

Recent Developments at the Biological Small-Angle Neutron Scattering Instrument (Bio-SANS) at Oak Ridge National Laboratory

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The Center for Structural Molecular Biology (CSMB) at Oak Ridge National Laboratory (ORNL) is a national user facility funded to support and develop the user access and science research program of the Biological Small-Angle Neutron Scattering (Bio-SANS) instrument at the High Flux Isotope Reactor (HFIR). The Bio-SANS instrument is ideally suited for studies of biomacromolecules including proteins, DNA/RNA, lipid membranes and other hierarchical complexes. Bio-SANS has a diverse range of sample environment capabilities for the studies of biological systems. These include a pressure cell to monitor chemical reactions in situ such as biomass pretreatment studies, a multi-position sample holder with rotational (tumbling) capability especially useful for studying suspensions, a humidity-controlled chamber critical for membrane studies and a flow cell for systems that partition to multiple phases (e.g. microemulsions) with additional capability of flowing one or two phases during measurement. We have developed a series of new sample environment capabilities that open new opportunities for the studies of biological systems. A robotic sample changer sample environment has been installed that supports measurement of a range of sample types including solutions, suspensions, powders, and solid materials. It can maintain samples during storage (up to 58) in a desired temperature range between 10 – 70 °C. A Peltier heating block at the sample position allows rapid temperature change between 10 – 100 °C for in operando measurements. Another example is combined size-exclusion chromatography – SANS for fractionation of biomacromolecules in beam. A novel aspect of this capability is the ability to perform continuous flow measurements as well as fractionation of complex mixtures of biomacromolecules. Other improvements to Bio-SANS include a new data acquisition system and a data reduction program that allows wedge-reduction for anisotropic systems such as biomass, and the ability to time-slice data files for analysis of time-resolved SANS measurements. In addition, the Bio-SANS detector system is currently being upgraded to include an additional mid-range detector bank that will greatly benefit time-resolved measurements of a variety of biological systems.

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