MM 1: Topical Session Glass Dynamics I

Time: Monday 10:15–11:30 Location: H16

Topical Talk MM 1.1 Mon 10:15 H16

Colloidal Liquids and Glasses under Shear — •Stefan Egelhaaf — Condensed Matter Physics Laboratory, Heinrich-Heine-University, 40225 Düsseldorf, Germany

Colloidal liquids and glasses have been investigated experimentally. They consist of hard-sphere colloids with a short-range attraction induced by the depletion effect of non-adsorbing polymers, which allows us to control the range and strength of the particle-particle interactions. In these systems, liquid and crystalline states represent the equilibrium phases, while non-equilibrium, arrested states are observed at high colloid and/or polymer concentrations.

We have investigated the behaviour of these non-equilibrium states under shear. They were subjected to oscillatory shear as well as switch-on and switch-off of steady shear flow. The effect of shear on the structure and dynamics of the particles was determined. Due to their size, the particle motion can be followed using confocal microscopy and their dynamics quantified by, e.g., the mean-squared displacements. The transient dynamics show super-diffusive motion at intermediate times. These results are compared to recent simulations and theoretical predictions.

Topical Talk MM 1.2 Mon 10:45 H16

Relaxation and flow in glassy colloids — •Hans M. Wyss[1,2], Johan Mattsson[1,3], Alberto Fernandez-Nieves[1,4], Kunimasa Miyazaki[5,6], Zhibing Hu[7], David R. Reichman[5], and David A. Weitz[1] — [1]Harvard University, Cambridge, USA — [2]TU Eindhoven, Eindhoven, Netherlands — [3]Chalmers University, Gothenburg, Sweden — [4]Georgia Tech, Atlanta, USA — [5]Columbia University, New York, USA — [6]Tsukuba University, Tsukuba, Japan — [7]University of North Texas, Denton, USA

For different molecular glass-forming liquids, the dynamics of glass formation show broad variations, as often characterized by the concept of fragility - the sensitivity of the viscosity or structural relaxation time on temperature as the glass is approached. Glass formation can also be studied in colloidal materials, where increasing concentration has an effect analogous to decreasing the temperature in molecular liquids. However, in this analogy only highly fragile behavior has been observed.

In this talk I will show that by using soft, deformable particles the concept of fragility can be extended to colloidal glasses. We capture the entire range of dynamic behaviors merely by varying the softness of the individual mesoscopic particles. Hard particles make "fragile" glasses and soft particles make non-fragile, or "strong", glasses. Remarkably, we find that elasticity has an equivalent effect in molecular systems, where elasticity directly reflects fragility. I will further show how in colloids an externally enforced flow can be used to further study the structural relaxation in these materials.

MM 1.3 Mon 11:15 H16

Dynamics of colloidal suspensions in a modulated light field — •Cecile Dalle-Ferrier, Matthew Jenkins, and Stefan Egelhaaf — Lehrstuhl für Physik der weichen Materie, Heinrich Heine Universität, Düsseldorf, Deutschland

We experimentally investigated the structure and dynamics of an aqueous suspension of charged polystyrene beads in a modulated light field. The light field can be considered as an external 1D-periodically modulated potential, which has been shown to be a good model for the non-Gaussian dynamics in glassy systems of cage escape and subsequent recaging [1]. Our samples indeed showed glassy behaviour in the modulated light field, even in the case of dilute samples. Following the particles with microscopy, we find that the time-dependence of the mean-square displacement exhibits a plateau and the value of the non-gaussian parameter is non-zero. The height of the plateau and its extension in time, and more generally the dynamics of the particles, depend on the characteristics of the potential such as its amplitude and period. These results indicate that the application of a modulated light field to a colloidal suspension is a convenient tool to turn a liquid into a glass-like system. It offers extensive control of this transition through the parameters of the light field. We plan to use this model further to progress our understanding of the glass transition, in particular the characterization of glassy dynamics, including dynamical heterogeneities.

[1] B. Vorselaars et al., Non-Gaussian nature of glassy dynamics by cage to cage motion, Phys. Rev. E, 75, 011504 (2007)