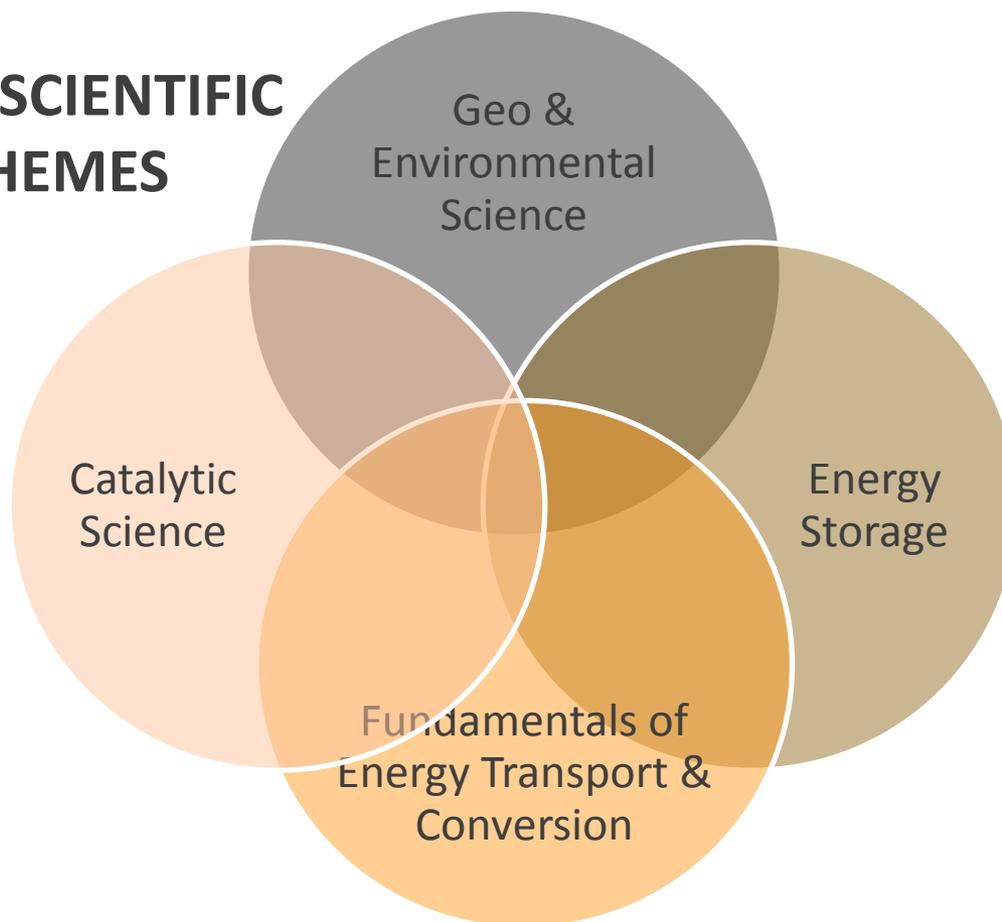


Chemical Sciences - Strategic Plan

THE GOAL: To provide state-of-the-art facilities and instrumentation that contribute to the understanding and control of chemical processes in complex environments

