Toughening Approach

Electrospun Nanofiber Coating of Fiber Materials: A Composite Toughening Approach

Companies could apply this technology in producing fabric products for use in composite manufacturing.

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Textile-based composites could significantly benefit from local toughening using nanofiber coatings. Nanofibers, thermoplastic or otherwise, can be applied to the surface of the fiber tow bundle, achieving toughening of the fiber tow contact surfaces, resulting in tougher and more damage-resistant/tolerant composite structures. Other modifications to the composite properties such as thermal and electrical conductivity could be made through selection of appropriate nanofiber material.

Investigations of the failure and damage mechanisms of textile composites has led to the conclusion that toughening of the matrix material would result in increased material performance. Several approaches exist in which the bulk of the matrix is modified either through chemical formulation or the addition of fillers. These methods can detrimentally affect the processability of the resulting matrix material. Other methods exist that rely on modification of the fiber material (so-called “fuzzy fiber” approaches) that results in reduced fiber performance.

Control of the needle electric potential, precursor solution, ambient temperature, ambient humidity, airflow, etc., are used to vary the diameter and nanofiber coating morphology as needed. Post-coating heat treatments may also be used for the purpose of curing, drying, oxidation, annealing, etc. The array of electrospinning jets may be varied as needed to achieve uniform,