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Interlaminar Adhesive Strength of Nano Reinforced Glass/epoxy Laminates

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Polymer fiber reinforced laminate composites have been widely used in aerospace, automobile and marine industries, despite their low interlaminar fracture toughness. The improvement of the interfacial adhesion is an important goal on polymer composite researches. One way recently explored to improve interlaminar shear strength is the use of nanoclays and carbon nanotubes to reinforce the matrix.

Interlaminar fracture is significantly influenced by adhesive strength of fiber/matrix interfaces. Critical strain energy release rate (G_C) is the most common parameter used for quantify interfacial strength. However, time-dependent subcritical debonding can occur at lower mechanical loads than those required for interlaminar fracture toughness (IFT). Interfacial crack grow can be studied using fracture mechanics parameters. The most usual way to model the crack propagating along the layer interfaces are the, da/dt versus G curves, in which G represents the macroscopic energy required to separate the interface.

This work presents the results of a current study of the fracture toughness and of the subcritical crack grow of epoxy/glass fiber laminates. Different batches of matrices were used: pure epoxy resin and nanoparticle reinforced epoxy. The laminates were produced by a moulding in vacuum process with the flow directed to get particles preferentially orientated. The results were fitted in a power law region of the da/dt versus G curves, obtained from tests performed under constant load, for dry materials and long term hydro aged composites. Mode I interlaminar fracture toughness was also performed. Significantly improvements of G_C were obtained by the incorporation of nanoclays and carbon nanotubes into the resin, reaching 17% for 1% of nanotubes and 31% for 3% of nanoclays.