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Solar Mediated Synthesis Graphene Oxide and Its Structural, Morphological Properties

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ABSTRACT

At the present study, The graphene oxide (GO) was prepared by Hummer's modified method. The reduced graphene oxide (rGO) was prepared by solar mediated. Graphene (G) is a newcomer material that holds promising properties for structural, morphological. The production of high quality growth a good yield is a long-standing goal for reduced graphene oxide. The structural and morphology properties investigated and carried out of X-ray diffraction (XRD), Field-emission scanning electron microscopy (FESEM), Energy-dispersive X-ray spectroscopy (EDS), Fourier transform infrared spectroscopy (FTIR) and Raman spectroscopy. This simple and cost-effective method of rGO prepared for fabrication of various electronic storage devices.

KEYWORDS:- Graphene oxide, Structural, Nanosheets, Oxidation, Raman.

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1. INTRODUCTION

In the last few decades, the great interest that surely preludes a way to search on Graphene oxide materials are in allotrope of carbon with two dimensional honeycomb sp^2 crystalline lattice¹. The orthorhombic atomic structure of graphene is able to supply a building platform for the epitaxial growth of nanostructures. Graphene oxide (GO) is derived from chemical oxidation of graphene and oxidation of Graphite Graphene (GN), an allotrope of carbon material, conquered the world of nanotechnology in the last decade because of its unique properties. Among the techniques, electrochemical method was reported as a reliable and low cost method to produce highly pure graphene². Carbon materials have been precise as the most favored electrode materials, due to their high electrical conductivity, chemical stability, large accessible surface area. So far, several well-developed porous carbons with different morphologies have been extensively investigated, such as porous carbon nanospheres, carbon nanopowers, carbon nanosheets, carbon nanofibers, graphene, graphite foams and so on. Graphene and carbon nanosheets, are of great potential as electrode materials. owing to some of unique properties, large surface area and porous layer structure^{3,4}. Moreover, the synthetic process of graphene is relatively complicated and high-cost, which violates the requirements of easy operation, high acquiesce and high excellence in the useful industrialized applications⁵.

2. MATERIAL SYNTHESIS AND EXPERIMENTAL TECHNIQUE

GO was synthesized from graphite powder using Hummer's method⁶. The reduced GO was prepared using a convex lens of 100 mm diameter to focus solar radiation^{7,9}.

RESULTS AND DISCUSSION

3. XRD ANALYSIS

The XRD pattern of synthesisd GO/rGO with diffraction with Cu $K\alpha$ radiation ($\lambda=1.54178$ Å). are depicted in Fig. 1(a) and (b) shows GO/rGO exhibited a well-crystalline orthorhombic crystal type of the structure (JCPDS card no:89-8491). All the samples of GO/rGO featured sharp diffraction peaks indicate that GO at 11.83, 42.78 with corresponds that (001) and (100) the peaks¹⁰.

