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Complex Fluid Microstructure, Rheology and Glass Transitions: Effect of Continuous Phase Molecular Weight

CHARLES ZUKOSKI, University of Illinois

The mechanical properties of suspensions depend dramatically on the suspension microstructure. Microstructure in turn depends on the nature of particle interaction potentials. For those systems that are thermally activated there will be an equilibrium microstructure and thus equilibrium transport properties. One of the model systems used to understand the links between interactions, microstructure and transport properties is that of hard spheres suspended in a Newtonian continuous phase. This model system can be studied experimentally and direct comparisons made with model predictions. With the increase in particle volume fraction, if the particles cannot crystallize, the suspension forms a glass where long range self diffusion is essentially eliminated. The approach to the glass transition has been studied experimentally and agreement with models is strong. In this talk we discuss what changes as the continuous phase takes on a granularity where the continuous phase molecules have substantial degrees of freedom. In particular, we investigate the mechanics and microstructure of hard sphere suspensions in polymer melts. The particles are composed of silica while we use polyethelene glycols of different weights ranging from small degrees of polymerization through the entanglement molecular weight. These studies are motivated by a desire to understand properties of polymer nanocomposites where the role of particle/polymer segment interactions is poorly understood but the state of particle dispersion is key to composite properties. In this talk I explore equilibrium and nonequilibrium phases of this system and compare with extant theoretical approaches.