Title: Micellization behaviour of gemini surfactants in presence of ionic liquids

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Project Overview

Search for newer surfactants with greater surface activity gave birth to bis-surfactants, which were later termed as "Gemini" surfactants. Gemini are considerably more surface active than conventional monomeric surfactants. All gemini possess at least two hydrophobic chains and two ionic or polar head groups and spacers with different nature. These surfactants, because of their unique solution properties such as very low CMC, high detergency, high solubilization and high surface wetting capability, possess a wide range of applications such as in mining, petroleum, chemical, pharmaceutical and biochemical research. Gemini are also utilized as catalysts in several organic and inorganic reactions. They are also used as preservatives, anticorrosives and antimicrobial agents. Currently, gemini surfactants have also attracted attention as potential gene delivery agents.

With the growing development or application of Gemini-type surfactants, studies on mixed systems of conventional or simple surfactants with Gemini surfactants have also been increasing in the last decades. Mixed micelles that contain more than one type of surfactants are of great importance from the viewpoint of fundamental, technological, pharmaceutical, and biological research. In applied areas, mixed surfactants often perform better than a single surfactant, when used in industrial preparations and pharmaceutical and medicinal formulations, enhanced oil recovery process for the purpose of solubilization, suspension, dispersion or catalyzing functions. When two (or more) types of surfactants are in solution, a complex balance of intermolecular forces is responsible for the formation of mixed micelles.

Ionic liquids (ILs) are organic salts that are liquid at temperatures below 100 ◦C. Because of their unique chemical and physical properties, they can serve as new solvents for catalysis, synthesis and extractions and are alternatives to the use of volatile organic compounds.

Ionic liquids can be added as co-surfactants or hydrotropes to aqueous solutions of common surfactants, thus affecting the surface activity and the critical micelle concentration (CMC) of these solutions. Certain ILs self-aggregate in aqueous and non

aqueous media and can form micelles as surfactants do, due to the presence of distinct hydrophobic and hydrophilic moieties. Moreover, it was shown that ILs might form mixed micelles with surfactants. Properties of these mixed micelles often strongly depend on the surfactant/IL ratio. Therefore, the use of surfactant/IL systems make it possible to built specific properties in the organized medium. As surfactant based processes are found to be important in many fields (pollution control, conventional groundwater pump-and-treat processes, wastewater purification etc.) the possibility of controlling the structure of the organized media is promising.

The architecture of the complex, organized structures is an important point in numerous applications of micellar systems and we feel that a good understanding of this topic may induce new use of mixed surfactant/IL solutions.

Training Objectives

During the research training student will learn:

(i) Synthesis and characterization of potentially applicable gemini surfactants.
(ii) Handling novel class of solvents (ionic liquids).
(iii) Student will also gain experience in variety of techniques to monitor surface activity such as: surface tensiometry, electrical conductivity, high precision densimetry, fluorescence spectroscopy and ^{1}H NMR.

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