

hiXAS

ADVANCED XAFS SOLUTION

X-ray



hpspectroscopy

hiXAS

Features

Table-top XAS system

- integrated lab-based EXAFS and XANES solution
- no need to apply and wait for beamtime
- fast non-scanning polychromatic acquisition provides reproducible results
- ideally suited for in-situ/in-operando measurements

Synchrotron-quality spectra

- energy range 4.0 to 25keV
- high resolving power of 4000
- wide bandpass of up to 1keV
- extreme sensitivity for analyte concentrations < 1wt%
- flexible switching between dedicated EXAFS and XANES modes

Applications

- chemical state analysis for geology, biology, materials research
- information on atomic distances, oxidation state, coordination number
- analysis of K-absorption edges of 3d-transition metals



Inside view of hiXAS with X-ray source, crystal analyzer, and detector. Two ports for sample environments allow for automated batch sample measurements and facilitate installing in-situ/in-operando environments.



View of crystal and detector setup inside hiXAS. The HAPG crystal is specifically optimized to the target application. High resolving power and efficiency are obtained simultaneously. The hybrid detector with large sensor area enables assessing sample homogeneity.

XANES analysis

Table-top XAS system

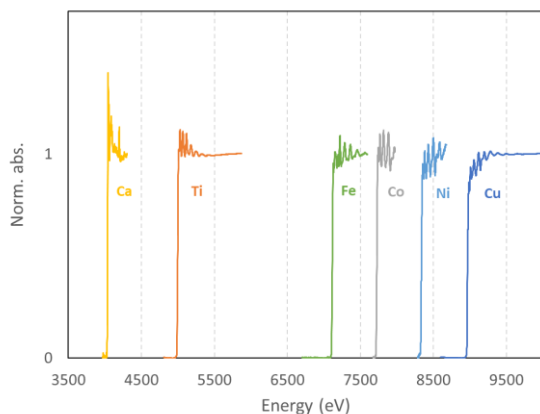
- structure analysis near x-ray absorption edge
- extreme sensitivity for analyte concentrations below 1 wt%
- fully automated batch processing of samples, no manual exchange of crystals required

Synchrotron-quality spectra

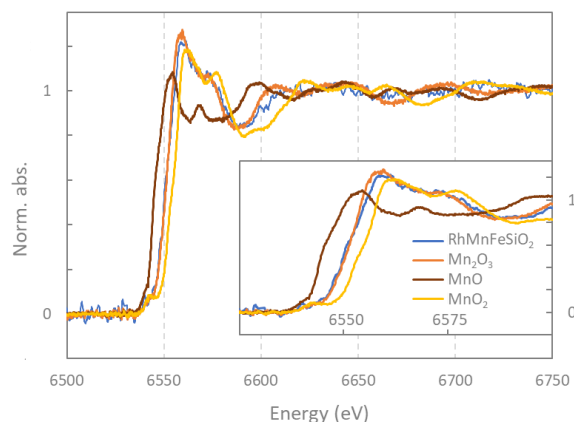
- spectral features of synchrotron measurements are accurately reproduced
- high resolving power of 4000
- wide bandpass of up to 600eV
- spatially-resolved detection allows for assessment of sample homogeneity

In-situ measurements

- fast polychromatic acquisition enables in-situ/in-operando measurements, even with extended time series
- ample space for complex sample setups (gas supply, heating, cryo-cooling, etc)
- two ports for long-term deployment of sample setups



XAFS measurements of 3d transition metals and Ca K-edge at 4.0keV. A wide range of elements can be accessed with the instrument.

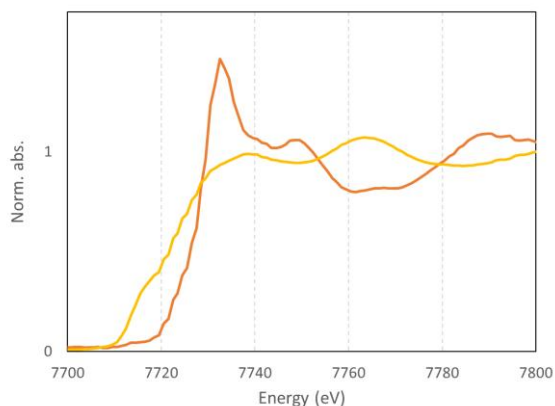


Oxidation state analysis of a nanoparticle catalyst for synthesis gas conversion. Mn and Fe are added as promoters for tuning the selectivity of the reaction.

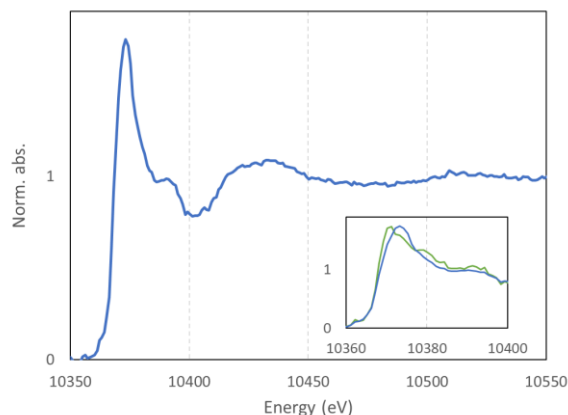
Despite a Mn content of only 1.4wt%, the hiXAS measurement in comparison with reference spectra clearly indicates the oxidation state.