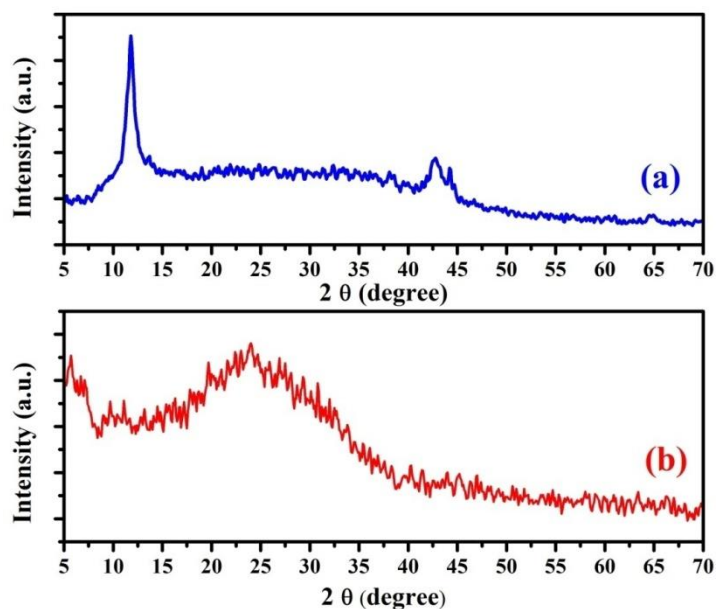


Figure 1. XRD pattern of GO/rGO nanosheets

The diffraction peaks of rGO at 10.30, 23.31 & 43.76 with corresponds that (001), (002) & (100) diffraction plane of the hexagonal crystal structure with lattice constants $a=2.47$ and $c=6.79$ Å. The crystalline size (D) of the GO/rGO samples were calculate using Scherrer formula based on (1)

$$D = \frac{0.89\lambda}{\beta \cos \theta} \quad (1)$$

where λ is the wavelength of the X-ray radiation, θ is the diffraction angle and β is the full width at half maximum (FWHM). Measured broadening of the GO/rGO samples with (001), (100) and (001), (002), (100) X-ray peaks gave average crystalline size about at 72.97 nm, 14.03 nm and 19.59 nm, 14.31 nm, 21.23 nm for the GO/rGO.

4. FESEM ANALYSIS

FESEM morphology of GO/rGO nanosheets are shown in Fig.2 (a-b). The morphological analysis also clearly shows the formation of GO/rGO. Both GO and rGO sheets are well micrometer size of the 2D wrinkled structure morphology¹¹.

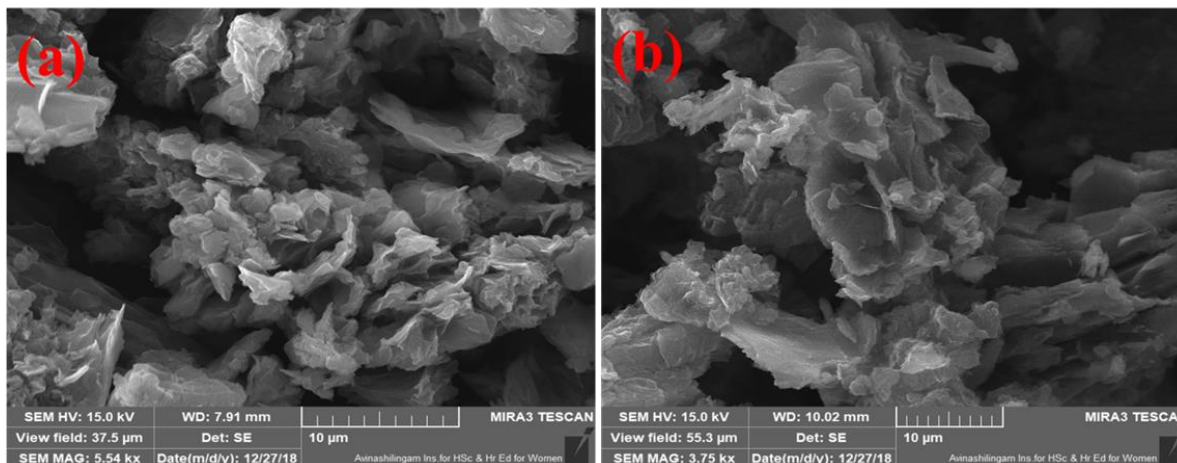


Figure 2. FESEM micrographs of GO/rGO nanosheets

5. RAMAN ANALYSIS

The structure information was studied as GO/rGO samples are exhibits that in the series of bands at 143,493,625, 687,847,1172,1369,1617,1840,1980,2234 and 2336 cm^{-1} all band can be attributed to the fundamental vibration modes in graphene oxides¹². The reduction of GO and rGO sheets were further confirmed through Raman spectra. As shown in Fig. 3 (a,b), the Raman spectra of GO displays two characteristic Raman bands centered at 1369 at 1617 cm^{-1} are assigned to the well known D and G bands, respectively.

