Experimental report

31/08/2022

Proposal: 9-12-587 **Council:** 10/2019

Title: Structure and position of Silica-core PNIPAM-shell hybrid microgels at liquid-air interfaces as a function of temperature and compression.

Research area: Soft condensed matter

This proposal is a new proposal

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Samples: C6H4D7NO-SiO2

Instrument	Requested days	Allocated days	From	To
FIGARO Langmuir trough	2	2	25/03/2021	27/03/2021

Abstract:

We plan to use neutron reflectometry to study silica-core D7-pNIPAM-shell hybrid microgels. The knowledge on the position of the inorganic core and the response of these particles to external stimuli as e.g. temperature are crucial to their many applications in optical and electronic devices. Furthermore, a better understanding of the out-of-plane behavior of these systems is crucial to understand the response of emulsion stabilized by microgels. We plan to use two different core size and different shell thickness. The use of D7-pNIPAM will increase the contrast giving more robust data measured using both D2O and air contrast marched water. The simultaneous fit of the data at different contrasts will give fundamental insight into the three-dimensional response of these systems. This information will be combined with Langmuir-Blodgett trough measurements and ex-situ atomic force microscopy measurements. The use of these different techniques will give a comprehensive description of the behavior of core-shell particles both in and out-of-plane.

In the experiments we measured different Hybrid Silica-NIPAM at the air-water interface and their response to temperature and compression. Measurements were conducted at 20 and 40˚C at both air-D_2O and air-null reflecting water (NRW) interface. During the experiment the surface pressure was monitored by film-balances with paper plates.

Figure 1A-D the reflectivity curves of hybrid silica-core-pNiPAM-shell microgels are shown at 20 and 40˚C. In Figure 1A-B the silica core has a radius of 105 nm (CS-105) and in Figure 1C-D a radius of 60 nm (CS-60). The surface pressure as approx. 19 mN/m for all measurements.

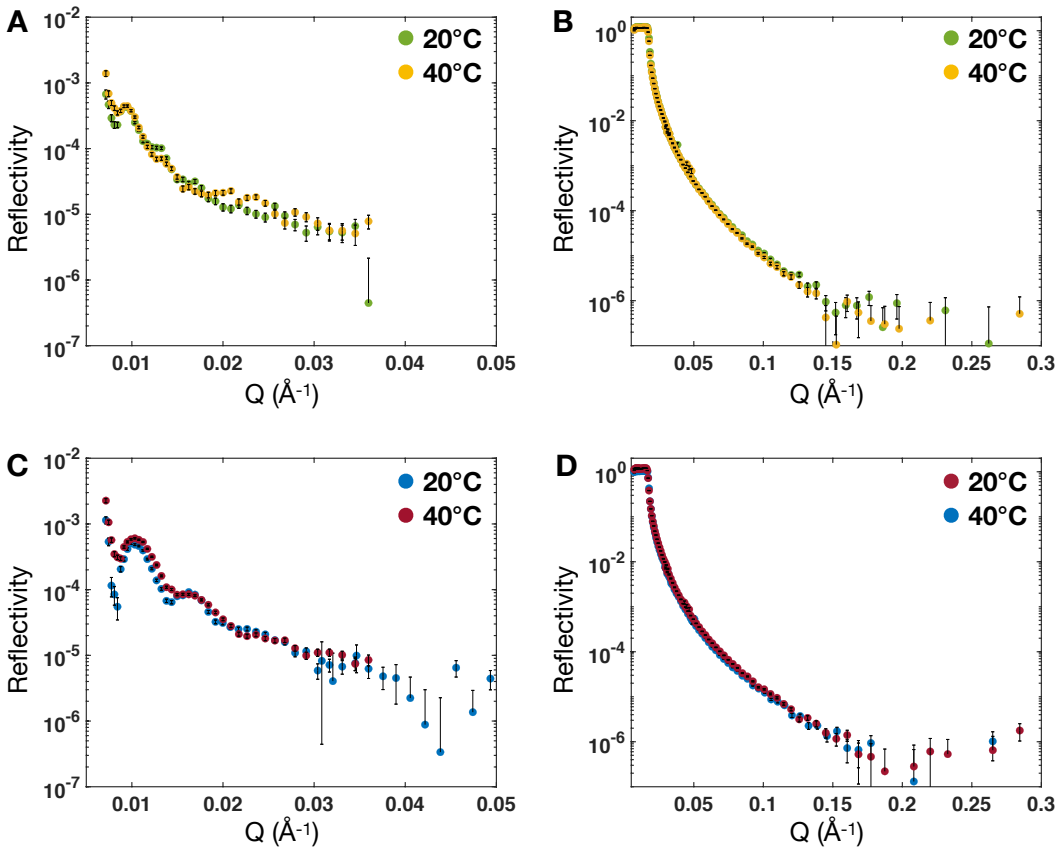

Figure 1: Reflectivity curves of hybrid silica-core-pNiPAM-shell microgels. (A-B) Reflectivity curves of hybrid microgels with a silica core radius of 105 nm at the air-NRW (A) and air-D_2O (B) interface. (C-D) Reflectivity curves of hybrid microgels with a silica core radius of 60 nm at the air-NRW (A) and air-D_2O (B) interface. All measurements were performed at a surface pressure of approximately 19 mN/m

At the air-NRW interface oscillations can be seen (Figure 1A and C) for both core-shell microgels. At 20 ˚C the oscillations appear to be more pronounced. For the CS-60 the minima of the oscillations appear to be shifted to higher Q. In both cases, temperature leads to an increased reflectivity at low Q (~0.07-0.015 $Å^{-1}$). No oscillations are visible at the air-D_2O interface.

The reflectivity curves that monolayers of hybrid silica-core-pNiPAM-shell microgels react to temperature when crossing the VPTT.

In Figure 1A and C and increase of the reflectivity with temperature is observed. This agrees with earlier experiments (9-11-1871) of hydrogenated microgels [see]. We are currently fitting

the reflectivity curves to quantify the reaction of the particles to temperature when crossing the VPTT. Fit are performed both using MOTOFIT withing the IgorPro environment and in collaboration with Y. Gerelli using a customized MATLAB code.