The Nonlinear Langevin Equation Theory and Its Applications to the 2D Colloidal Glasses

(Invited Talk #3)

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The microscopic nonlinear Langevin equation theory is applied to study the localization and activated hopping of two dimensional hard disks in the deeply supercooled and glass states. Quantitative comparisons of dynamic characteristic length scales, barrier and their dependence on the reduced packing fraction are presented between hard-disk and hard-sphere suspensions. The dynamic barrier of hard disks emerges at higher absolute and reduced packing fractions and correspondingly, the crossover size of the dynamic cage which correlates to the Lindemann length for melting is smaller. The localization lengths of both hard disks and spheres decrease exponentially with packing fraction. Larger localization length of hard disks than that of hard spheres is found at the same reduced packing fraction. The relaxation time of hard disks rises dramatically above the reduced packing fraction of 0.88, which leads to lower reduced packing fraction at the kinetic glass transition than that of hard spheres. The present work provides a foundation for the subsequent study of the glass transition of binary or polydisperse mixtures of hard disks, normally adopted in experiments and simulations to avoid crystallization.