

New insights into colloidal phase transitions using neutron scattering techniques

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The fundamentals of crystallisation and glass formation in atomic systems are not yet fully understood. Hard-sphere colloidal nanoparticles have been shown to be promising model systems for understanding crystallisation and glass formation in atomic systems: As colloidal motion is Brownian, rather than ballistic, kinetics and dynamics are orders of magnitude slower than in atomic systems and can be studied in real-time. However, despite previous work, key elements are still missing from our understanding of phase transition in colloidal suspensions especially regarding metastability, supercooling and the glass transition. In particular, there is still no clear understanding of the effects of polydispersity: although studies of both polydisperse and binary mixtures of hard sphere colloids have been performed, a systematic study of the effects of polydispersity on structure, crystallisation kinetics and particle dynamics is still lacking.

One of the reasons for this is the relatively limited types of suspensions which have been studied - most particles used for such studies need to be suspended in mixed solvents for refractive index matching for light scattering studies, which introduces potential problems such as selective solvation and evaporation. In this work we explore the possibility of using ionic liquids (ILs) and deep eutectic solvents (DESSs) as the suspending solvent, as these can be tuned to match the refractive index of the particles, and don't suffer from evaporation. We will then develop suitable binary colloidal suspensions consisting of deuterated & non-deuterated nanoparticles suspended in the solvent. With a combination of lab techniques and beam time allocations at the Australian Synchrotron, ANSTO and overseas neutron facilities, we will expansively investigate the nature of metastability, crystallisation and the glass transition, and provide a significant advance on our current understanding of these processes.

Level of Expertise

Student

Speakers Gender

Female

Do you wish to take part in the poster slam

Yes

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