Mixtures of spherical particles - co-existing crystal and liquid phases

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Charged colloidal particles can order as dispersions in deionised water and are well-known to form crystal structures that have a low yield stress and flow readily while exhibiting long-range three dimensional order. Large single crystals can be observed [1]. In practical applications there are often distributions of size and understanding the behaviour of such systems is important. Binary mixtures with different size particles constitute a simple system that can be understood a model for various applications such as coatings.

Small-angle neutron scattering with mixtures of normal hydrogenous and deuterated latex particles in combination with H_2O/D_2O contrast variation allows the partial structure factors for each component in a mixture to be determined. Results for a number of concentrations and compositions of particles in deionised water will be presented. At low ionic strength the constituents on their own form crystals. These will be contrasted with old studies that have investigated dispersions with added electrolyte so as to resemble binary liquid mixtures [2].

Our new results show that mixtures of strongly interacting (repulsive potential) particles with two different sizes display interesting behaviour: small particles can be inserted in the gaps between large particles. We have observed that for systems where each component would on its own form crystals, the crystalline order of the large particles in a mixture is destroyed whereas the structure for the small particles retain sharp Bragg diffraction peaks. The small particles thus act as macroions that screen interactions between large particles as well as cluster within interstices but their order is not significantly perturbed.

[1] M. S. Hellsing, A. R. Rennie, R. K. Heenan and S. E. Rogers, *RSC Advances*, 2012, **2**, 7091.
[2] R. H. Ottewill, A. R. Rennie and G. D. W. Johnson, *Adv. Colloid Interf. Sci.* 2003, **100-102**, 585.