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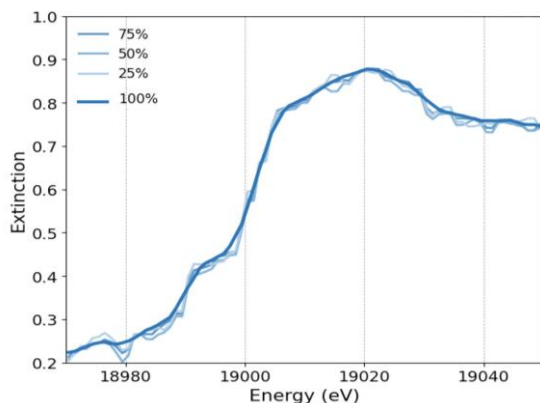
XANES analysis



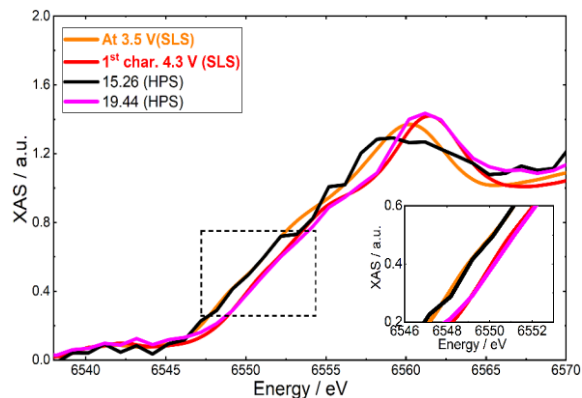
XANES measurement of NMC622 battery electrode material ($\text{LiNi}_{0.6}\text{Mn}_{0.2}\text{Co}_{0.2}\text{O}_2$ slurry on Al foil) at Co K-edge with Co foil for reference.



Measurement of Ga K-edge of $\beta\text{-Ga}_2\text{O}_3$. Inset shows 2eV peak shift with $\text{Ga}_2\text{O}_3\text{-Al}_2\text{O}_3$ solid solution due to varying coordination of Ga with oxygen.



High-Z XANES measurement of TiNb_2O_7 at Nb K-edge at 19.0keV. The two-source option of hiXAS allows for the installation of a dedicated high-energy source, significantly improving measurements above 20keV.



In-operando battery cell characterization on hiXAS at Mn K-edge. Accurate measurement of the sub-eV shift due to charge-discharge. The non-scanning acquisition of hiXAS and the convenient software integration facilitate in-operando studies of battery charge cycles.

EXAFS analysis

Table-top XAS system

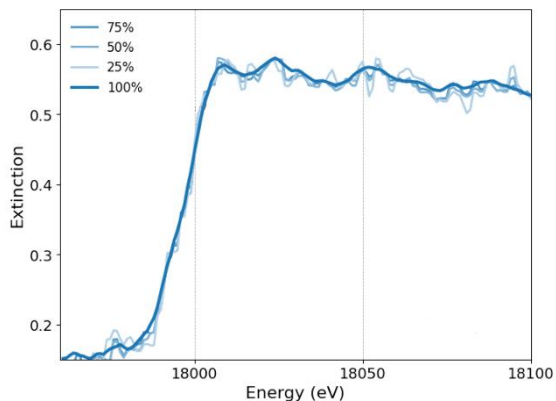
- structure analysis in extended range of absorption edge
- provides information on interatomic distances and near-neighbor coordination numbers
- large spectral bandwidth combined with high flux

Synchrotron-quality spectra

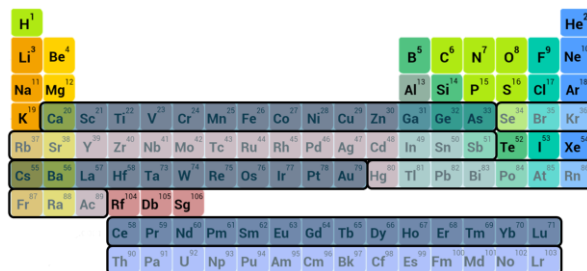
- high-efficiency HAPG crystal provides the high photon flux crucial for EXAFS ($> 10^7$ ph/s)
- extremely wide bandpass of 1000eV
- high resolving power of 1800, constant over full range

In-situ measurements

- non-scanning acquisition of large energy range enables stable results, even for in-operando measurement series over days, e.g. for battery charge cycles
- non-equidistant spectra evaluation provides improved signal-to-noise for large wavevectors



High-Z XAFS measurement at Zr K-edge at 18keV, demonstrating the instrument performance at high energies. Light-colored curves indicate the decreasing noise with measurement time, enabled by the interim saves function of hiXAS.



Primary range of elements accessible for EXAFS and XANES measurements with hiXAS. Absorption edges at higher energies can be investigated with customized system versions.

Specifications

Topology	X-ray tube source von Hamos HAPG spectrometer hybrid detector	
Energy range	4.0-25keV, customized system versions for higher energies available	
Analyte concentration	down to < 1wt%	
Sample mount	two sample ports with multi-sample turret mount. in-operando cells available: electrochemical liquid cell, battery pouch cell, heating cell	
Footprint	4.0m x 1.0m, compact versions available	
Software suite	intuitive system control, fully automated batch processing, time series definition, variety of analysis functions, in-operando cell integration	
	EXAFS mode	XANES mode
Resolving power	1800	4000
	constant over full energy range	
Energy bandpass	1000eV	600eV
Flux at 8keV	$20 \cdot 10^6$ ph/s	$1 \cdot 10^6$ ph/s
Acquisition time	3min	8min
	normalized to analyte concentration	

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