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# GRAPHENE REINFORCED POLYMER COMPOSITES-A REVIEW

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**ABSTRACT**

*Now-a- days, composites materials used as substitute for traditional engineering materials such as iron, steel, ferrous alloys etc due to their superior engineering properties. In this series, Graphene is the newly added carbon allotrops in the carbon Nano materials family for reinforcing polymer composites. This paper briefly covers the current research on graphene, and graphene based composite materials, including the preparation methods, properties, characterization techniques and the application area. Graphene is a 2D dimensional nano materials with signallayer of carbon atoms arrange in hexagonal manner. The graphene has rich in chemical, electrical and mechanical properties and the new fashion start in research by adding graphene or graphene oxide into polymer to utilize outstanding property of reinforced materials.*

***Keywords:*** *Graphene, Graphene composite, Nano materials, polymers.*

## INTRODUCTION

The various scientists were puzzling over the graphene for decade, since in 1947 Canadian physician, Phillip Wallace evolved his new idea about the electrical behavior of graphite. Since 1961,the German chemist Hensn-Peter Behmn and colleagues having discovered single layer graphite structure in as liquid mixture containing a low content recognized by the SEM electronic microscopic.Actually the graphene was produced by the Geim and Konstantin Novoselov[1]**.** According to them graphene is single layer carbonatom and the atom arranged into hexagonal cells of wax known as honeycomb of cave. Thus the graphene is like the block building of carbon material and its structure defined as a twodimensional (2D) of carbon particals[2]**.** Measurable factors are superlative such as strength, stiffness, elasticity, thermal and electrical conductivity[3]**.**These superior properties of graphene that can be replaced many other materialsin existing applications. However, graphene also be regarded as an element of innovative technologies due to all these extreme properties that are combined in a single material[4]**.** Due to being transparent, conductive and elastic will be

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beneficial in order to altered circumstance in electronics, whereas it is useful quality its use in minimize injury and prevents in movement, and the list ofsuch arrangements is incessantly rising. The structure of graphene has likely carbon alotrops in 2D form consisting atom vertex with lattice $sp^2$ hybridization and the length between to carbon to carbon about 0.142 nm.

By a fundamental constant that has been defined the condencepropertis of a physical matter and do not underlet on the material parameter. Under suspense graphene capacity only show by the structure constant, also the parameter related between light and relative electrons associate with quantum effect. Besides only in graphene consist one atom thik has been found absorption a significant incident light[5].

**Synthesis of Graphene and their oxides**

Some of best and suitable methods are described as highely uses for production of graphene like mechanical and chemical exfoliation of graphite. The natural and artificial growths of graphene on silicon, titanium, tantalum carbide and different material substratum like Ni, Cu, Pt, and Ru. The graphene formed by the mainly chemical vapor deposition, graphite oxidation and exfoliation of graphite and biomass[6]. From the other researcher claimed like Andre Geim and kostyaNovoselov extorted monolayer crystallite from large size of graphite in 2004 and coming out graphene in layers form from the graphite to transfer onto silicon plate. This process was often called micromechanical split or it was referred to as the scotch tape technique[1]. Since then, there has been an outburst in the exploration of graphene in terms of its synthesis, characterization, properties as well as its specific potential application. B Sreenivasulu et al preparer methods of graphene and others graphene based nano composite polymers[7]. In addition, it is describing its possibilities applications also the methods of Preparation GO, and others GO nano composite polymers.

Briefly, summarizing some of the important methods has using graphite as a raw material for graphene production.

