

Phase Equilibria and Aggregate Structures of Complexes of Surfactants and Polyelectrolytes in Water

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Introduction

Surfactants are a common product in detergents and soaps, used to decrease the surface tension of water due to its dual hydrophobic/hydrophilic nature. At different concentrations of water, they form different aggregate structures, either micellar, micellar cubic, hexagonal, lamellar, or a mixture of structures. They can also form a single phase solution or a two phase solution with the complex precipitating out. This project dealt with replacing the usual counterions with a polyelectrolyte to observe the structures and size of the structures that form. The objective was to decrease the size of the aggregate structures and to develop phase diagrams for the different mixtures.

Procedure

Two different procedures were used to make two different surfactant/polyelectrolyte complexes. The first procedure involves preparing two resins with H⁺ and OH⁻ ions. The surfactant was then washed with the cationic resin and the copolymer with the anionic resin to replace the counterions with OH⁻ and H⁺, respectively. A 0.5 mole solution of the copolymer was then created and titrated into the surfactant solution until the pH inflection point was reached.

The second procedure involved creating an acidic polymer solution to increase the number of counter ions, and then mixing it with the surfactant solution. The surfactant/polymer complex precipitates and is filtered out. The complex is re-dissolved in ethanol, re-precipitated in water, and then filtered again to eliminate the counterions. Due to difficulties with filtration and possible ethanol remaining in the complex, the procedure was repeated without re-dissolving to compare results.

Once the complexes were created, they were freeze-dried to eliminate the excess water. Samples were then made with measured quantities of complex and water.

Results and Discussion

An initial range of samples was created to give a baseline analysis of the phase sequence for the complex as water content is increased. The first complex was cetyltrimethylammonium and poly(styrenesulfonic acid-co-maleic acid) made following the first procedure. The second complex was Sodiumdodecyl sulfate and Peietox® created following the second procedure, having one sample series with ethanol and one without. Seven to eight 0.3g samples of each complex were made varying the percent of water. These were then mixed using a centrifuge. Through visual analysis and using polarized light, the number of phases and possible aggregate structures were determinable. The samples will then be analyzed using small angle x-ray scattering (SAXS). The structure is determined by the scattering pattern caused by the sample and the location of the peaks, and the size of the unit cells is determined by the relationship of the peaks (size, position, slope, etc). This analysis will be performed in September of 2006 on the samples made.

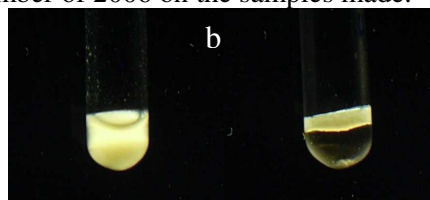


Figure 1: (a) single phase sample; (b) two phase sample

References

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