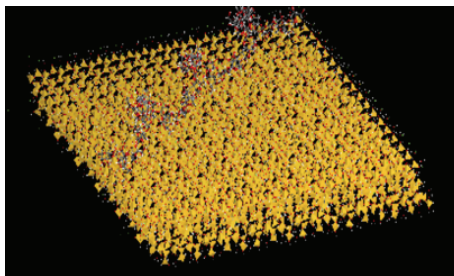


Center for Advanced Studies in Novel Surfactants (CASNS)

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Center website: <http://www.columbia.edu/cu/iucr/>

Enhanced Products to Aid Mineral Processing

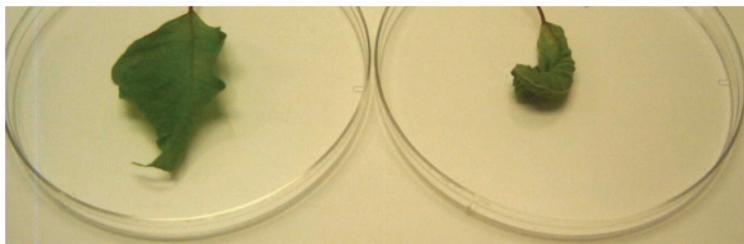


One of the business units in the sponsor chemical company develops products for use in the mineral processing and mining industries. Suppression of the mineral talc is a problem in flotation processes used in mineral separation industries. Currently, some polysaccharides are used in the industry for the depression of talc, but an understanding has been lacking of how the polysaccharides function, a knowledge that would allow the design of molecules with better efficiency. Research at the Center for Advanced Studies in Novel Surfactants (CASNS) has addressed problems related to the depression of talc

using polysaccharides. The research has provided important insights that have been used to design better molecules for this application. Based on this research the company has made and tested new polymers. Initial tests yielded promising candidates that are now in field testing. Developing a new product to commercialization can take 5 to 10 years, including all stages of toxicological and environmental testing. Such testing helps assure that the product meets specifications and satisfies all regulatory requirements. In addition to the talc studies, center students helped to develop a rapid screening technique now in use by the company to identify products that have improved processes that recover precious metals from ores. For more information, contact Dr. P. Somasundaran, 212.854.2926, ps24@columbia.edu.

Advances in Basic Science of Skin Cleansing

Fundamental research at the Center for Advanced Studies in Novel Surfactants (CASNS) on surfactant binding to proteins has benefited development of skin cleansing and skin care products at a center sponsor's main R&D center for skin research. Washing and cleansing can be a damaging process for skin, so the choice of surfactant becomes very critical in order to minimize damage. Insights on surfactant blends are critically important in deciding what kind of blends to incorporate into product formulations. One of the key factors is surfactant micelle charge density, which affects the irritation potential of surfactants. The goal is to minimize charge density up to a point, because with zero charge density, as in non-ionic surfactants, there is usually not enough lather and foam to satisfy customer demand. Formulation science focuses on how to blend components to achieve the desired balance. Fundamental work has been conducted on surfactant binding to proteins. Researchers have investigated how when protein denaturation occurs the surfactant binds, how reversible it is, and how it may be affected by variables such as cleanser pH and temperature. Insights gained from this research are being used by a center sponsor in skin cleansing and skin care products. For more information, contact Dr. P. Somasundaran, 212.854.2926, ps24@columbia.edu.



Above: Mild surfactant treated leaf after exposure to open air for 48 hours-barrier in better condition limiting water loss (left); Harsh surfactant treated leaf after exposure to open air for 48 hours-damage to barrier leads to rapid water loss (right).

Characterization of Nanostructures in Mixed Surfactant Solutions

An analytical ultracentrifugation (AUC) technique is used for the first time to quantitatively determine the nanostructures of colloid complexes in surfactant/surfactant, surfactant/phenol and surfactant/protein mixtures in solutions. This technique is nondestructive and is particularly powerful for distinguishing the size and shape of various colloidal species in solution on a nanoscale. Information on micellar size, shape and aggregation number for a sugar-based surfactant has been obtained using AUC recently. More interestingly, coexistence of two types of micelles in mixed polyethylene oxide/sugar-based surfactant has been revealed. Also micellar growth has been identified for the first time in the sugar-based in the presence of phenol. Both dynamic and equilibrium characteristics of nanoparticles, nanogels for drug-delivery, polymer-surfactant and surfactant/protein mixtures can be obtained using this technique. A number of industries, such as personal care, drugs, nano-technology, enhanced oil recovery and mineral processing can produce next generation products using information on speciation, in terms of the type, size and shape of these supramolecular structures. For more information, contact Dr. P. Somasundaran, 212.854.2926, ps24@columbia.edu.

Mechanisms of Interactions of Surfactants With Liquid Vesicles and Biomembranes

Results of research conducted at the Center for Advanced Studies in Novel Surfactants (CASNS) on membrane-surfactant interactions with simpler biomembranes such as phosphatidic acid (PA) and phosphatidyl choline (PC) liposomes using electron spin resonance and fluorescence demonstrated for the first time in the history of liposome research that one of the liposome component, (PA) exits first upon interaction with the surfactant, dodecyl sulfate (DS) causing liposome disintegration. It was also discovered that while cholesterol made the liposome more resistant towards the surfactant, protein made the liposome more vulnerable. It was also seen that protein undergoes structural reorientation in the presence of DS, with its preferential exit out of the liposome membrane, causing the liposome disintegration. These findings have significant implications for the formulation and use of consumer and drug products.

The results on the mechanisms of surfactant interaction with biomembranes help industry formulate efficient and milder personal care products. For more information, contact Dr. P. Somasundaran, 212.854.2926, ps24@columbia.edu.

Conformational Behavior of Hydrophobically Modified Polymers

Hydrophobically modified polymers have been tuned for nanodomains that can extract and deliver at will cosmetics/drugs/toxins by controlling pH, temperature or ionic strength of the system. These systems have the advantage that they have features of both the polymers and the surfactants. Due to the associative nature of the hydrophobic groups, hydrophobically modified polymers can form intramolecular nanodomains at all concentrations of the polymer and inter-molecular aggregates under different conditions. Thus, poly (maleic acid/octyl vinyl ether) forms hydrophobic nanodomains that can solubilize and release drugs, dirt etc. by changing pH, salinity and/or temperature. Changes in the size and structure of the nanodomains thus formed have important applications in rheology control, coating, delivery of actives and removal of overdose toxins. For more information, contact Dr. P. Somasundaran, 212.854.2926, ps24@columbia.edu.

Novel Polymeric Nanoparticles for Extraction and Release of Drugs and Fragrance

Nanoparticles are finding-increasing applications as effective drug/attribute delivery devices. Researchers at the Center for Advanced Studies in Novel Surfactants (CASNS) have synthesized poly (acrylic acid) and polymeric nanoparticles that successfully incorporate fragrances and antimicrobial agents into nanoparticles. Novel polyacrylamide and poly (acrylic acid) nanoparticles (20 –100nm) have been synthesized by reverse microemulsion. It was observed that 1% cross-linked poly(acrylic acid) nanoparticles could incorporate 38% of linalyl acetate added to the system in about 4 hours. The efficacy of extraction increased further when the nanoparticles were modified with hydrophobic moieties such as propyl amine and hexyl amine. The efficacy of these nanoparticles was excellent also for the extraction and release of vanillin, a flavoring ingredient for food materials and perfumes. For more information, contact Dr. P. Somasundaran, 212.854.2926, ps24@columbia.edu

