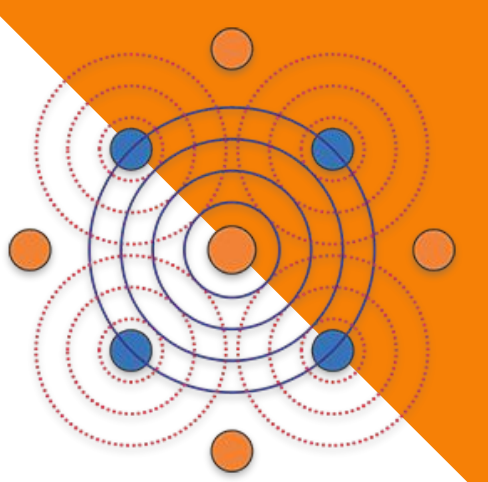


*easy*XAFS

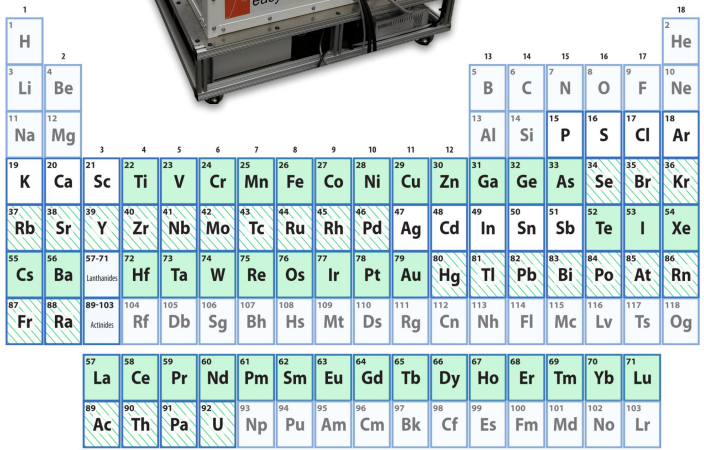
XAFS every day in every lab. Globally.

International Workshop on Laboratory-Based Spectroscopies
October 2024

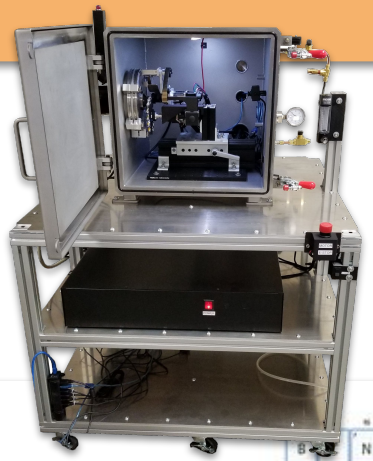
Devon Mortensen devon@easyxafs.com

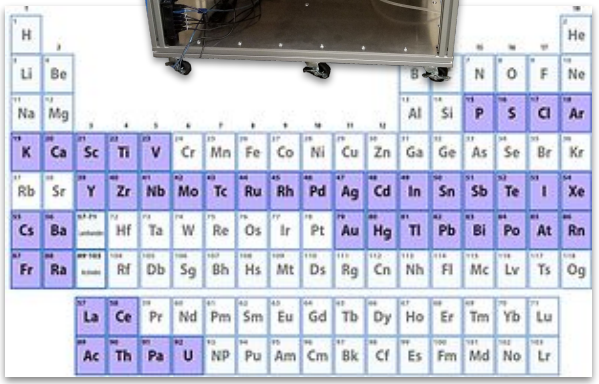
easyXAFS

easyXAFS Spectrometers



Hard X-ray (4.5-25* keV)
XAFS and XES





Tender X-ray (2-5 keV)
XES only

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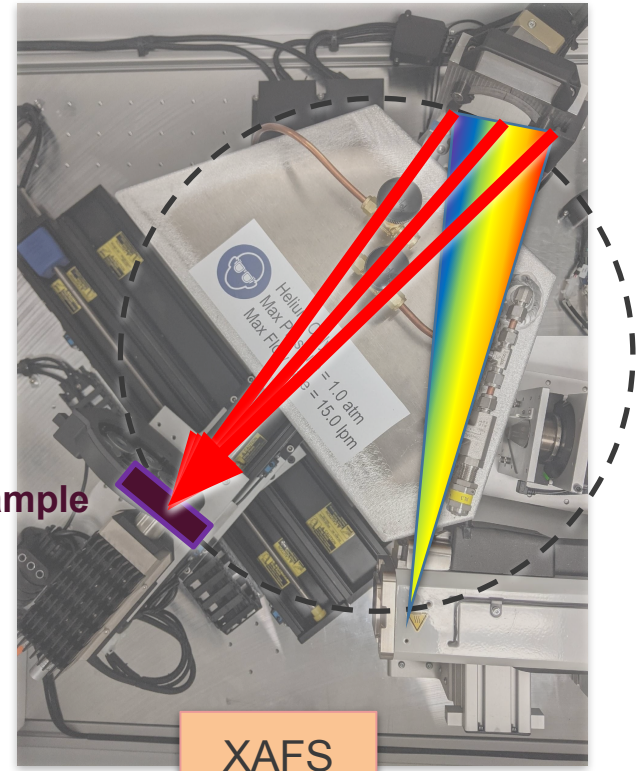

