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GRAPHENE AND ITS ANALOGOUS: VERSATILE FILLER FOR HYBRID MATERIALS WITH ELECTRONIC APPLICATIONS: A REVIEW

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ABSTRACT
Among different nanostructures, graphene analogues (Graphene oxides, reduce graphene oxide and graphene) are in the limelight for their unique layer dimension with high aspect ratio, easy processability, ease of chemical modification, high mechanical, and thermal properties. Incorporation of nanostructural intermediate like graphene oxide (GO) to the polymer core via in situ polymerization approach and thereafter its conversion to reduced graphene oxide (r-GO) is generally performed to achieve uniform distribution of r-GO sheets. Graphene oxide also plays an important role in anchoring in situ formed metal nanoparticles on its extended surface with inhibiting of stacking behaviors. Other layer nanostructures are also combined with graphene oxide to achieve the desirable properties for electronic applications. Therefore, the fabrication of graphene based hybrid nanostructures has opened a new dimension in making of potent filler for polymer nanocomposites. This review article deals with the collection of various polymer nanocomposites, reinforced with graphene based nanostructures for their applications towards high charge storage capacitors, electro-active materials and gate dielectrics

Keywords: *Graphene oxide, nanocomposite, supercapacitor, dielectric properties, synergistic effect,*

INTRODUCTION:

Graphene is generally a two dimensional nanostructure, blessed with unique physico- chemical properties like high electron mobility **[1]**, extraordinary electronic properties, high mechanical strength **[2]**, excellent thermal stability **[3]**, light weight and high specific surface area **[4]**. Ever since its discovery in 2004 to the till dates, graphene has remained one of the hot topics of advanced research. These unique physicochemical properties of graphene make them very interesting in fabrication of polymeric nanocomposite by taking graphene and it's analogous as filler **[5-7]**. One of the analogous of graphene is graphene oxide (GO) which contains various oxygen containing functional groups (i.e. hydroxyl and epoxy groups) and can be prepared by simple modified Hammer's method **[8]**. Since GO exhibits poor electrical conductivity, it is typically reduced by means of chemical reaction with strong reducing agent (i.e. hydrazine) to prepare highly conductive reduced graphene oxide (r-GO) **[9]**

Graphene based polymer nanocomposites are cited everywhere, starting from the packaging to the biomedical application. With the progress of advanced research, graphene based materials are widely used in making of electronic devices (capacitors and supercapacitors), sensing of biomolecules and purification of water.

Present review mainly focuses on technological application of graphene based polymer nanocomposites dealing with making of electronic devices, such as supercapacitor and dielectric materials.

2 Graphene Based Polymer Nanocomposites for Supercapacitor Materials

The term "supercapacitor" is related to the material of enhanced capacitive performance as compared to conventional capacitors **[10]**. Conventional capacitors are formed by the combination of metal plates and dielectric materials (ceramic or plastic). With switching on the capacitor, the negative and positively charged metal plates of the capacitor introduce an electric field which in turn develops the desirable polarisability to the dielectric materials of the capacitor. Due to the polarization behaviour, capacitor has high charge-storing capacity at a given voltage. But the charge releasing capacity of solid dielectrics is very slow as compared to supercapacitor. Typical fabrication of supercapacitor involves the dipping of large size electrodes to the electrolyte solution which are then separated by a very thin layer of insulator. The separable membrane is generally made up with carbon, paper or plastics. Supercapacitor materials can store typically 10 to 1000 times more energy per unit mass or volume as compared to other charge storing devices with unique characteristics that form a bridge between rechargeable batteries and electrolytic capacitors **[11, 12]**. In