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Editorial corner – a personal view
Improving fibre/matrix interface through nanoparticles

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It is widely recognized that fibre/matrix interfacial strength controls several mechanical properties of composite materials, in particular the matrix-dominated ultimate parameters. In the last thirty years an impressive number of experimental and modelling efforts have been focused on the understanding of fibre/matrix interfacial bond with the aim to improve it. Over the years, two main strategies emerged for polymer composites: i) the development of specific fibre sizings/coatings/treatments and/or ii) the addition of coupling agents to the matrix resin.

In the recent years new strategies came to light: in fact, the availability of various types of nanoparticles offered the possibility to tailor the fibre/matrix interactions at a nanoscale level. In particular, some recent investigations proved that nanoparticles homogeneously dispersed in a polymer matrix can play a beneficial role on the fibre/matrix interfacial adhesion in several types of structural composites. For example, the introduction of organo-modified clays in an epoxy matrix led to the formation of a stronger interface with E-glass fibres, with an increase of the interfacial shear strength of about 30% for a filler content of 5 wt% (DOI: 10.1177/0021998311420311). Concurrently, the evaluation of the fibre/matrix contact angle revealed an improved wettability when organo-modified clays were added, and a simultaneous enhancement of the fracture toughness of the resin matrix. This approach could be also adopted to add specific functional properties to composite materials, such as damage controlling capabilities (DOI: 10.1016/j.compositesa.2012.03.019).

Another approach relies on the possibility to confine nanoparticle in the interfacial region, with the advantage of localizing their presence in the area where stress transfer takes place, thus reducing the overall quantity of nanoparticle required. As an example, a sizing containing single or multi-walled carbon nanotubes has been used for coating glass fibres (DOI: 10.1016/j.compscitech.2007.10.009). Two simultaneous results have been reached, to 'heal' surface flaws and to enhance interfacial adhesion in a polypropylene matrix, indicating nanotube related interfacial toughening mechanisms.

An amazing amount of research has gone, and still goes, into the understanding of the properties of nanoscale particles and their usage to improve engineering materials. Development of polymer composites can surely benefit from this research, including the 'old issue' of fibre/matrix interface.

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