PHYSICAL MATHEMATICS SEMINAR

SOFT MATERIALS: CONTROLLING AND PROBING STRUCTURE FORMATION AT THE MESO SCALE

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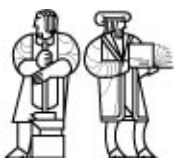
ABSTRACT:

Soft materials such as polymers, colloids or surfactant systems exhibit a wide range of fascinating structural, dynamic and mechanical behaviors. They contain structural elements at the meso scale, larger than molecules, but smaller than macroscopic objects. Examples of soft materials are ubiquitous; they include for instance paints, food systems, ceramic precursors, cosmetics, and many other industrial products. I will present a very general mechanism for the control of structure formation in these systems. Based on our experimental data on a colloidal model system, we develop a simple physical picture that bridges the gap between colloidal gel networks and colloidal glasses, two distinctly different out-of-equilibrium states of soft matter. Surprisingly, even though the formed structures consist of a network of strands, their macroscopic mechanical response is governed by the glass-like behavior and slow structural relaxation processes within those strands.

Studying these macroscopic properties on a variety of soft materials, we find remarkable similarities in their rheological behavior both in linear and nonlinear viscelastic measurements. Our experiments show that these properties can be unified by considering the effect of the strain-rate amplitude on the structural relaxation of the material. We present a new form of oscillatory rheology, Strain-Rate Frequency Superposition (SRFS), where the strain-rate amplitude is fixed as the frequency is varied. We show that SRFS can isolate the response due to structural relaxation, even when it occurs at frequencies too low to be accessible with standard techniques.

TUESDAY, APRIL 3, 2007
2:30 PM
Building 2, Room 146

Refreshments at 3:30 PM in Building 2, Room 349
(Applied Math Common Room)



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