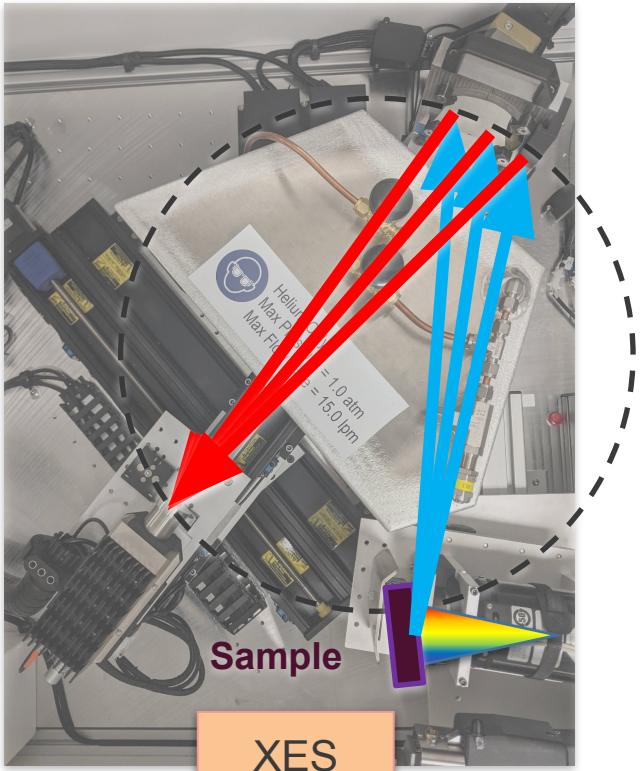

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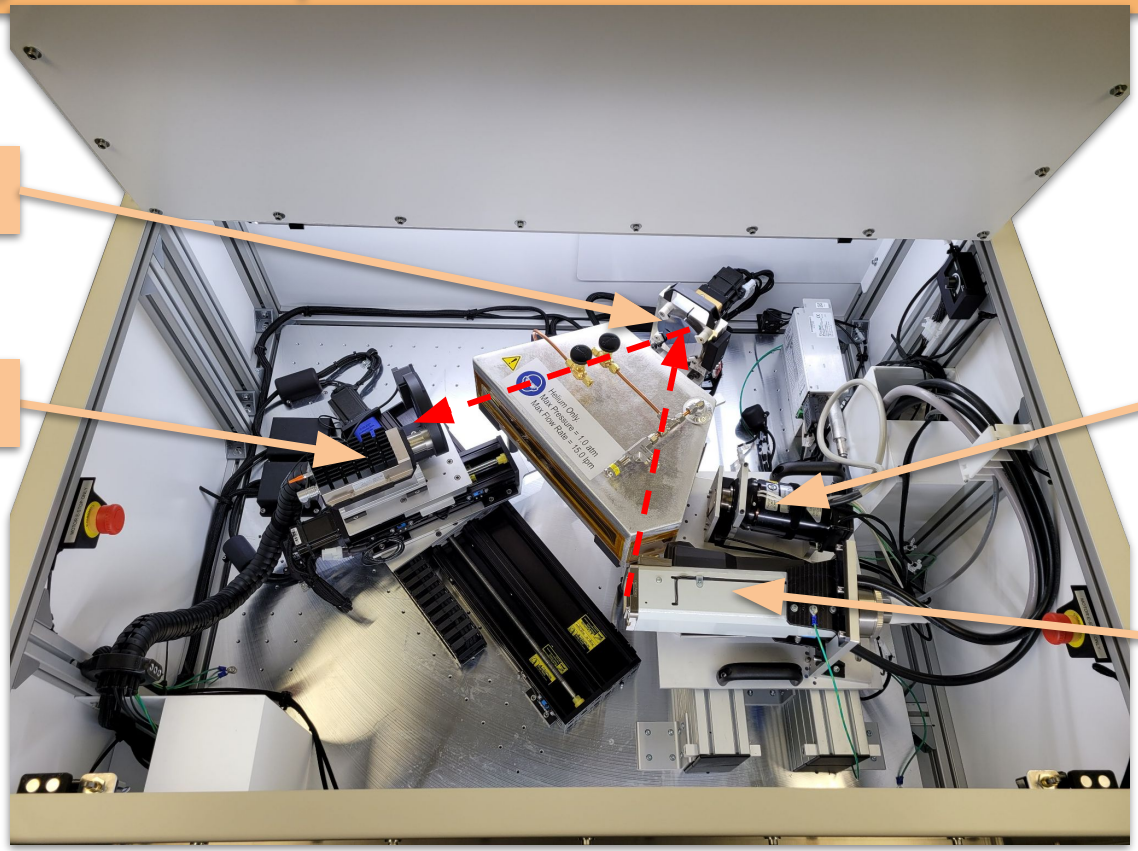
easyXAFS Spectrometers



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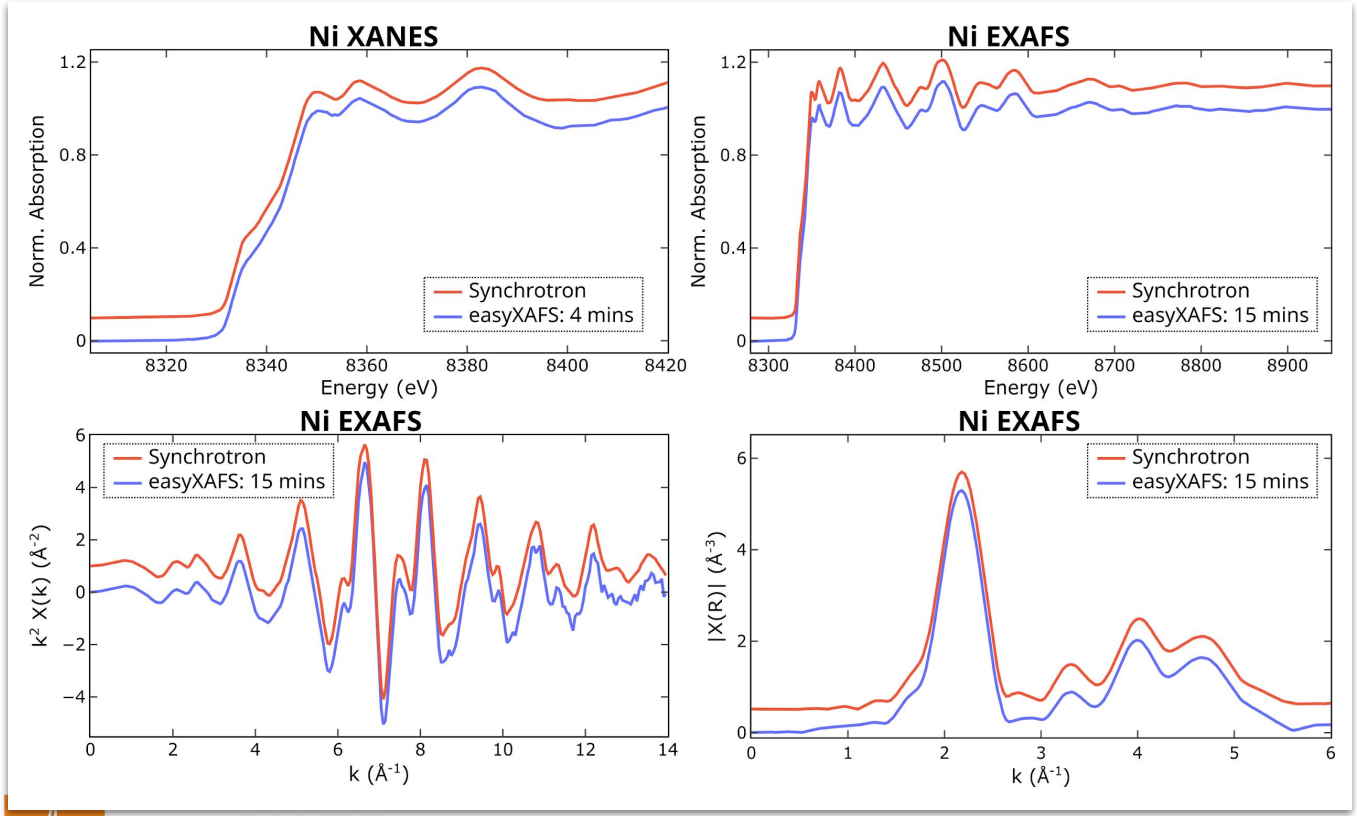
easyXAFS Spectrometers



