INNER-SHELL SPECTROSCOPY (ISS)

BROOKHAVEN NATIONAL LABORATORY

NATIONAL SYNCHROTRON LIGHT SOURCE II

Inner Shell Spectroscopy (ISS) is a damping wiggler beamline at sector 8-ID providing world-leading XAS facilities with fast scanning capability in a wide energy range. The key instrument at ISS is a sample chamber which integrates detection system and sample environment allowing high detection efficiency and exceptional opportunities to develop *in-situ* and *operando* experiments for catalysis, battery research and material growth applications.

BEAMLINE CHARACTERISTICS

TECHNIQUES:

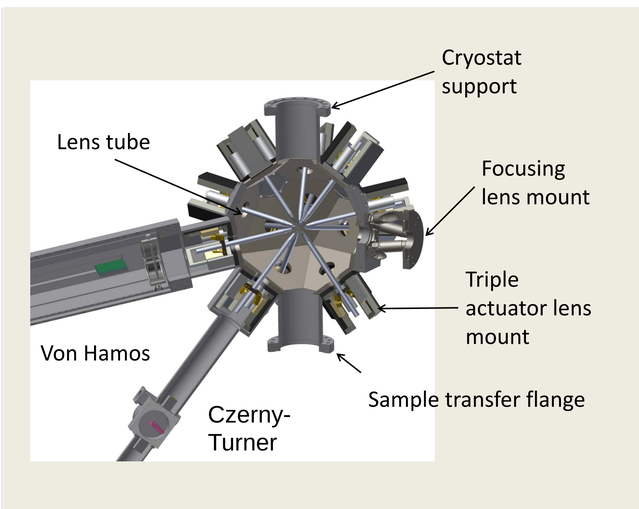
- X-ray Absorption Spectroscopy (XAS)
- X-ray Emission Spectroscopy (XES)
- X-ray Energy Loss Spectroscopy (XELS)

ENDSTATION DETAILS:

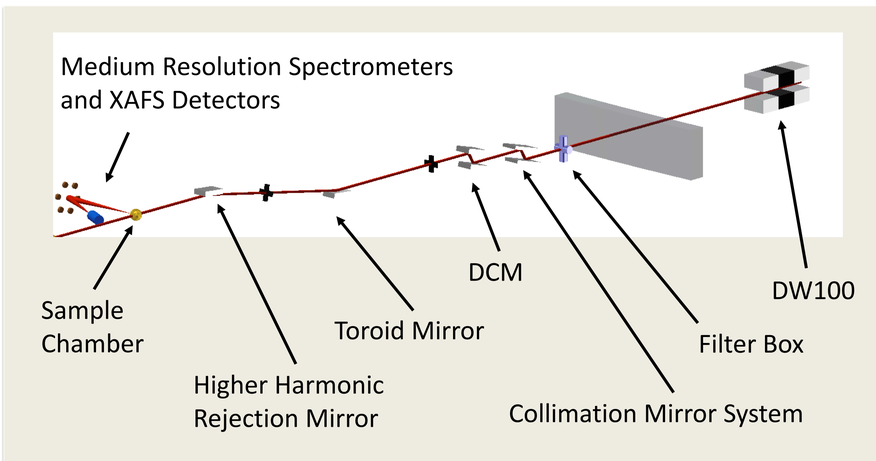
- Sample environment with integrated detection system
- Elaborated gas handling system allowing fast switching
- Automatic sample handling

ISS at NSLS-II:

- Will enable XAS measurements on dilute and ultra-dilute samples.
- Will allow high throughput experiments with dedicated sample environments for catalysis, battery research, and materials growth applications.
- A novel sample environment in combination with optimized photon delivery system allows fast scanning (QEXAFS compatible)



Detail of the sample chamber system: The system will have 19 ports which will be equipped with silicon drift diodes and with medium resolution spectrometers



Beamline layout showing the key components of the ISS beamline

Overview

PORT: 8-ID
SOURCE: Damping Wiggler (2x DW100)
ENERGY RANGE: 5 –36 keV
ENERGY RESOLUTION: $\Delta E/E = 10^{-4}$
SPATIAL RESOLUTION: 25 μm
CONSTRUCTION PROJECT: NEXT
BEAMLINE STATUS: Construction
AVAILABLE TO USERS: Fall 2016

