Experimental Report

Proposal: **9-12-353** **Council:** 4/2014

Title: Structure in new electrophoretically and magnetophoretically responsive silica organosols.

This proposal is a new proposal

Researh Area: Chemistry

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Samples: surfactant-Holmium-Neodymium-silica-alkanes

Instrument	Req. Days	All. Days	From	To
D33	1	1	01/09/2014	02/09/2014

Abstract:

Silica dispersions in organic solvents (“organosols”) have been recently studied. The cationic didodecyldimethylammonium bromide (DDAB) is an effective stabilizer of silica in organic solvents. The bromide counterion can be readily swapped for a magnetic analogue, which results in development of new functional nanoparticles: silica organosols that are both electrophoretically and magnetophoretically responsive. In order to understand the mechanism by which DDAB and its magnetic analogues modify silica particle surfaces, contrast variation SANS measurements are needed to reveal the adsorbed layer structures.

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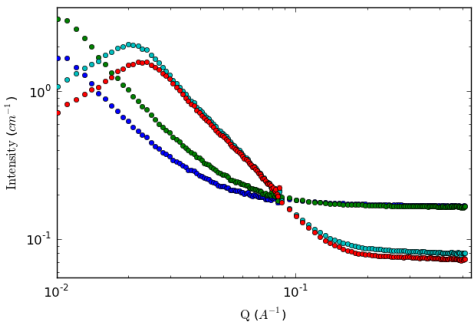
Instrument: D33
Dates of experiment: 01/09/2014 to 02/09/2014

It was not possible to study dispersions of electrophoretic and magnetophoretic silica organosols owing to instability.

Recent research in our group has shown interesting results regarding the formation of tetramethylorthosilicate (TMOS) gels. These gels are used as binders in many interesting industrial products (such as anti-reflective or self-cleaning films), but the nanostructure of these formulations is poorly understand. SANS has been used to gain understanding of the structure, as the gels include structures over the nm-lengthscale.

The figures shown below present SANS of TMOS gels (also containing acetic acid) grown in D_2O as a function of pD (adjusted with DCl or NaOD) and TMOS concentration (Rd=[D_2O]/[TMOS]). The main influence on the gel structure is whether the medium is acidic or basic (Figure 1). The fractal dimension of SANS in acid solutions is 2 and in basic solutions is 1.6, and there is a peak in the SANS in basic solutions at Q=0.02 $Å^{-1}$ (size corresponding to 314 Å). There is also a slight influence of pD (Figure 2). The fractal dimension in basic solutions at pD=10 is 1.6 and at pD=12 is 2.0. The fractal dimension relates to the interconnected structure of the gel, and the peak relates to the size of an aggregate species. Further analysis will reveal additional information about the structure of the binder gels.

These gels were studied after they were completely formed, and this has enabled structures of the final binder films to be characterized. The main interest in studying these films, however, is the way that they form, and time-resolved SANS experiments have been planned to enable the process of film growth to be fully understood.



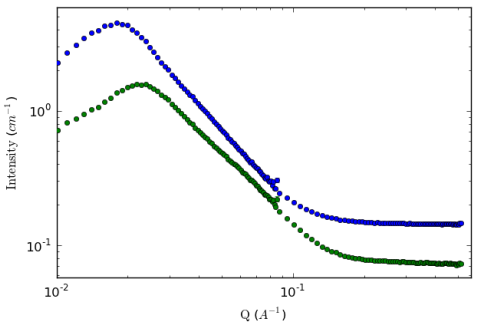


Figure 1 (left). SANS of silica gels in acid and basic media with Rd=75 (green pD=5, blue pD=4, teal pD=10, red pD=12).
Figure 2 (right). SANS of silica gels with different ratios of D_2O to TMOS (Rd) at pD=10 (blue Rd =25, green Rd=75).