Mechanical exfoliation is also known as micromechanical cleavage (MC), or the Scotch tape method. It is oldest, most popular methods extensively used in production of graphene and it led as graphene birth[3]. In this method there are no require any special equipment. The major equipment is adhesive tape and graphite flask that are peeled off continuously. To get graphene layer clean the tape using peel off the flakes, repeat the process until the mono layer achieves. This method is used by the Geim et al. to produced graphene layer[1].There are various ways that can be developed the monolayer graphene, but this is the best and most popular methods to produce the graphene. Chemical Vapour deposition (CVD) is also sometime known as straightforward methods. In this methods produce a very high quality of graphene and up to large scale, for a good quality of graphene it is required a special type of

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equipment and concerning a guideline of pressure, temperature and time duration[3]. CVD the name implies that the deposition of liquid particles onto the substrate, often using as the gaseous for the carrier. It has a special type of reaction chamber in which the ambient temperature is set, the combined gases coming into the chamber and contact with the substrate. The substrate is deposited at very slow speed and the denoted micron/hour. The characteristic of this method is produce high quality of graphene as well as high purity, density and fine grained[8][9]. The methods are use in different basis of the variation of different opted pressure like low pressure and high-pressure CVD methods. Graphene is produced under two steps in the CVD method firstly, decomposed of material at very high temperature (Pyrolysis) carried on to the substrate inhibit rapid temperature of gas. The second phase includes of creating the carbon structure dissolved from carbon under the temperature control[7].Graphite is fully soaked in the chemical acid like sulphuric and nitrate acid, which begin oxidation and then breakout process[10]. The breakout is cognizable by the infiltration of graphite layer within mixture, the results implies formation of inconstancy graphite layer.

Finally, the graphite layer reduces and retain with lower yield. The graphite is introduce by the following procedure is exfoliation of the minerals acid under the temperature[7]. This result tends to produce scalable graphene; the major drawback of this procedure is that produce defects in graphene further modify the surface and its properties. The problem faced researcher raise the standard quality of graphene production. The defects of this graphene single layer carbon atoms, is relationship fault with conflict and lots of up and down affect the properties such as electrical, transparent, not permeable, the thermal property of this is best specific value of Graphene property[6]. The production of graphene is mainly tow type top down and bottom up. The use Bottom up is in chemistry to production monolayer structure from carbon atoms. The chemical vapour deposition (CVD) is the excellent technique used in this process, which is produce a single layer of graphene on the copper or nickel sheet. In this technique defects arise on the monolayer as holes and crack propagation and wrinkles[11]. This reasons a spreading poor quality and a reduction in the graphene properties [4][6].

## PROPERTIES OF GRAPHENE

The graphene posses a tremendous property according to the Yin Yu et al investigate the Post buckling of graphene reinforce plate under thermal behaiver, a good agreement with the homogenous GRC sheet considering thermal environment and described the properties GRC sheet[12]. It has concluded the buckling load increase of the graphene reinforcement sheet. Zhangxin Guo et al done the Multi scale FEM analysis of GRC on macroscopic homogeneous model is proposed for a 3-D FEM of the mechanical behavier of graphene polymer composites[13]. Hui-Shen et al findout the

