Experimental Report

11/09/2013

Proposal: **9-10-1326** **Council:** 10/2012

Title: Mechanism of charging metal oxide colloids in non-polar solvents

This proposal is a new proposal

Researh Area: Chemistry

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Samples: AOT-water-alkane (cyclohexane) - inorganic particles (e.g. silica, metal oxides)

Instrument	Req. Days	All. Days	From	To
D11	1	1	14/05/2013	15/05/2013

Abstract:

The aim is to characterize the surface of charged metal oxide colloids in non-polar liquids. Surfactant is added to stabilize charges on particle surfaces, and is present as inverse micelles. Acid-base interactions, arising from proton transfer from the colloid surface to inverse micelles are one mechanism proposed for the origin of particle surface charge in non-polar solvents. Recent results of the electrophoretic mobility with metal oxide nanoparticles support this mechanism, but there have been no studies of the structure these particle/surfactant surfaces.
Contrast-variation SANS (CV SANS) will be used to determine how surfactant inverse micelles interact with model metal oxide colloids. By using deuterated surfactant (D-AOT) with associated H_2O as well as H-AOT with associated D_2O, it will be possible to determine whether proton (deuteron) transfer occurs, and if so, whether the surfactant adsorbs appreciably on the surface. By systematically varying the metal oxide type and surfactant concentration, this study will reveal any universal behavior.

9-10-1326
Title :
Mechanism of charging metal oxide colloids in non-polar solvents
Instrument :
D11
Dates of experiment :
From : 14/05/2013 To : 15/05/2013

This project involved studying the adsorption of AOT surfactants onto the surface of mineral oxide nanoparticles in dodecane. Four oxides were chosen for study: silica (SiO_2), alumina (Al_2O_3), magnesia (MgO), and zinc oxide (ZnO). As contrast-variation SANS (CV-SANS) measurements were to be performed to determine the structure of the adsorbed surfactant layer, the first step was to determine the SLD of all the nanoparticles. As the densities of the colloids were poorly known, this could only be done experimentally, by measuring $I(Q)$ in the limit of Q=0 from the Guinier approximation upon varying the solvent SLD (different H_2O/D_2O ratios). The types of curves obtained are shown in Figure 1, which is for 100 nm spherical silica particles. The following values for the SLDs were measured: silica (3.47×10^{-6} Å^{-2}), alumina (5.96×10^{-6} Å^{-2}), magnesia (7.41×10^{-6} Å^{-2}), and zinc oxide (5.43×10^{-6} Å^{-2}). From these values, contrast-matched solvents were made. However, the particles could only be dispersed at such low volume fractions that it was not possible to measure sufficient scattering intensity to determine the adsorbed surfactant layer structure, and therefore, the surface structure has not been determined.

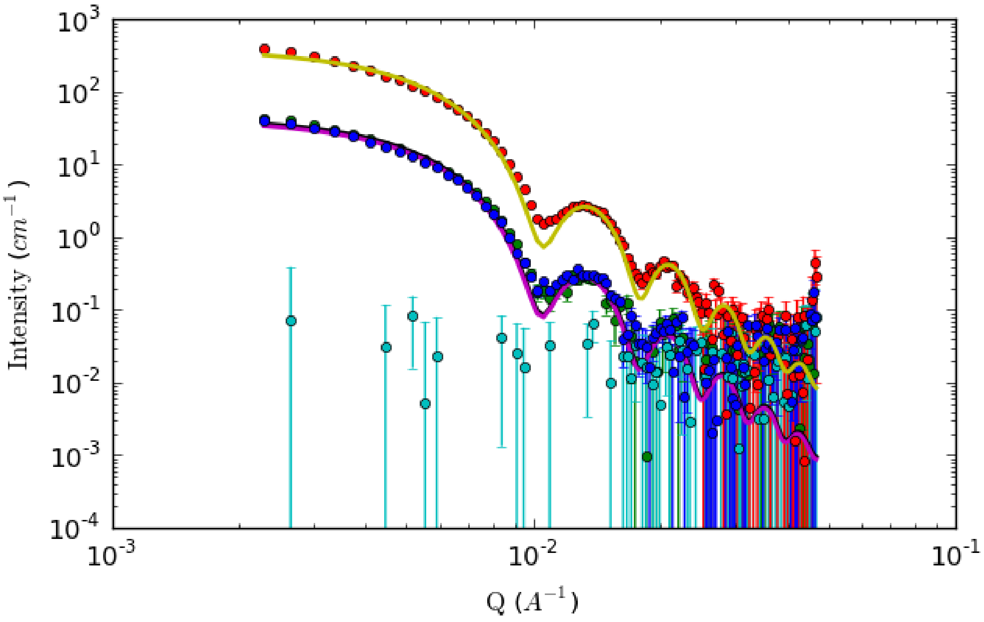

Figure 1. The scattering from 100 nm silica in H_2O/D_2O mixtures measured on D11. The lines show best fits to the data assuming monodisperse spheres, including instrumental smearing, and the radii are consistent with the expected particle size.