Nanoscale Inorganic-Organic Fiber Sizings for Enhanced Energy Absorption in Structural Composite Materials

Prior research has shown the importance of the fiber-matrix interphase on the balance of properties found in glass-fiber reinforced composite materials. Traditionally, modification of the interphase to increase one composite property has led to the reduction in others. A team of researchers led by ARL has recently demonstrated the ability to increase energy absorption in glass-fiber composites while maintaining or improving other critical composite performance parameters. This was accomplished designing specialized nano-engineered fiber coatings (also known as sizings) to control the strength, failure-mode, and post failure response of the fiber-matrix interphase. The use of nanoscale colloidal silica and reactive organo-metallic precursors were used to produce a sizing that demonstrated improved interfacial adhesion and increased energy dissipation during impact events. Most recently, this approach has been applied to modify commercially manufactured fiber-glass reinforcements in a commercial manufacturing setting. The use of these nanoscale fiber sizings increased the Mode II fracture toughness of laminated composites by 100% over the baseline material, without decreasing fiber strength or negatively affecting the strength or stiffness of the composite.

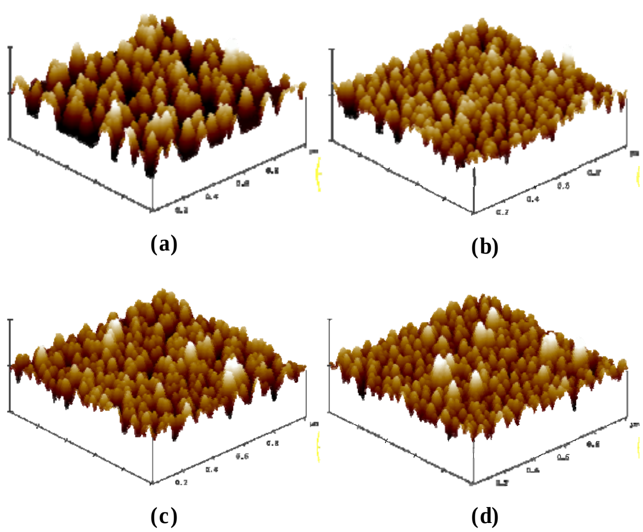

Figure 1: Atomic Force Images of model nano-engineered inorganic-organic coatings used to controllably alter the surface topology and adhesion of structural glass-fiber reinforcements for composite materials.

The ability to achieve increases in a host of composite properties by modifying the interphase has great importance in the accelerated use of advanced composites in many protection applications. Work is presently ongoing to further scale the processes and validate performance increases in extreme military environments and loading conditions.

Publications and Patents

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