Supporting Information

Template free single pot synthesis of SnS_2@Cu_2O/reduced graphene oxide (rGO) nanoflower for high performance supercapacitors

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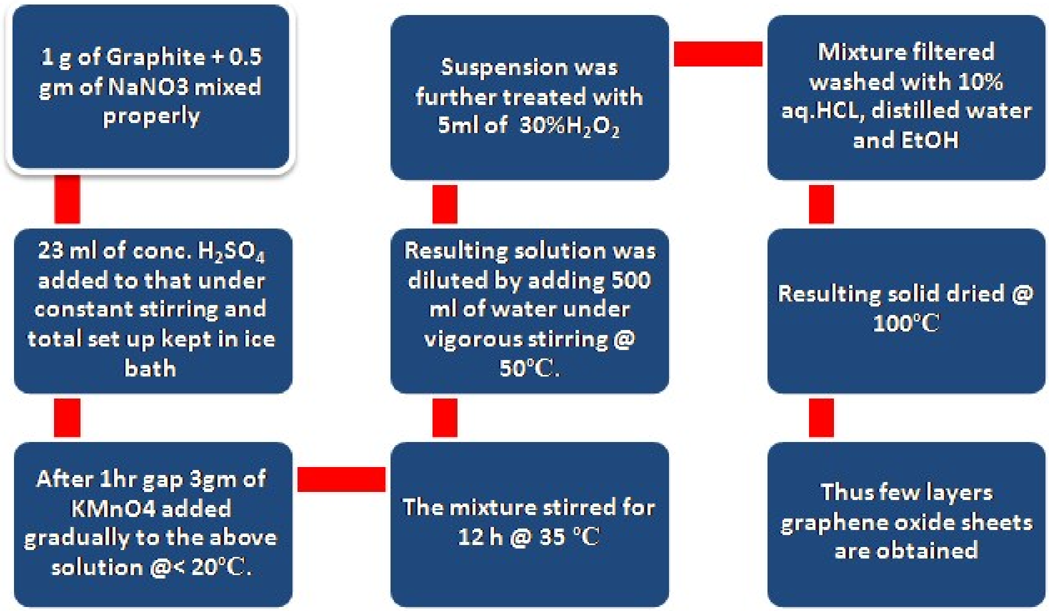

Fig. S1 Schematic presentation of Modified Hummer's Method

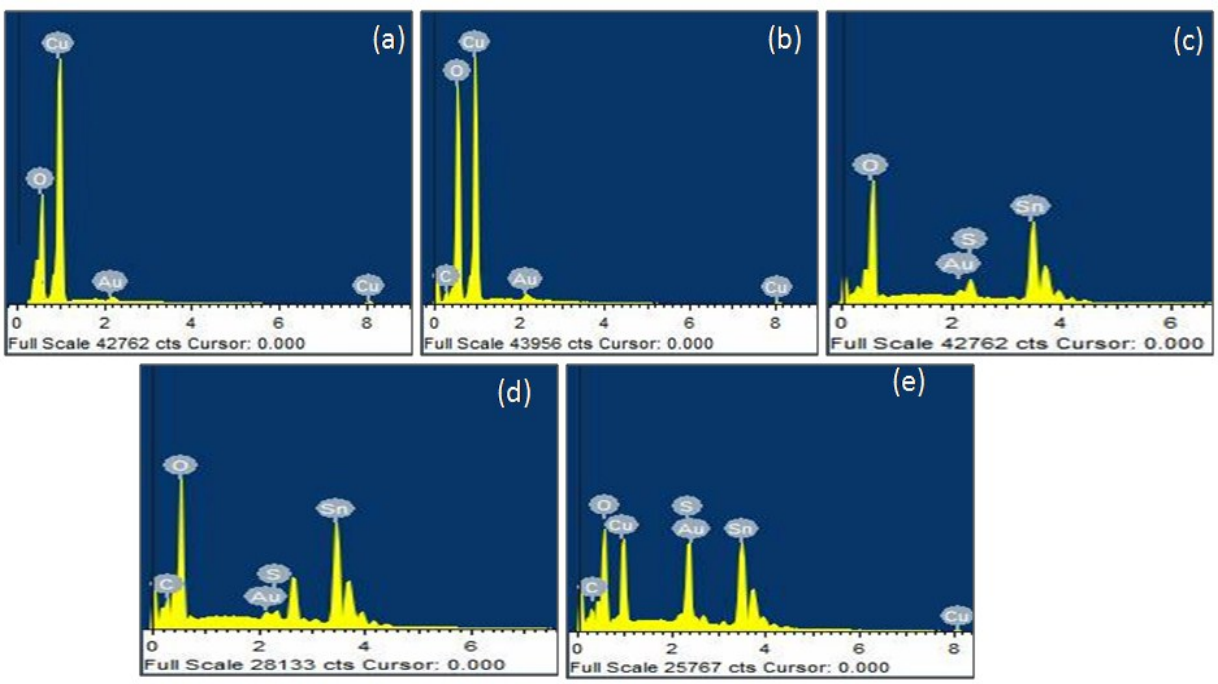

Fig. S2 (a-e) Represents the EDS images of (a) CuO nanoparticle (b)CuO@rGO composite (c) SnS (d) SnS@rGO composite (e) SnS_2@Cu_2O/rGO composite

