MATERIALS AND STRUCTURES SYMPOSIUM (C2)
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# CNT AND BNNT ENHANCEMENT OF POLYMER-MATRIX COMPOSITES FOR SPACE APPLICATIONS

**Abstract**

Polymer-matrix composites (PMCs) offer high specific mechanical properties that are required for several space applications. PMC structures, however, lack a few space-related functional characteristics (e.g., electromagnetic and neutron radiation shielding effectiveness). Recent progress in nanotechnology has made several nano-based materials available with the potential to address the current limitations of conventional PMC structures. The study targets the nano-enhancement of PMCs using two different nanotubes (NTs): carbon nanotubes (CNTs) and boron nitride nanotubes (BNNTs). CNTs and BNNTs both have exceptional mechanical properties and thermal properties as well as low densities. CNTs are electrically conductive and can provide lightweight electromagnetic shielding. Conversely, BNNTs are electrically insulating, have considerably higher thermal stability, and can shield against neutron radiation due to orders of magnitude higher absorption cross section for boron vs. carbon. Two different approaches are taken here to incorporate these NTs into PMC structures. In the first approach, the NTs were mixed into the matrix before PMC is fabricated. This method has shown to be effective to incrementally enhance mechanical properties of the PMCs (e.g., interlaminar or impact properties) at low content of NTs (often less than 1 wt%) while imparting some functional advantage(s) (e.g., modest electrical conductivity). The second approach is based on the addition of a thin NT-based layer (i.e., films or sheets) to the PMCs. This method has the obvious advantage of not otherwise modifying the existing PMCs preparation (which is typically made using traditional prepreg layup, followed by autoclaving). This work examines the manufacturing advantages and disadvantages of each approach in details. The discussions were supported by various characterization techniques relevant to space applications including

mechanical, electrical, thermal analysis.