XANES: 4 minutes
EXAFS: 15 minutes

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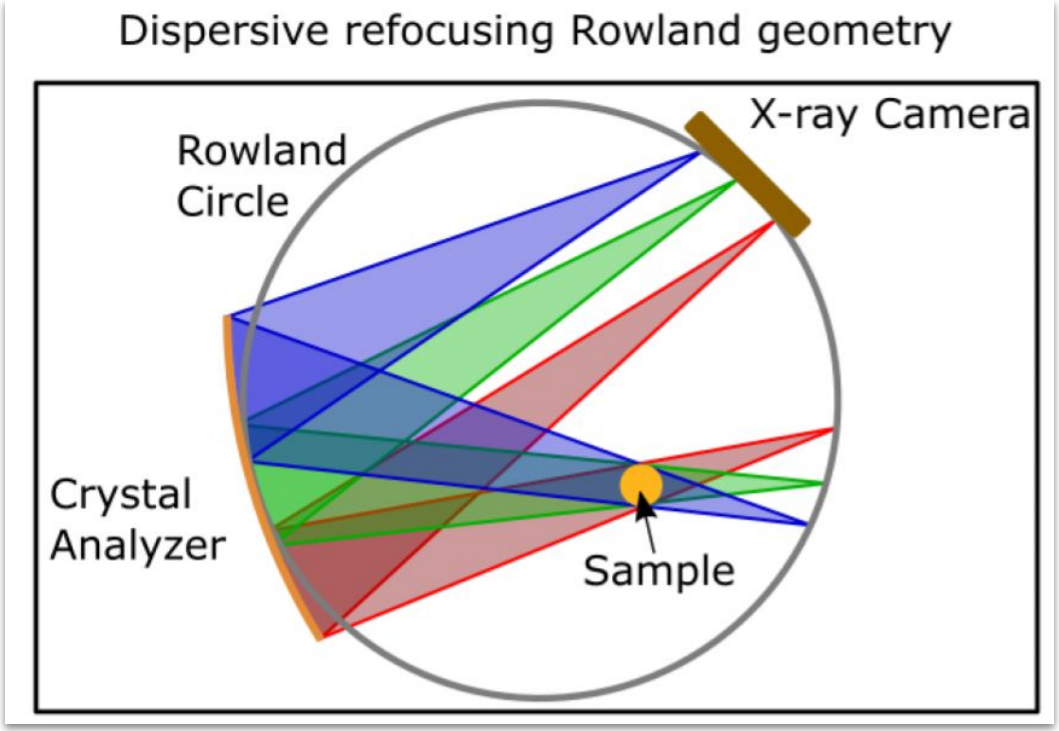
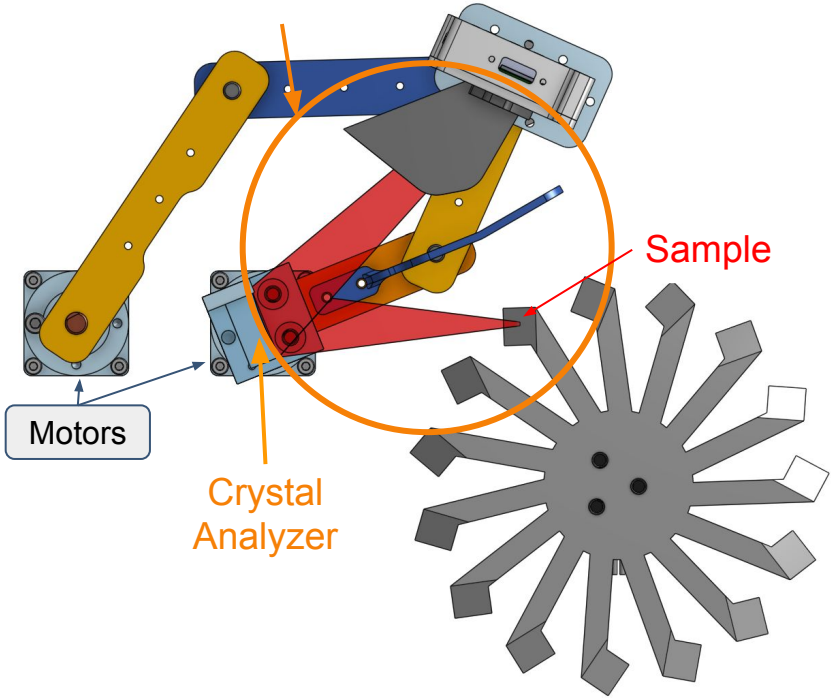
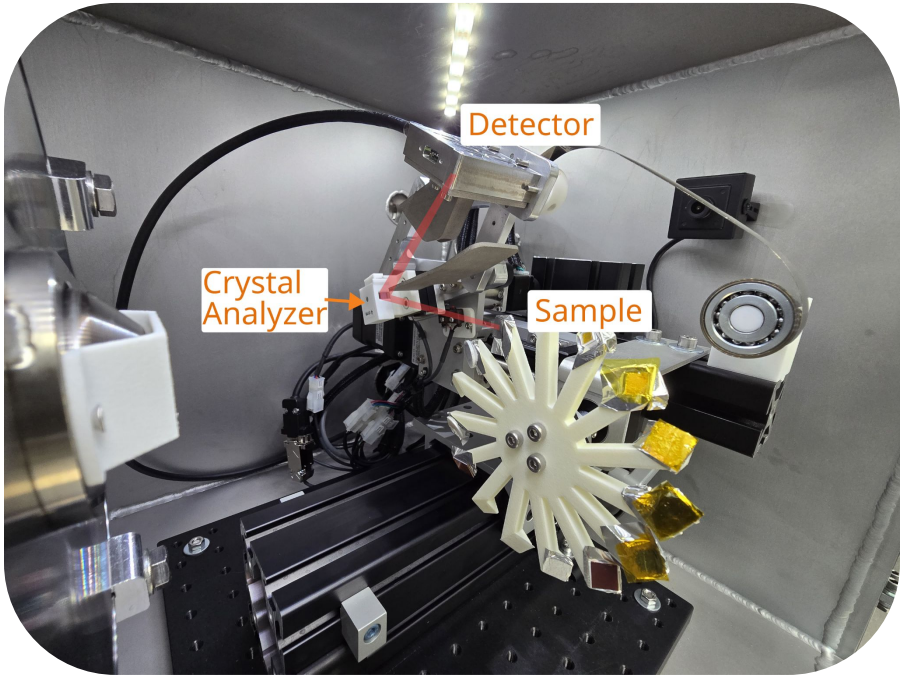
easyXAFS Spectrometers



