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Micro-Scale Polymer Matrix Elastic Properties in Composites using Inelastic Light Scattering Measurements and Molecular Dynamics Simulations MICHAEL ALDRIDGE, KATHERINE SEBECK, ANTHONY WAAS, JOHN KIEFFER, Univ of Michigan - Ann Arbor — Polymer matrix composites with carbon fiber reinforcement are used in a wide range of aerospace and industrial applications. Composite behavior predictions based on continuum mechanics have been inaccurate, and required empirical corrections, due to the lack of polymer materials property information. The involved length scales make measurement of the elastic properties within fiber tows and near to individual fibers difficult. Micro-Brillouin and Raman light scattering provide sufficiently high spatial resolution to probe the mechanical properties and chemical composition of the matrix, without interfering with the thermo-mechanical equilibrium of the material. Elastic properties of an epoxy resin have been measured between and within the fiber tows of a composite with this technique, and compared to a bulk epoxy resin. These experimental results are complemented with molecular dynamics simulations of the interface, allowing extrapolation of findings to nanometer length scales. A diminished elastic modulus is observed in close proximity to fibers. We identify the extent to which residual stresses, chemical inhomogeneities, or structural rearrangements near the interface contribute to this effect in order to explain the underlying reason for this finding.

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