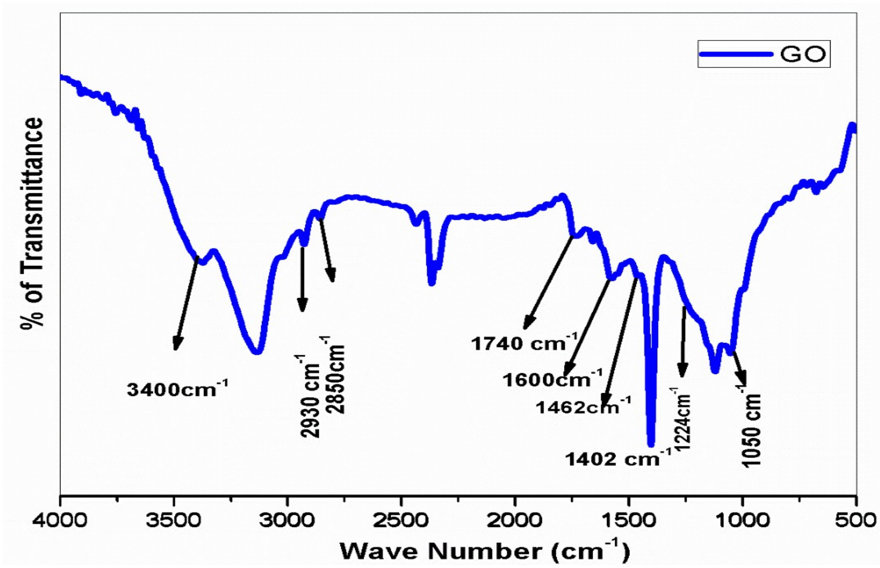

Fig. S3FTIR spectra of GO

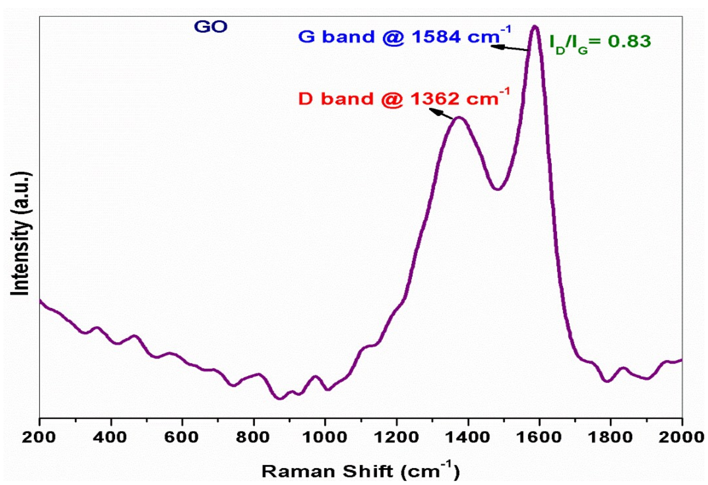

Fig. S4RAMAN spectra of GO

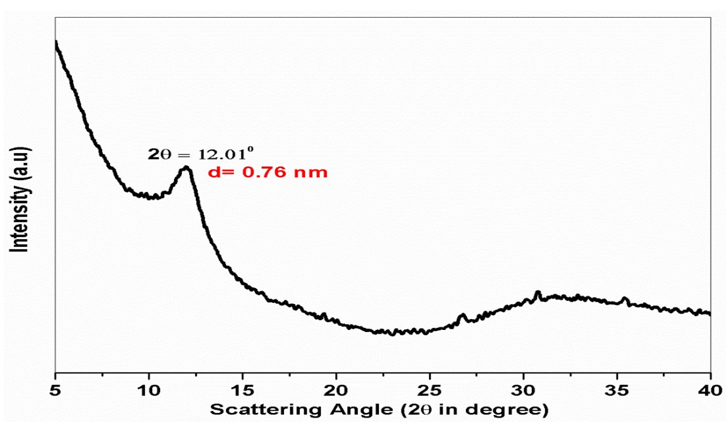

Fig. S5XRD spectra of GO

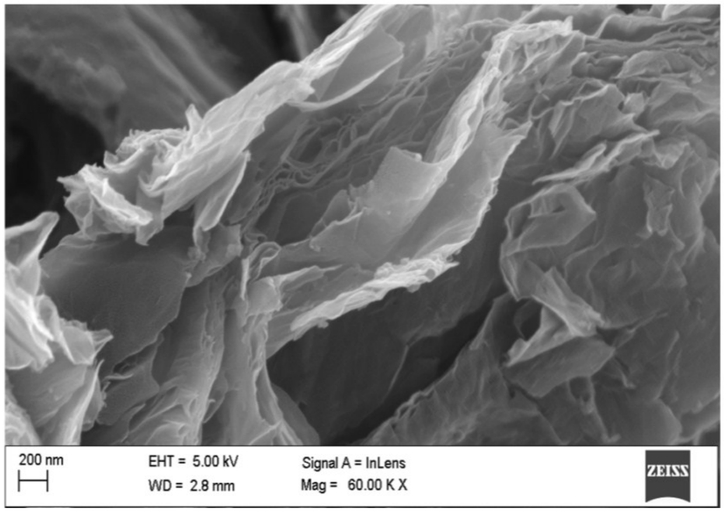

Fig. S6FESEM of GO

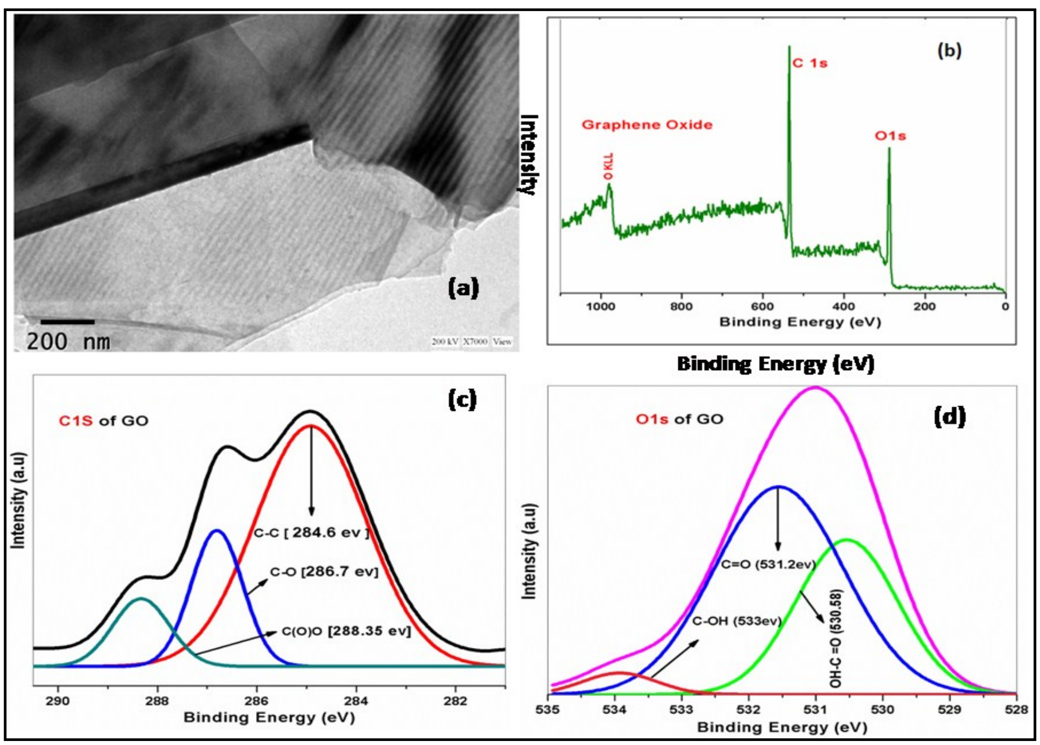

Fig. S7(a) TEM of GO (b) XPS survey spectra of GO (c) C 1s of GO (d) O 1s of GO