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Nonlinear vibration activity of FGR composite those panels acting as thermal behaiver and considering cylendrical laminates stable on the elastic, vibration of graphene reinforcement composite considering cylindrically and under elastic foundation and heat conditions and the properties of Graphene composite are treated piece-wise FGM material[14]. Sang-Hwa Yoon and Hee-Tae Jung modification polycarbonate using graphene and synthesis of nanosheetsfor the applications PC-g-MGNS nano composites via the fictionalization of graphene with MDI and subsequent grafting with PC. The PC-g-MGNS nano composites exhibit a increase in 20.5% tensile strength and a 22.7% modulus elasticity over those of conventional solvent-mixed PC–graphene nano composites because containing the interactionbetween PC and graphene[15]. Gang Li and Bowen Xiong tested the tensile streangth considering the nano graphene sheet fabrication of graphene aluminum composite nanosheet is using high energy pressing milling under the vacuum. Containing the graphene is at different weight of percentage about (0.25, 0.5 and 1.0 wt. %) investigated tensile strength of GNSs/Aluminum composites[16]. Jinghang Liu et al characterized GO and Graphene nano sheet alluminium Reinforced using powder and prepared composite characteristics posses aluminum matrix nano-composite are introduced to reduce the GO composite by colloidal graphite oxide coated on the aluminum particles and use the heat treatment process[17]. Graphene has high modulus of elasticity of 1 TPa and the tensile strength is 130 GPa, having the thermal and chemical stability is very high[18]. The interfacial bonding between the graphene is 0.1 to 1 J/$m^2$. The interfacial shear modulus is 4 MPa and strength is 0.08 MPa of a Vander Val. Graphene has considered around 200 times stronger than structural steel. It has stretched during the performed PMMA beam. It has seen in Raman Signal along with the matrix strain[11].Graphene possesses best electron carrier at room temperature ~ 200.000 $cm^2$/ V·s. For e.g. Si at RT~ 1400 $cm^2$/ (V·s), carbon nanotube: ~ 100.000 $cm^2$/ (V·s), organic semiconductors (polymer, Oligomer): <10 $cm^2$/ (V·s), some of most material illustrate in the table that indicate the conductivity of graphene having best over the other material. Graphene and the carbon nano composite have outstanding thermal and electric conductivities, computing the process them as the fillers in composite material to concerning agreement conductivities**,** their significant differ in the geometry, this is examine using approximation method. That is clearly show that graphene composite is more desirable in conductivity rather than the carbon composite[19]. The optical properties of graphene response like electron, including its spin and postulated the existence of nature with the smooth structure constant α= 0.007297353 also known as coefficient of absorption[20]. It has an ability to absorb 2.3% the white light and visible without the Microscope. Graphene also recognize by optical microscopy on a silicon substrate.

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The different layer of graphene has different contrast on absorption spectrum[4][6].

## CHARACTERIZATION OF GRAPHENE

The researcher has been using a serval technique to charecterise the graphene structure like macroscopic lavel as well as micro structure. It has been included SEM, TEM, RAMAN SPECTROSCOPY and Optical microscopy. Optical microscope has been helpful screening of graphene sheet for their quality, morphology and calibrate thickness based on color and contrast. SEM & TEM characterization the structure information of micro, nano materials based on electron scanning of workpiece surface by the secondary electron like the action stimulated from sample surface[21]. It has nanometric fluctuation due to the atomic thickness of graphene, thus secondary electron emitted very less. Creation of image in the SEM mainely the collected secondary electron by reflectection of sample structure, a lot of shrinkage that have the formed in surface of graphene after transferring on to the substrates due to this reason charecterisation area of graphene sheet large[22].

But in the TEM (modified the SEM) electron beam passing through the sample of graphene, the image is created by the scattering and absorption by the object through the electron differection spectrum. Raman Spectroscopy one of the other most important characterization nondestructive detection technique based on light scattering and incident of light on sample, distigueses between the monolayer and bilayer of graphene. change of frequency of scattering light due to moleculer vibrations. It has been showing in spectrography of graphene and graphite by using 514 nm laser exitation form two peak 1583 and 2100 $cm^{-1}$respectevely that show the carbon $sp^2$ and symmetry while there inelastic scattering phonos[24].

## FABRICATION OF GRAPHENE REINFORCED COMPOSITE

The preparation method of Graphene polymer composite, a mixture of different substances, and situ polymerization and melt of different substance in order to mix in prominently procedure to synthesis graphene-based polymer composite that is sustain dissoluble trend like water, $CH_32CO$, $CHCL_3$ (Chloroform) and methylbenzene. Method is including the soluble of polymer in suitable dissolution and cover with the regime of out stream protrusion graphene for example PMMA (Poly methyl meth acryl ate) have been fluently mix with the GO. The surface GO is act as alkyl amine and alkyl chlorosilanes for improving the Natural solution. Composites can be confrere by the simply by means of filter for example SWNT polymer Composite[7][21]. This method is including very simplest Procedure as use of heat and powder diffusion fillers in the polymer mesh, it can for both polymer materials like polar or non Polar e.g. PMMA, graphene Polypropylene and GO poly[3][21].This is method of preparing nylon graphene composites by the numerous monomers of GO. In this method graphite oxide thermally reduce into the

