

# hiXAS

## INTEGRATED XAS SOLUTION

X-ray



**hp**spectroscopy

# 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 4.5 to 25keV
- high resolving power of 4000
- wide bandpass of up to 1keV
- extreme sensitivity for analyte concentrations to a few wt%
- flexible switching between EXAFS and XANES mode

### 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 facilitates installing in-situ/in-operando environments.



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

## XANES analysis

### Table-top XAS system

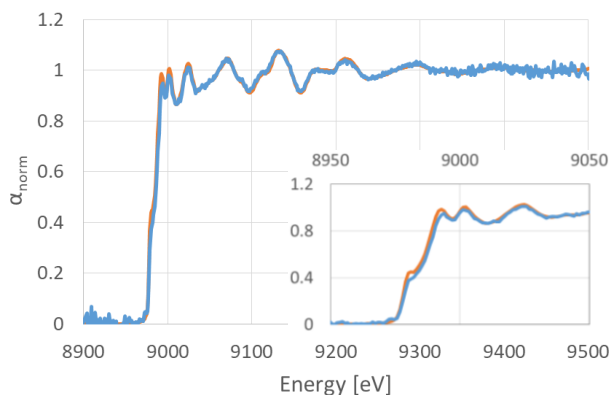
- structure analysis near x-ray absorption edge
- extreme sensitivity for analyte concentrations down to 1wt%
- fully automated batch processing of samples, no manual exchange of crystals required

### 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

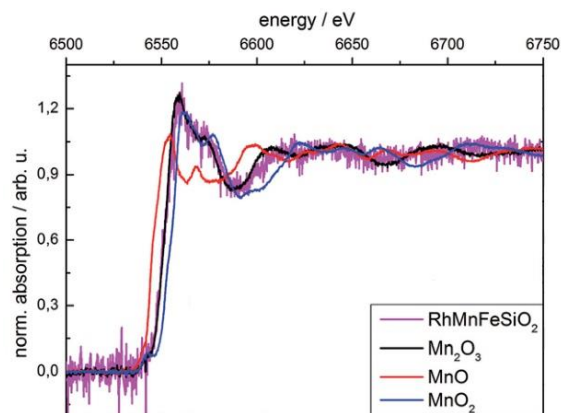
- fast polychromatic acquisition enables in-situ/in-operando measurements, even with extended time series
- ample space for complex sample setups (gas supply, heating, cryo-cooling, etc)
- two ports for long-term deployment of sample setups



XANES spectrum of a 10um-thick Cu foil from hiXAS (resolving power  $E/\Delta E = 4000$ , blue line) and comparison to a synchrotron measurement (APS beamline 13-ID-E, resolving power  $E/\Delta E = 8000$ , orange line).

The excellent agreement demonstrates the high quality result of hiXAS. Measurement time 8min.

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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.

*Faraday Discuss.* 208 207 (2018)

## EXAFS analysis

### Table-top XAS system

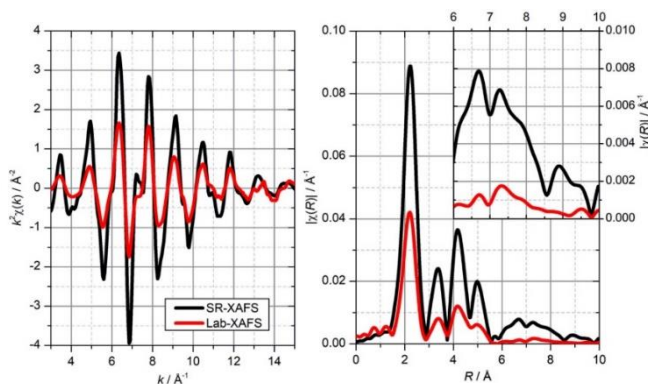
- structure analysis in extended range of absorption edge
- provides information on interatomic distances and near-neighbor coordination numbers
- large spectral bandwidth combined with high flux

### 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

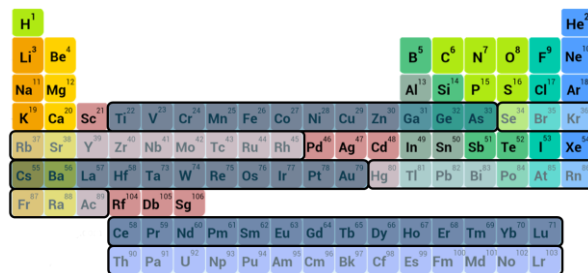
- non-scanning acquisition of large energy range enables stable results, even for in-operando measurement series over days, e.g. for battery charge cycles
- non-equidistant spectra evaluation provides improved signal-to-noise for large wavevectors



Sample XAFS measurement of hiXAS of a 10um Cu foil, comparing lab-based (red lines) and synchrotron (black lines) results. EXAFS oscillations (left) and corresponding Fourier transformation (right).

All peak positions are accurately reproduced. Measurement time 3min.

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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	4.5-25keV, customized system versions for higher energies available	
Analyte concentration	down to a few wt%	
Sample mount	two sample ports, turret mounts for multiple samples (powder, foils, liquid cell)	
Footprint	4.0m x 1.0m, compact versions available	
Software suite	integrated system control, fully automated batch processing, variety of spectra calibration and analysis functions	
	EXAFS mode	XANES mode
Resolving power	1800	4000
	constant over the whole 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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