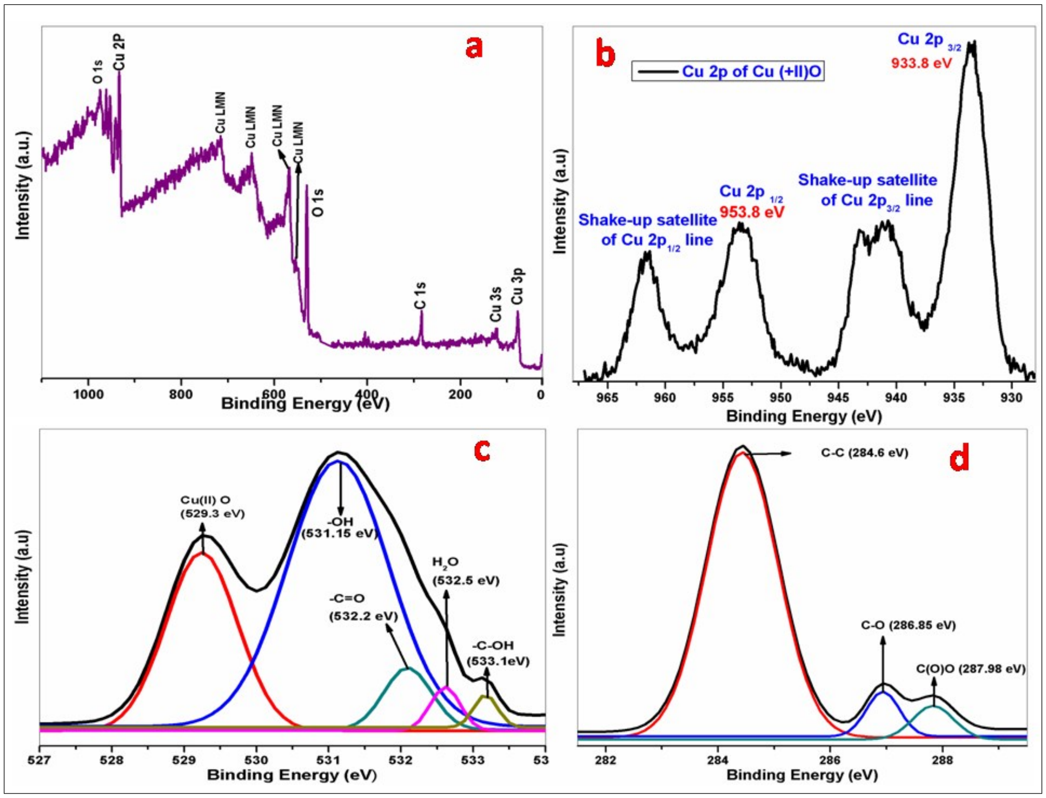

Fig. S8XPS (a) Survey spectra of CuO@rGO (b) core level spectra of Cu 2p of CuO@rGO (c) deconvoluted analysis of the O1s core level spectra of CuO@rGO (d) C1s spectra of CuO@rGO.

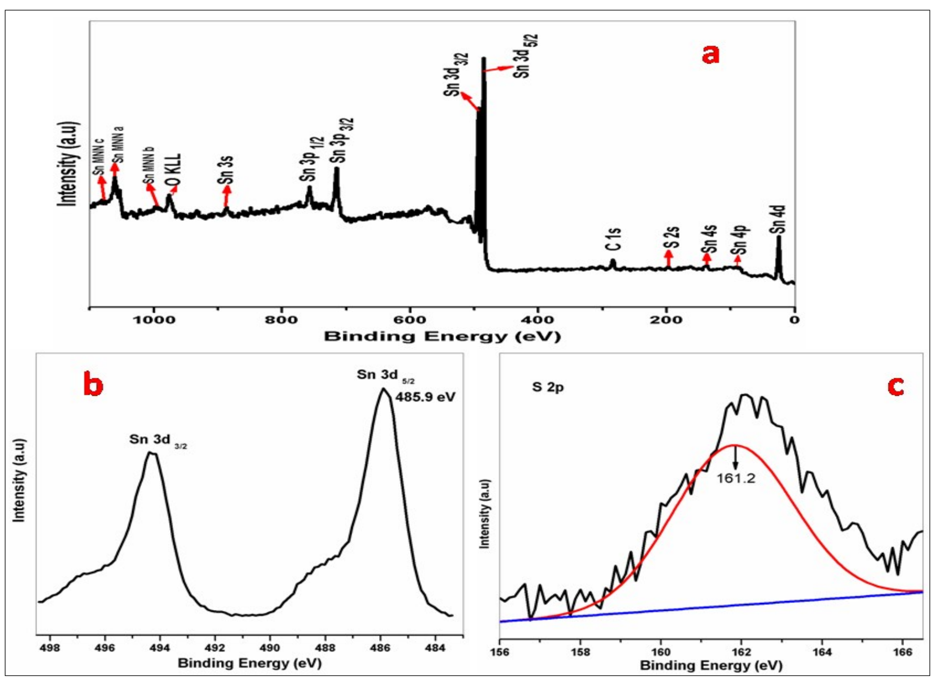

Fig. S9XPS (a) Survey spectra of SnS (b) core level spectra of Sn 3d of SnS (c) deconvoluted analysis of the S2p core level spectra of SnS.

