Abstract

Graphene, a two-dimensional nano-carbon material with outstanding mechanical and physical properties attracted the scientists for exploring and studying its structure and using it in many critical applications. This work is divided into three parts, preparation of graphene by five different routes, preparation of graphene oxide, and preparation of two different types of graphene/ (epoxy+toluene) nanocomposites and graphene oxide/ (epoxy+toluene) nanocomposites.

The routes used in the preparation of graphene are; pyrolysis of asphalt route, chemical exfoliation of graphite route, chemical unzipping of carbon nanotubes route, gas-liquid phase unzipping of carbon nanotubes route, and electrophoretic deposition of graphene oxide route. All these routes were modified by different ways through preparation process. Graphene oxide, characterized by its significant mechanical properties, was prepared through this work by the modified Hummers method.

All the prepared materials were characterized by Atomic Force Microscopy (AFM), Scanning Electron Microscopy (SEM) and Raman spectroscopy. Graphene with small thickness of about (0.68 nm) was obtained through this work via pyrolysis route with a large diameter and large-scalability. Another route for producing graphene with good properties and large-scaling ability is the chemical exfoliation route which uses traditional graphite as a raw material to prepare graphene. These two routes were used to prepare graphene as reinforcement in the preparation of

epoxy nanocomposites assisted by using toluene as dispersing agent and at three different volume fractions (0.5 %vol., 1.5% vol., and 3% vol.).

Another type of polymer nanocomposites was prepared by using graphene oxide as reinforcement with epoxy at three different volume fractions (0.5% vol., 1.5% vol., and 3% vol.). All the prepared nanocomposites were subjected to some mechanical tests (Tensile test, Impact test and Hardness test) and thermal conductivity test to study the effects of using these reinforcements on the mechanical and thermal conductivity properties of the polymeric matrix. A great enhancement in the mechanical properties of the prepared nanocomposites has been revealed and the optimum value is reached when epoxy was reinforced with (1.5% vol.) of graphene oxide. This led to increase the ultimate tensile strength by (85%), impact strength by (245%), and hardness by (228%).

The result of thermal conductivity test shows, a great and significant enhancement in the magnitude of thermal conductivity of the composites reinforced by graphene at (3% vol.). The optimum enhancement in the magnitude of thermal conductivity is for the sample reinforced by graphene prepared via pyrolysis route with (3% vol.) which leads in increasing rate in the value of coefficient of thermal conductivity (K) equal to (163%). Reinforcing by graphene oxide does not have remarked effect on the thermal conductivity property of the prepared nanocomposites.