Structure, Dynamics & Rheology of Stimuli Responsive Gels

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Colloidal dispersions play an important role in many different applications as e.g., paints or pharmaceutical formulations. Since the rheological behavior is relevant for processing of these materials, many studies on flow properties have been reported in the literature. However, colloidal suspensions can also be used as model systems in soft condensed matter to investigate structure and dynamics of concentrated systems. Order–disorder transitions similar to atomic systems are found in colloidal dispersions as well, but here repulsive interactions dominate the equilibrium phase behavior. There has been considerable effort in determining and understanding the rheological properties of dense suspensions and the majority of this work has concentrated on hard, non-deformable particles which are simple to deal with experimentally and theoretically. Sterically stabilized suspensions have been studied intensely as models of hard sphere systems. The difficulty with hard particles is that in order to explore the rich phase behaviour, one has to physically change the volume fraction. Microgel particles are a class of materials that can be used as model systems and which play an important role in technical applications as well. They consist of crosslinked macromolecules of colloidal size which depends on the temperature of the solvent. The particle interaction potential strongly depends on the crosslinking density and temperature, and these microgels exhibit a behavior ranging from that of polymer solutions to that of hard spheres. The effective volume fraction of a thermosensitive microgel suspension can be changed simply by changing the temperature of the solvent in which it is suspended.

In this work, we synthesize poly(*N*-isopropylacrylamid) (PNIPAM) microgels using emulsion polymerization technique and study their rich phase behaviour using a combination of scattering, rheology and imaging techniques. We also synthesize ionic microgels by copolymerizing PNIPAM with acrylic acid (AAc) giving them a pH sensitivity also. We are particularly interested in understanding the effect of softness/elasticity of the particles on the glass transition and their aging behaviour.

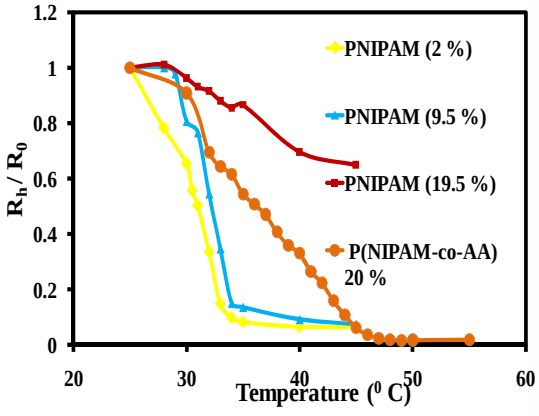

Fig. 1: Particle size of microgel suspensions obtained using 3D-DLS technique

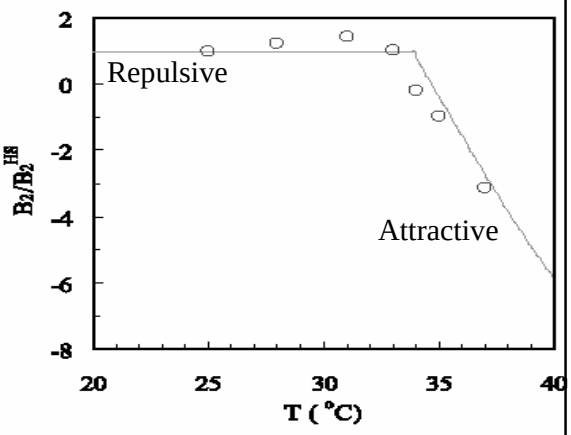

Fig. 2: Interparticle potential of microgel particles obtained using static light scattering