Supplementary Information

Synthesis of Ge_4Se_9 nano plates and its Reduced Graphene Oxide Composite for Electrochemical Energy Storage Application

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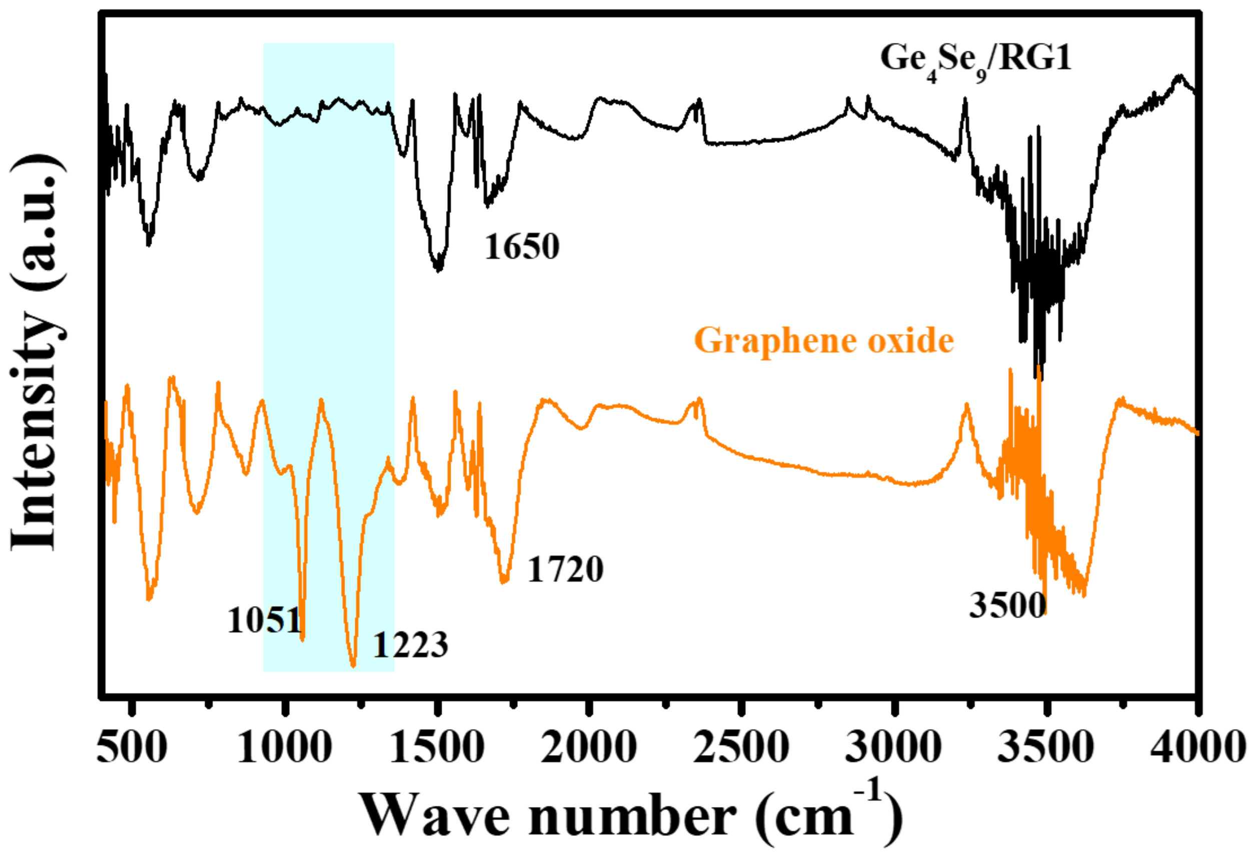


Fig. S 1 Fourier Transform Infrared spectrum for graphene oxide and Ge4Se9/RG1 composite.

In this work, the effective reduction of graphene oxide (GO) to reduced graphene oxide (RG) in the composite has been confirmed from the above FTIR spectrum. It has been clearly observed that in case of the GO, there are four high intense reflectance peaks at 3500, 1720, 1223 and 1051 cm^{-1} assigned to the stretching vibration of –OH (hydroxyl/adsorbed water etc.), C=O (carbonyl group of aldehyde/ketone/carboxylic acid) and C-O (epoxy/alcoholic). [1, 2 3] After the hydrothermal reduction, in case of the composite, the peaks at 1050, 1223 and 1720 cm^{-1} are observed to be vanished signifying the reduction of the corresponding oxygen functional groups. But another peak at around 1650 cm^{-1} (attributed to the conjugated C=C linkage) has been raised in RG demonstrating the retention of π-conjugation.

