Local structure and dynamics in colloidal fluids, clusters and gels

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Gels in soft matter systems often exhibit hallmarks of arrested phase separation. We consider a colloid-polymer mixture which is quenched by increasing the polymer concentration, from a fluid to a 'cluster fluid' and then a non-ergodic gel. Using confocal microscopy, we study both the static structure and dynamics in 3D, presenting the first time-resolved 3D coordinate tracking of a colloidal fluid. While significant changes in structure are observed upon the formation of a network, they are accompanied by a limited dynamic slowing.

Furthermore, deeper quenching, upon which there is a significant dynamic slowing, is accompanied by more subtle changes in structure. We find evidence of five-fold symmetry, which may inhibit access to global potential energy minimum, fluid-crystal coexistence, leading to gelation. We find strong spatial correlations between particle motion at all state points, including the non-ergodic gel. In particular, the connection between coordination number and (local) displacement suggests mobility enhancement on the gel surface, hinting at 'surface melting'.

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