Probing Particle Dynamics in Dense Colloidal Suspensions with Coherent Radiation

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We discuss the application of light and neutron scattering to dense colloidal suspensions ranging from the nano-scale to the micron-scale and covering such different systems as for example nanoparticle and globular protein solutions as well as ceramic slurries. We will furthermore give an outlook to the application XPCS. We expect that this new technique will provide access to many systems where multiple scattering of light and the limited q-range has prohibited quantitative measurements in the past.

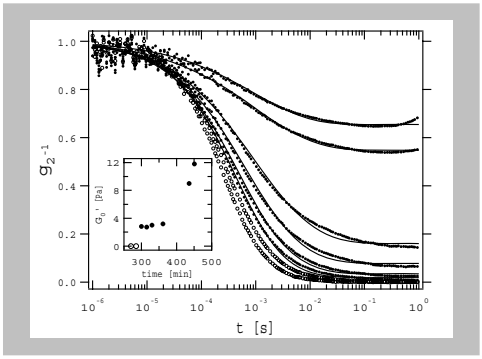

Figure 1: DWS intensity autocorrelation function before (open symbols) and after gelation (solid symbols). Inset: Gel elastic modulus (from [4]).

Particular emphasis will be given to the phenomenon of the so-called dynamical arrest, where dense colloidal or soft matter systems exhibit dramatic changes of their viscoelastic properties and 'solidify'. This means that on the time scale accessible to experiment these systems do not fully relax and in a photon correlation spectroscopy (PCS) experiment they appear nonergodic [1]. In dense complex fluids, such as colloidal suspensions and gels strong multiple scattering of light further complicates the situation. To characterize the sample properties over the full range of interest we employ a rather unique set of static and dynamic light and small angle neutron scattering (SANS) experiments [2]. In moderately turbid systems we use multiple scattering suppression schemes, such as 3D-dynamic light scattering [3] while for even more turbid samples diffusing wave spectroscopy (DWS) is suited to study the internal dynamics on nanometer length scales by measuring the intensity fluctuations of the diffusively transmitted light.

References

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