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MULTIFUNCTIONAL FIBER REINFORCED POLYMER COMPOSITES USING CARBON AND BORON NITRIDE NANOTUBES

Abstract

Recent progress in nanotechnology has made several nano-based materials available with the potential to address limitations of conventional fiber reinforced polymer composites, particularly in reference to multifunctional structures. Carbon nanotubes (CNTs) are the most prevalent case and offer amazing properties at the individual nanotube level. There already a few high-profile examples of the use of CNTs in space structures to provide added electrical conductivity for static dissipation and electromagnetic shielding. Boron nitride nanotubes (BNNTs), which are structurally analogous to CNTs, also present a range of attractive properties. Like the more widely explored CNTs, individual BNNTs display remarkable mechanical properties and high thermal conductivity but with contrasting functional attributes including substantially higher thermal stability, high electrical insulation, polarizability, high neutron absorption and transparency to visible light. This presents the potential of employing either or both BNNTs and

CNTs to achieve a range of lightweight, functional composites for space structures. There is significant interest from NASA and others to use BNNTs for radiation shielding of space structures and BNNTs can also be expected to be advantageous for reinforcement of high temperature materials, when electrical insulation is required, and in a range of other cases. However, to our knowledge there are no present examples of the use of BNNTs in real composites structures.

Here we present the case for application of BNNTs, in addition to CNTs, in space structures and describe recent advances in BNNT production at the National Research Council Canada (NRC) that have, for the first time, provided sufficiently large quantities to enable commercialization of high-quality BNNTs and accelerate development of chemistry, composites and applications based on BNNTs. Early demonstrations showing the fabrication and testing of polymer matrix composites at NRC, including fiber-reinforced composite panels containing CNTs or BNNTs and their potential for space applications (e.g., electromagnetic shielding, radiation shielding and thermal management), will be discussed.