easyXAFS Spectrometers





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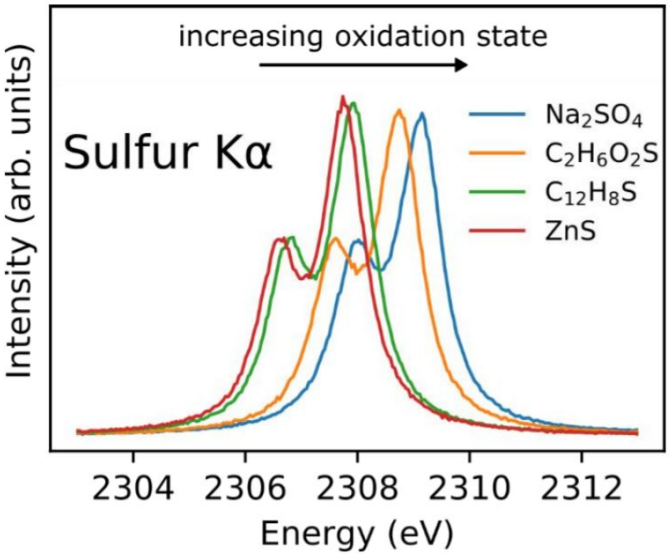
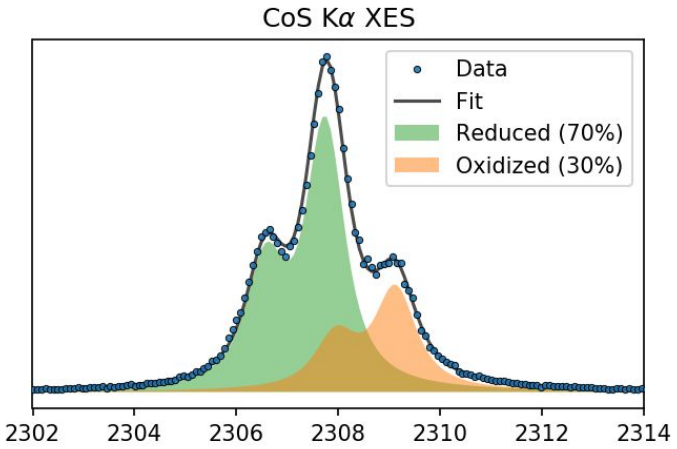
easyXAFS Spectrometers





Determine mixture by linear combination fitting

More information available at easyxafs.com

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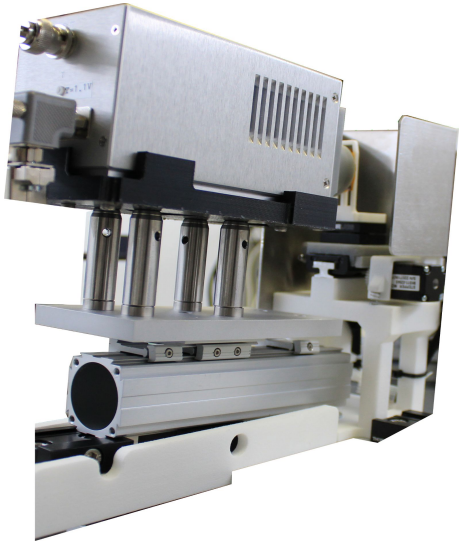
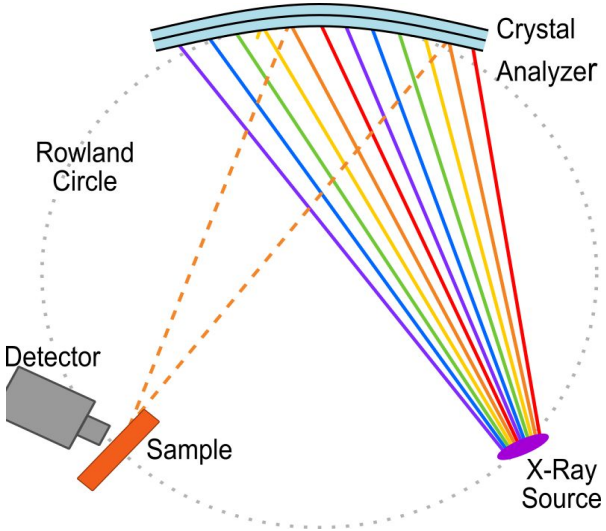
Tech Update: Fluorescence Mode





Enables measurement of dilute samples and samples that otherwise cannot be prepared in transmission mode (e.g., thin films, geological samples, etc.)

