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Commentary

Types of Nano Composites and their Applications

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DESCRIPTION

Particles between 1 to 100 nm in size are considered nanoparticles. Due to their size, these particles' atomic level characteristics differ. The characteristics of nanoparticles have altered, which is beneficial in many fields. Since the beginning of the century, one of the most intriguing fields for researchers is nanotechnology. Since then, there have been several developments in the science of nanotechnology. Metal nanoparticles, non-metal ceramic nanoparticles, semiconductor nanoparticles, and carbon nanoparticles are some of the several types of nanoparticles. Due to their tiny size and high surface-to-volume ratio, nanoparticles have certain chemical and physical characteristics that differentiate them from the respective bulk materials. If a composite material has a component with nano scale morphology, such as nanoparticles, nanotubes, or lamellar nanostructure, the material is said to be nanocomposites. They are multiphase materials because they have many phases, and at least one of those phases should have diameters between 10 and 100 nm. Nanocomposites have evolved as useful alternatives to engineering materials that currently have limitations to overcome them. Based on their scattered matrix and dispersed phase components, nanocomposites may be categorized. Modern synthetic techniques have made it feasible to produce a variety of intriguing new materials with unique qualities because of this nano-technology field. A bulk matrix and one or more nano-dimensional phase that have different characteristics due to differences in structure and chemistry are called nanocomposites. Properties that have shown significant improvements include: mechanical characteristics (strength, bulk modules, withstand limit, etc.), temperature stability, reduces formation of gas, and retards the flame. Gas, water, and solvent permeability are decreased, with additional external appearance, an increase in electrical conductivity, and increased resistance to chemicals compared to conventionally filled polymers, improving optical clarity. Polymer-based nano materials are the most advanced materials being researched and developed right now among a variety of nanocomposites. Polymer-based nanocomposites certainly benefit from characteristics including film-forming capacity, active functions, and dimensional diversity. Inorganic nano clusters, clays, metals, oxides, or semiconductors can be combined with a variety of organic polymers, organometallic chemicals, biological molecules, enzymes, and sol-gel-related polymers to produce nanocomposites.

Based on whether or not the composite contains polymeric material, the following categories of nano composite materials can be developed. Non-polymer-based nanocomposites are those in which the compositions do not include any polymers or components generated from polymers. Inorganic nanocomposites are another term for non-polymer-based nanocomposites. They may also be divided into three distinct categories: ceramic-based, and metal-based nanocomposites.

Due to their increased catalytic characteristics and improvement in optical properties related to individual and differentiated metals, bimetallic nanoparticles are being explored in depth in the form of alloy or core-shell structures. Metal nanocomposites, such as Pt-Ru nanocomposites, are another category for non-polymer-based nanocomposites. Ceramic composites containing more than one solid phase, at least one of which has dimensions in the nano scale range (50-100 nm), are referred to as ceramic-based nanocomposites. For instance, nanocomposites made of hydroxyapatite and titanium combines the magnetic, chemical, optical, and mechanical capabilities of both phases. The non-polymer-based nanocomposites can also be categorized as ceramic nanocomposites, which can be used as artificial joint implants for fracture; it might significantly lower surgical costs, and would increase the patient's mobility. If zirconia-toughened alumina nano composite implants are utilized efficiently, the lifespan of bones would be extended by 30 years. Calcium sulfate-biomimetic apatite nanocomposites are another instance of ceramic/ceramic nanocomposites.

The application of non-polymer-based nanocomposites that are metal or ceramics, such as calcium phosphate, hydroxyapatite, and bioactive glass nanoparticles, are very advantageous in alveolar bone regeneration and enamel replacement, are where both metal-based nanocomposites and ceramic-based nanocomposites hold the most potential. In addition, they are utilized in the production of implants, scaffolds; diagnostics, and biomedical equipment, bio-nanocomposites are also used in the cosmetics industry. They are also particularly useful as gas-separation membranes, contact lenses, and catalysts. The

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biopolymer-based nano composite is useful in the treatment of osteomyelitis because it promotes tissue regeneration. Nanostructured organic/inorganic nanocomposites are used in artificial bone implants and help regulate load-bearing bone grafts. Controlled electrophoretic assembly of bioinorganic composite materials is carried out using living cells.

CONCLUSION

Nanocomposites and the many uses they have are both expanding quickly. The production of new fire retardant polymers, UV protection gels, drug delivery systems, high-strength fibers and films, anti-corrosion barrier coatings, lubricants, and stretch paints will all exceed 600,000 tons globally during the next ten years. Nanocomposites have drawn interest from the automotive and industrial sectors by improving characteristics, particularly mechanical ones. They can be applied to or utilized in a variety of vehicle types, including timing belt covers, door covers, and engine covers. Other uses include vacuum cleaner blades, mower hoods, cell phone case covers, etc.