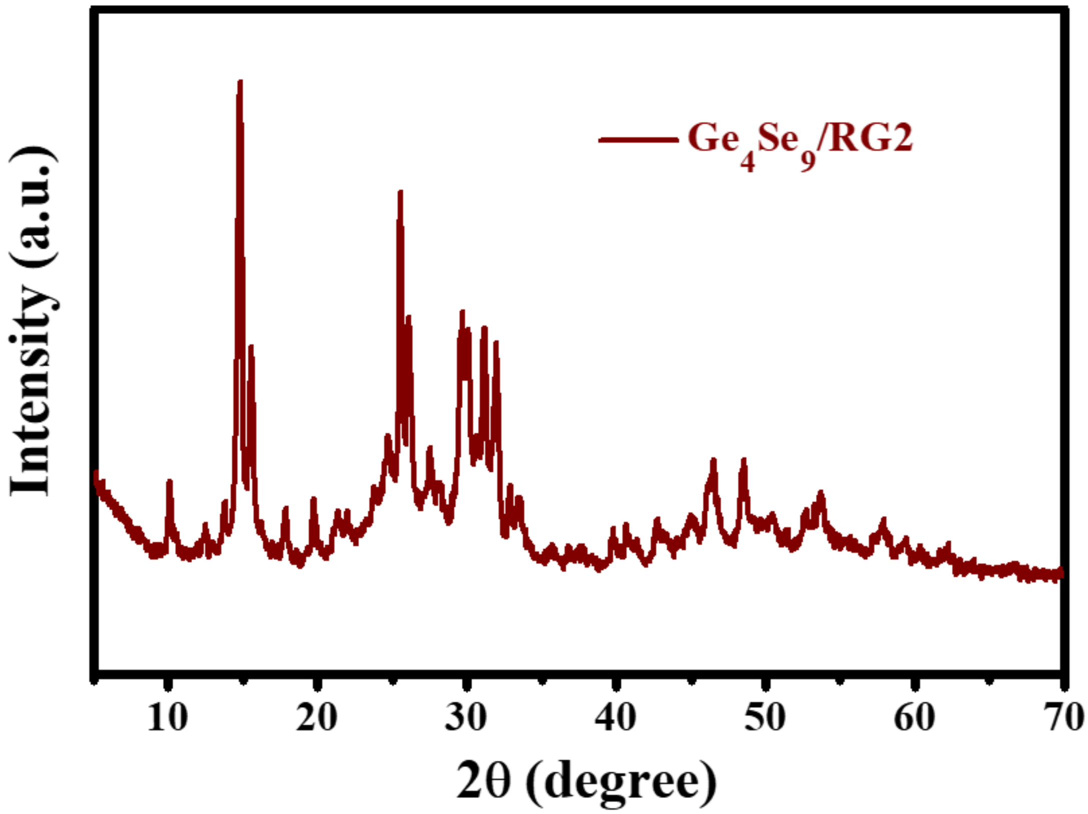


Fig. S 2 Powder X-ray diffraction pattern for Ge_4Se_9/RG2 composite.

