



Center for Advanced Studies in Novel Surfactants

Columbia University in the City of New York

Novel surface-active molecules for better performance and cleaner environments

*A National Science
Foundation
Industry/University
Cooperative
Research Center
since 1998*

Center Mission and Rationale

The mission of the IUCRC for Advanced Studies in Novel Surfactants (IUCS) is to establish structure-property relationships of surface-active molecules, including oligomeric and polymeric surfactants as well as bio-molecules. The aim of the Center is to develop and characterize novel surfactants for industrial applications such as coatings, dispersions, deposition, gas hydrate control, personal care products, soil decontamination, waste treatment, corrosion prevention, flotation, and controlled chemical reactions. The research focuses on the design and development of specialty surfactants, characterization of their solution and interfacial behavior, and identification of suitable industrial applications for these materials.

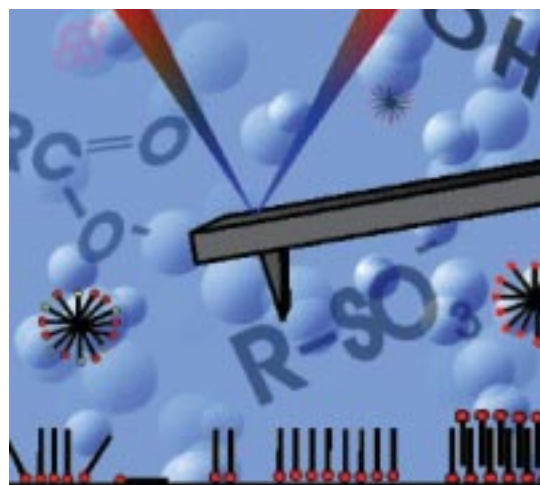
The goals of the IUCS are to:

- Perform industrially relevant research to address the technological needs in commercial surfactant and polymer systems
- Develop new and more efficient surface-active reagents for specific applications in the industry and methodologies for optimizing their performance
- Promote the use of environmentally benign surfactants in a wide array of technological processes
- Build a resource center to perform and provide state-of-the-art facilities for characterization of surface-active reagents and their equilibrium and dynamic behavior at interfaces.

Research Programs

The Center's interdisciplinary research program encompasses the interest of the faculty in the Henry Krumb School of Mines, the Department of Chemical Engineering and Applied Chemistry, and the Department of Chemistry. Some of the projects being conducted at the Center are:

- Experimental and theoretical studies on the phase behavior of mixed surfactants and surfactant-polymer systems, as commercial systems are invariably mixtures
- Interfacial behavior of environmentally benign alkyl (poly)glucoside surfactants
- Surfactants and polymers for dispersion/flocculation and deposition of particulate matter
- Studies on the interactions of surfactants with bacteria and biosurfaces
- Development of spectroscopic methods for determination of molecular, micro-, and nano-structures at interfaces.



Probing of the interfacial microstructure

- Exploration of new microgels and their applications in aqueous systems
- Studies on the surface and colloidal properties of novel surface-active solvents such as the alkyl pyrrolidones; these have shown interesting potential for flocculation of coal dispersions
- Investigation of surfactant clusters for control of chemical reactions in polymerization, crystallization, habit formation, corrosion, and electrodeposition
- Probing the interactions of DNA, dendrimer, and membrane using fluorescence techniques
- Interfacial behavior of hydrophobically modified polymers, dual polymers, and polymer-surfactant systems
- Photochemistry and magnetic resonance spectroscopic probes of supramolecular structures and migrational pathways of organic molecules absorbed on zeolite.

Sponsors

The faculty members of the IUCS have a strong record of industrial collaboration. Joint research with industry is encouraged at all levels. The Center professors have active collaborations with more than a dozen U.S. companies and with research institutions in France, Germany, Bulgaria, Italy, India and Australia.

Facilities

The IUCS researchers have access to facilities in the colloid and interfaces laboratories at Columbia University. These laboratories are well equipped with Atomic Force

Microscope (AFM), Quartz Crystal Microgravimetry (QCM), Surface Plasmon Resonance (SPR), Fourier Transform Infrared (FTIR) spectrophotometer, fluorescence spectrophotometer, microcalorimeter, surface area analyzer, scanning electron microscope–energy dispersive X-ray fluorescence (SEM-EDX), inductively coupled plasma (ICP) spectrophotometer, UV/visible spectrometer, instrumented flotation machines, particle size analyzer, Du Nuoy and Wilhelmy and spinning drop tensiometers, high performance liquid chromatograph (HPLC/GPC), electron spin resonance spectrometer (ESR), Brookefield viscometer, Brookhaven photon correlation spectroscopy (PCS), analytical balances, Analytical Ultracentrifuge, and Zeta meters. The polymer science laboratories used by the Center include modern facilities for polymer synthesis, a Cesium 137 gamma irradiator, light scattering, differential scanning calorimetry (DSC), FTIR and UV spectrophotometry. Nuclear magnetic resonance (NMR), ESR and Mass spectrometers are situated in the Department of Chemistry. Transmission and scanning electron microscopes and X-ray diffraction facilities exist within the Henry Krumb School. Atomic absorption and ion chromatography are used for monitoring the concentration of electrolytes. Polymeric materials are examined by impact hammer and instron testing facility. Laboratory extruders, melt blenders, and injection molding apparatus are also present. The processing laboratory has, in addition to carver presses, a large Tetrahedron temperature and pressure programmable 24-ton press. Several electrobalances are available for diffusion studies in glassy media. In addition a fully equipped optical laser bench is used to measure diffusion rates by interference methods. The laboratories are equipped with a wide range of optical microscopic apparatus (transmission and reflection, polarized and interference) together with computer-assisted particle size analysis facilities.

Center Headquarters

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