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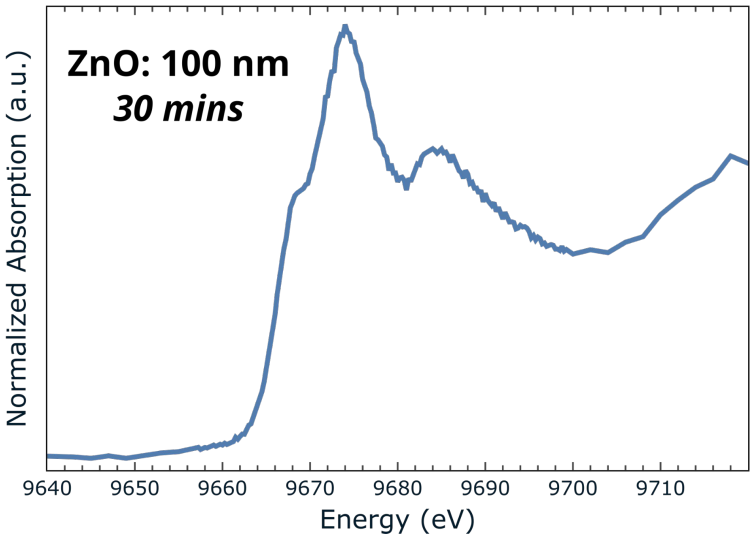
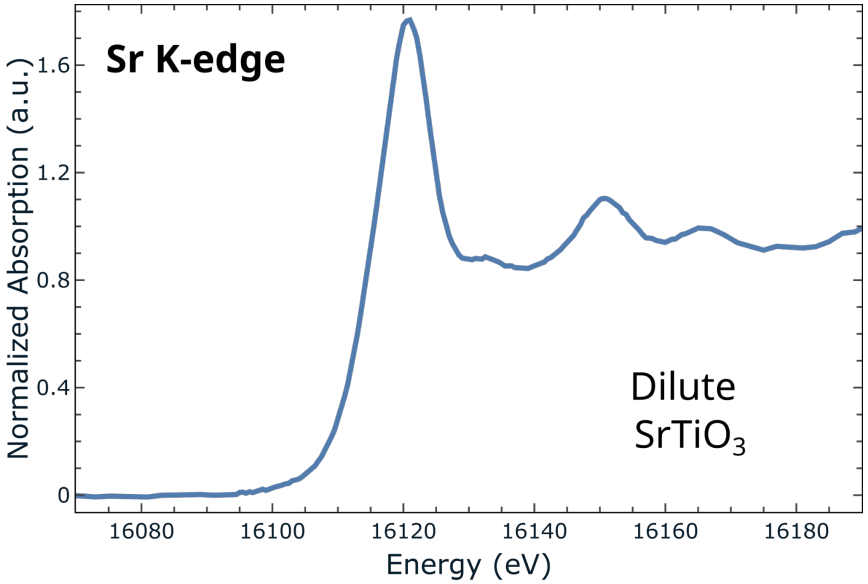
Tech Update: Fluorescence Mode





Rapid Thin Film Data

High Energy Performance

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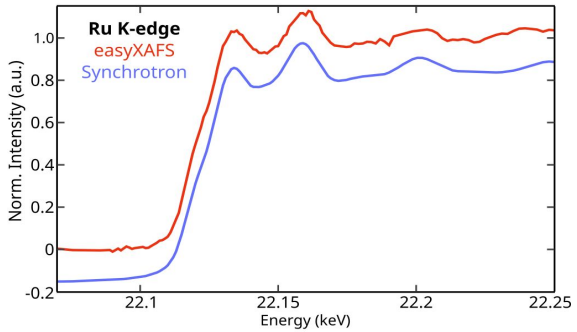
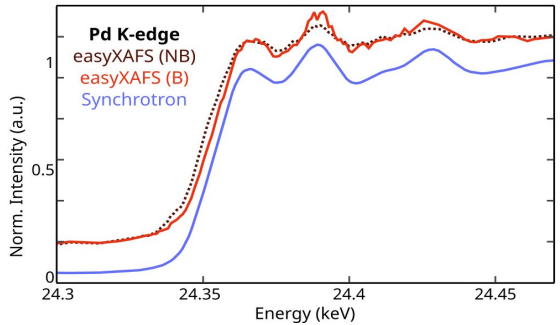
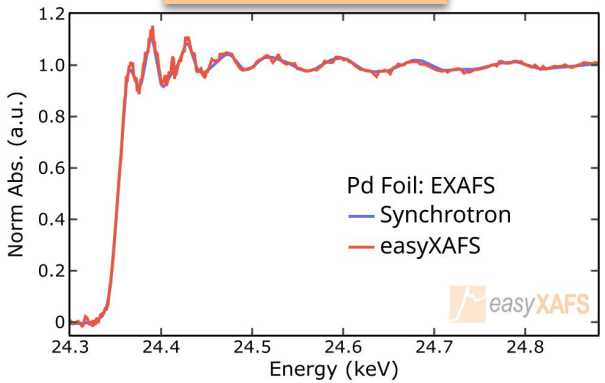
Tech Update: High Energy Performance

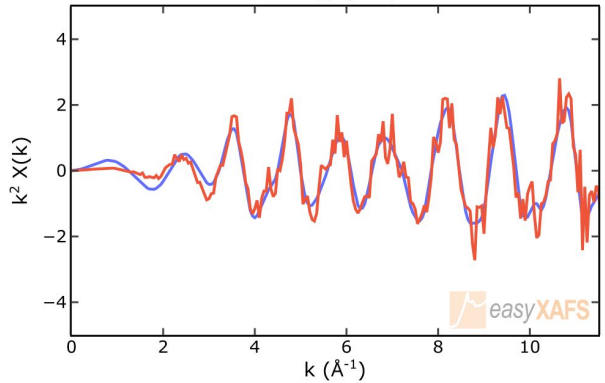
2023





2024





Full EXAFS up to 25 keV

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Business Updates

- Over 100 lab spectrometers ordered

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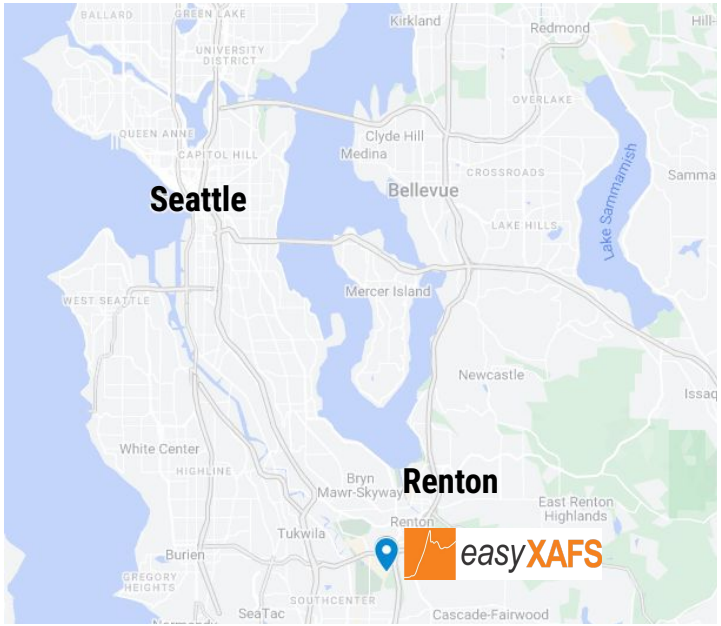
Business Updates

- Over 100 lab spectrometers ordered
- New manufacturing facility in Renton, Washington



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Business Updates

- Over 100 lab spectrometers ordered
- New manufacturing facility in Renton, Washington
- Newly launched Measurement Services

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Our Mission

- **Enrich**
- **Enlarge**
- **Elevate**
- **Empower**

the community of scientists, engineers, educators and businesses using advanced x-ray techniques

