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Constitutive modeling of nanotubeâ€“reinforced polymer composites

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Abstract

In this study, a technique is presented for developing constitutive models for polymer composite systems reinforced with single-walled carbon nanotubes (SWNT). Because the polymer molecules are on the same size scale as the nanotubes, the interaction at the polymer/nanotube interface is highly dependent on the local molecular structure and bonding. At these small length scales, the lattice structures of the nanotube and polymer chains cannot be considered continuous, and the bulk mechanical properties can no longer be determined through traditional micromechanical approaches that are formulated by using continuum mechanics. It is proposed herein that the nanotube, the local polymer near the nanotube, and the nanotube/polymer interface can be modeled as an effective continuum fiber by using an equivalent-continuum modeling method. The effective fiber serves as a means for incorporating micromechanical analyses for the prediction of bulk mechanical properties of SWNT/polymer composites with various

nanotube lengths, concentrations, and orientations. As an example, the proposed approach is used for the constitutive modeling of two SWNT/polyimide composite systems.

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Keywords

B. Mechanical properties; B. Modelling; C. Anisotropy; Carbon nanotubes; Nanotechnology

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