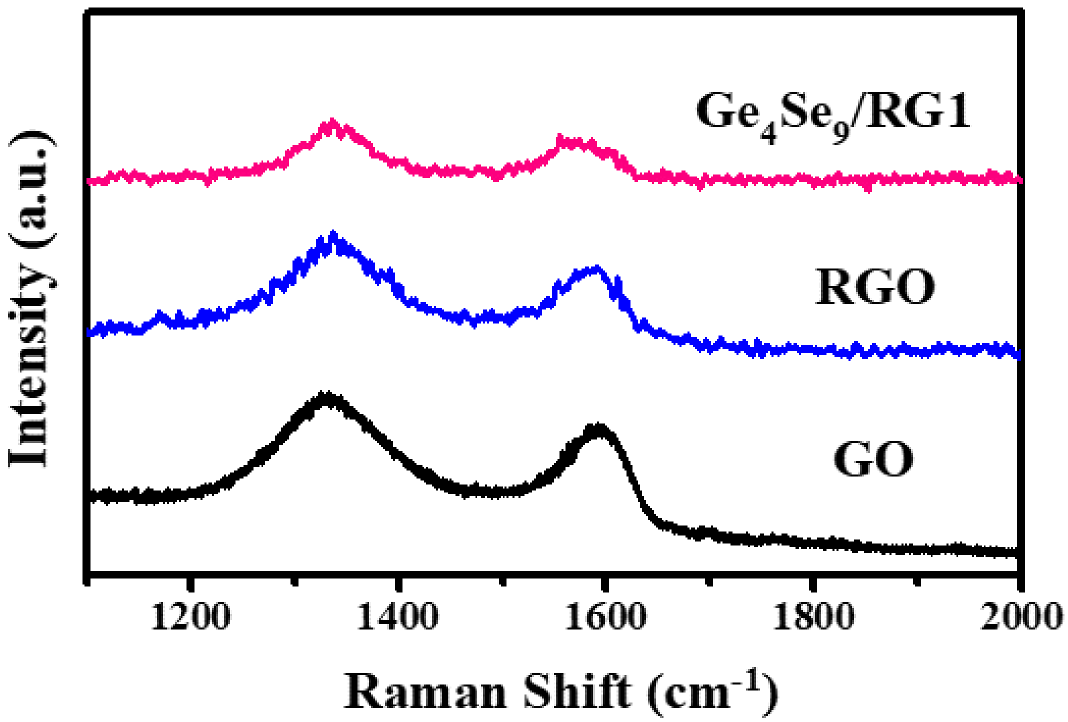
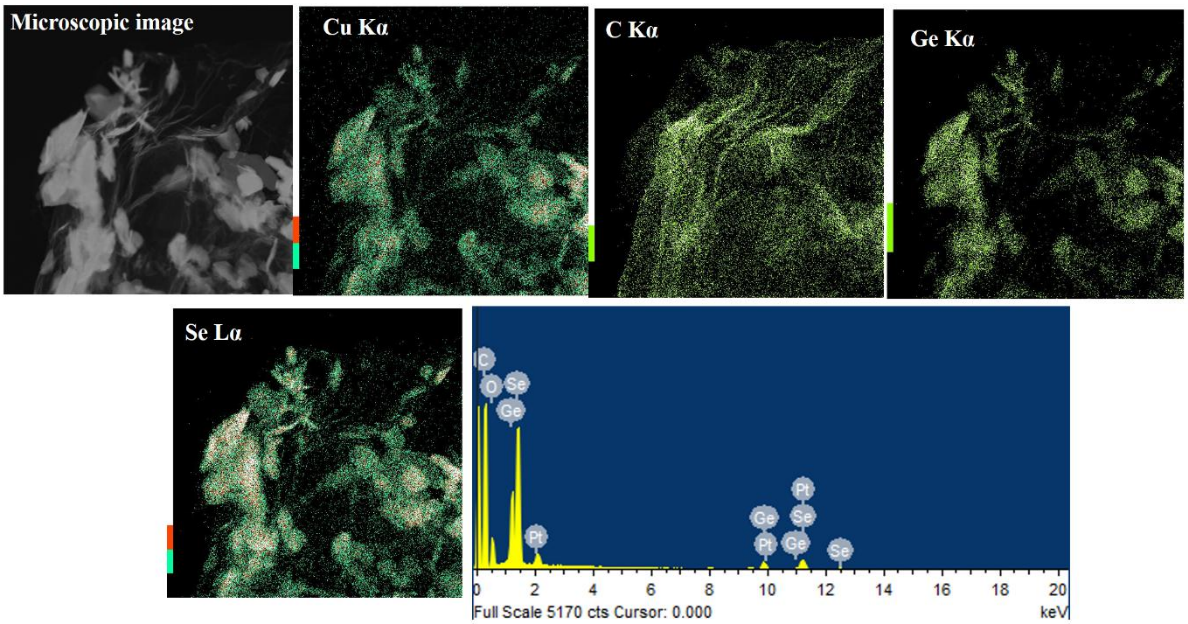


Fig. S 1 Raman spectrum for GO, rGO and Ge_4Se_9/RG1 composite showing the I_D and I_G bands of Graphene.



Element	Weight%	Atomic%
C K	72.84	94.41
Ge K	8.41	1.73
Se L	18.75	3.86
Totals	100.00	100.00

Fig. S 2 Elemental mapping and EDAX spectrum for Ge_4Se_9/RG1 composite. The Table showing the weight percentage and atomic percentage of C, Ge and Se in the Ge_4Se_9/RG1 composite