Niche specialist technique

Standard analytical tool

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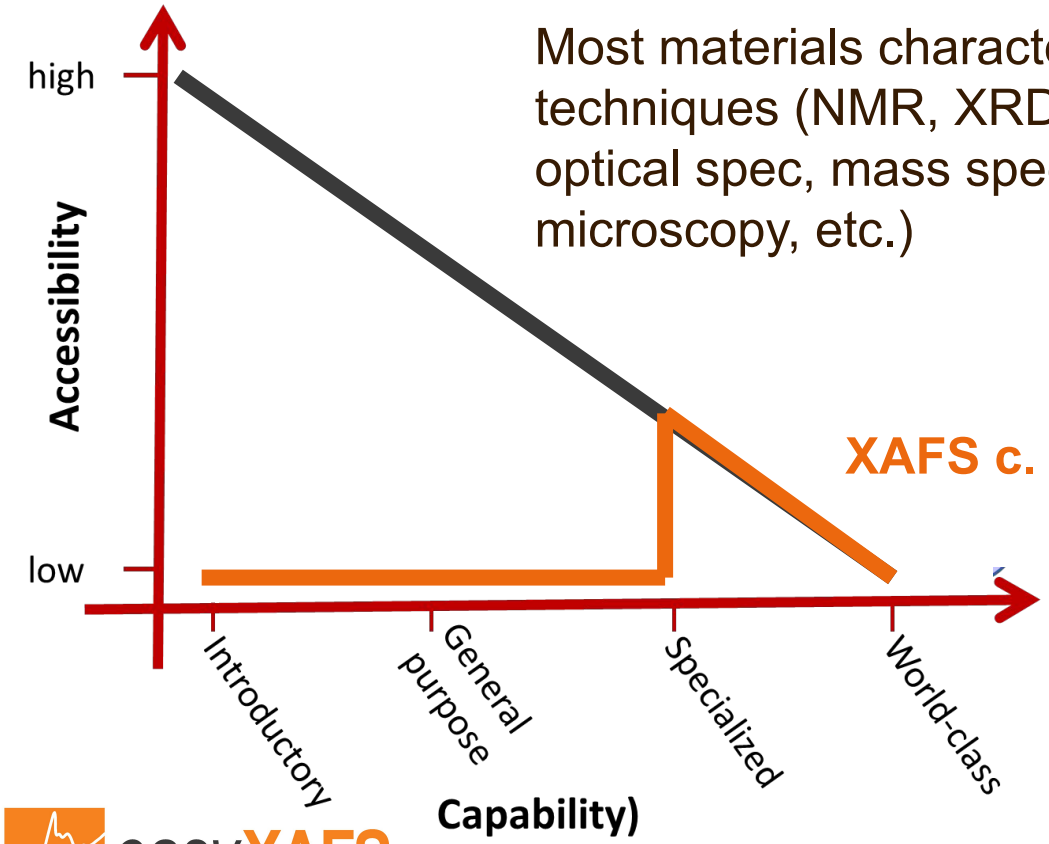
The Path to Analytical Use

Most materials characterization techniques (NMR, XRD, XRF, optical spec, mass spec, electron microscopy, etc.)



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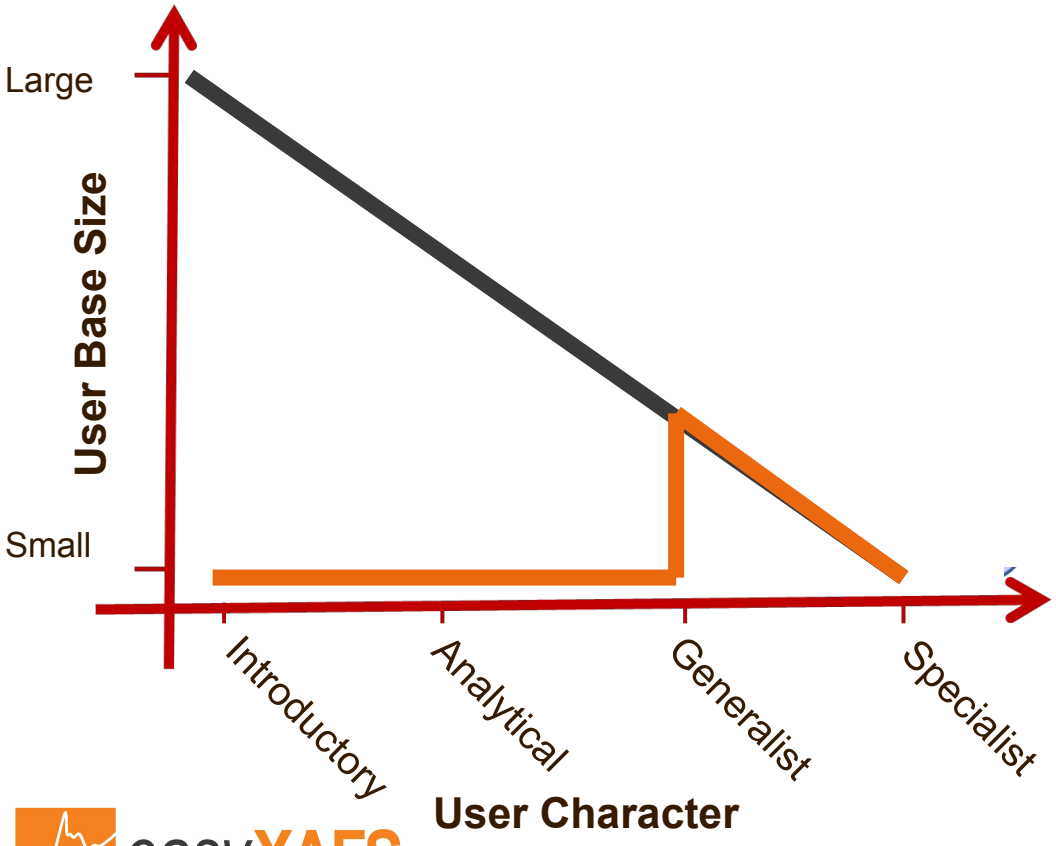
The Path to Analytical Use



Specialist: use of XAFS instrumentation and analysis is a core purpose of study.

Generalist: XAFS analysis augments multiple other techniques to give a comprehensive perspective on materials characterization.

Analytical: Qualitative test or routine figure-of-merit extraction, such as for precursor validation of material fabrication, quality control, degradation study, etc.

