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Jamming transition as probed by quasi-static shear simulations

CLAUS HEUSSINGER, LPMCN, Universite Lyon 1

This contribution deals with flow properties of amorphous colloidal or granular materials close to their jamming threshold. There is by now ample evidence that the (athermal) jamming transition ("point J") can be thought of as a critical phenomenon with a divergent length-scale. While much effort has been put into characterizing the critical properties of the arrested solid state, only little is known about the actual physical mechanisms that lead to this arrest when coming from the flowing side. We try to fill this gap by studying the particle dynamics in the flowing state. We show how the motion of single particles is connected to the growth of dynamical heterogeneities. Approaching point J from below we find a diverging dynamical susceptibility. The associated particle mobilities show signs of strong spatial correlations, with patterns involving string- and loop-like excitations as well as compact regions of active particles. As a result we can develop an intuitive and appealing picture that describes flow in terms of a "liquid of temporarily rigid clusters". This picture of how flow is realized below point J contrasts well with the traditional view of plastic flow in "soft-glassy" materials, where flow is described by the failure of localized defects embedded in an elastic solid. We argue that this latter behavior is observed in the yield-stress flow regime above point J.