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Nanocomposites

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Abstract: - **The definition of nanocomposites has broadened significantly to encompass a large variety of systems such as one-dimensional, two-dimensional, three-dimensional and amorphous materials, made of distinct dissimilar components and mixed at the nanometer scale. This research presents a detailed definition of nanocomposites, its origin, classification, properties, benefits, as well as its future. With the proper choice of compatibilizing chemistries, the nanometer-sized clay platelets interact with polymers in unique ways. The paper shows that the application possibilities for packaging include food and non-food films and rigid containers. In the engineering plastics arena, a host of automotive and industrial components can be considered, making use of lightweight, impact, scratch-resistant and higher heat distortion performance characteristics. In plastics the advantages of nanocomposites over conventional ones don't stop at strength. The high heat resistance and low flammability of some nanocomposites also make them good choices to use as insulators and wire coverings.**

***Keywords*:- Nanocomposites, nanoparticles, biomineralization, nanomer, polymer**

I. INTRODUCTION

Dimensionality plays a critical role in determining the properties of matter. The nanostructure of a material is the key factor in the development of novel properties and in controlling the structure at the nanolevel . Therefore a highly promising field of the twenty-first century, which is expected to totally restructure the technological applications in the fields of semiconductors, inorganic, as well as organic The term "nanotechnology" can be defined as the controlled manipulation of materials with at least one dimension less than 100 nm. This technology attempts to integrate chemistry, physics, materials science, and biology to create new material properties that can be exploited to develop facile processes for the production of electronic devices, biomedical products, high performance materials and consumer articles. The commercialization of nanotechnology is expected to boost wide technological development, improve quality of life and societal benefits around the world. The definition of nano-composite material has over the years broadened significantly to encompass a large variety of systems such as one-dimensional, two-dimensional, three-dimensional and amorphous materials, made of distinctly dissimilar components and mixed at the nanometer scale. The general class of nanocomposite organic/inorganic materials is a fast growing area of research. Significant effort is focused on the ability to obtain control of the nanoscale structures via innovative synthetic approaches. Nanocomposites can then be defined as nanomaterials that combine one or more separate components in order to obtain the best properties of each component (composite). In nanocomposite, nanoparticles (clay, metal, carbon nanotubes) act as fillers in a matrix, usually polymer matrix.

II. PREPERATION OF NANOCOMPOSITIES

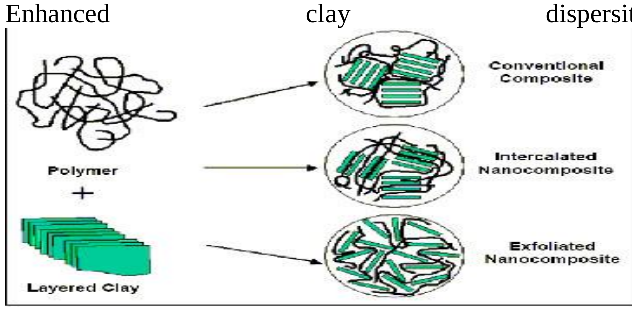
The preparation of nanocomposites can be done by three routes, which are "solution blending, the molten state, and in situ polymerization." They pointed out that the latter consists in placing the monomer and the catalyst between the clay layers, and polymerization takes place in the gap, so as polymerization progresses the spacing between the clay's layers increases gradually and the dispersion state of the clays changes from intercalated (the ordered of layered silicate gallery is retained) to exfoliated (delamination with destruction of the clay sheet order).

The advantages of this method are :

The one step synthesis of the metallocene polymer nanocomposites;

Improved compatibility of the clay and the polymer matrix;

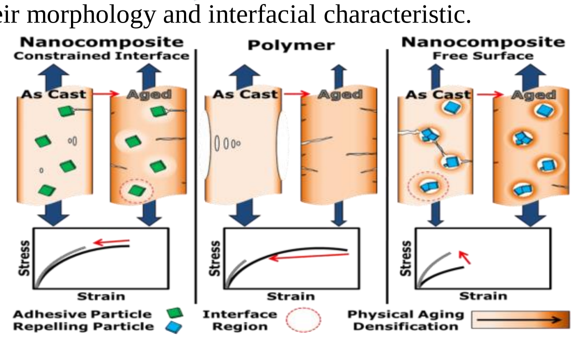
Enhanced clay dispersity.