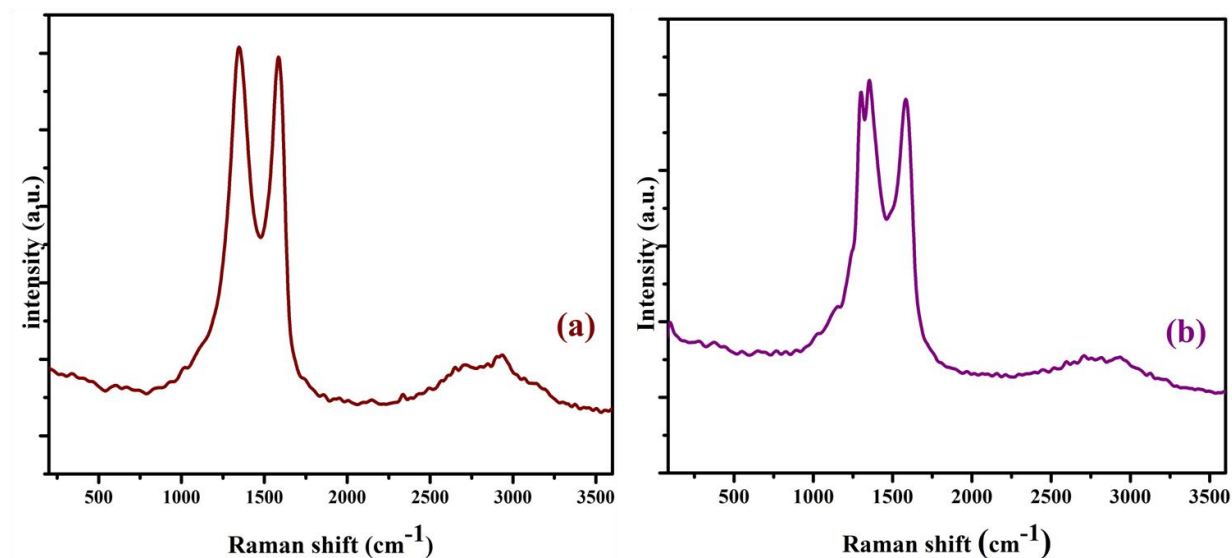


Figure 3. Raman spectrum of GO/rGO nanosheets

The D band ($\sim 1369\text{ cm}^{-1}$) corresponds to the disorder in the sp^2 carbon network, and the G band ($\sim 1617\text{ cm}^{-1}$) is associated with the tangential vibrations of the sp^2 carbon atoms in the hexagonal Planes¹³.

In general, the D band is known as imperfect band that typically arises from the first order diffusion of sp^3 hybridized carbon atoms, while the G band is mainly reflected from the stretching vibration of sp^2 hybridized C=C bonds. From Fig. 3(a), there is a shift occurs in Raman peaks positions for pure graphene oxide. This confirms the bond formation between graphene layers. The ID/IG ratio of the D-band to the G-band is related to the disorderness of the sp^2 domainsowing to the removal of the oxygen functional groups.

6. FTIR-SPECTROSCOPY

FTIR spectroscopy analysis in order to investigate the structure and functional groups in GO/rGO. In this Fig.4 (a,b) illustration are clearly reduction of GO/rGO samples are well shows band structure confirming a successful reduction of GO. As shown as Fig.4 (a)the broad peak presented at 3420 cm^{-1} in the heigh frequency area in the stretching and bending vibration OH groups of water molecules are GO adsorbed in the bonds. It can be concluded that the samplewas strong hydrophilicity. in the peak at 2364 cm^{-1} C-H asymmetric vibration which confirms the grafting of long C-C aliphatic chain reaction to the GO nanosheets¹⁴.

