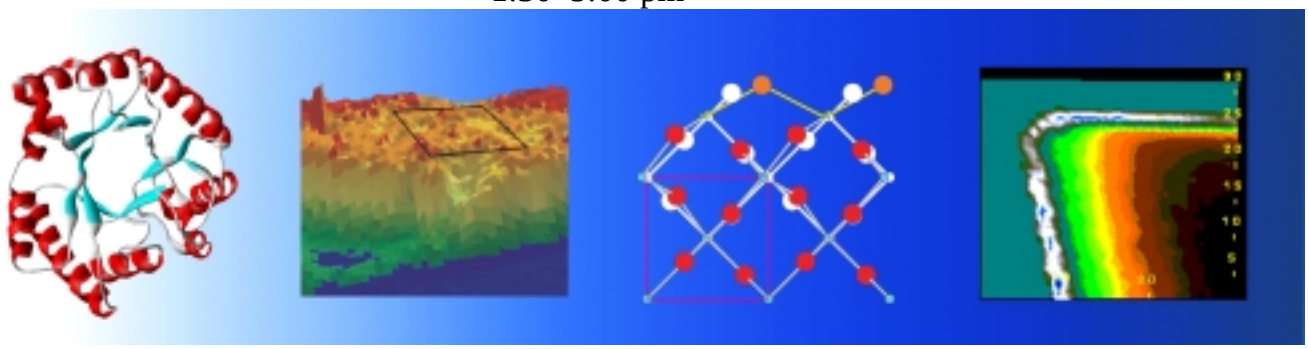
Workshop 5: Small-angle X-ray Scattering—Applications & Techniques

Gabrielle Long, organizer

Thursday, October 11, 2001
1:30–5:00 pm



Small-angle x-ray experiments at third-generation x-ray sources offer a broad range of quantitative micro- and nanostructural measures of polymeric, biological, geological, metallurgical, and ceramic materials of high current interest. Studies in many of these areas, which are now performed *in situ*, were previously either impractical or not accessible at all. This workshop will include presentations of recent accomplishments and novel applications of the technique, as well as recent advances in instrumentation and analysis.

1:30–2:00 pm **Structural Development during Processing of High-strength Fibers**
Ben Chu, *State University of New York / Stony Brook*

2:00–2:30 pm **The Dynamics of Colloids, Polymers, and Polymer Thin Films Studied by Coherent SAXS Techniques**
Simon Mochrie, *Yale University*

2:30–3:00 pm **Ultra-small-angle X-ray Scattering Studies of Anisotropic Ceramic Materials**
Andrew Allen, *National Institute of Standards and Technology*

3:00–3:30 pm **Refreshments**

3:30–4:00 pm **Anomalous Small-angle X-ray Scattering from an Operating Rechargable Li Ion Battery Cell**
P. Thiyagarajan, *Argonne National Laboratory*

4:00–4:30 pm **Time-resolved Small-angle Scattering Studies of RNA Folding**
Lisa Kwok, *Cornell University*

4:30–5:00 pm **Evidence for Elongated Ionic Clusters in Poly-Perfuorosulfonic Acid Membranes**
J. David Londono, *DuPont Central Research*

Structural Development during Processing of High-strength Fibers

Ben Chu, S*tate University of New York / Stony Brook, Stony Brook, NY 11794 USA*

The structure and morphology of spun polymer fibers are highly dependent on the spinning conditions used during processing. Microstructure changes in the filament that develop in response to conditions between the spinneret and the take-up device can often determine the filament's mechanical performance. For high-strength fibers, a variety of spinning processes have been developed, including melt spinning, gel spinning, and drawing of fibers after the initial spinning process. The lecture will emphasize structural development during the gel spinning of poly-p-phenylenebenzobisoxazole (PBO) by means of small-angle x-ray scattering and wide-angle x-ray diffraction.

The Dynamics of Colloids, Polymers, and Polymer Thin Films Studied by Coherent SAXS Techniques

Simon Mochrie, *Yale University, New Haven, CT 06521 USA*

The emerging technique of x-ray photon correlation spectroscopy will be introduced. Applications to the dynamics of concentrated colloidal suspensions, binary polymer blends, block copolymers, and polymer surfaces will be described.

Ultra-small-angle X-ray Scattering Studies of Anisotropic Ceramic Materials

Andrew Allen, *National Institute of Standards and Technology, Gaithersburg, MD 20899 USA*

Ultra-small-angle x-ray scattering (USAXS) at a third-generation synchrotron source offers a new window for materials microstructure characterization in the physically important size region from nanometers to micrometers. Previously available only for homogeneously distributed microstructures, the large size range has recently become available for anisotropically distributed materials as well. The development of a practical anisotropic USAXS capability will be described using examples from textured ceramic materials and ceramic coatings.

Anomalous Small-angle X-ray Scattering from an Operating Rechargable Li Ion Battery Cell

P. Thiyagarajan, *Argonne National Laboratory, Argonne, IL 60439 USA*

Anomalous small-angle x-ray scattering (ASAXS) offers contrast variation that enables the separation of species-specific structures. In this talk, ASAXS for the *in situ* characterization of a rechargeable Li battery cell will be presented, as well as a description of potential applications in other areas of materials science.

Time-resolved Small-angle Scattering Studies of RNA Folding

Lisa Kwok and Lois Pollack, *Cornell University, Ithaca, NY 14853 USA*

Time-resolved small-angle x-ray scattering, combining microfabricated continuous flow cells with pink beam, had earlier been applied to the study of protein folding. In this talk we discuss the extension of this technique to studies of RNA folding. Folding of the *Tetrahymena* ribozyme will be discussed.

Evidence for Elongated Ionic Clusters in Poly-Perfuorosulfonic Acid Membranes

J. David Londono, R. V. Davidson, and S. Mazur, *DuPont Central Research, Wilmington, DE 19880 USA*

Poly-perfuorosulfonic acid (PFSA) contains about 15 mol % of ionic side-groups, where sulfonate groups segregate from the nonpolar matrix forming ion rich domains or clusters. These clusters have an important effect on the properties of this material. Standing questions pertain to the shape of the clusters and the distribution of clusters within the crystalline and amorphous phases. In contrast to a widely accepted spherical cluster network model, there is ample evidence for polar sulfonic acid domains that are locally planar and parallel. This talk will include results from swelling and deformation data to demonstrate the existence of elongated domains and to show that after moisture uptake by an initially dry unoriented sample has ceased, there is a prolonged period of reorganization. The results suggest that spherical water droplets migrate and coalesce to conform to the shape of the lamellar ionic domains. In addition, clusters may be present in the amorphous and crystalline phases.