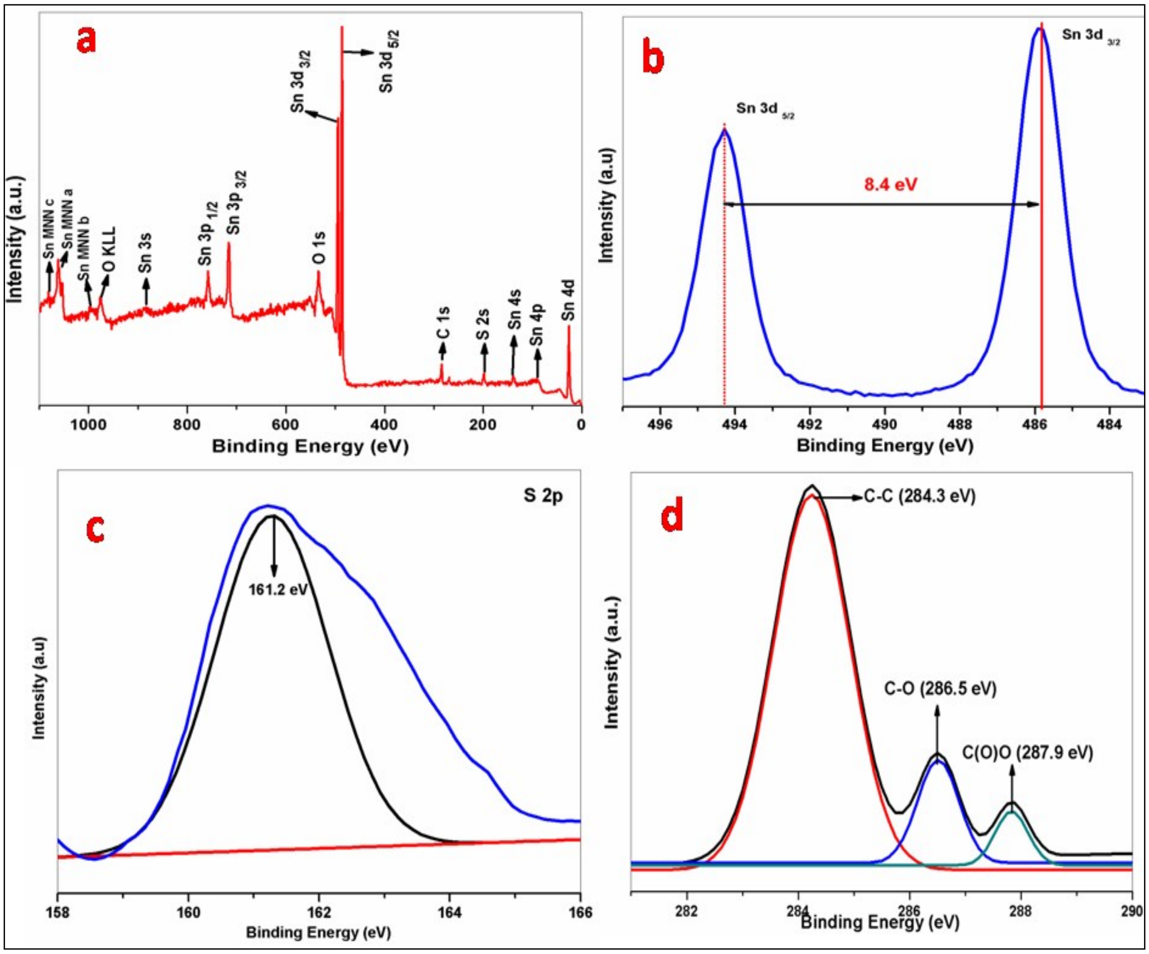

Fig. S10XPS (a) Survey spectra of SnS@rGO (b) core level spectra of Sn 3d of SnS@rGO (c) deconvoluted analysis of the S 2p core level spectra of SnS@rGO (d) C1s core level spectra of SnS@rGO.

S11: Preparation of Electrode and Electrochemical measurement in three and two electrode systems

The electrochemical performance like cyclic voltammetry (CV), galvanostatic charging-discharging (GCD) and Electrochemical Impedance spectroscopy (EIS) was performed by three electrode as well as in two electrode system taking 1 M aqueous KOH and 1 M $TEABF_4$ in acetonitrile as electrolyte. A platinum foil and a Ag/AgCl electrode were used as counter and reference electrodes, respectively in three electrode system. 1.5 % of Nafion solution in ethanol was used as a binder. The electro active materials and nafion were mixed in the weight ratio

95:5 and dispersed in ethanol. Then the mixture was drop casted on tip of the graphite electrode (working electrode) by micro pipet. Nafion as a binder can influence the electrochemical performances of the electrode material. Lufrano et al. [S1] established that 10–30% Nafion as binder has very little effect on specific capacitance; hence it can be considered that 5% Nafion would have negligible effect on the electrochemical performances of the electrode materials.

