New insights into colloidal phase transitions using neutron scattering techniques

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INTRODUCTION

- Fundamentals of **crystallisation** and **glass transition** are not fully understood.
- **Binary colloidal suspensions** are a good model.
- Brownian, real-time motion.
- Limited studies on **dynamics** and **structure**. [1-3]

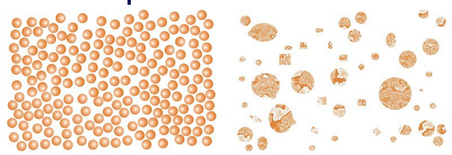
RESEARCH QUESTIONS

1. What **combination of nanoparticle** and **solvent** will be the ideal colloidal system to study?

2. How do **different volume fractions φ** affect the crystallisation and phase behaviours of the system?

$$\varphi = \frac{Volume_{particle}}{Volume_{total}}$$

3. How does **change in polydispersity** affect the crystallisation and phase behaviours of the system?



4. What **resolution** do we need to measure the **full range of scattering vectors q** during solidification processes in our neutron scattering experiments?

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CHOOSING THE IDEAL SYSTEM

Particle

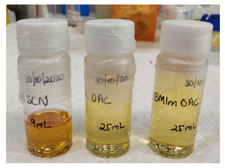
- Large particles, relatively cheap, non-volatile.

Testing: **Silica** (d = 20-2470 nm) and **Polystyrene** (d = 62-2500 nm)

Solvent

- Refractive index **n** match, similar density **ρ**, transparent, relatively cheap, reasonable viscosity **η**. Potentials: ionic liquids and deep eutectic solvents.

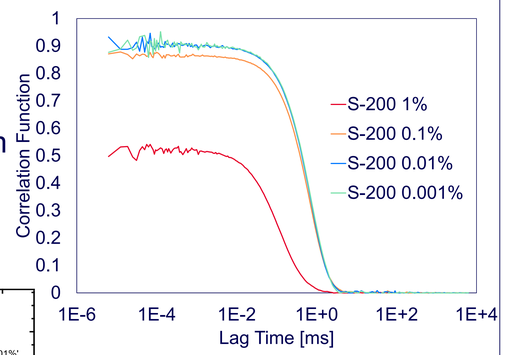
Testing: **BMIm Acetate** and **BMIm Thiocyanate**



PRELIMINARY RESULTS

- Checking particles are stable with DLS.

Fig. 1 Light scattering data for silica d = 200 nm at four concentrations.



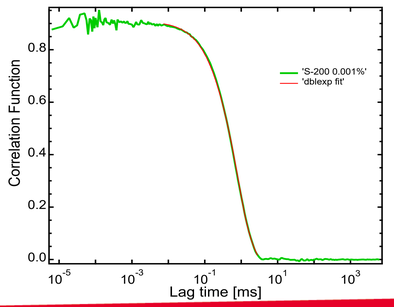
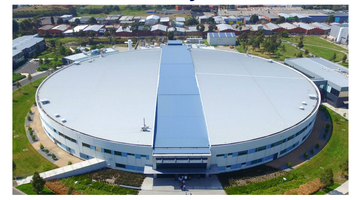


Fig. 2 Double exponential fit of dataset for 0.001% concentration of silica (S-200 0.001%).

TECHNIQUES

DLS & SEM, RMMF

SAXS, RMMF & Australian Synchrotron

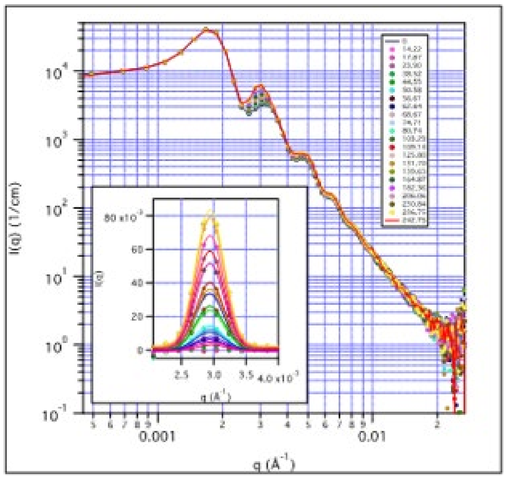


U/SANS, ANSTO

VSANS, NIST

PREVIOUS WORK [4-8]

Fig. 3 SANS data for SMU39 at a volume fraction of 0.54 over a period of ~250 minutes following the quench. The inset highlights the growth of the main crystalline peak with Gaussian fits.



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