EXTENDED ABSTRACT

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Engineering at the nanoscale: a strategy for developing high performance functional polymer nanocomposites

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Abstract:

In future technologies the talk will concentrate on various approaches used to engineer materials at the nanoscale for various applications. To highlight the challenges and progress, in particular, the case of clay, carbon nanostructures, metal oxides, bionanomaterials will be used . Several bio-degradable polymer systems will be considered such as rubbers, thermoplastics, thermosets and their blends for the fabrication of functional polymer nanocomposites. It mainly discusses the incompatibilising binary polymer blends, interfacial activity of nanomaterials . Various self assembled architectures of hybrid nanostructures can be made using relatively simple processes. Some of these structures offer excellent opportunity to probe novel nanoscale behavior and can impart unusual macroscopic end properties. Taking into account their multifunctional properties, the proffesor will talk about various applications of these materials. The review topics are applications of nanocellulose, chitin, clay, metal oxides, carbon nanomaterials and their hybrids.

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Discussion and Conclusion:

Carbon-based nanomaterials like carbon nanotubes, graphene and its derivatives, nanodiamond, fullerenes, and other nanosized carbon allotropes have recently attracted tons of attention among the scientific community thanks to their enormous potential for a good number of applications arising from their large specific area , high electrical and thermal conductivity, and good mechanical properties . The combination of carbon nanomaterials with polymeric matrices (i.e., thermoplastics, epoxies, conducting polymers, biopolymers, etc.) leads to new nanocomposites with improved structural and functional properties due to synergistic effects , with applications in a variety of fields, such as in electronics, energy storage, automobiles, aerospace engineering, biomedicine, and so forth.

In particular, the properties of carbon-based polymer nanocomposites are often easily tuned by carefully controlling the carbon nanomaterial synthesis route and additionally the versatile synergistic interactions amongst the nanomaterials and polymers. In this regard, non-covalent and covalent approaches are wont to modify the surface of carbon nanomaterials with the aim of improving their dispersion and interfacial interactions . The non-covalent strategies are based on the intermolecular interaction on the nanomaterial surface via physical adsorption and/or wrapping , though the nanomaterial–polymer interfacial interaction is typically weak, and this limits the effective stress transfer. These comprise solution mixing, melt-blending, and in situ polymerization. The solution method requires the dispersion of both the carbon nanomaterial and the polymeric matrix in a suitable solvent.The covalent method relies on the formation of a bond between the polymer and therefore the nanomaterial , resulting in a robust interfacial interaction, though can disrupt the conjugated π system of the nanomaterial, hence modifying the properties. Thus, novel surface modifications of carbon nanomaterials are required in order to develop nanocomposites with improved properties compared with conventional composites. This Special Issue, with a collection of 14 original contributions and one review, provides selected examples of the most recent advances in the preparation and characterization of polymer nanocomposites incorporating carbon nanotubes and graphene or its derivatives for a variety of applications.