FOUR SCIENTIFIC THEMES

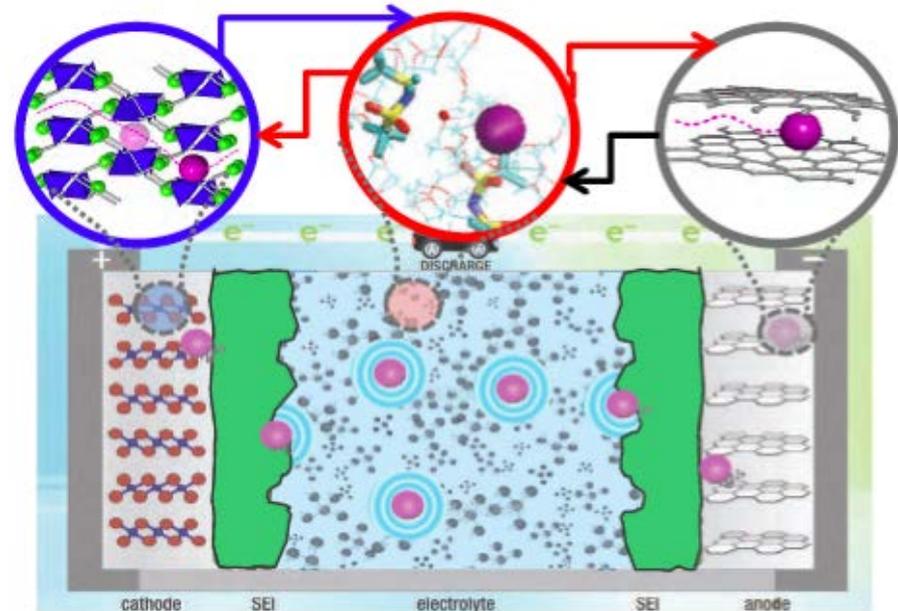


Energy Storage Research

Can we understand and control interacting phenomena in electrochemical systems?

*Electrochemical Systems are Complex
Across both Length and Time Scales*

- Interfacial chemical reactions
- Solvation dynamics
- Ionic and electronic transport in solids
- Phase transformation and morphology evolution



APS provides unique characterization tools that span multiple length & timescales.
PDF, SAXS, Diffraction, Imaging & Tomography



Beyond Li Ion
5x performance (energy density)
5x cheaper

Catalysis

Can we understand the mechanism and dynamics of catalytic transformation in order to design and synthesize efficient catalysts?

Comprehensive Capabilities:

Four sectors with a suite of in-situ techniques including X-ray scattering and spectroscopy:

9-BM (XAS)

10-ID (XAS)

11-BM (Hi res powder diff)

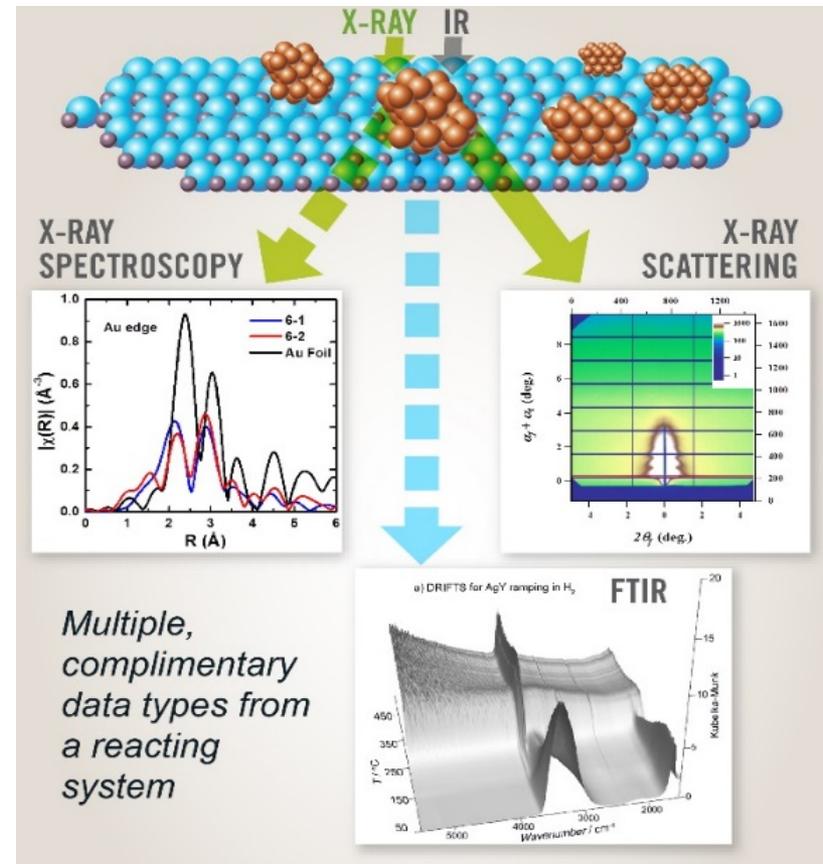
11-ID-B,C (PDF)

