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Temperature effect on nano-rubber toughening in epoxy and epoxy/carbon fiber laminated composites

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ABSTRACT

The nano-rubber toughening effects on neat epoxy and epoxy/carbon fiber composites under a range of temperatures from -80 ^{o}C to 50 ^{o}C were investigated. Nano-rubber particles (100 nm) toughened significantly neat epoxy at all temperatures with a maximum toughness value at 20 ^{o}C and lower values on either side. The influence of temperature on the delamination fracture toughness of epoxy/carbon fiber composites with nano-rubber filled epoxy matrices compared to those with neat epoxy matrices mirrored the same trend of nano-rubber particles on epoxy. However, except at -50 ^{o}C, the toughness of nano-rubber/epoxy cannot be fully transferred to the composites against delamination. Optical (OM) and scanning electron microscopy (SEM) examinations revealed that different extent of plastic void growth and matrix shear yielding led to different toughening efficiency on (a) bulk epoxies and (b) epoxy/carbon fiber laminates with varying intensity of crack-wake bridging and delamination crack growth.

Keywords: A. Polymer-matrix composites (PMCs). B. Fracture toughness, Nano-rubber particles, Temperature effect.

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