International Journal of ChemTech Research
CODEN (USA): IJCRGG ISSN: 0974-4290
Vol.7, No.3, pp 1162-1166, 2014-2015

ICONN 2015 [4th -6th Feb 2015]
International Conference on Nanoscience and Nanotechnology-2015
SRM University, Chennai, India

Structural and Optical characteristics of Graphene nanoplatelets doped with Zinc Sulphide

Mahmud Abba Ibrahim[1], Annie Sujatha.R[1]*, Mani Rahulan.K[1], Pandian.C[1]

[1]Department of Physics and Nanotechnology,SRM University

Abstract : In the present work, ZnS doped Graphene nanoplatelets were prepared by wet chemical route. The prepared samples were characterized by X-ray diffraction (XRD), to confirm the formation of ZnS doped Graphene. The FTIR analysis was performed to study the presence of functional groups. The optical absorption was observed from UV –Vis spectrometer and the absorption edge was found at 266 nm. Scanning Electron Microscope (SEM) micrograph images shows slightly agglomerated spherical and morphology. The EDS analysis confirms the presence of the elemental components present in the given sample.
Key words: Graphene, Luminescence, Supercapacitors.

.

Introduction

Graphene nanoparticles have potential applications as a photocatalyst, in the photodegradation of toxic dyes, light emitting diodes, fuel cells and Supercapacitors. Graphene is a two dimensional material with zero bandgap having diverse applications in various fields such as photonics,electronics and biotechnology. The synthesis of graphene with defects suffers poor optical properties. Doping of carbon materials with organic and inorganic ions have been reported earlier to improve the properties. Doping carbon materials with inorganic salts such as ZnS ,ZnSe,CdS,CdSe is reported to have increased the luminescence efficiency.

Surface modification of carbon nanomaterials by organic molecules shows increased luminescence efficiency[1-9]. Previous works shows several fold increase in luminescence when it is doped with inorganic salts before treating them with organic salts. This work reports the doping of graphene nanoplatelets with ZnS to prepare the material for better optical performance.

Materials and methods

Industrial quality grapheme nanoplatelets of thickness about 1-5nm was purchased with a purity of 2% by weight of oxygen and 98% by weight of carbon was purchased from Reinste ventures. It has a surface area of 500 and 750 m /g and average particle diameters greater than 2 microns with an appearance of black granules. These are unique nanoparticles consisting of short stacks of graphene sheets has a platelet shape. Aqueous suspension of nanoparticles with

Zn(CH COO) is subjected to hydrolysis with sodium sulphide. The doped ZnS was annealed further for purification[10-12].

Structural characterization of the product obtained was performed by X-ray Diffractometer with CuKα radiation (λ=1.5406 Å), using X'per PRO (PANalytical) advanced with 2θ ranging. Optical absorption measurements were performed using UV–Vis NIR spectrophotometer in the range of 200–800 nm. The elemental identification was performed through EDS measurements. The FTIR analysis shows presence of functional groups. The morphology was studied from SEM micrographs.

Results & Discussion

X-Ray diffraction studies

Fig. 1 shows the XRD pattern of ZnS doped graphene nanoplatelets. The XRD pattern of graphene shows a broad peak, at 2θ =25.63°, attributed to the (002) lattice plane, corresponding to a d-spacing of 0.33 nm. which appears along with the spectrum of ZnS peaks at 2θ values of 29°, 48.1° and 56° can be indexed to the (111), (220) and (311) lattice planes of cubic sphalerite ZnS (JCPDS card no. 00-003-0579) confirming that that ZnS is incorporated into graphene . The lattice constants from XRD is calculated as a = b = 5.39 Å.

