Fabrication, functionalization, and application of carbon nanotube-reinforced polymer composite: an overview

ABSTRACT

A novel class of carbon nanotube (CNT)-based nanomaterials has been surging since 1991 due to their noticeable mechanical and electrical properties, as well as their good electron transport properties. This is evidence that the development of CNT-reinforced polymer composites could contribute in expanding many areas of use, from energy-related devices to structural components. As a promising material with a wide range of applications, their poor solubility in aqueous and organic solvents has hindered the utilizations of CNTs. The current state of research in CNTs—both single-wall carbon nanotubes (SWCNT) and multiwalled carbon nanotube (MWCNT)-reinforced polymer composites—was reviewed in the context of the presently employed covalent and non-covalent functionalization. As such, this overview intends to provide a critical assessment of a surging class of composite materials and unveil the successful development associated with CNT-incorporated polymer composites. The mechanisms related to the mechanical, thermal, and electrical performance of CNT-reinforced polymer composites is also discussed. It is vital to understand how the addition of CNTs in a polymer composite alters the microstructure at the micro- and nano-scale, as well as how these modifications influence overall structural behavior, not only in its as fabricated form but also its functionalization techniques. The technological superiority gained with CNT addition to polymer composites may be advantageous, but scientific values are here to be critically explored for reliable, sustainable, and structural reliability in different industrial needs.

Keyword: Carbon nanotubes; SWCNT; MWCNT; Polymer composites; Covalent functionalization; Non-covalent functionalization; CNT nanocomposites