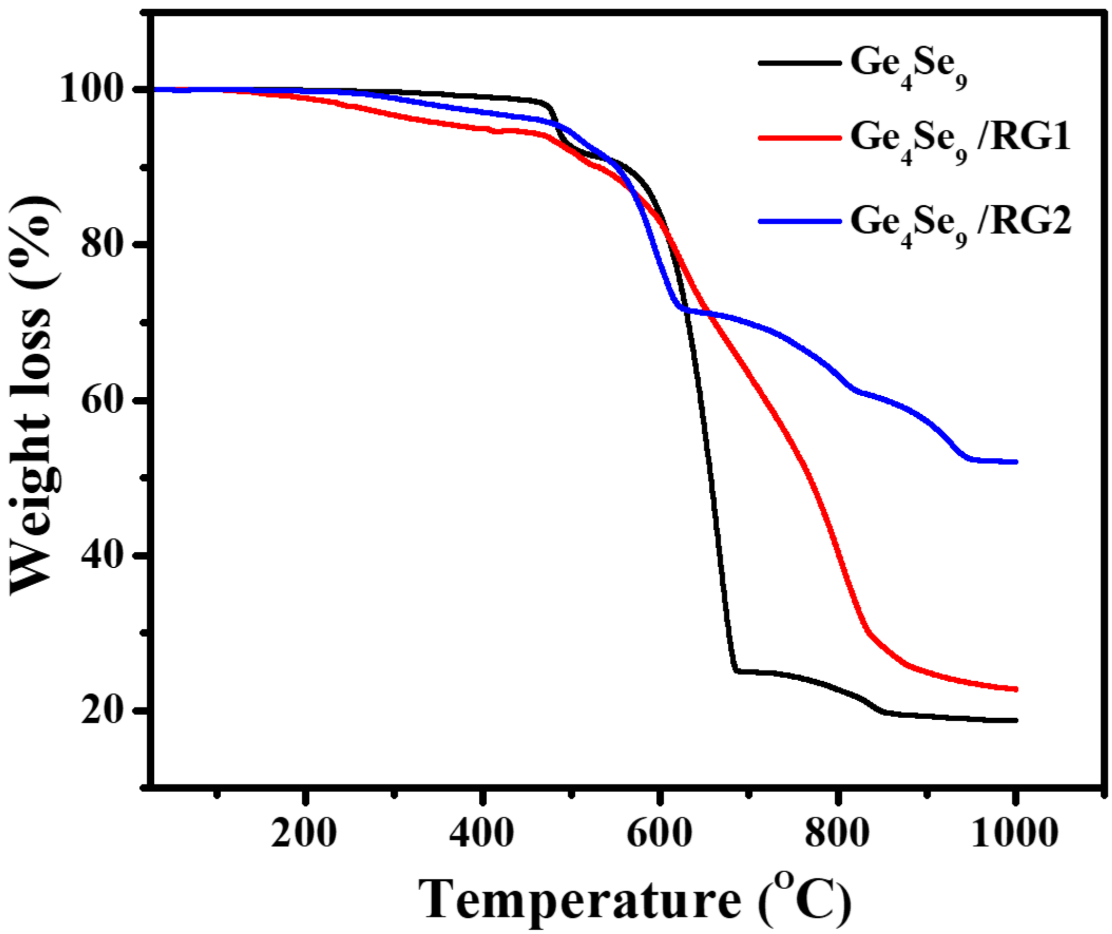


Fig. S 3 Thermogravimetric analysis of Ge_4Se_9, Ge_4Se_9/RG1 and Ge_4Se_9/RG2 composite