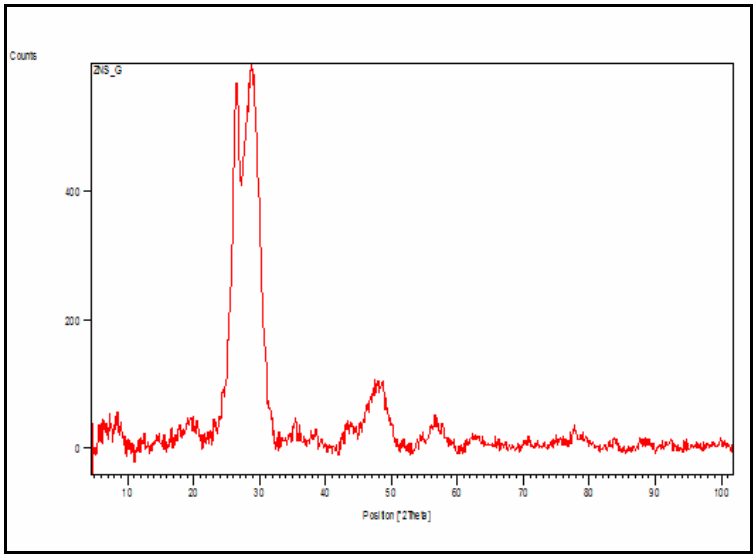

Fig. 1: Powder XRD pattern of ZnS doped Graphene nanoplatelets

Functional group and elemental confirmation studies

The FT-IR analysis of the samples performed shows the functional groups as in Fig. 2. The FT-IR spectra exhibits strong bands appearing in 476.52 cm^{-1} and 421.32 cm^{-1} and a peak at 1578.85cm^{-1}.The peak at 1578.85 cm^{-1} corresponding to the aromatic C-C bond indicating the presence of graphene and the peaks at 476.52 cm^{-1} and 421.32 cm^{-1} corresponds to Zn and S stretching[13].

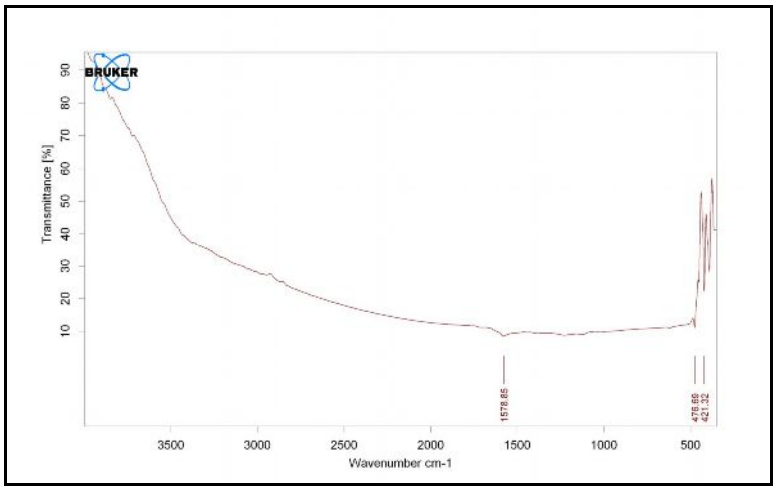

Fig. 2 FT-IR spectrum of ZnS doped Graphene nanoplatelets

3. UV-Vis absorption

UV-Visible spectrum of ZnS doped Graphene nanoplatelets is shown in Fig. 3. In this spectrum λ_{max} is observed at 266.92 nm attributable to π-π* transition of the atomic C-C bonds of graphene[14] . The absorption is observed in the shorter wavelength region showing that the inclusion of inorganic dopant Zinc sulphide with graphene increases the light conversion efficiency.

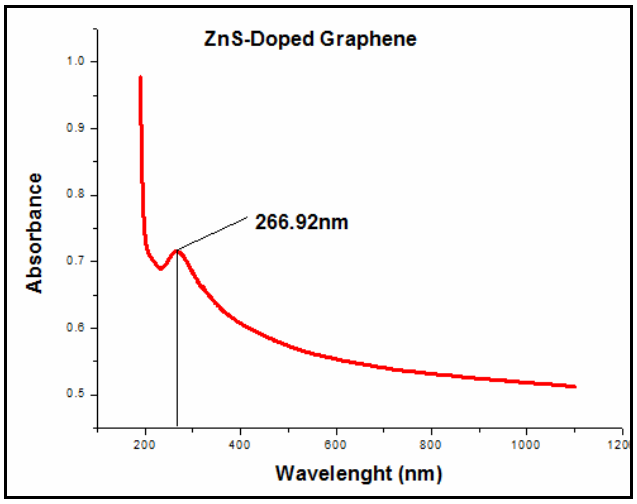

Fig. 3: Optical spectra (UV-Visible absorption) of ZnS doped Graphene nanoplatelets

Surface Morphological studies

The SEM micrographs shows the samples at different scale bars of 5µm, 3µm, 1µm and 500 nm.The figure shows slightly spherical morphology with little agglomeration and random orientation.

