Constitutively Complex Fluids: Transport Properties and Simulations

Modeling and Algorithmic Approaches to Constitutively-Complex, Micro-structured Fluids

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Abstract

The team for this Project consists of Forest and Mitran at UNC Chapel Hill, Miller at UC-Davis, and Trebotich at LBNL. Our projects focus on modeling and algorithmic approaches to hydrodynamics of fluids with complex microstructure, where the dynamics of the microstructure cannot be decoupled from the momentum equations. Forest's primary role in this effort is in the multiscale theory, analysis and model development of complex fluids, and in the applications of advanced algorithms to systems and properties of interest to The Office of Science and DOE.

The process of identifying the correct and computationally viable model for a given complex fluid is quite involved. There is no universal model system that fits the diversity of microstructures. Thus the field has evolved as almost insular sub-fields devoted to particular applications: oil slurries, colloidal suspensions, nanoscale particle dispersions, dilute to highly entangled polymer systems. Our team has selected a handful of model complex fluids with which to advance the microstructure-hydrodynamic modeling, algorithms, and application-driven simulations. Forest's primary research emphasis has been on high performance nano-materials processing and property assessment, and on flow and diffusive transport properties of highly entangled polymeric fluids.