XAS: X-RAY ABSORPTION SPECTROSCOPY FOR BIOLOGICAL, ENVIRONMENTAL, AND ENERGY SCIENCES

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BEAMLINE CAPABILITIES

X-ray absorption spectroscopy beamline emphasizing studies of dilute samples from biological, environmental, and energy sciences-related fields.

- 3-pole wiggler source in the 5-25 keV energy range; provides continuity of service and expanded capabilities for an extensive, highly-productive user community.
- Enables EXAFS/XANES studies of dilute (<100 µM) samples.
- Sagittally focusing monochromator providing flexible beam size & tunable flux density (~0.2mm x 0.5mm to 2mm x 10mm, maintaining flux), with modern 31-element (or better) solid state Ge fluorescence detector.
- Multiple endstations (cryogenic, in situ, high throughput) with rapid changeover capabilities.
- Will be the #1 facility of its kind in the US and only such facility on the East Coast

APPLICATIONS

Time-Resolved RFQ XAS
Flux and detector capabilities will further enable XAS studies of dilute samples from time-resolved freeze-quench trapping of very short-lived intermediates formed during enzyme reactions, providing new chemical insights.

(above) Time-resolved XAS spectra of TNFα converting enzyme during catalysis.

HT XAS for Systems Biology
High throughput (HT) determination of the metal content of fractionated biological materials and proteins from large scale proteomic and metabolic studies will be feasible, including detailed XAS studies of metalloproteins identified from HT screening efforts.

(above) Metabolic pathways in P. furiosus

In Situ Studies of Biological Catalysis
Increase scope of in situ studies of enzymes, including probing structure-property relationships for metalloproteins with electro-active sites through tandem XAS and electrochemical experiments.

(above) In situ electrochemical/XAS studies of laccase in the presence of Ar or O₂ carried out at NSLS X3B.

ADDITIONAL INFORMATION

Many elements of the highly utilized and successful NSLS X3B beamline endstation will be implemented and further improved upon at the completed NSLS-II XAS beamline (see photos at left). These include cryogenic multicell sample holders, an automated high-throughput metal screening apparatus with space for 220 samples, and an advanced 31-element solid-state germanium fluorescence detector that is currently being commissioned at NSLS X3B.

With its focus on studies of dilute samples in biological, environmental, and energy sciences fields, XAS will fill an important niche within the community of X-ray absorption spectroscopy beamlines that have been approved for NSLS-II, while exhibiting synergy with numerous life-sciences oriented beamlines that comprise a “Biology Village”.

Solomon et al. (2007) PNAS USA 104, 4931

T.M Arruda et al., Ph.D. dissertation, Northeastern University

Prof. Robert Scott, University of Georgia, personal communication