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Recent Advances in Polymer Nanotechnology and Nano Composites

Mark Twain*
Department of Chemical Engineering, Yale School of Medicine, United States

INTRODUCTION

Polymer or copolymer nanoparticles are disseminated throughout the polymer matrix to create polymer nanocomposites. The group working on polymer nanotechnology will create tools for patterning useful surfaces. The creation of adhesives, sealants, coatings, potting, and encapsulating compounds has greatly benefited from nanotechnology. Products with improved thermal stability, water/chemical resistance, transparency, thermal conductivity, and tensile strength have been developed thanks to nanoparticle fillers such bentonites, nano-sized silica particles, and zeolites. Polymer matrix-based nanocomposites have emerged as a significant focus of current study and development in the vast subject of nanotechnology. The polymer literature has been dominated by exfoliated clay-based nanocomposites, although there are many other important areas of current and rising research. Exfoliated clay-based nanocomposites are covered in detail in this study, along with other crucial topics including barrier characteristics, flammability resistance, biological applications, electrical/electronic/optoelectronic applications, and fuel cell interests. Regarding crystallisation and glass transition behaviour, the crucial subject of the "nano-effect" of nanoparticle or fibre inclusion in comparison to their larger scale counterparts is addressed. Of course, the inclusion of nanoscale filler or fibre also helps other polymer (and composite)-based features, which are also covered.

DESCRIPTION

The length, diameter, and twist of the nanotube affect its electrical, thermal, and structural characteristics. There is a tonne of study being done right now since the CNTs' characteristics are so intriguing. For instance, at a 6^{th} of the weight, their tensile strength is 100 times that of steel. To broaden the uses of synthetic fibres such polyvinyl alcohol, polymethylmethacrylate, and polyacrylonitrile, CNTs are being researched in the textile industry. To improve the intended effects or to obtain numerous performance impacts in devices, CNTs are now being explored in a number of additional application domains. These include the creation of lubricants, coatings, catalysts, electro-optical devices, medicinal applications, nanometer-sized semiconductor devices, probes, sensors, conductive and high-strength specialty composites, and systems for energy storage and conversion. Sales of newly developed nanotechnology items, which made up 0.1% of worldwide manufacturing output in 2005 and are predicted to reach 15% by 2014, provide an indication of the field's growth. Beginning in 2010, nanotechnology would be present in the majority of produced items or high-end products. By the end of 2004, venture capitalists had invested $ 1 billion in nanocompanies.

An expanding field of study is the incorporation of nanoparticles in polymeric matrices to create polymer nanocomposite with the goal of maximising the "nano-effect" received from the nanoparticles and minimising the drawbacks of the polymer. Polymers are combined with nanoparticles in the form of nanosheets, nanotubes, nanofibrils and quantum dots to create polymer nanocomposites. These materials have adjustable mechanical, thermal, electrical, magnetic, and optical characteristics. However, it is crucial to make sure that the chosen nanoparticles are well dispersed throughout the matrix and have good compatibility with the matrix material in order to achieve a high-quality composite. Therefore, it is important to maintain careful control over the parameters used in the selection and operation of the polymer nanocomposites synthesis process. The publication provides an overview of the various manufacturing methods used to produce polymer nanocomposites packed with nanoparticles. Additionally, an effort is made to comprehend how these nanoparticles affect the mechanical and thermal characteristics of polymer nanocomposites. By adjusting two parameters-first, the polymer to clay or

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Corresponding author Mark Twain, Department of Chemical Engineering, Yale School of Medicine, United States, E-mail: mark23@email.com

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polymer to layered silicate ratio, and second, the processing methods-novel polymer nanocomposites may be created. Both academia and business are actively researching and interested in the creation of polymer nanocomposites using various clays, surfactants, and polymers. Commercial applications: Toyota's timing belt cover use for cars was the most well-known use of polymer nanocomposites. Later on, General Motors used exfoliated clay reinforcement of TPO (thermoplastic polyolefin) for an outside step assist in another vehicle application. Obviously, exfoliated clay reinforcement has a wide range of other applications. One of the first tennis ball applications for exfoliated clay in barrier applications was a 20 mm layer to stop depressurization. One of the first applications for carbon fibre composites was in sporting goods. This is also true for carbon nanotubes, which are used in specialised hockey sticks and tennis rackets to strengthen the epoxy matrix of the carbon fibre composite.

CONCLUSION

In advanced composites, nanocomposites might gain a significant commercial importance. Due to the low strength and modulus of the matrix phase in carbon fibre reinforced composites, there are restrictions on the qualities that may be achieved. Significant improvements in the modulus and strength contributions of the matrix to the general characteristics of the composite would be possible by altering the matrix phase with carbon nanotubes at the lower scale of dimensions and carbon nanofibers at the higher scale of dimensions. While unidirectional composites might benefit somewhat from this, cross-ply composites the primary kind of composite structure used in advanced composite applications might see a considerable improvement. This idea is being thought about right now and might enable a significant advancement in the field of advanced composites. Future applications for wind energy turbines and aircraft depend on these advancements.

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CONFLICT OF INTEREST

There are no conflicts of interest.