

Thermosensitive Colloidal Atoms and Molecules – Do we understand the Glassy State?

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Suspensions of colloidal particles have acquired much interest recently since they can serve as model systems for condensed matter. Thus, spherical colloids with diameters around 100 – 200nm suspended in water may be viewed upon as colloidal “atoms” which provide a model for the fluid-to-solid transition and in particular the glass transition. The volume fraction of the particles in suspension is the only control parameter of these systems. The modulus of the resulting colloidal crystals is decreased by ca. 9 order of magnitude (“soft matter”) as compared to conventional systems. Moreover, motions of these colloidal atoms are slowed down by ca. 10 orders of magnitude which allows us to study the glass transition in a detailed fashion. We have introduced thermosensitive particles as model systems [1]. These particles allow us to adjust the volume fraction in a well-defined manner and to study the fluid-to-glass transition in unsurpassed precision.

In my lecture, I’ll present our recent work on these systems. First, suspensions of spherical particles will be discussed. These “colloidal atoms” provide ideal model systems for the fluid-to-glass transition and I’ll discuss our recent rheological studies of colloidal glasses. Special emphasis is laid on the comparison with mode-coupling theory in close collaboration with the group of M. Fuchs, University of Konstanz [1,2]. Mode-coupling theory is shown to provide an excellent description of the experimental data. In a second part I’ll discuss work on thermosensitive dumbbell-shaped colloids that serve as a model system of simple diatomic molecules (“colloidal N₂”). Here we observe a phase transition of these microgels to a plastic crystal [3]. All investigations demonstrate that colloidal glasses can be fully modeled in terms of mode-coupling theory. Thus, we believe that the glassy state in these model systems is understood in many central aspects.

1. M. Siebenbürger, M. Fuchs, M. Ballauff, *Core-shell microgels as model colloids for rheological studies, Soft Matter* **2012**, *8*, 4014.
2. M. Siebenbürger, M. Ballauff, T. Voigtmann, *Creep in Colloidal Glasses*, *Phys. Rev. Lett.* 2012, **108**, 255701.
2. F. Chu et al., *Synthesis and Characterization of Monodisperse Thermosensitive Dumbbell-Shaped Microgels*, *Macromol. Rapid Comm.*, **2012**, *33*, 1042.