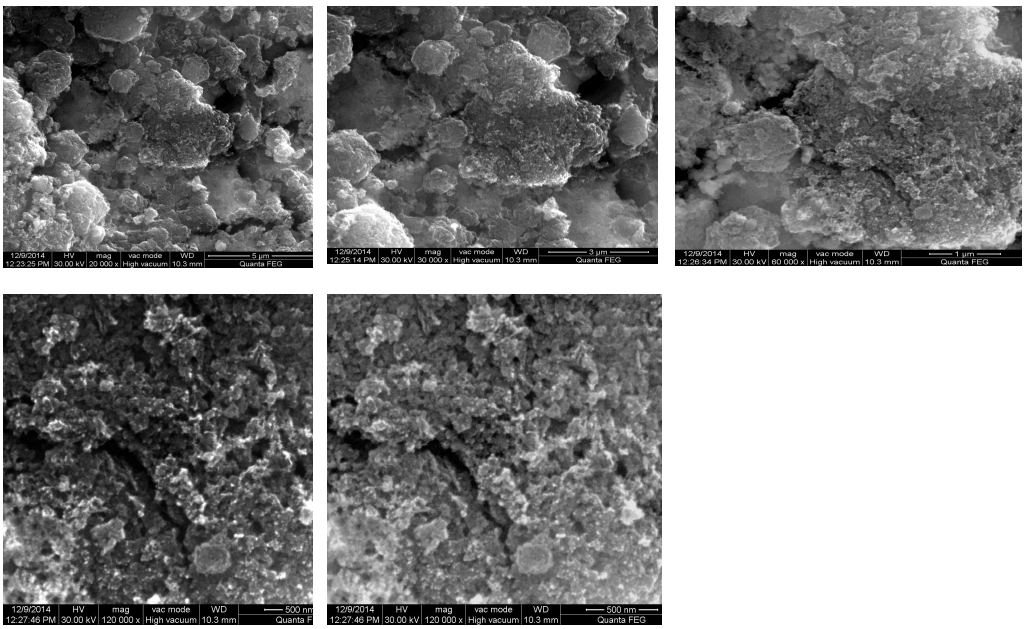

Fig. 4: SEM images of ZnS doped Graphene nanoplatelets

EDAX

The EDAX of the **of** ZnS doped Graphene nanoplatelets as shown in the fig 5 confirms the presence of Zn, S,and C, and in the sample where the ratio of the elements present is in the required stoichiometric ratio is given in the table1 below.

Table.1 Stoichiometric ratio

El	AN	Series	unn. C [wt.%]	norm. C [wt.%]	Atom. C [at.%]	Error (1 Sigma) [wt.%]
C	6	K-series	96.52	79.31	94.09	12.28
Zn	30	K-series	17.63	14.49	3.16	0.47
S	16	K-series	7.54	6.20	2.75	0.31
Na	11	K-series	0.00	0.00	0.00	0.00
		Total:	121.70	100.00	100.00	

