INNER SHELL SPECTROSCOPY (ISS)

BROOKHAVEN NATIONAL LABORATORY

NATIONAL SYNCHROTRON LIGHT SOURCE II

SCIENTIFIC SCOPE

The Inner Shell Spectroscopy (ISS) beamline is a high flux damping wiggler beamline at sector 8-ID providing high throughput and high energy resolution hard X-ray spectroscopy. It will offer a suite of in-situ and operando setups which can be combined with various spectroscopic tools probing the structural and chemical changes during materials growth and energy conversion or storage. Fast scanning monochromators, high flux, and an integrated gas handling system provides a fast probe of the chemical state matched to the dynamics of reaction and growth reactors.

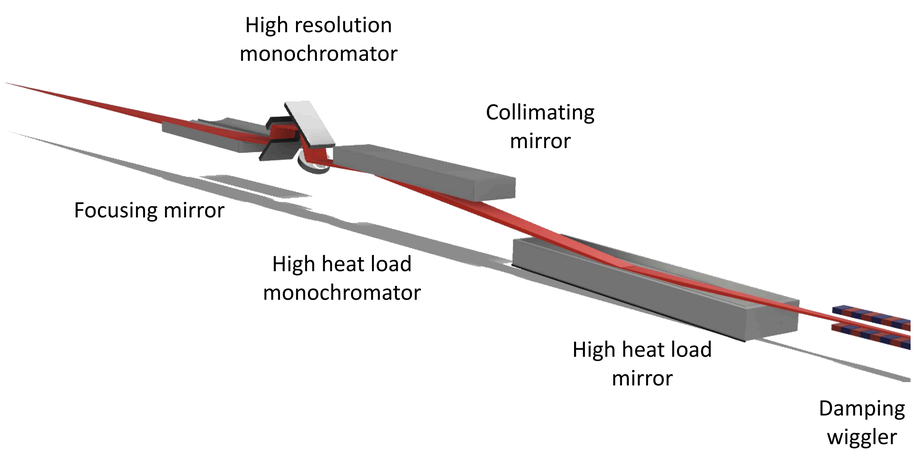
BEAMLINE CHARACTERISTICS

TECHNIQUES:

- High throughput transmission and total fluorescence XAFS/EXAFS with typically 10s acquisition time per sample.
- High throughput partial fluorescence XAFS/EXAFS with typically 3 min acquisition time per sample.
- Dedicated operando setups for battery, fuel cells, and atomic layer growth reactors.
- Fast-switching gas handling system providing a wide range of gases (O_2, NO_2, H_2, CH_4, C_2H_6, NH_3, CO, silane, phosphine, arsine, CO_2, N_2, He).
- Additional four temperature-stabilized liquid sources allowing a wide range of metallo-organic compounds.

ISS at NSLS-II:

- High-throughput analysis will be intgrated into fast-pace material development pipeline for battery and fuel cell applications
- Operando spectroscopic analysis of energy materials will allow improving the efficiency of energy conversion and storage
- High-resolution X-ray spectroscopy will allow elucidating fine details of catalytic and enzymatic reactions



ENDSTATION DETAILS:

- Ambient or controlled gas environment
- Sample temperature control
- Sub-millimeter to 25 µm spot size

Overview

PORT: 8-ID

SOURCE: Damping Wiggler (2x DW100)

ENERGY RANGE: 4.9 – 36 keV

ENERGY RESOLUTION: $\Delta E/E = 10^{-4}$-10^{-5}

Beam Size: 60x3 mm, 700x100 µm (standard), 40µm^2

BEAMLINE STATUS: Open to users

BEAMLINE PHONE: 631.344.1408

BEAMLINE WEBSITE: www.bnl.gov/nsls2/beamline/8-ID

Beamline Staff

Klaus Attenkofer
Lead Beamline Scientist

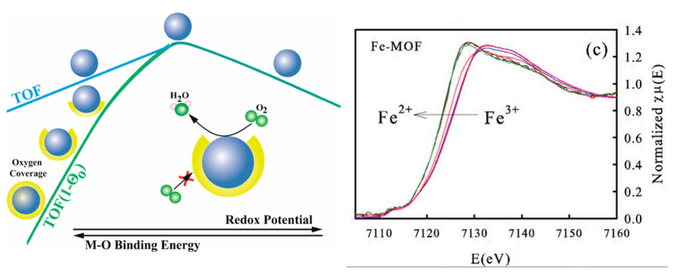
Eli Stavitski
Beamline Scientist

Apply for Beam Time

Beamlines at NSLS-II are available to all scientific researchers through a peer-review proposal process. For more information, see the NSLS-II Users' Guide at:

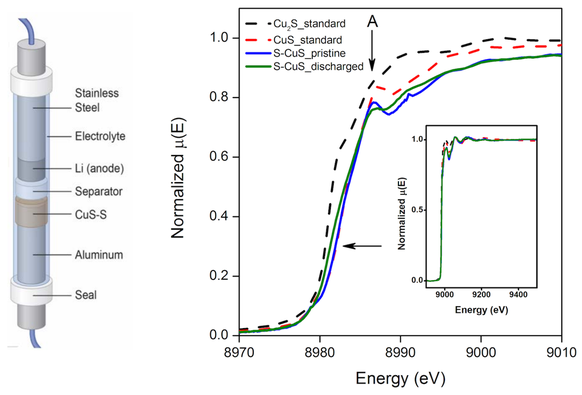
www.bnl.gov/ps/userguide/

SCIENTIFIC APPLICATIONS

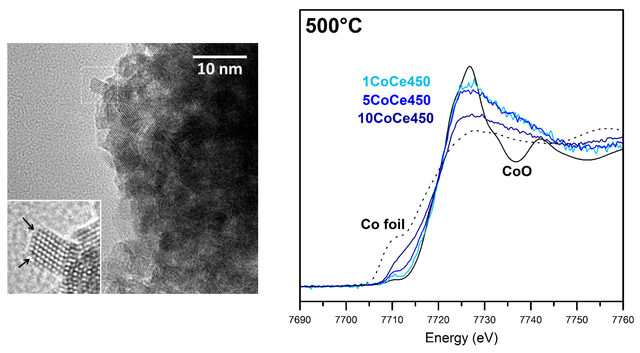


Jia et al., JACS 2017

Accelerating oxygen reduction reaction (ORR) is key to the commercialization of the fuel cell technology. Operando XAS study of the working electro-catalyst delivers information on its chemical state during the process, allowing for optimization of its chemical composition and surface reactivity



Battery performance is determined by multiple simultaneous chemical processes occurring in a working device. ISS will allow in situ element-specific measurements to establish the degradation mechanisms and find the pathway to prevent battery failures.



Understanding complex transformations behind heterogeneous catalytic reactions is critical to improve their efficiency and develop new energy conversion routes. XAS at ISS coupled with controlled sample environment allows to study catalytic systems under industrially relevant conditions