11-ID-D (time resolved)

12-BM (XAS, SAXS)

12-ID-B, C (SAXS, WAXS, and GISAXS)

Upgraded, Upgrading



Fundamentals of energy transport & conversion

Can one control energy and charge transfer at the level of electrons, atoms & spins?

Pump-Probe:

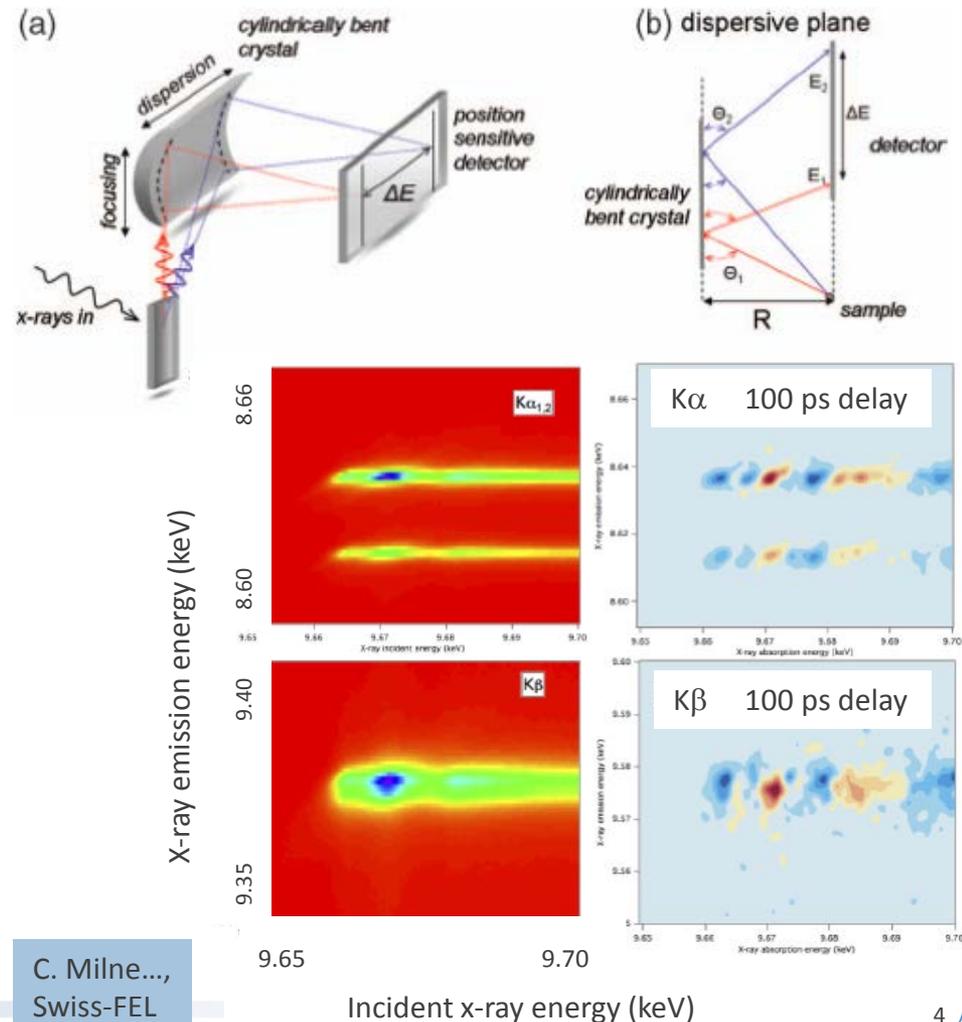
Ultrafast coherent excitation followed by x-ray probe yields individual molecule/system response on 100 ps timescales

APS is uniquely suited due to time structure of storage ring.

