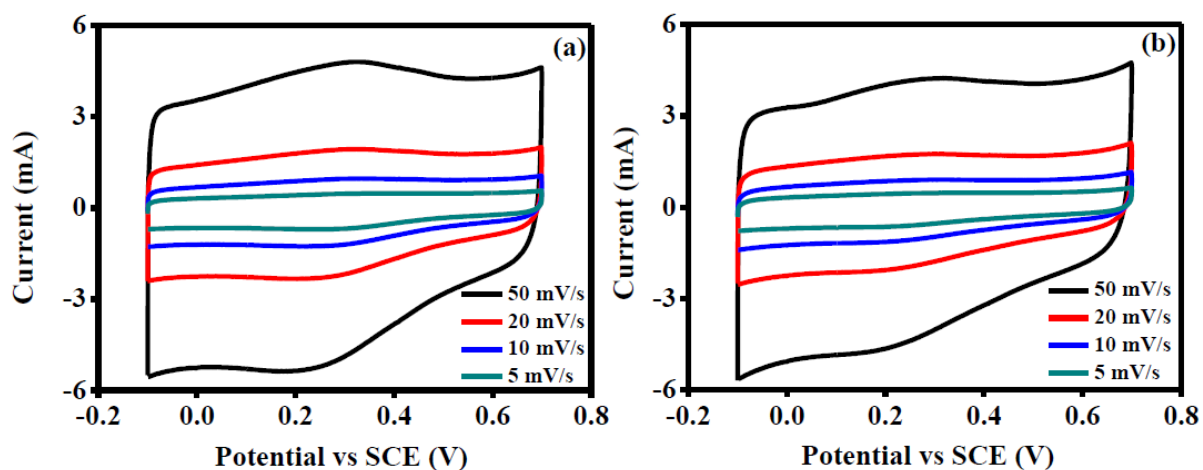|	Carbon	Oxygen	Hydrogen	Sulphur
RG(150)	70.3	26.8	1.1	1.8
RG(150+N)	70.2	26.7	1.0	2.1
GO(150)	47.4	48	2.2	2.4
GO(150+N)	39.4	57	1.3	2.2

Fig. S6: Overlay plot of cyclic voltammograms at different scan rates for RG(150) (a) and RG(150+N) (b).