	Experiment title: Phase behaviour of mixed sphere-platelets suspensions	**Experiment number**: 26-02-501
Beamline: BM26	**Date(s) of experiment**: 02.03.2010-05.03.2010	**Date of report**: March 2010
Shifts: 9	**Local contact(s)**: Dr. Giuseppe Portale	

Names and affiliations of applicants (* indicates experimentalists):

Dr. Dzina Kleshchanok*, Dr. Andrei V. Petukhov*, Dr. Dmytro Byelov*, Janne-Mieke Meijer* M. Sc., Prof. Dr. Henk N. W. Lekkerkerker; Van 't Hoff Laboratory for Physical and Colloid Chemistry, Utrecht University, Padualaan 8, 3584 CH Utrecht, The Netherlands

Dr. Anatoly Snigirev, ESRF

Report: (max. 2 pages)

First of all, we would to stress that we have applied for 12 shifts of beam time. For a reason, which was not clarified to us, only 9 shifts were granted. Moreover, due to technical problems at the beam line, building and alignment of the mictoradian setup[1] took 30 hours. As a result, only 42 hours were used for data collection. This put an enormous pressure on the experimental team and the beam line personnel. In these short time limits we were unable to completely fulfill the planned experimental program. Still, we did our best to make use of the time available.

Our aim was to obtain information about the nature of liquid-crystalline phases occurring in mixed suspensions of charged platelets and spheres. The study was performed on gibbsite (γ-$Al(OH)_3$) platelets with a diameter of 230 nm and commercial silica spheres Ludox CL with a diameter of 16 nm. We found that silica spheres play a role of a very effective depletant agent in this mixed system. Thus, an addition of already a small amount of spheres led to the disappearance of the nematic phase. Instead, isotropic/columnar phase coexistence is found in the mixed suspensions. This finding is different from the previous studies on polymer/platelets mixtures, which showed that polymer depletants induce additional isotropic and nematic phases in platelet suspensions[2].

Our measurements were performed on suspensions with varying platelet and sphere concentrations. Here we would like to present a brief summary of the results. Aqueous suspensions of gibbsite platelets showed isotropic, nematic and columnar phase formation with the increasing amount of platelets. The 2D scattering patterns corresponding to these phases are shown in Figure 1.

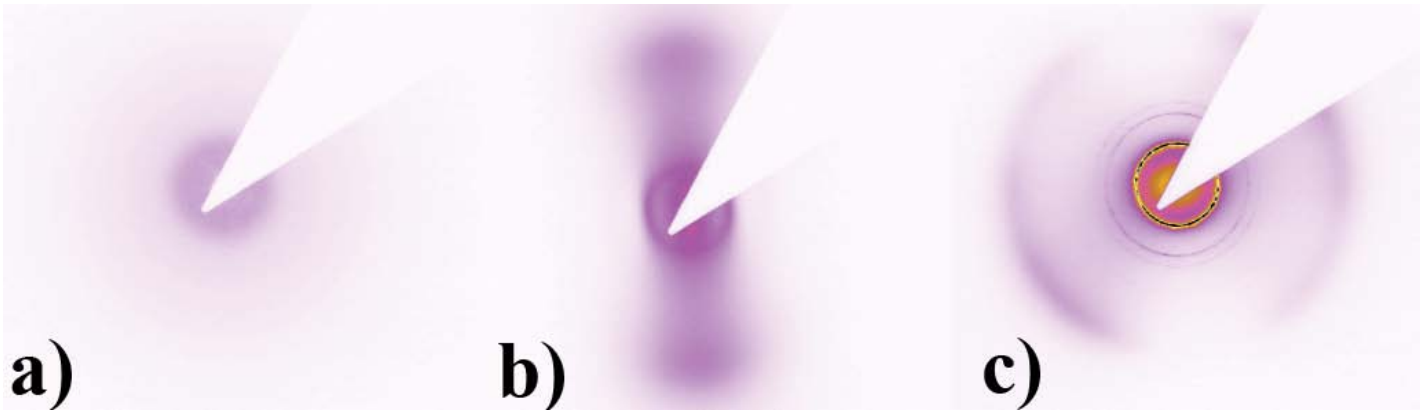

Figure 1. The scattering patterns obtained from an aqueous suspension of pure gibbsite showing three phase coexistence. From the top to the bottom of the capillary the following phases appear: a) isotropic, b) nematic, and c) columnar.