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graphene, 0.01-10 wt % is obtained by this method. There is the modification of graphene using the XPS, TGA, FTIR and AFM measurement. Elasticity changed with the graphene 0.01 wt% and disputes an extraordinary reinforced composite[7].The scope of GRP composite is use CNF, EG and CNT usually present as the Epoxy, PET (Polyethylene tetra phthalate), PC (polycarbonate), and PVDF (poly vinylidene fluoride) etc. **G**raphene based epoxy composites best for the expansion property of 0.01 wt% GO and also be notify the conductivity 1 wt% to 5 wt % of GO up to the 6.44 W/mK that is 4 times greater than pure epoxy[25].

## CONCLUSIONS

From the above literature review it has been found that, Graphene reinforcement composite is a novel engineering material having superior properties which successfully replaced the other metallic alloys. The excellent quality of graphene composite materials produces chemical vaporization of graphite based on the thermal optimization procedure. The current knowledge about fabrication and characterization of graphene composites is in initial phase. Therefore, Fabrication, characterization and machining aspects of graphene composites have become the predominant research area for industry as well as academia.

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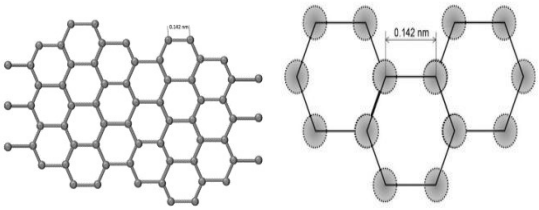


***Figure 1:*** *Graphene lattice structure of a honeycomb carbon atom in 0.142 nm length [4]*

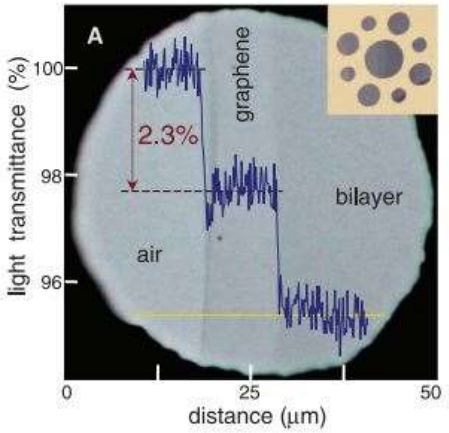


***Figure 2:****Transmittance of white lights function[5]*


***Figure3:*** *Hummers methods of graphene*

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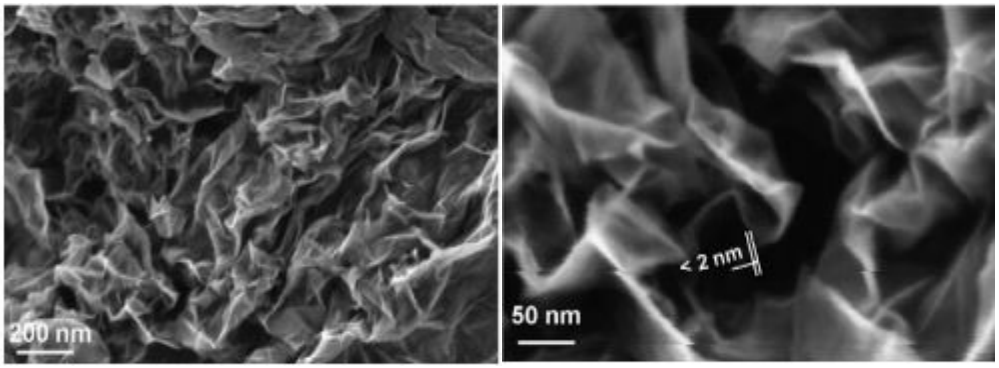


***Figure 4:*** *A SEM image aggregate reduced GO sheet[23]*