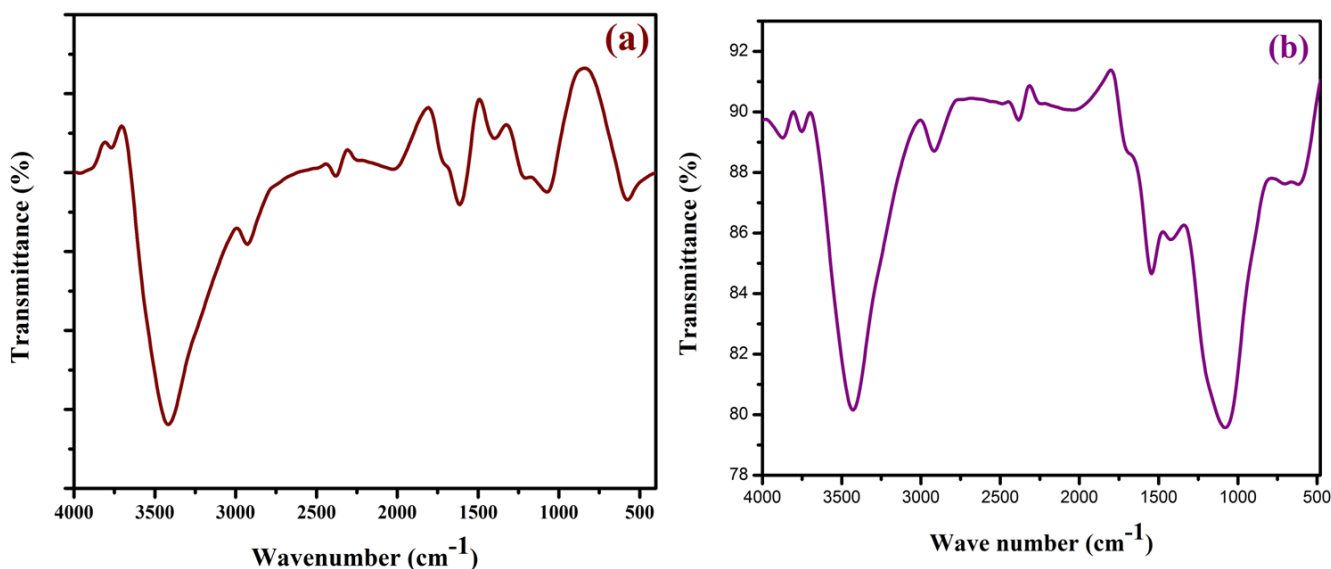


Figure 4. FTIR Spectrum of GO/rGO nanosheets

The growth of GO the eminence peaks for carboxyl C=O were seen at 1721 cm^{-1} . In the spectra can be compared the GO/rGO in Fig.4. The peak at 1616 cm^{-1} attributed to the aromatic C=C group could be seen in both GO and rGO samples. In this case of peak at $1404\text{--}1049\text{ cm}^{-1}$. The peaks at 838 cm^{-1} and 588 cm^{-1} are responsible for skeletal vibration of C=C bonds and after thermal reduction peaks are sharpened as a percentage amount of C=C bonds in rGO are higher than GO. Therefore, observed that GO/rGO confirmation of stretching vibration in the peak about at 444 cm^{-1} that most of C-O peaks containing groups onto the GO nanosheets are removed in the reduction process using rGO as the reducing agent in these peaks was observed.

7. CONCLUSIONS

The GO/rGO was successfully synthesized by Hummer's modified method and eco friendly solar induced conventional method. The XRD pattern result shows the interlayer d-spacing of rGO is to some extent higher than graphene oxide. FESEM images demonstrate wrinkled nanosheets of GO/rGO. EDS analysis shows the presence of carbon and oxygen elements in GO/rGO. The FTIR and Raman spectroscopy generalizes specific functional groups like hydroxyl, carboxyl, epoxy molecule by its sharp peaks of D and G band. This simple and cost effective method eventually becomes appropriate for rGO application in nano composite materials and fabrication of various electronic devices.

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