Field-Directed Self-Assembly of Soft Thermo-Responsive Colloids

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Ionic poly(N-isopropyl-acrylamide) (PNIPAM) microgels are ideally suited as model systems to study the complex phase behaviour found for particles interacting via a soft potential. Moreover, subjecting the particles to an alternating electric field results in an additional dipolar contribution to the interaction potential, which strongly depends on the strength and frequency of the applied field. Here we use confocal laser scanning microscopy (CLSM) in combination with different scattering techniques to study the system as the dipolar interactions are increased. In the dilute regime, a fluid to string-fluid transition is observed, Fig. 1. [1]. At high densities we see how a face-centred cubic (FCC) crystal diffusively transforms into a body-centred tetragonal (BCT) crystal via nucleation and growth. However, in the reverse direction, the BCT phase transforms cooperatively into a metastable body-centred orthorhombic (BCO) phase, which only relaxes back to the FCC phase as the temperature is increased [2]. The kinetics at this over-packed state is thus either diffusive or martensitic depending on the path. In order to learn more about the origin of this puzzling path dependence, we investigate the influence of the particle softness using ionic microgels with different crosslink densities. We also study the shape and size of the particles as a function of packing fraction and field strength by performing small-angle neutron scattering experiments at so-called zero average contrast conditions as a function of the applied field strength.

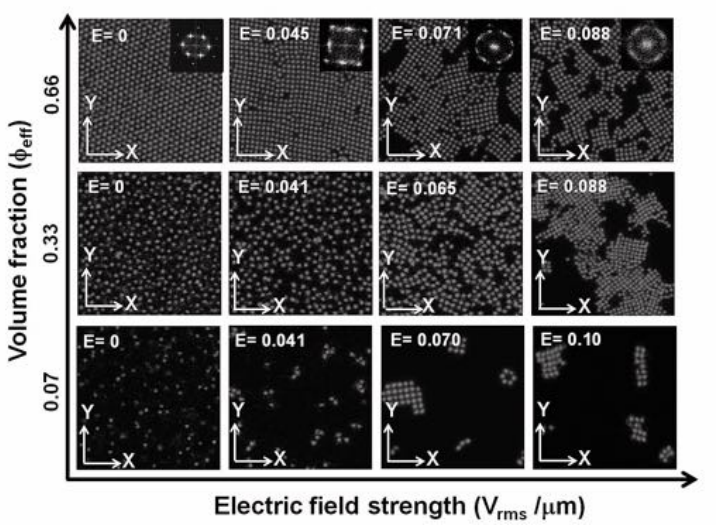

Figure 1 Examples of field-induced structures.

[1] S. Nöjd, P. S. Mohanty, P. Bagheri, A. Yethiraj and P. Schurtenberger, Soft Matter, 2013, **9**, 9199.
[2] P. S. Mohanty, P. Bagheri, S. Nöjd, A. Yethiraj and P. Schurtenberger, Phys. Rev. X, 2015, **5**, 011030