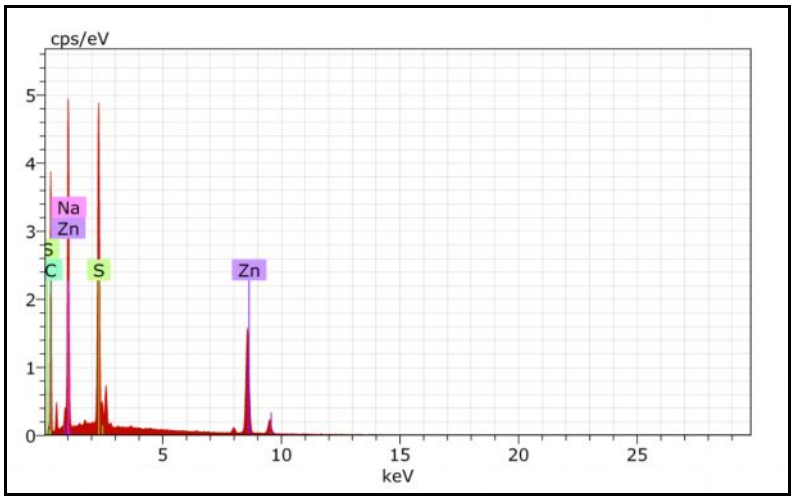

Fig.5.EDAX spectrum of ZnS doped Graphene nanoplatelets

Conclusions

We have synthesized ZnS graphene nanoplatelets by chemical route . The as prepared sample after annealing was characterized for structural determination which shows diffraction peaks for both Graphene and ZnS . The spectroscopic analysis reveals characteristic peaks for C-C bond in graphene and other peaks for the stretching for ZnS.The absorption spectrum exhibits maximum absorption peak at the lower wavelength region.The morphology studies are performed using SEM analysis .The elemental composition and constituent identification observed from EDAX spectrum. In this report we suggest a facile method to dope Graphene with inorganic salt before a surface passivation can be done with organic molecules in order to obtain higher luminescence yield which can pave way for new optical materials

References

1. Wilson, W.L., Szajowski, P.F. and Brus LE. Science. 1993, 262, 1242–1244.
2. Li, Z.F. and Ruckenstein, E., Nano Lett., 2004, 4, 1463–1467.
3. Bharali, D.J., Lucey, D.W., Jayakumar, H., Pudavar, H.E. and Prasad, P.N., J. Am. Chem. Soc., 2005, 127, 11364–11371.
4. Yu, S.J., Kang, M.W., Chang, H.C., Chen, K.M. and Yu, Y.C., J. Am. Chem. Soc., 2005, 127, 17604–17605.
5. Sun, Y.P., Zhou, B., Lin, Y., Wang, W.J., Fernando, K.A.S., Pathak, P., Meziani, M.J., Harruff, B.A., Wang, X., Wang, H.,
6. Luo, P.J.G., Yang, H., Kose, M.E., Chen, B., Veca, L.M. and Xie, S.Y., J. Am. Chem. Soc., 2006, 128, 7756–7757
7. Cao, L., Wang, X., Meziani, M.J., Lu, F.S., Wang, H.F., Luo, P.J.G., Lin, Y., Harruff, B.A., Veca, L.M., Murray, D., Xie, S.Y. and Sun, Y.P., J. Am. Chem. Soc., 2007, 129, 11318–11319.
8. Zhou, J.G., Booker, C., Li, R.Y., Zhou, X.T., Sham, T.K., Sun, X.L. and Ding, Z.F., J. Am. Chem. Soc., 2007, 129, 744–745.
9. ZnS-Graphene nanocomposite: Synthesis, characterization and optical properties DOI: 10.1016/j.jssc.2012.02.048

10. Jin-Song, H., Ling-Ling, R., Yu-Guo, G., Han-pu, L. and An-Min, C., Mass Production and High Photocatalytic Activity of ZnS Nanoporous Nanoparticles, DOI: 10.1002/anie.200462057
11. Hoffmann, A.J., Mills, G., Yee, H. and Hoffmann, M.R., Q-sized CdS, Synthesis, Characterization and efficiency of photo initiation of Polymerization of several vinylic. Monomass. The Journal of Physical Chemistry b, 1992, 96, 5546-5552.
12. DOI: 10.1021/j100192ao67
13. Guo, H., Wang, X., Qian, Q., Wang, F. and Xia, X., A green approach to the synthesis of grapheme nanosheets, ACS Nano, 2009, 3, 2653-2659.
14. Xu, S., Yong, L., Wu, P., One-pot, green, rapid synthesis of flower-like gold nanoparticles /reduced graphene oxide composite with regenerated silk fibroin as efficient oxygen reduction electrocatalysts, ACS Appl. Mater.Interfaces., 2013, 5, 654-62.

*****