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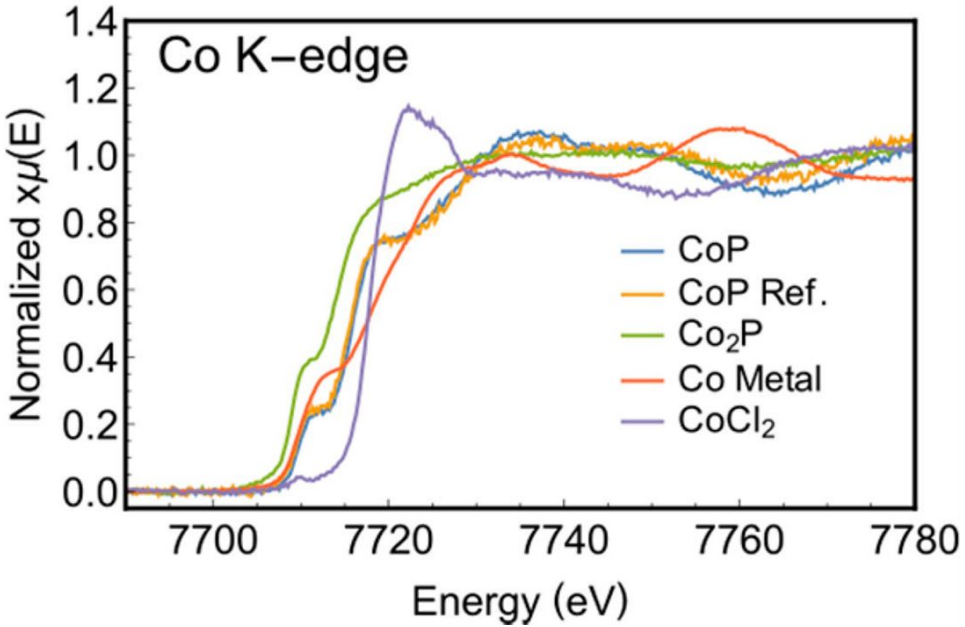
Analytical Use Case: Nanophase Identification



Mundy, Cossairt, et al., Chemistry of Materials 2018

Analytical question: Did I make CoP or Co_2P nanoparticles?

→XRD, optics, XPS, all inconclusive, but the XANES is unambiguous

Doesn't require XAFS expertise, just comparison to reference standards.

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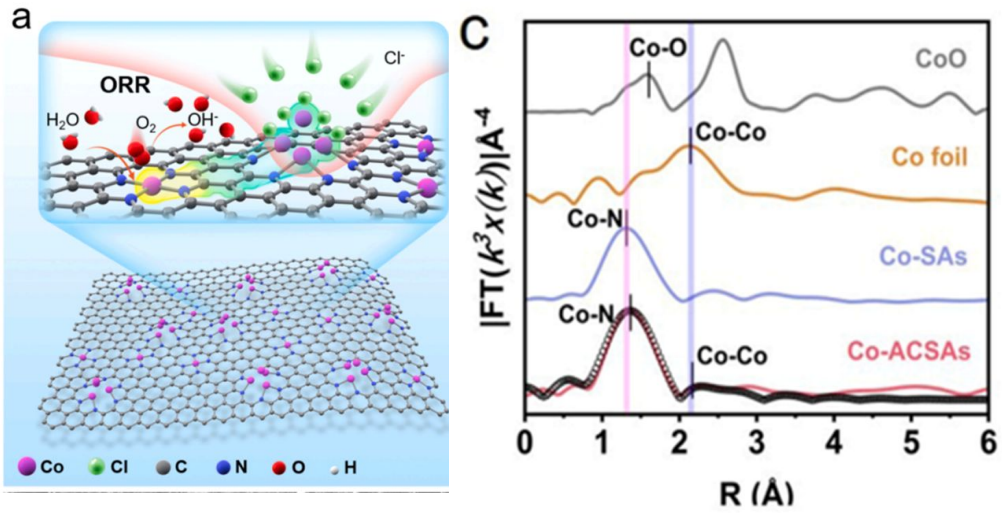
Analytical Use Case: Single Atom Verification



Analytical questions: Did I successfully synthesize a single atom catalyst?

→Typical EXAFS application. There is often no alternative method.

Doesn't require deep EXAFS analysis. Only demonstrated absence of metal-metal peak.

Lu, Lu, Guo et al., Energy Storage Materials 2024

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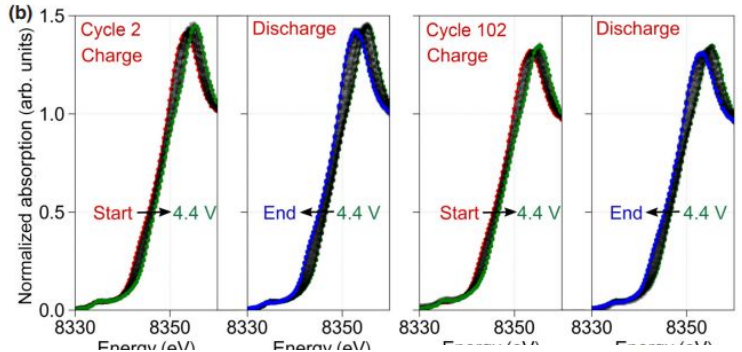
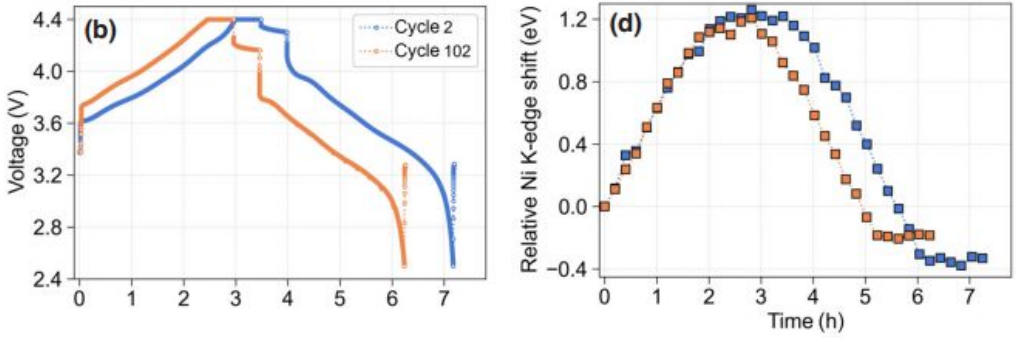
Analytical Use Case: Battery Fade





S. Menon, A., et al. PRX Energy 3, 013004 (2024).

Analytical question: How can I gain insight into bulk degradation mechanisms using operando methods?

→ XAFS provides additional insight to XRD by directly probing Ni environment.

