MPROVING THE MECHANICAL PROPERTIES OF CARBON FIBRE COMPOSITES USING THE COMBINATION OF GRAPHENE AND FIBRE NANOTUBES

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Abstract

Abstract - The incorporation of multifunctional carbon nanomaterials; graphene nanoplatelets (GNP) and cup-stacked carbon nanotubes (CSCNT) into the polymer matrix of conventional carbon fibre reinforced composites as fillers presents the potential for mechanical multifunctional improvements such as strength, stiffness and toughness properties without disrupting the original in plane mechanical properties. In this research, the graphene, fibre nanotubes, and a combination of them were dispersed within a thermosetting resin matrix via combination of mechanical dispersion techniques. These include ultra-sonication and ball milling/mixing to achieve homogenous dispersion and high exfoliation of carbon nanomaterials in the matrix.The main purpose of mixing both nanofillers together in the matrix is to increase the strength and toughness properties of the polymer matrix by availing the synergetic influence between the carbon nanomaterials. Subsequently the using an optimum nanofilled matrix in the manufacture of hybrid fibre composites to investigate the effect of the optimized nano phase matrix on the mechanical properties of conventional carbon fibre composites. The properties under consideration are flexural strength, interlaminar shear strength and Mode I, Mode II interlaminar fracture toughness. Highest improvements of the nanocomposites were achieved in flexural strength and flexural modulus after a combination of 2 wt.% graphene and 2 wt.% fibre nanotubes by approximately 40% and 61%, respectively. High improvements in the mechanical properties of carbon fibre reinforced hybrid nanocomposites were also gained after using the same proportional weight content of the combined nanofillers. The flexural strength and flexural modulus were improved by approximately 18% and 28% respectively. The interlaminar shear strength improved by 37%. The initial (i.e. VIS) and propagation energy values of Mode II interlaminar fracture toughness were increased by approximately 155% and 132% respectively. The dispersion degree of nanoparticles was evaluated by transmission electron microscopy (TEM). The fracture mechanisms for hybrid fibre composites were investigated by scanning electron microscopy (SEM) to show the synergetic associated mechanisms of hybrids composites.