A supercapacitor test cell for the two electrode system was fabricated by mixing different sample in dispersant N-methyl pyrrolidone with PVDF and carbon black (in the mass ratio of 80:15:5) and coated over two symmetrical platinum foils. As prepared samples were vacuum dried overnight at 80 °C and weight of sample were measured. These coated platinum foils were dipped in to electrolytes (1 M TEABF4 in acetonitrile) for overnight. Then one coated platinum electrode as well as a uncoated platinaum elctrode both were sandiwitched by a piece of separating filter paper which is wetted in 1 M TEABF4 (tetraethyl ammonium tetrafluoroborate) in acetonitrile (organic electrolyte) and finally the full set up was pressed tightly. The stainless steel crocodile clip can be used as current collector. All electrochemical properties like as Cyclic voltammetry and Galvanostatic Charging discharging (GCD) were measured for two electrode configuration within potential window (0-1.6V) for organic electrolyte. The CV testing was done between 0.0 V and 1.6 V at different scan rates from 5 to 50 mV s-1 and the The GCD measurements were carried out in a potential window between 0.00 V to 1.6 V in 1 M TEABF4 in acetonitrile (organic electrolyte) at 1 A/g current density. The two electrode fixture is done by same procedure by Ma et al. [S2] and by Dolui et al. [S3].

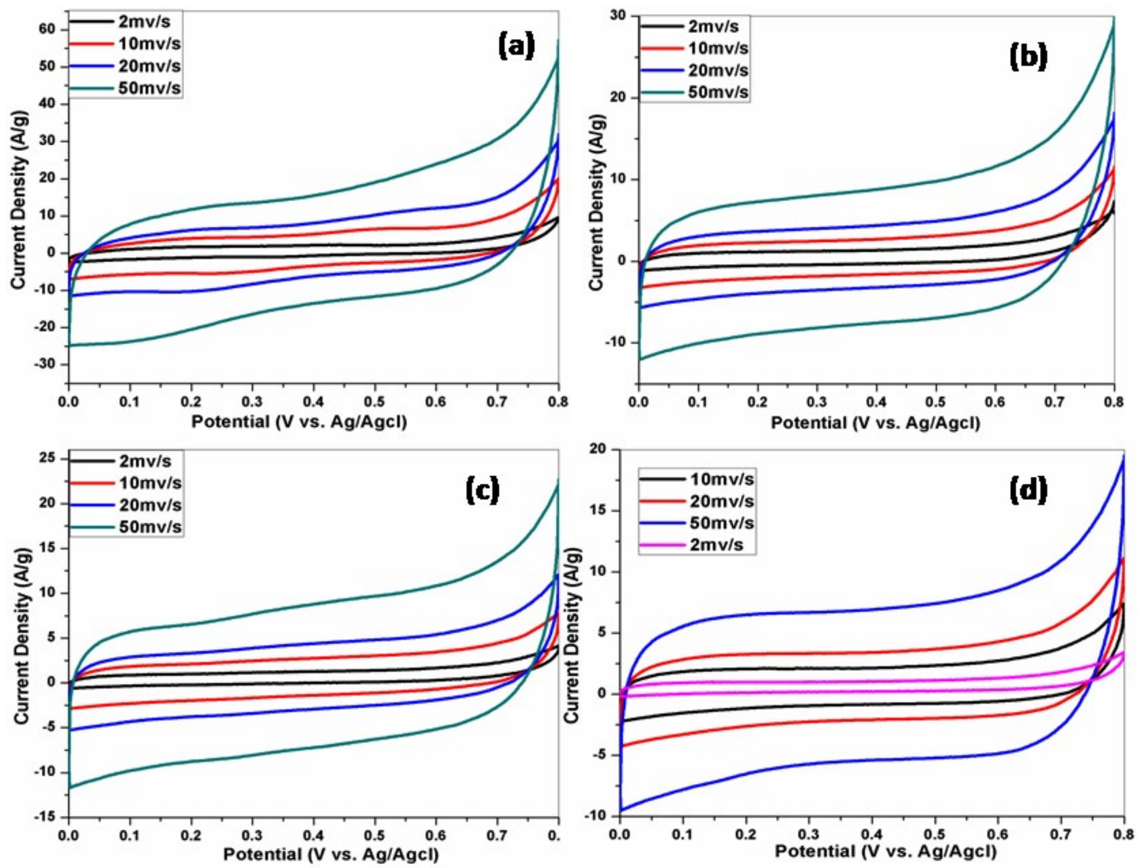

Fig. S12CV curve at different scan rate for (a) SnS@rGO (b) CuO@rGO (c) SnS (d) CuO

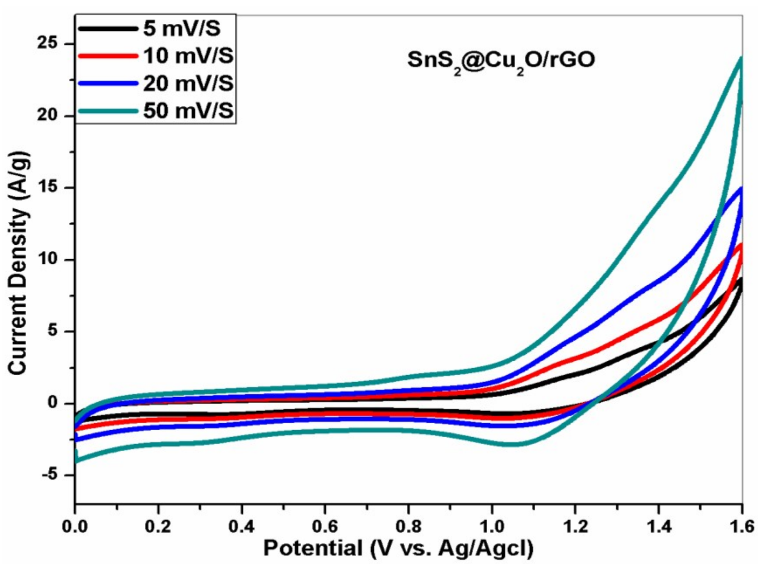

Fig. S13CV plot of $SnS_2@Cu_2O/rGO$ at different scan rate in two electrode organic electrolyte configuration