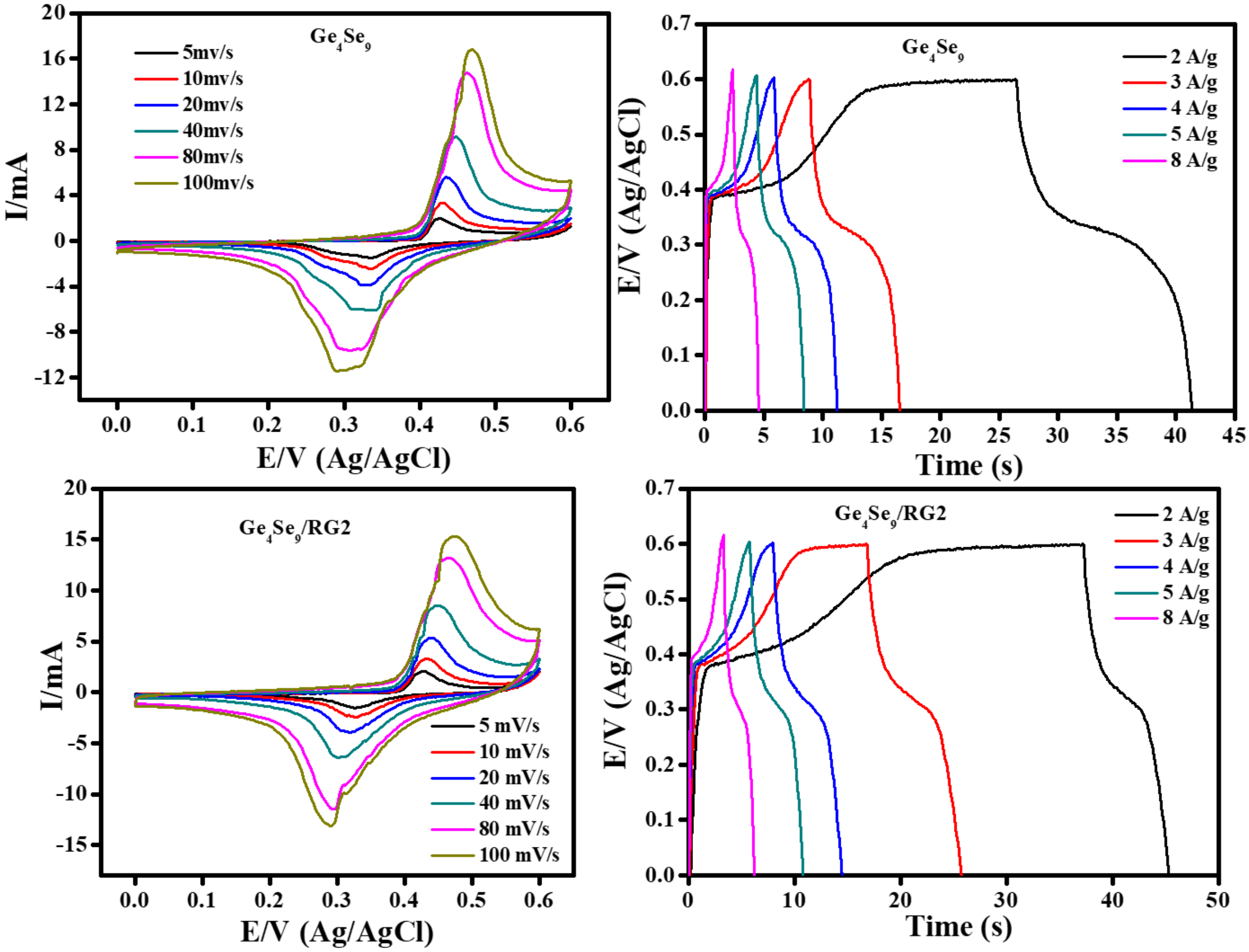


Fig. S4 Cyclic voltammogram and Galvanostatic charge-discharge profiles for Ge_4Se_9 and Ge_4Se_9/RG2 composite.

Table S1. Table showing the comparison of the electrochemical energy storage performance of Ge_4Se_9/RG1 composite with the reported literatures.

Electrode material	**Specific capacitance [F g^{-1}]**	**Energy density [W h kg^{-1}]**	**Power density [k W kg^{-1}]**	**Cyclic stability**	**References**
$MnMoO_4$/GR	364	202.2	8	1000	Dalton Trans. 2014, 43, 11067–11076.
3D-$GeSe_2$	300	----	----	2000	Adv. Mater. 2013, 25, 1479–1486
$MoSe_2$/rGO	211	----	----	10000	Dalton Trans., 2016, 45, 9646–9653
$SnSe_2$ Nano disk	168	----	----	1000	ACS Nano, 2014, 8, 3761-3770
SnSe NSs	228	----	----	1000	
MoS_2/Gr	243	73.5	19.8	1000	International Journal of Hydrogen energy, 2013, 38 14027-14034

WSe_2/GR	389	34.5	400 Wkg^{-1}	3000	Materials Letters, 2018, 223, 57–60
α-MnSe	96.76 (0.1mA/cm^2)	8.60	47.05 Wk^{-1}	2000	Electrochimica Acta, 2018, 268, 403-410
VSe_2 – RGO	680	212	3.3	10000	Chem. Commun., 2017, 53, 228-231
Ge_4Se_9	100.8	5.04	3.56	……..	This work
Ge_4Se_9/RG1	220 F g^{-1}	12	4.6	10000	
Ge_4Se_9/RG2	120 F g^{-1}	6.0	3.59	…….	

References

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2. A. K. Samantara, S. Chandra Sahu, A. Ghosh and B. K. Jena, *J. Mater. Chem. A*, 2015, **3**, 16961–16970.
3. H. Li, T. Lu, L. Pan, Y. Zhang and Z. Sun, *Journal of Materials Chemistry*, 2009, **19**, 6773-6779.