

MAR11-2010-007469

Abstract for an Invited Paper
for the MAR11 Meeting of
the American Physical Society

Yielding mechanisms and particle rearrangements in colloidal glasses and gels under shear

GEORGE PETEKIDIS, IESL-FORTH

Steady and oscillatory rheology was utilized to study the mechanical response of colloidal glasses and gels with particular emphasis in the way these are shear melted (yield) [1,2]. We used suspensions of hard sphere colloids with short-range depletion attractions induced by the addition of non-adsorbing linear polymer. The linear viscoelasticity and the yielding mechanisms at different regimes of colloid volume fraction and particle attractions are discussed. While hard sphere glasses exhibit a single step yielding due to cage breaking, attractive glasses show a two-step yielding reflecting bond and cage breaking respectively [1]. Here we present experimental data both along a line of equal attraction, varying the particle volume fraction, from an attractive glass to a low volume fraction gel as well as at intermediate and high volume fractions with increasing the attraction strength. In attractive gels yielding remains a two step process until very low ϕ 's. The first yield strain is related with in-cage or inter-cluster bond breaking while the second yield point is attributed to breaking of cages or clusters into smaller constituents [3]. The latter increases as volume fraction is decreased due to enhancement of structural inhomogeneities. When the range of attraction was increased, both yield strains increase, scaling with the range of attraction and accompanied structural changes. Brownian Dynamics simulations and Dynamic Light scattering under shear (LS-echo) provide information on the microscopic particle rearrangements and structural changes during yielding and flow such as the size and structure of clusters that change under steady shear as a function of shear rate. Work in collaboration with: N. Koumakis, (FORTH), M. Laurati, S.U. Egelhaaf (U. Duesseldorf) and J. F. Brady (Caltech).

[1] K. Pham et al. J. Rheology 52, 649 (2008)

[2] M. Laurati, J. Chem. Phys. 130, 134907 (2009)

[3] Koumakis and Petekidis, submitted (2010); Laurati et al, submitted (2010)