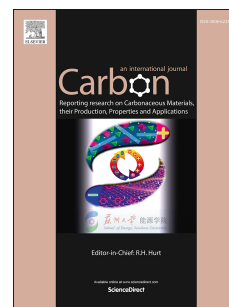


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Mechanical Properties of Graphene Nanoplatelet/Carbon Fiber/Epoxy Hybrid Composites: Multiscale Modeling and Experiments

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Abstract

Because of the relatively high specific mechanical properties of carbon fiber/epoxy composite materials, they are often used as structural components in aerospace applications. Graphene nanoplatelets (GNPs) can be added to the epoxy matrix to improve the overall mechanical properties of the composite. The resulting GNP/carbon fiber/epoxy hybrid composites have been studied using multiscale modeling to determine the influence of GNP volume fraction, epoxy crosslink density, and GNP dispersion on the mechanical performance. The hierarchical multiscale modeling approach developed herein includes Molecular Dynamics (MD) and micromechanical modeling, and it is validated with experimental testing of the same hybrid composite material system. The results indicate that the multiscale modeling approach is accurate and provides physical insight into the composite mechanical behavior. Also, the results quantify the substantial impact of GNP volume fraction and dispersion on the transverse mechanical properties of the hybrid composite while the effect on the axial properties is shown to be insignificant.

1. Introduction

Carbon/epoxy composites are a prime component of many modern aircraft structures because of their exceptional mechanical properties relative to their bulk mass density. The bulk-level

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