Change in K-edge half-height energy used as rough stand-in for bulk Ni oxidation state

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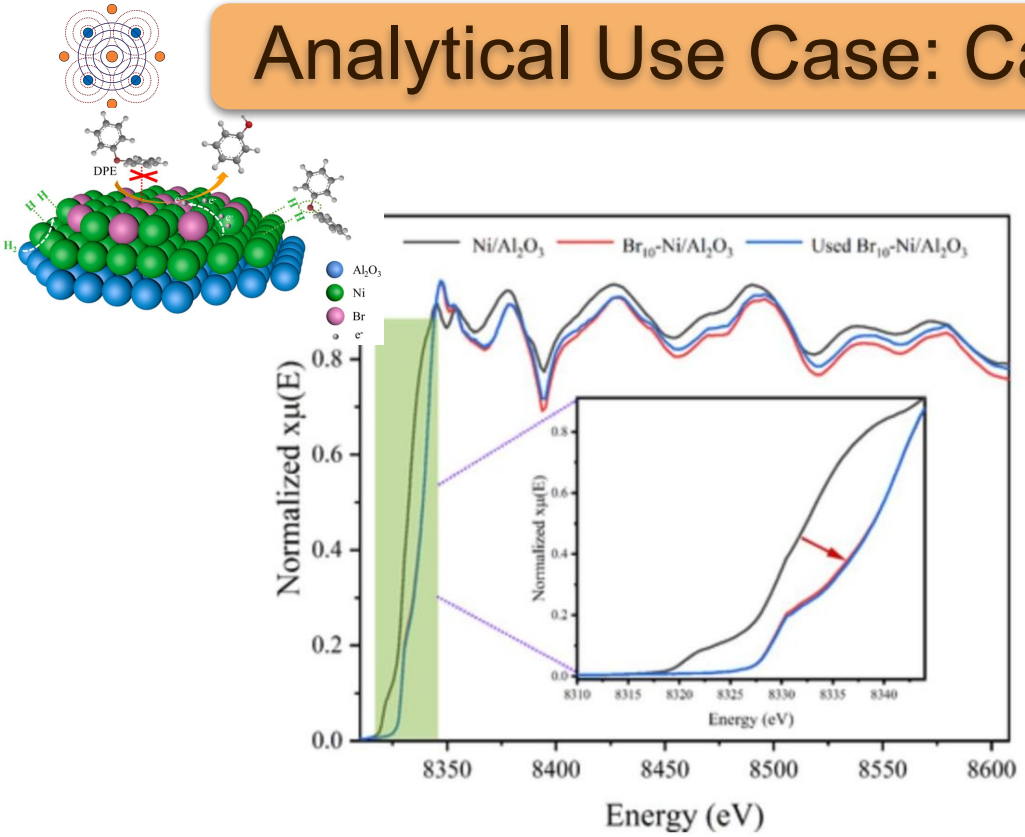
Analytical Use Case: Catalyst Stability



Yang, Zhang, et al., Chemical Engineering Journal 2023

Analytical question:

→How does bromination of Ni nanoparticles affect chemistry and stability?

Full XANES analysis not performed. General observations used to support larger set of analyses (XRD, TEM, FTIR, XPS).

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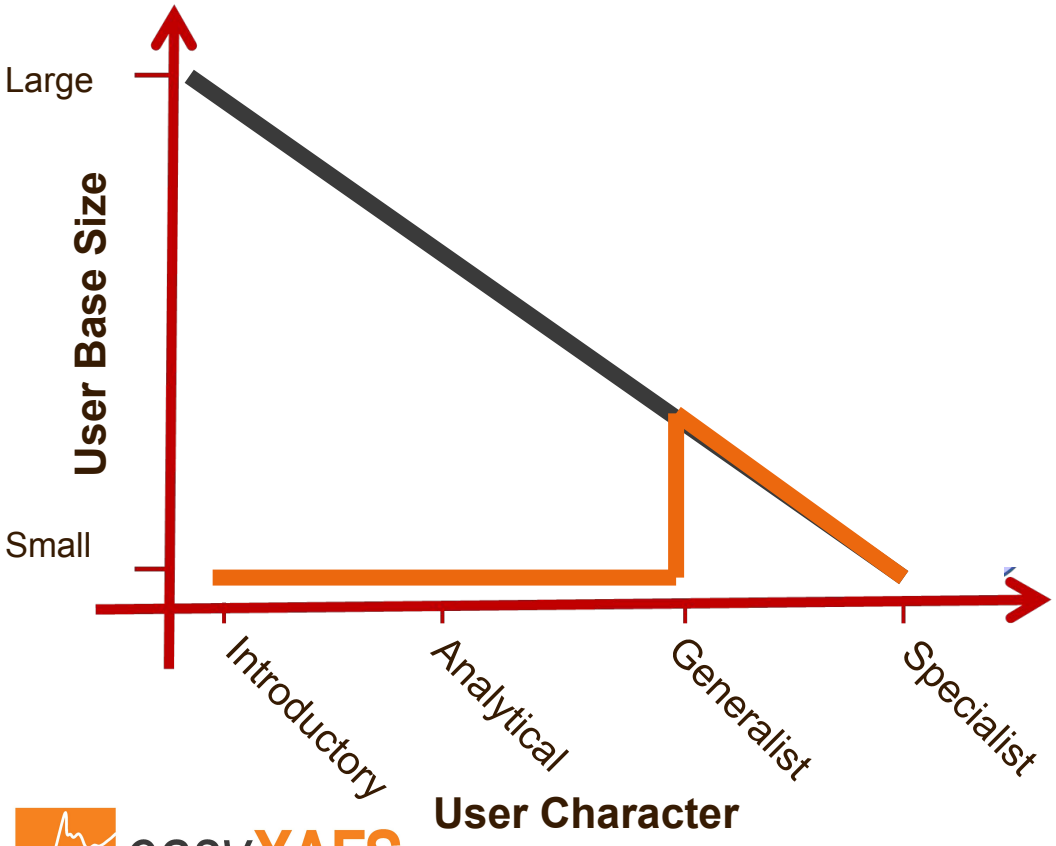
The Path to Analytical Use: Challenges



The majority of future growth will be from a "non-expert" user base.

How can XAFS experts and instrument manufacturers work together to mitigate "bad" data and data analysis from non-experts?

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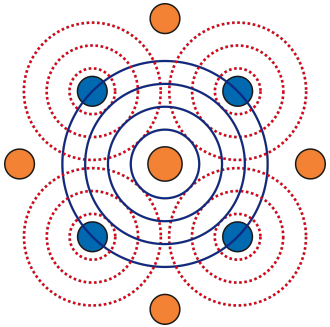

Questions?

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