The addition of silica spheres (at low and moderate concentrations) to the gibbsite suspensions led to the appearance of the columnar phase just below the isotropic phase, as shown in Figure 2.a. Additionally, at the bottom of the same capillary there is a sediment, which does not show the positional order of the columnar phase (Figure 2.b). This is presumably an arrested state at too high osmotic pressure. A disordered state was also found at large concentrations of spheres (Figure 2.c). This state was formed due to a strong depletion attraction between the platelets. However, there is a difference between the two disordered structures. The scattering intensity in panel c monotonically decays, which suggests a house-of-cards or sponge-like structure. The scattering in panel b, however, displays a broad shoulder suggesting a nematic columnar-like structure with pronounced correlations on distances of the order of the platelets diameter.

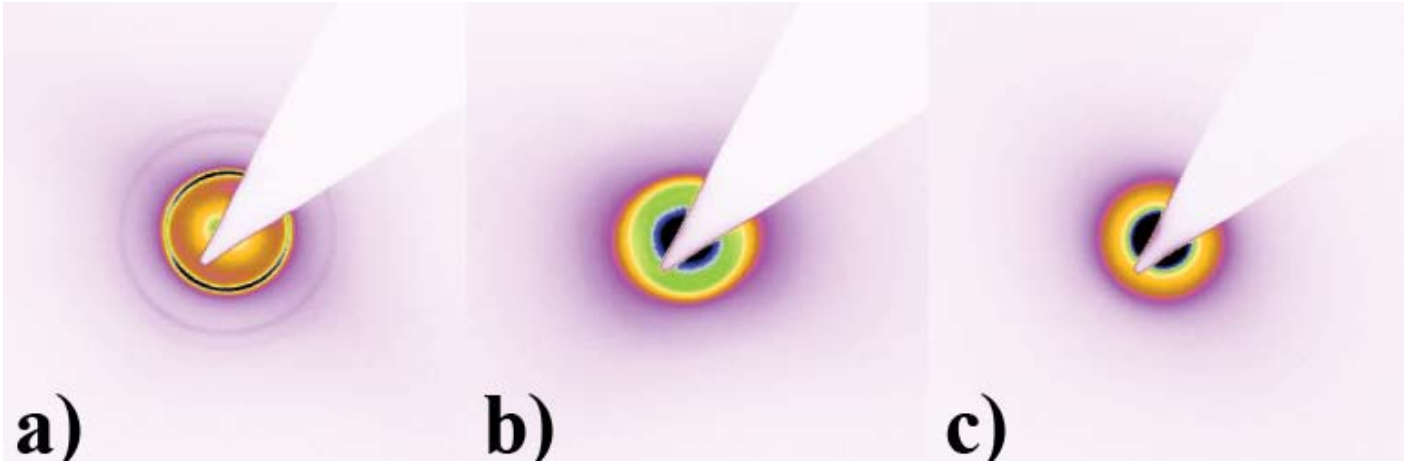

Figure 2. The scattering patterns obtained from an aqueous mixed gibbsite/silica suspension. Pattern a shows a columnar structure present in the 100 g/L gibbsite suspension with 100 g/L silica spheres in it. Pattern b) is obtained from the sediment at the bottom of the same capillary. Pattern c displays a disordered state found at large concentrations of spheres ($\geq$ 150 g/L).

Our goal now will be to analyze the 2D scattering patterns to characterize structures in the mixtures of platelets and spheres in great detail. We want to understand how the lattice spacing in platelet structures is changing with the sphere concentration. An important question is how the spheres are located in the columnar phase of platelets. Finally, we aim to construct an experimental phase diagram of platelet/sphere mixtures and compare it to the theoretical predictions.

1. Petukhov, A. V., *et al.*, *J. Appl. Cryst.* **2006,** 39, 137-144.
2. van der Kooij, F. M.; Lekkerkerker, H. N. W., *Phys. Rev. E* **2000,** 62, 5397-5402.