Structural and micromechanical characterization and modeling of the interdiffusion region between two thermoset resins

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The local interactions at the interface between two thermoset resins are investigated using microscopic, chemical and micromechanical characterization techniques. An attempt is made to relate local observations with a theoretical model predicting the topology and the mechanical properties along the interface.

Understanding, characterizing and modeling the behavior of the interface region between two thermoset resins is of particular interest for the optimization of the SQ-RTM (same qualified resin transfer molding) process. [*B. Coulon et al, Interface characterization and interdiffusion distance quantification for epoxy resin/resin and resin/prepreg interfaces, Article submitted for Composites Part A*]. From a more fundamental viewpoint, a proper understanding of the properties of graded interfaces related to the interdiffusion process is a challenging task, essential with respect to controlling the best conditions for making reliable systems.

The characterization techniques include scanning electron microscopy, Raman spectroscopy and nano-indentation. The rubber elasticity theory, simple homogenization and different diffusion laws are used to build a model system. Novel nano-indentation techniques are used to probe the samples at temperatures above Tg.

Along a profile perpendicular to the interface going from a low epoxy functionality to a higher functionality, the elastic modulus increases gradually as a direct result of the different crosslink density and different chain flexibility of both resins. The shape of the mechanical gradient in the interphase, its chemical composition and the evolution of the microstructure are investigated as a function of different curing histories.