New Advances in Fiber Diffraction using Neutrons

Paul Langan

Understanding the structure, dynamics and properties of fibrous systems is an important research challenge that has been addressed in the past using both X-ray and neutron diffraction and scattering. The scope of fiber diffraction is broad. Fibers consist of structural aggregates that are preferentially aligned along a particular direction, called the fiber axis, but have random orientation about this direction. Fibers occur naturally in forms including amyloid plaques, muscle tissue, and plant fibers but they can also be prepared by orienting polymers and polymeric assemblies such as DNA and filamentous viruses, as an alternative to crystallization. Synthetic polymers that are oriented during processing have fiber properties. Many materials and composites have fibrous characteristics that are important for their properties. Although X-ray diffraction is usually the technique of first choice to characterize fibrous systems, an important advantage of neutron diffraction is that neutrons are highly sensitive to H and can therefore reveal direct information about hydrogen bonding, solvation and hydration. Neutron scattering can also be used spectroscopically to provide information about dynamics. Further, the difference between scattering from H and D enables the use of D labeling to highlight specific components of complex multicomponent fibrous systems. In this presentation, recent applications of neutron diffraction to fibrous systems will be discussed and the technical developments that will enable new types of experiments that are presently not possible will be discussed.