Beamline Team

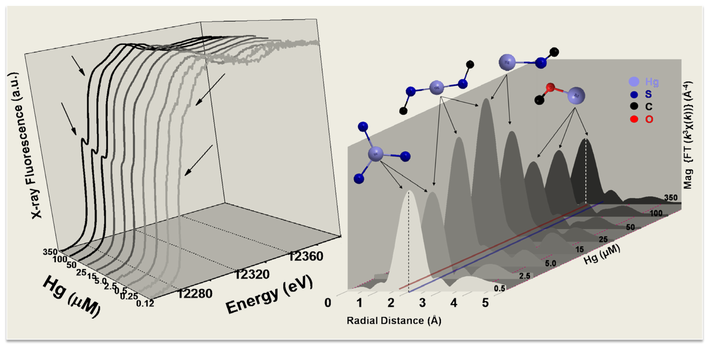
STAFF

Klaus Attenkofer: lead beamline scientist
Eli Stavitski : beamline scientist
William Loo: mechanical engineer
Cindy Longo: designer
Sung-Leung So: controls engineer

ADVISORS

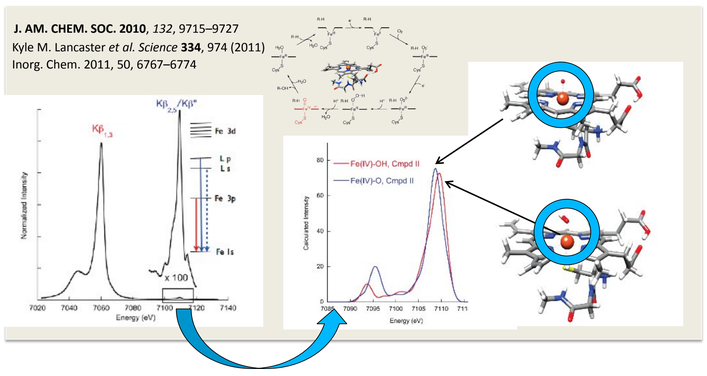
Bruce Ravel (NIST)
Serena DeBeer (MPI Bioanorganische Chemie)
Bruce Bunker (University of Notre Dame)
Andy Dent (Diamond)
Shelly Kelly (UOP)
Jose A. Rodriguez (BNL)
Joseph Woicik (NIST)

SCIENTIFIC APPLICATIONS



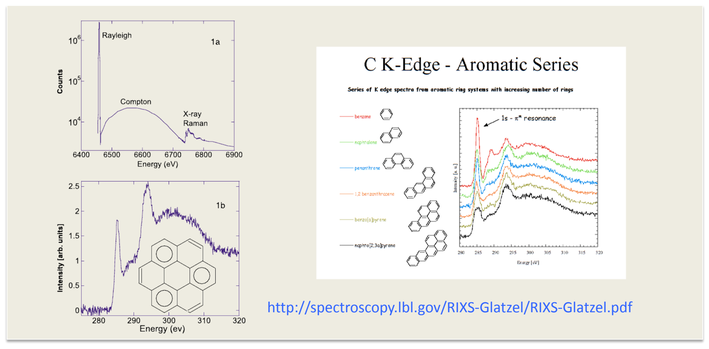
Low concentration XAS

Understand the interaction of Hg with bacterial cell surfaces: The Hg L_{III} edge XAS analysis showed that Hg complexes entirely with sulfhydryl groups at the nanomolar and low micromolar concentrations, and with carboxyl sites at high micromolar concentrations. This example shows the importance of low concentration measurement capabilities.



X-ray Emission Spectroscopy (XES)

Methane monooxygenase (MMO) is an ideal systems for time-resolved, dispersive XES studies. The transformations can be monitored on ms time scale in a stop-flow arrangement, as a function of spin state at the iron (Kβ main line), and changes in ligand/substrate binding (valence core region).



X-ray Energy Loss Spectroscopy (XELS)

XELS offers an enticing approach to collect spectroscopic information in the hard X-ray regime otherwise restricted to conventional soft X-ray spectroscopy. Since a hard X-ray probe is used, XELS is compatible with many *in situ* sample environments, opening soft X-ray spectroscopy to operating batteries, controlled atmosphere environments, and more.