Seminar of SFB 910

Robin Kopp

Universität Konstanz

“Generalized nonlinear integral models for time-dependent flows of viscoelastic liquids near the glass transition”

Starting from Brownian motion using Mode-coupling theory, a model for colloidal systems near the glass transition can be derived and extended to describe systems under simple shear flow. Schematic models are introduced for simplification, which do not contain the tensorial structure and wave vector dependency of thefull theory anymore.

We analyze constant shear rate and constant stress situations and the respective response of the colloidal system. For the constant shear rate situation the stress-strain curves show agreement with experiments especially concerning the observed stress overshoot. To analyze the stress controlled case we developed a numerical solution algorithm including a coarse graining scheme for the time axis, optimized for the use on the scientific computing cluster.

The typical s-shape of the strain-rate curve was found, which is characteristic for colloidal glasses. The creep regime before the onset of yielding was found to follow a power law behavior as found in experiments and mesoscopicmodels. The stress overshoot in the stress-strain curves suggests a quadratic dependence of the stress on the strain close to the static yield stress which could be verified by fitting the yield stress of the strain curves. We observe that in our model the static yield stress is larger than the dynamic yield stress in stress and rate controlled situations.

Overall, by comparing to experimental data, simulations and different theoretical approaches, good agreement could be found for rate controlled situations and small and large stresses in the stress controlled approach while a number of open questions regarding the accuracy and validity of the model remain.

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Technische Universität Berlin · Institut für Theoretische Physik · Hardenbergstraße 36 · 10623 Berlin

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