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CARBON NANOTUBE / POLYMER NANOCOMPOSITES : FROM NON-COVALENT SURFACE TREATMENT OF NANOTUBES TO HIGH PERFORMANCE MATERIALS

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ABSTRACT

The fine and if possible homogeneously dispersion of rigid particles in polymer matrices is a very widely used method that allows for readily increasing the rigidity of the so-obtained composite materials. Depending on the intrinsic nature of the added filler, other properties can also be enhanced such as fire resistance, gas barrier, electrical and thermal properties. However, such improvements of composite materials performances usually require high filling levels, detrimental to the ultimate mechanical properties of the resulting materials. Polymer nanocomposites represent a new class of composite materials, i.e., particle-filled polymers for which at least one dimension of the dispersed particles is in the nanometer range. This variety of nanofillers provides the related composite materials with significantly improved properties most often at filler content as tiny as a couple of wt% or even less.

Due to their remarkable properties combined with low density, carbon nanotubes (CNT) are more and more considered as reinforcing nanofillers for polymer matrices. However, the key-challenge remains to reach high level of nanoparticle dissociation (i.e., to break down the ropes of aggregated nanotubes) as well as fine dispersion upon melt blending within the selected matrices. Among the various disaggregating strategies studied, we investigated non-covalent (supramolecular) surface treatment of the CNTs allowing for complete destructuration of the native filler aggregates without any loss of the inherent properties of the electro-conductive nanotubes. Indeed, it is known that more conventional covalent surface treatment of CNTs often reduce their electrical conductivity and other mechanical performances. First we studied the so-called "polymerization-filling technique" (PFT) for coating the nanotubes with a thin polyolefin layer, which is formed by *in situ* polymerization process catalyzed directly from the nanofiller surface. Secondly attention has been drawn on non-covalent functionalization/polymer "grafting" of the nanotube surface via either π–π stacking, cation-π bonding, charge transfer or CH-π interactions.

Extent of CNT disaggregation and quality of dispersion in solvents and polymer matrices will be presented as well as some selected applications in fields as versatile as solar cells, electro-conductive bioplastics and anti-biofouling coatings. Such applications will be presented from lab-scale prototype to industrial-scale commercialized products.

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