Unique suite of excitation and probe capabilities – from terahertz to UV with XES, XAS, XDS, nanodiffraction (7-ID, 11-ID, 14-ID)

High-repetition-rate excitation sources permit characterization of transient states with fidelity comparable to ground states.

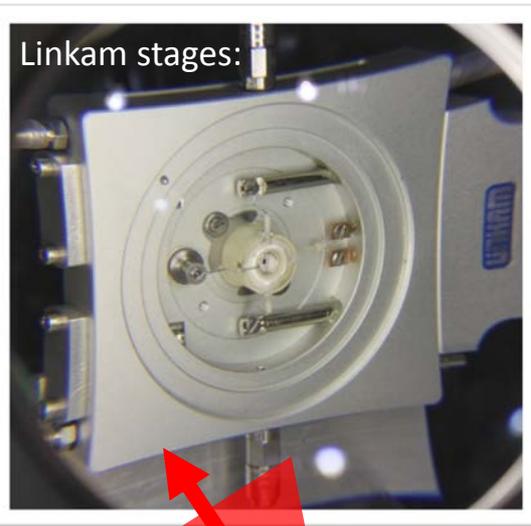
Time-resolved RIXS on ZnO nanopartilces



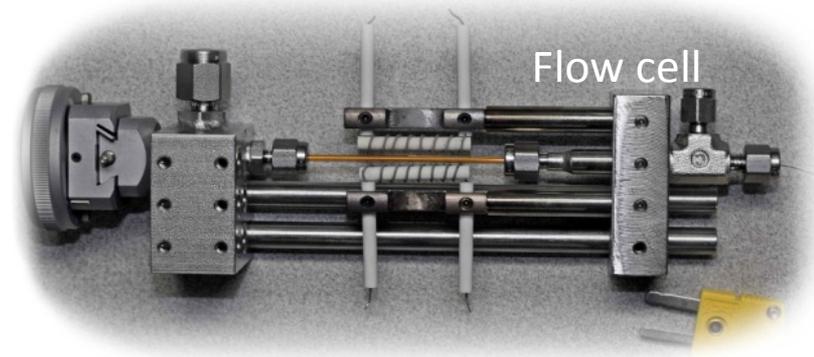
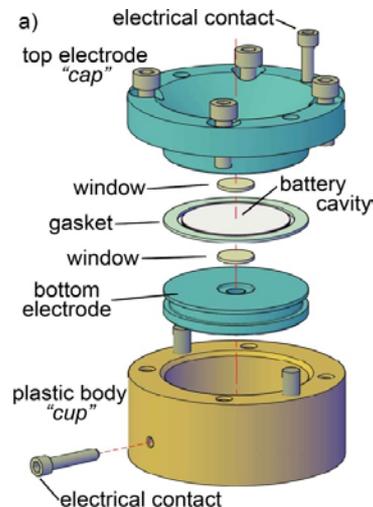
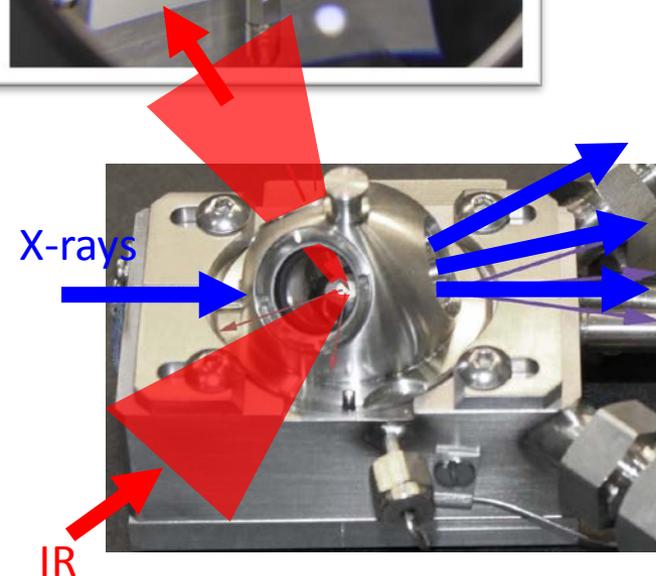
C. Milne...,
Swiss-FEL