Nanocomposites can also be prepared by dispersing a Nanomer nanoclay into a host polymer,Montmorillonite is hydrophilic and relatively incompatible with most hydrophobic polymers, so it must be chemically modified to make its surface more receptive to dispersion. After the clays are chemically treated, they are dispersed in the polymer. This is observed that the clays are incorporated into the polymer matrix by one of two approaches: during polymerization or by melt compounding . The dispersion process requires a custom solution for each polymer used, so developing polymer nanocomposites becomes a capital intensive research and development project. Nanocomposites also demonstrate enhanced fire resistant properties and are finding increasing use in engineering plastics. Nanomer nanoclays provide plastics product development teams with exciting new polymer enhancement and modification options. With the proper choice of compatibilizing chemistries, the nanometer-sized clay platelets interact with polymers in unique ways. Application possibilities for packaging include food and non-food films and rigid containers.

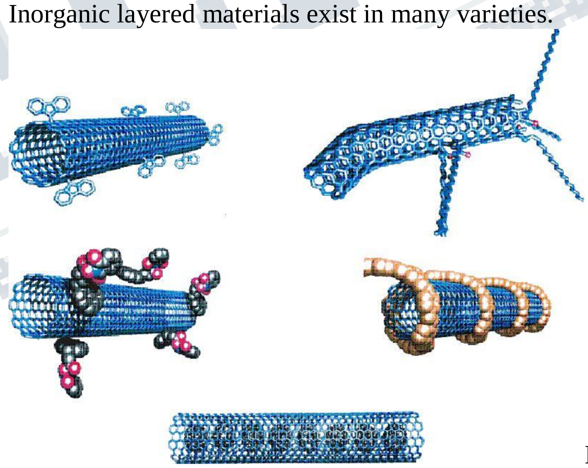
III. CLASSIFICATION OF NANOCOMPOSITES

The general class of nanocomposite organic/inorganic materials is a fast growing area of research. Significant effort is focused on the ability to obtain control of the nanoscale structures via innovative synthetic approaches. The properties of nanocomposite materials depend not only on the properties of their individual parents, but also on their morphology and interfacial characteristics.The general class of nanocomposite organic/inorganic materials is a fast growing area of research. The properties of nanocomposite materials depend not only on the properties of their individual parents, but also on their morphology and interfacial characteristics. There are basically two modes of classification for nanocomposites. They are the organic and inorganic nanocomposites. So many efforts are taken by the researchers to take control over nanostructures by synthetic approaches. The properties of the nanocomposites not only depend upon the individual parent compositions but also on their morphology and interfacial characteristic.



IV. PROPERTIES OF NANOCOMPOSITES

Nano-composites have gained much interest recently. Significant efforts are underway to control the nano-structures via innovative synthetic approaches. The properties of nano-composite materials depend not only on the properties of their individual parents but also on their morphology and interfacial characteristics. The physical, chemical and biological properties of nano materials differ from the properties of individual atoms and molecules or bulk matter. By creating nano particles, it is possible to control the fundamental properties of materials, such as their melting temperature, magnetic properties, charge capacity and even their colour without changing the materials' chemical compositions. Nano-particles and nano-layers have very high surface-to-volume and aspect ratios and this makes them ideal for use in polymeric materials. Such structures combine the best properties of each component to possess enhanced mechanical & superconducting properties for advanced applications. The properties of nano-composite materials depend not only on the properties of their individual parents but also on their morphology and interfacial characteristics. Some nanocomposite materials could be 1000 times tougher than the bulk component.
Inorganic layered materials exist in many varieties.



