Mechanical Properties of Nano Graphene Composite Materials

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Abstract

Composite resin is one of the most important materials used in all industrial and medical fields nowadays, but it has many properties and advantages that distinguish it from metals. Many problems appeared previously due to the materials used and to overcome these problems, A composite resin with great physical and mechanical properties and compatibility has been developed. Composite resins are resin filled with high compressive strength, corrosion resistance, light weight, ease of application and high transparency. The objective of this review article is to review composite materials, including the most important conditions and the ratios affecting them. The literature on composite materials and the measurement of many physical properties, research methodologies, and contributing factors are selected and reviewed

Keyword: composite resin, nano composite resin, dental material, Graphene

DOI Number: 10.14704/nq.2022.20.9.NQ44425 **Neuro Quantology 2022; 20(9):3729-3731**

1 Introduction

There are many factors affecting the manufacture of industrial, medical and military applications, and the materials manufactured for them may be the basis for this. Therefore, many researchers were interested in manufacturing materials that have new and useful properties more than metals and improving those properties by using many chemical additives or by adding nanomaterials. As it happens now in most applications. Graphene is an important material that improves the mechanical properties, which will be discussed and researched and its effect on the properties through the study of literary articles.

2 Enhancement of mechanical properties with nanoparticles without graphene particles

Many materials used in medical and industrial applications have improved their mechanical and physical properties by adding a group of nanomaterials.[1] investigate the interaction between a low replacement ratio of different nano-particles (SiO2, Al2O3, clay, and CaCO3) and aminosilane in the matrices of cement paste and mortar[1], biopolymers have become more popular that is resulted from the growing concern on environmental issue and their enormous advantages. However, the application was limited by its thermal properties[2]. the effects of adding Nanoparticles of TiO2 and Al2O3 on the mechanical properties of epoxy hybrid composites. The materials used were epoxy resin, Titanium dioxide diameter (40-65 nm) and alumina diameter (45-75nm). [3], addition similar proportions from glass fiber and Thal silica sand Nanoparticles, with average particle size of 74.83 nm on the mechanical properties of hybrid epoxy composites[4], the mechanical properties are evaluated for epoxy polymer composites reinforcement by glass fabric and alumina (Al2O3), Titania (TiO2) and silicon carbide(SiC) as fillers [5], the mechanical properties of Hybrid Composites reinforced by Coconut Bunch Fiber (CBF) and Al2O3 Nanoparticles. The Epoxy resin is used as matrix, in addition to Natural coconut fiber and Al2O3 Nanoparticles. The samples of composite were prepared by hand-layup method[6], A polyester fabric with durable photo-, bio-, and magneto-activities was prepared in a single-step process. In the proposed method alkali hydrolysis of

polyester fabric was carried out along with the synthesis of the TiO2/Fe3O4/Ag nanocomposite [7], Compressive properties are commonly weak parts in structural application of fiber composites. Matrix modification may provide an effective way to improve compressive performance of the composites. In this work, the compressive property of epoxies (usually as matrices of fiber composites) modified by different types of nanoparticles was firstly investigated for the following study on the compressive property of carbon fiber reinforced epoxy composites [8], This paper reports a novel approach to toughen epoxy resin with nano-silica fabricated from rice husk using a thermal treatment method with a particle size distribution in range of 40–80 nm [9], experimentally investigate the interaction between a low replacement ratio of different nano-particles (SiO2, Al2O3, clay, and CaCO3) and aminosilane in the matrices of cement paste and mortar [10], used the Nano-alumina (Al2O3, 30 nm) particles to reinforce epoxy resin and its effect on the mechanical properties of the epoxy Nanocomposites. Epoxy resin E-51 is used and the prepared samples contain different proportions of Alumina Nanoparticles (1%, 3%, 5% and 7%) wt [11], studied the effect of adding different proportions (2%,3%,4% and 5%) wt of Nano silica particles on the mechanical properties of the hybrid glass fibre composite [12], studied the effect of adding 9% wt of micron rubber and 10% wt of silica Nanoparticles to epoxy polymer on fatigue and fracture behavior [13], they used epoxy resin (DGEBA), Nano particles such as carbon nanotubes and clay, 10-30 nm. They prepared samples epoxy / clay, epoxy / hybrid (carbon nanotubes and clay)[14], study of the role of functionalized multi-walled carbon nanotubes (MWCNT-COOH) and singlewalled carbon nanotubes (SWCNT) in improving the mechanical properties of epoxy resins [15],

3 Enhancement of mechanical properties with Graphene nanoparticles

studied creep of epoxy– graphene platelet (GPL) with weight fraction (0.1,0.3and 0.5) % with different stresses level. At 20MPa stress, almost nanocomposite has same creep strain (0.25%) by period 36 hours, while with 40MPa there is different creep strain at room temperature [16,17], studied the effect of adding different proportions of Graphene Nanoplatelets (GNPs) as reinforcement to epoxy resin. The materials used in this study were EPO-622 epoxy resin, Graphene Nano platelets , 5–25 nm of size with four proportions (0.25%,0.5%,1% and 1.5%) wt [18], Graphene nanoplatelets (GNPs) are novel nanofillers possessing attractive characteristics, including robust compatibility with most polymers, high absolute strength, and cost effectiveness [19,20], The remarkable properties of graphene and graphene oxide (GO) make it as an ideal candidate for high performance cement-based composites. This paper firstly investigated the effects of graphene and GO on the hydration, microstructures and mechanical properties of cement paste [21], Graphene is a novel class of nanofillers possessing outstanding characteristics including most compatible with most polymers, high absolute strength, high aspect ratio and cost effectiveness [22], Low-dimension carbon nanomaterials, such as carbon nanotubes (CNTs) and graphene nanoplatelets (GNPs), are effective mechanical reinforcements in polymer composites. Epoxy matrix composites were fabricated by functionalizing CNT and GNP nanofillers using melamine and nondestructive ball milling [23], Graphene Nanoplatelets (GNPs) filler and carbon fabric to reinforce the epoxy matrix and to enhance their mechanical properties [24], investigated the addition of Nanomaterials, Graphene Nanoplatelets (GNP) and Reduced-Graphene Oxide (RGO) to polymer composite and studied their effect on fatigue strength[25], investigated effect of adding graphene with different weight fractions up to 0.5%wt.to epoxy to enhance the strength and creep resistance. From tensile test, the tensile strength for (0, 0.1, 0.25and0.5)%wt. of graphene were (25.5,26.6,29.2and32.3) MPa respectively [26], 2D graphene and its derivatives are used as potent high strength filler materials contributing in the enhanced mechanical properties of resulting polymer composites [27 -30].

Conclusions

Through this research, many conclusions can be drawn, including that

1-composite materials are light in weight, cheap in cost, easy to manufacture, transparent and with good properties compared to metals.

2-The addition of nanomaterials improves the mechanical and physical properties, in general, and in well-studied volume and weight ratios.

3-The addition of nano-graphene material improves the dynamic mechanical properties clearly

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