Performance of Glass Woven Fabric Composites with Admicellar-Coated Thin Elastomeric Interphase

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ABSTRACT

Adequate stress transfer between the inorganic reinforcement and surrounding polymeric matrix is essential for achieving enhanced structural integrity and extended lifetime performance of fiber-reinforced composites. The insertion of an elastomeric interlayer helps increase the stress-transfer capabilities across the fiber/matrix interface and considerably reduces crack initiation phenomena at the fiber ends. In this study, admicellar polymerization is used to modify the fiber/matrix interface in glass woven fabric composites by forming thickness-controlled poly(styrene-co-isoprene) coatings. These admicellar interphases have distinct characteristics (e.g., topology and surface coverage) depending on the surfactant/monomer (S/M) ratios used during the polymerization reaction. Overall, the admicellar coatings have a positive effect on the mechanical response of resin transfer molded (RTM), E-glass/epoxy parts. For instance, ultimate tensile strength (UTS) of composites with admicellar sizings improved 50 to 55% over the control desized samples. Interlaminar shear strength (ILSS) also showed increases ranging from 18 to 38% over the same control group. Interestingly, the flexural properties of these composites proved sensitive to the type of interphase formed for various admicellar polymerization conditions. Higher surface coverage and film connectedness in admicellar polymeric sizings are observed to enhance stress transfer at the interfacial region.

Keywords: admicellar polymerization, elastomeric interphases, thin films, poly(styrene-co-isoprene), surfactants, fiber-reinforced polymer composites, resin transfer molding (RTM).

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