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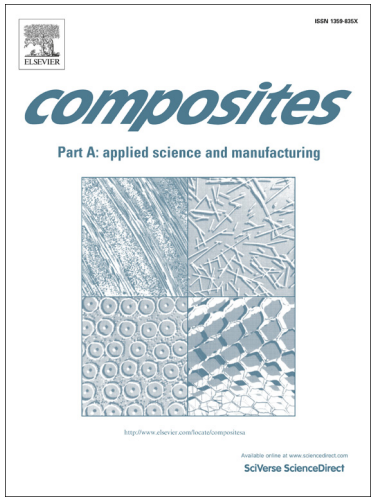

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Mixed Mode interlayer fracture of glass fiber/nano-enhanced epoxy composites

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Abstract

Increasing interlaminar fracture toughness (IFT) has long been an important goal in the fiber reinforced composites field. For that purpose some research has recently explored the use of nanoparticle reinforced matrices to improve interlaminar strength. In this present paper a small quantity of nanoclays (NC) and multiwalled carbon nanotubes (MWCNT) were used in order to enhance the IFT of glass fiber/epoxy composite laminates. The composites sheets were produced by a vacuum moulding process. Mode I, Mode II, and Mixed-Mode I/II tests were performed to determine critical strain energy release rates, using double cantilever beam, end-notched flexure, and Mixed-Mode Bending specimens, respectively. Significant improvements in IFT were obtained for all loading modes by the incorporation of NC into the epoxy resin, whilst MWCNT produced only moderate improvements. For Mode I, IFT improvement by the incorporation of nanoparticle fillers, reached about 31% for 3 wt% of NC and 17% for 1 wt% of MWCNT. In Mode II the increase was about 50% for 3 wt% of NC and 30% for 1 wt% of MWCNT. The dispersion of small quantities NC and MWCNT into matrices significantly improved Mixed-mode IFTs for all loading mode ratios G_{II}/G. The total fracture toughness G increased under Mode II loading components and linear Mixed-Mode fracture criteria reproduced the Gc versus Mode ratios G_{II}/G and G_I versus G_{II} relationship.