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Creep behavior prediction of multi-layer graphene embedded glass fiber/epoxy composites using time-temperature superposition principle

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Abstract

This article focuses on the prediction of the impact of multi-layer graphene (MLG) reinforcement on the mechanical performance of glass fiber/epoxy composites. Flexural tests have been performed at different temperatures (-196, 30, 70 and 110 °C). Composite with 0.1 wt.% MLG showed superior flexural performance at -196 °C, due to the generation of cryogenic clamping stress at the MLG/polymer interface. Long-term (upto one billion years) creep performance at relatively low temperature (30 °C) has been predicted using accelerated deformation at elevated temperatures and time-temperature superposition principle. It is revealed that MLG exhibits positive reinforcement efficiency even upto one billion years at 30 °C, after which it is negated and gradually becomes negative. However, this time span gets reduced at elevated temperatures due to the generation of unfavourable thermal stress at the MLG/polymer interface. Thermal characterization has also been conducted using Dynamic Mechanical Analysis, Thermo-gravimetric analysis and Differential Scanning Calorimetry.

Keywords: A. Graphene; A. Nanocomposites; B. Creep; B. Time-temperature superposition.