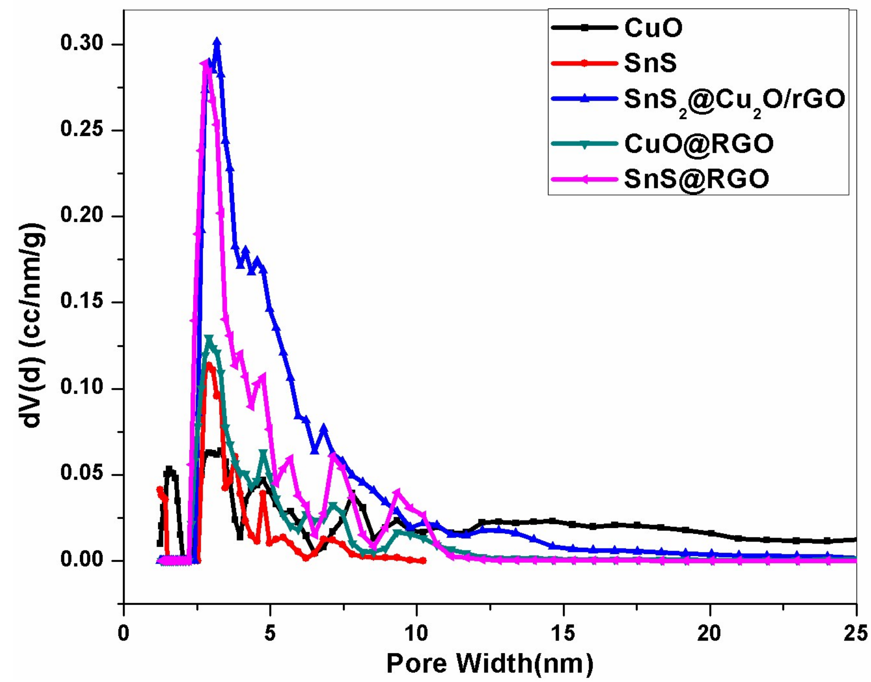

Fig. S14 Pore size distribution of the composites

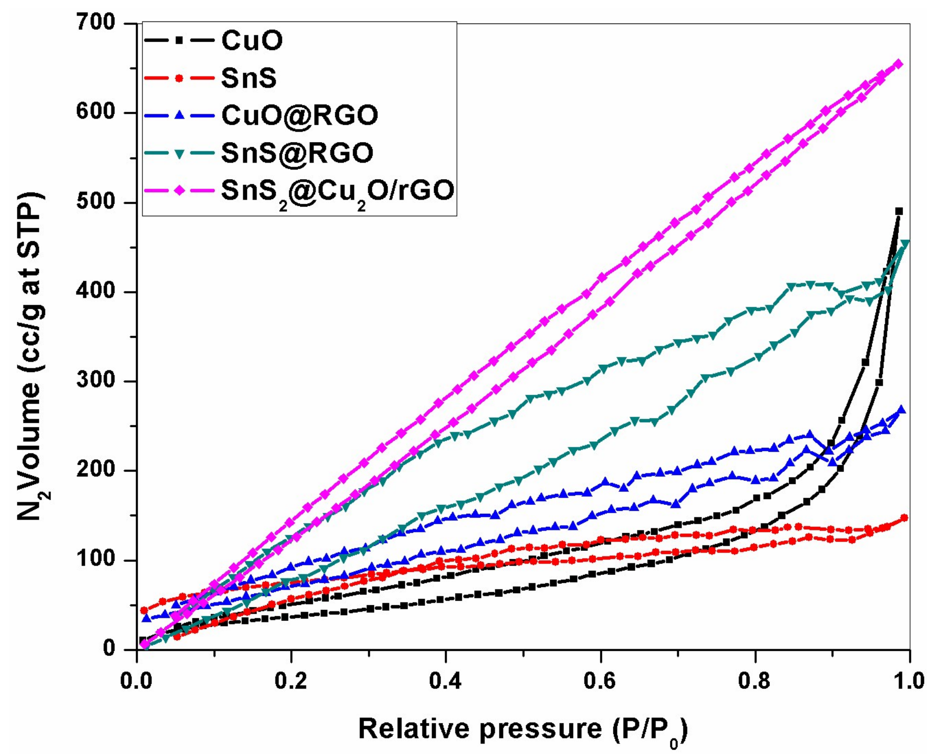

Fig. S15BET N_2 sorption isotherm for the composites at 77 K

Tab. S1 Specific BET adsorption properties of the composite along with SnS and CuO

Sample Name	Surface Area (m^2/g)	Pore Volume (cc/g)	Relative Pressure (P/Po)
CuO	203.404	0.600	0.98
SnS	227.241	0.198	0.98
CuO@rGO	303.015	0.324	0.98
SnS@rGO	306.584	0.603	0.98
SnS_2@Cu_2O/rGo	**959.75**	**0.944**	**0.98**

