

Raymond Pearson
Professor, Materials Science & Engineering
Director, Center for Polymer Science and Engineering
Lehigh University

Title: "On the use of silica nanoparticles to modify the processing and mechanical behavior of polymers"

Abstract:

The Pearson research group has investigated the use of colloidal silica nanoparticles (~ 25 to 50 nm in diameter) to improve the processing behavior and the mechanical behavior of both thermosetting and thermoplastic polymers. The model thermosetting system used consisted of a bisphenol A epoxy cured with piperidine. This is a lightly crosslinked epoxy capable of microshear banding and plastic void growth. The silica nanoparticles were found to induce these micromechanical deformation mechanisms as well as excite a third mechanism (microcracking). The result is a significant increase in fracture toughness. The addition of silica nanoparticles also increase the shear viscosity of uncured epoxies and this attribute is being examined for direct ink writing (DIW) processes. The model thermoplastic resins examined were polyamide-11 and polyamide-12 powders developed for selective laser sintering (SLS). In these systems the addition of silica nanoparticles on the surfaces of SLS powders improves powder flow and the presence of silica nanoparticles at the interfaces form appears to help strength the strength of these materials in the build direction. Fracture mechanics measurements and various fractography techniques will be discussed as well as modeling efforts to explain the improvements in mechanical behavior.

Biography:

Raymond A. Pearson has a B.S. degree in chemistry from the University of New Hampshire and a Ph.D. degree in materials science and engineering from the University of Michigan. He joined the Materials Science and Engineering Department at Lehigh University, Bethlehem, PA in August of 1990. In 2010, Ray became a Fellow of the Society of Plastics Engineers. In 2018 he won the Adhesion Society Award for Excellence in Adhesion Science. Ray is currently the Director of the Polymer Science and Engineering graduate program at Lehigh University and is heavily involved in the newly formed Faculty Senate.

Ray's research interests include all aspects of processing, deformation, yield, and fracture of polymers as well as a focus on adhesion and interfacial issues. Notable research accomplishments include the elucidation of toughening mechanisms in rubber-modified and silica nanoparticle-filled epoxies. Recent efforts are focused on developing polymer nanocomposites for 3D printing.