Nanocomposites are materials that incorporate nanosized particles into a matrix of standard material.
Some nanocomposite materials have been shown to be 1000 times tougher than the bulk component materials. Nanocomposites can dramatically improve properties like:
·Mechanical properties including strength, modulus and dimensional stability
Electrical conductivity
Decreased gas, water and hydrocarbon permeability
Flame retardancy
Thermal stability
Chemical resistance

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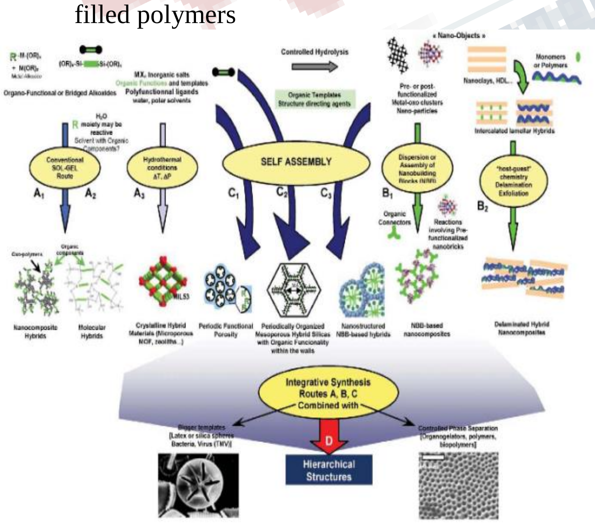
V. BENEFITS OF NANOCOMPOSITES

In general, nanocomposites exhibit gains in barrier, flame resistance, structural, and thermal properties yet without significant loss in impact or clarity. Because of the nanometer-sized dimensions of the individual platelets in one direction, exfoliated Nanomer nanoclays are transparent in most polymer systems. However, with surface dimensions extending to 1 micron, the tightly bound structure in a polymer matrix is impermeable to gases and liquids, and offers superior barrier properties over the neat polymer. Nanocomposites also demonstrate enhanced fire resistant properties and are finding increasing use in engineering plastics. Increased mechanical stability in polymer-clay nanocomposites also contributes to an increased heat deflection temperature. These composites have a large reduction gas and liquid permeability and solvent uptake.

Compression-injection molding, melt-intercalation, and co-extrusion of the polymer with ceramic nanopowders can form nanocomposites. Often no solvent or mechanical shear is needed to promote intercalation. Properties which have been shown to undergo substantial improvements include:

- Mechanical properties e.g. strength, modulus and dimensional stability
- Decreased permeability to gases, water and hydrocarbons
- Thermal stability and heat distortion temperature
- Flame retardancy and reduced smoke emissions
- Chemical resistance
- Surface appearance
- Electrical conductivity
- Optical clarity in comparison to conventionally filled polymers



Another important property of nanocomposites is that they are less porous than regular plastics, making them ideal to use in the packaging of foods and drinks, vacuum packs, and to protect medical instruments, film, and other products from outside contamination.

VI. THE FUTURE OF NANOCOMPOSITES

The number of commercial applications of nanocomposites have been growing at a rapid rate. It has been reported that in less than two years, the worldwide production is estimated to exceed 600,000 tonnes and is set to cover the following key areas in the next five to ten years:

• Drug delivery systems
• Anti-corrosion barrier coatings
•UV protection gels
• Lubricants and scratch free paints
• New fire retardant materials
• New scratch/abrasion resistant materials
• Superior strength fibres and films

Although Nanocomposites are realizing many key applications in numerous industrial fields, a number of key technical and economic barriers exist to widespread commercialization. These include impact performance, the complex formulation relationships and routes to achieving and measuring nanofiller dispersion and exfoliation in the polymer matrix. Investment in state-of-the-art equipment and the enlargement of core research team's is another bottleneck to bring out innovative technologies on nanocomposites. Future trends include the extension of this nanotechnology to additional types of polymer system, where the development of new compatibility strategies would likely be a prerequisite.

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