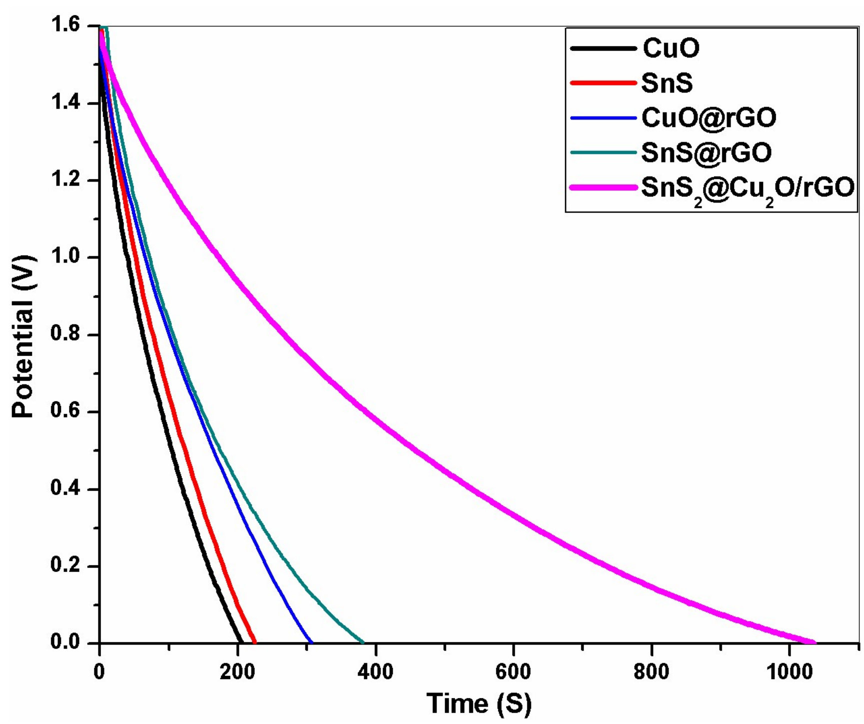

Fig. S16GCD curve for various composite along with SnS and CuO in two electrode configuration at the current density 1A/g

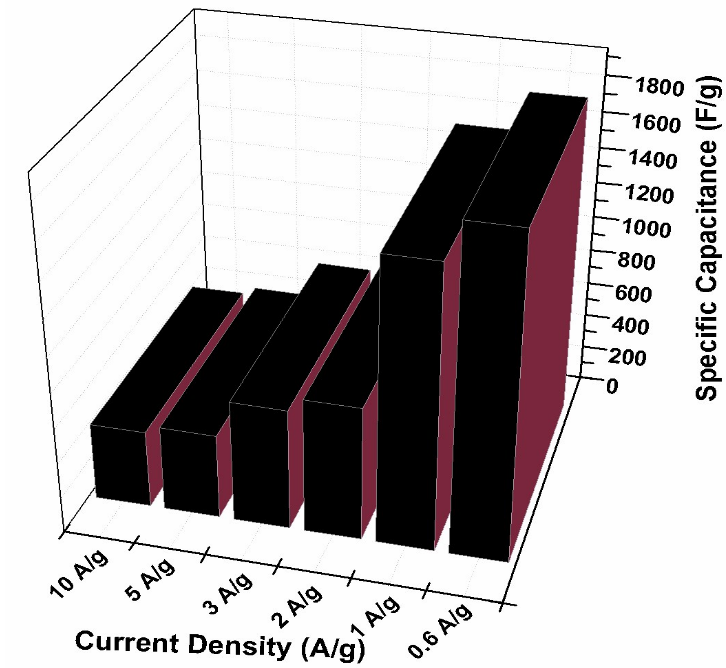

Fig. S17 Specific Capacitance vs current Density plot of SnS_2@Cu_2O/rGO composite

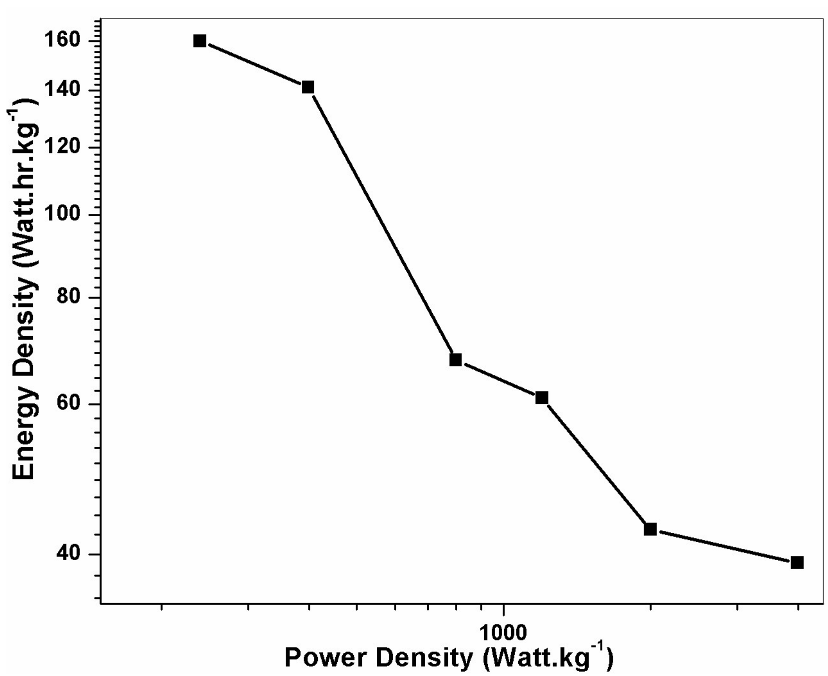

Fig. S18 Ragone plot of the composite SnS_2@Cu_2O/rGO

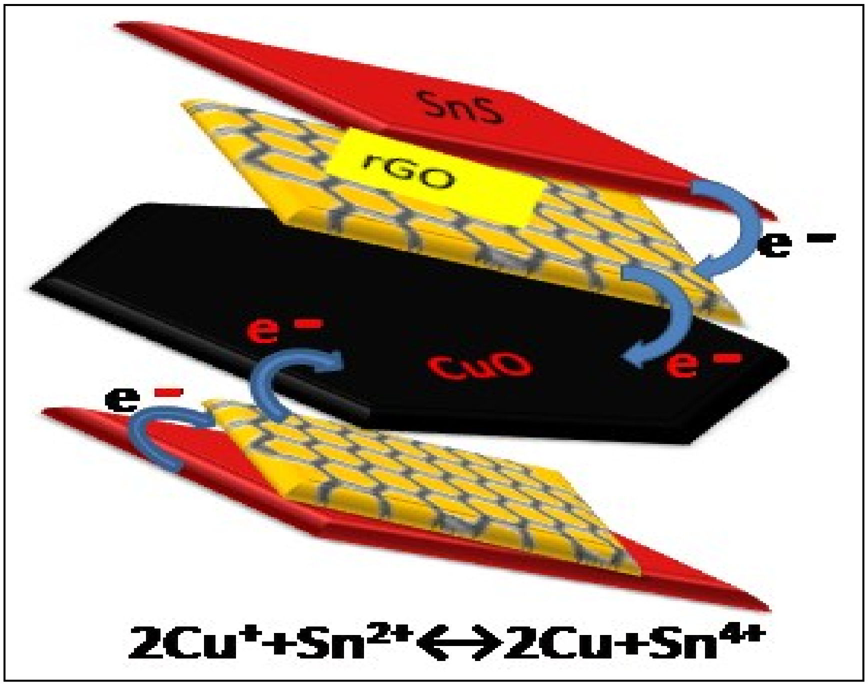

Fig. S19 Probable electron transfer in SnS_2@Cu_2O/rGO composite.

