Inorganic/Organic Core-Shell Hybrid Particles: From 2D to 3D arrangements

Matthias Karg
University of Melbourne – Bio21 Institute & School of Chemistry, Melbourne VIC 3010, Australia

Recently, inorganic/organic hybrid microgels gained enormous interest due to their unique properties. Different morphologies have been presented including core-shell structures, gel networks filled with inorganic nanoparticles and gels covered with nanoparticles[1,2]. For applications such as photonic crystals, core-shell particles are the most promising candidates because of their well-defined structure. Within the last years, different types of core-shell microgels with just one single nanoparticle core have been presented in the literature[3,4,5].

We report the preparation of core-shell hybrid particles with single nanoparticle cores. The cores consist of different inorganic nanoparticles, while the shell material is made of a responsive poly-*N*-Isopropylacrylamide network. These hybrids show a thermoresponsive character due to their polymer shell and e.g. optical or magnetic properties depending on the core material.

While the core diameter can simply be varied by the size of the used nanoparticles within the hybrid preparation, the shell thickness can be controlled by the polymerization time and the monomer feed concentration.

We have shown that the shell thickness can be used to control the particle density and the interparticle distance within monolayers of the core-shell composites (see fig. 1). The results nicely show how the overall hybrid dimensions can be used to tune the surface coverage. This control is important for applications such as sensor design.

In addition, we show first results on the preparation of colloidal crystals built from core-shell hybrid particles. These crystals show a very pronounced diffraction peak in the visible, which strongly depends on the volume fraction of the hybrid particles. Due to the responsive character of the polymer shell, temperature can be used to influence the volume fraction and hence melt the crystals.

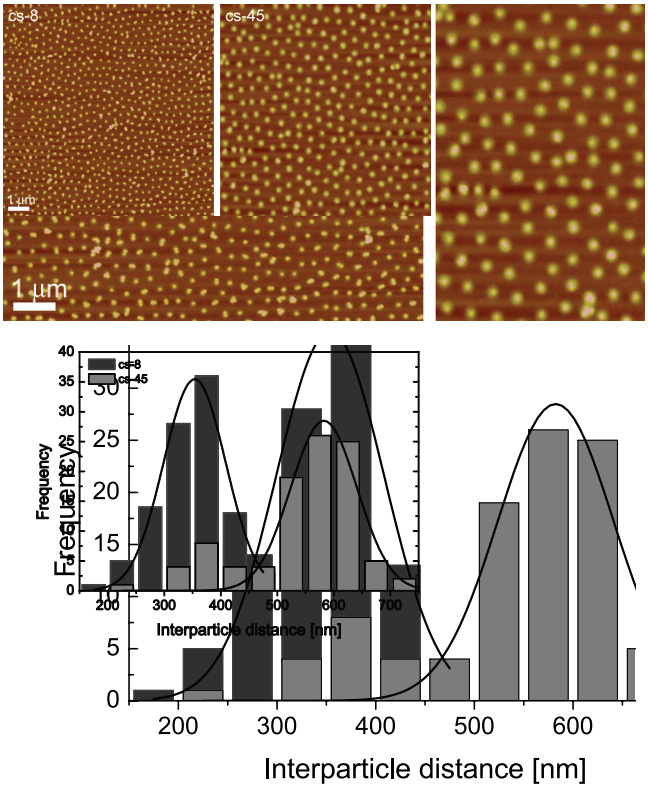

Figure 1. AFM analysis of core-shell particles. Top: AFM images of monolayers of core-shell microgels with different shell thicknesses. Bottom: Histograms for the interparticle distances determined from the left AFM images.

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