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# Carbon fiber/epoxy matrix composite interphases modified with cellulose nanocrystals

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ABSTRACT

Cellulose nanocrystals (CNCs) were used to modify the interphase between carbon fiber (CF) and an epoxy matrix to simultaneously strengthen and toughen the CF composite. CNCs were functionalized with 3-aminopropyltriethoxysilane (APTES) and surface modification was confirmed by Fourier transform infrared (FTIR) spectroscopy and X-ray photoelectron spectroscopy (XPS), which revealed the presence of the new chemical species. Functionalized CNCs (APTES-CNCs) were applied as part of a sizing to coat CFs and an optimum concentration was identified. Single fiber fragmentation tests (SFFT) showed that stronger adhesion between the CFs and the epoxy matrix was achieved for the fibers sized with APTES-CNCs, compared to unsized CFs and epoxy-only sized CFs. CFs sized with APTES-CNCs at a concentration of 1.0 wt% resulted in 81% increase in interfacial shear strength (IFSS) compared to unsized CFs, and the birefringent stress pattern seen during the SFFT supports the assumption that adding APTES-CNCs at the composite interphase promotes an improvement in the failure mode. These results demonstrate that sizing CFs with APTES-CNCs is an effective method to increase the interfacial properties in CF reinforced epoxy composites, and a potential approach for the development of ecofriendly and lightweight composite materials for aerospace and automotive applications.

*Keywords: B. Interphase; B. Fibre/matrix bond; A. Polymer-matrix composites (PMCs); A. Carbon fibres; Cellulose nanocrystal;*