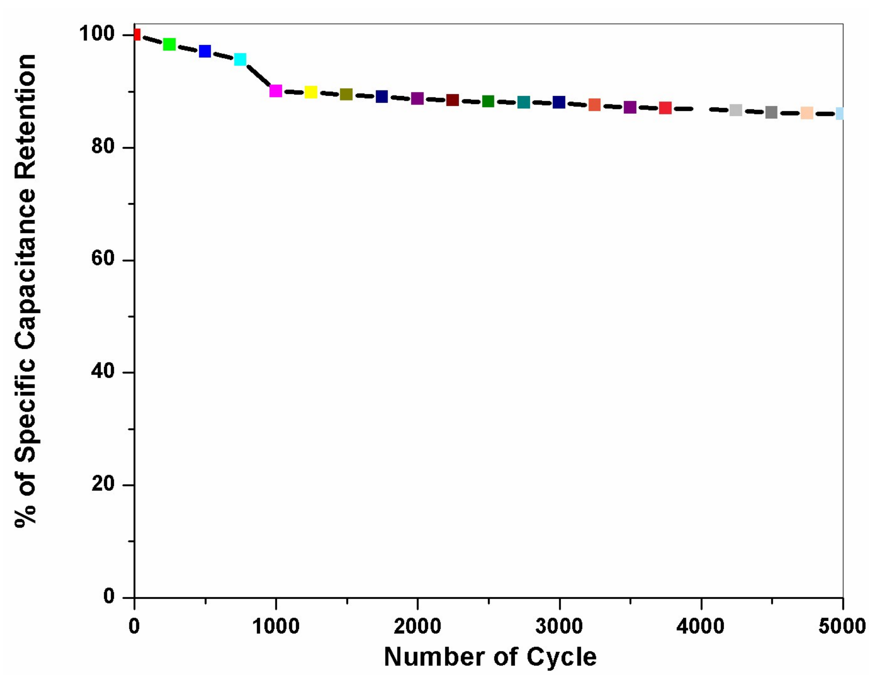

Fig. S20 Retention of specific capacitance for the composite SnS_2@Cu_2O/rGO composite at current density 1 A/g in three electrode system upto 5000 cycles

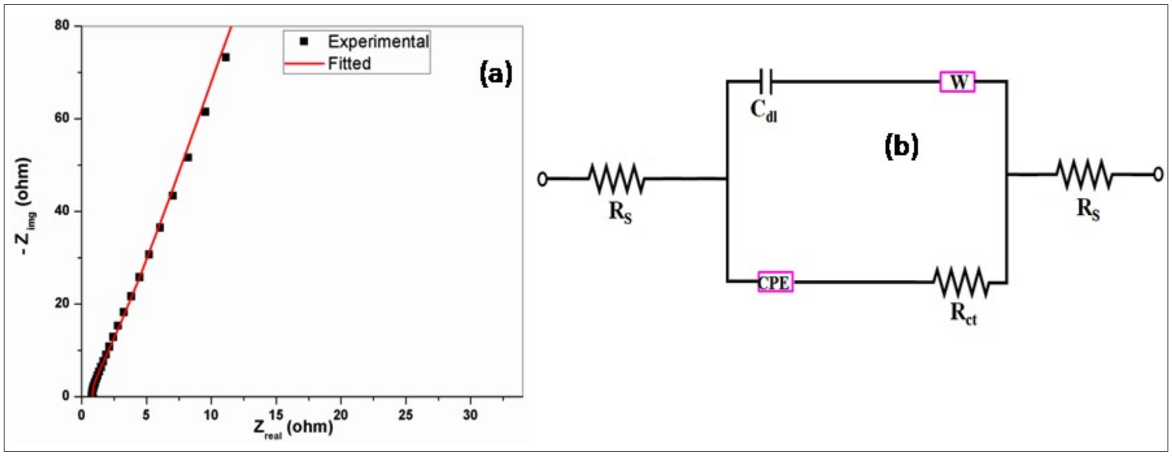

Fig. S 21 (a) Nyquist plots of SnS_2@Cu_2O/rGO nanocomposite after fitting with an equivalent electrical circuit. **Fig. S 21(b)**Equivalent circuit used for fitting the Nyquist plots

Tab. S2 Fitted value of Equivalent circuit elements obtained by the simulation of impedance spectra

Sample	**R_s(Ω)**	**C_{dl}**	**R_{ct}(Ω)**	**W**	**CPE**	**n**
SnS_2@Cu_2O/rGO	(0.1605+0.6612) = 0.8217	0.0006145	39.34	2.329×10^5	0.0004657	0.795

References

[S1] Lufrano, F.; Staiti, P.; and Minutoli, M. Influence of Nafion Content in Electrodes on Performance of Carbon Supercapacitors. J. Electrochem. Soc., 2004, 151, A64-A68.

[S2]Moussa, M.; Zhao, Z.; El-Kady, M. F.; Liu, H.; Michelmore, A.; Kawashima, N.; Majewski, P.; Ma, J. Free-standing composite hydrogel films forsuperior volumetric capacitance. J. Mater. Chem. A, 2015, 3, 15668-156674.

[S3] Bora, C.; Sharma, J.; Dolui, S. Polypyrrole/Sulfonated Graphene Composite as Electrode Material for Supercapacitor. J. Phys. Chem. C 2014, 118, 29688−29694.