Sample Environments

A CRITICAL INVESTMENT FOR ENABLING SCIENCE

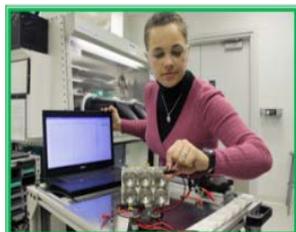


- Sample environments are key to enabling new science
- Commercial solutions are rarely, if ever, available (and often the X-ray measurements are compromised)
- In house development of sample environments are needed and are most effective when combining
 - A key scientific question
 - Engineering support
 - Beamline staff testing



Chemical Sciences Cluster

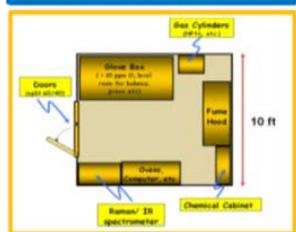
*SPECIALIZED LAB-BASED SAMPLE ENVIRONMENT PREPARATORY FACILITIES AND
COMPLEMENTARY ONLINE DIAGNOSTICS*



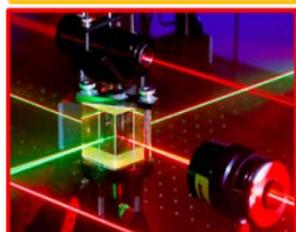
Electrochemistry
Lab



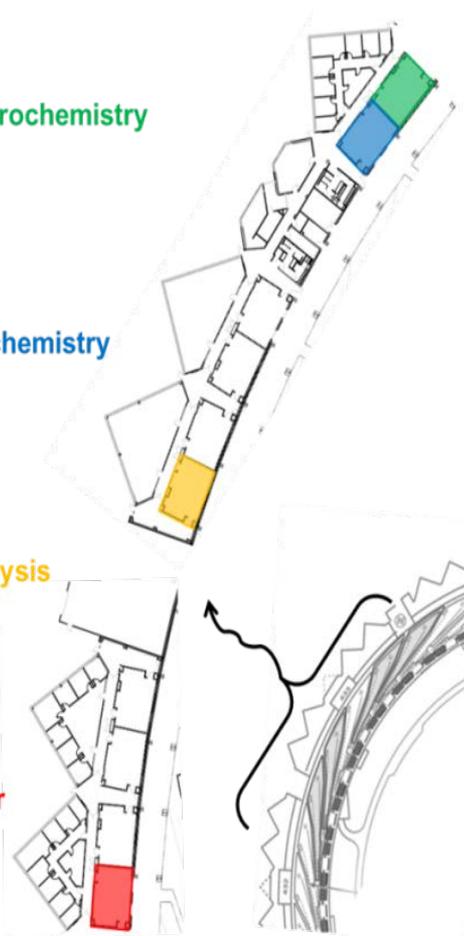
Geochemistry
Lab



Catalysis
Lab



Laser
Lab



Chemical Sciences Plan

INVESTMENTS THAT ENHANCE CAPABILITIES & BROADLY IMPACT ALL AREAS

■ 3 year outlook

- Establish a *Chemical Sciences Cluster*
- Support the development of combined measurements
 - Distributed access Raman spectrometer
- Provide support for Sample Environments
 - Standardized catalysis & energy storage chambers (Reactor Design Exchange)
- Add capacity: high-energy scattering @ 17-BM
- Add capabilities: Quick-XAS @ 9BM
- Develop novel high-resolution large-solid-angle emission spectrometers

■ MBA Upgrade

