Perspective

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Properties of Nanostructured Polymers

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Perspective

Nanostructured polymers (NSPs) are nanoscale polymeric materials that typically contain nanoparticles, nanofibers, nanowires, nanospheres, and other morphologies. Physical approaches (solvent evaporation, nanoprecipitation, salting out) or direct nanosynthesis (polymerization in micro- or nanoemulsions with nanoreactor compartments) can be used to make polymer nanoparticles (PNPs). Polymer nanofibers (PNFs) can be made using a variety of procedures, the most common of which is electrospinning, which involves pulling a charged polymer solution into long thin nanofibers when subjected to an opposite strong electric field. NSPs have improved qualities in general, such as superior structural and mechanical capabilities, making them viable alternatives for some building applications. For noise and air pollution filtration, a number of PNFs have been developed and used. PNFs can also be made with phase change materials, which are commonly used in the construction sector for thermal energy storage. We will summarise the morphologies and nanosynthesis methods of NSPs, specifically PNPs and PNFs, in this paper. In addition, for building applications, typical NSPs primarily employed in construction are introduced.

One of the most essential engineering materials is polymers. The use of polymeric materials in building has increased dramatically during the last four decades, owing to the following factors: The availability of fundamental raw materials for large-scale production; Outstanding features, such as light weight, chemical stability, and flexibility; Simple and flexible processing methods; Economic benefits, such as raw material and manufacturing costs, maintenance and operational costs, and so on; Costs to the environment are reduced. As a result, polymers, together with cement, ceramics, woods, and metals including aluminium, copper, and steel, are vital.

If a polymer is acceptable for construction purposes, it must have a number of critical qualities. First and foremost, its mechanical qualities are critical for all building applications. The mechanical qualities of a polymer can be assessed by stress testing its deformation and flow characteristics, and the polymer can then be classed as an elastomer (rubber-like products), stiff or flexible plastics, or a fibre based on the mechanical behaviour measured. Second, a polymer's thermal properties allude to its thermal stability, which is defined as the temperature range across which it can maintain its beneficial properties. Polymers are commonly used as insulators due to their poor heat conductivity. Finally, the flammability of polymers is an essential consideration in construction. The response of construction polymeric materials to combustion is typically complex, and it is dependent on the kind and specific additives employed in the polymers. Engineering thermoplastics, for example, soften and flow before ignition, but thermosetting plastics burn on the surface, and sometimes the charred residue even forms an insulating layer of the flame location. Weathering, permeability, and chemical stability are among of the other qualities.

The rapid advancement of nanotechnology has opened up new possibilities for the use of nanostructured polymers (NSPs) as construction materials. Polymer nanotechnologies not only improve material characteristics and perform other unique activities, but they also help save energy. NSPs have been created using a variety of ways, and their construction applications have been examined. Polymer nanoparticles and nanofibers are the most commonly studied and applied NSPs, such as polymer nanoparticles, -fibers, -wires, -spheres, and so on. The following section will provide a quick overview of the methods for synthesising polymer nanoparticles and nanofibers.

Polyurethane (PU) is a carbamate-linked synthetic polymer made up of organic molecules. They're made by reacting a di- or poly-isocyanate with a polyol in the traditional and most usual way. Polyurethanes are made from isocyanates and polyols, both of which have two or more functional groups per molecule. PUs have a wide range of uses in everyday life. PUs is mostly employed in the construction industry for coatings and building insulation. The use of nanostructured polyurethane (NS-PU) such as polyurethane nanoparticles (PU-NPs) has grown quickly in recent decades, as they can be utilised for a variety of applications such as adhesives and coatings.