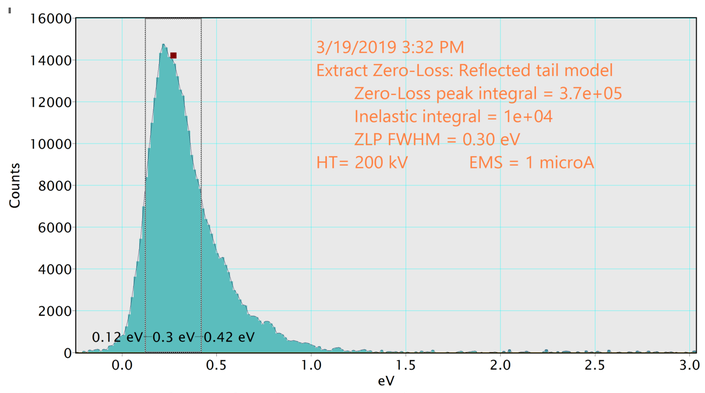
Atomic Resolution Analytical
Transmission Electron Microscope
NEOARM 200F

Cold Field Emission Gun

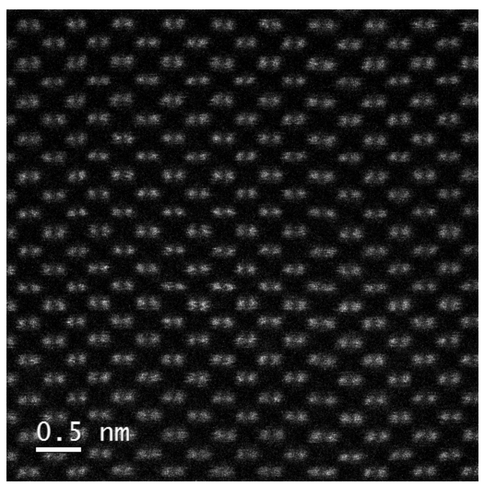
- high current densities for enhanced resolution in STEM imaging and spectroscopy
- narrow energy distribution of emitted electrons (0.3eV at 1µA and 0,47eV at 15µA) for outstanding energy resolution using EELS

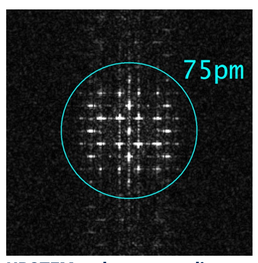


EEL-spectra of zero-loss peaks at beam currents of 1µA
verifying the energy spread of the cold-FEG to be 0.3eV

STEM Aberration Corrector

- imaging with atomic resolution (< 1 Å in STEM HAADF)
- atomic resolution elemental mapping with EELS and EDX

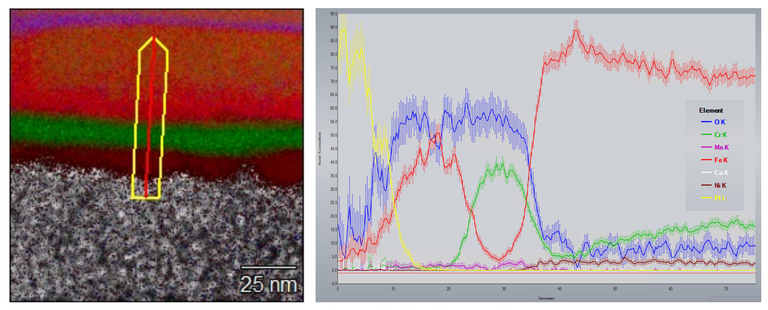




HRSTEM and corresponding Fast Fourier Transform
imaging of Si dumbbells in [110] orientation applying STEM HAADF confirms a resolution of ~0.8 Å

EDX Double SDD

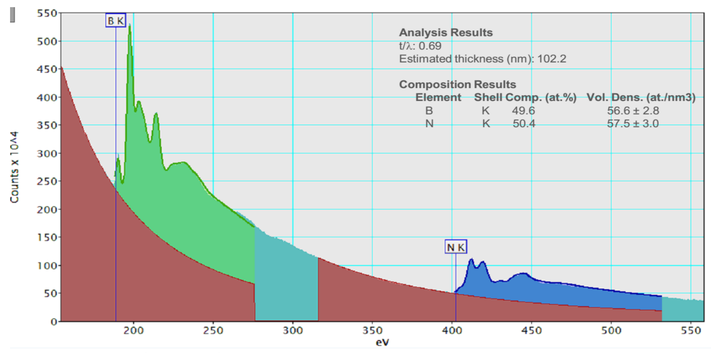
- 2 SD detectors, total area 200mm² (JEOL Centurio) resulting in a collection angle of 1.3sr and unprecedented count rates and processing of up to 100 000 cts/s
- highest available energy resolution (122eV at Mn Kα)
- spectral imaging for elemental quantification with subnanometer resolution



STEM EDX spectrum image with extracted quantitative line profiles
quantitative visualization of the local elemental composition across an oxidized steel surface with sub-nm resolution

EEL spectrometer

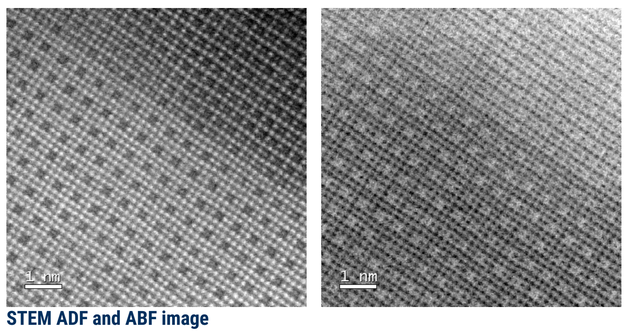
- novel Continuum spectrometer (Gatan) with an energy resolution < 0.3eV for quantification of light elements
- high speed EEL spectral imaging (up to 8000 spectra/s)
- dual EELS for simultaneous acquisition of core-loss and low-loss spectrum



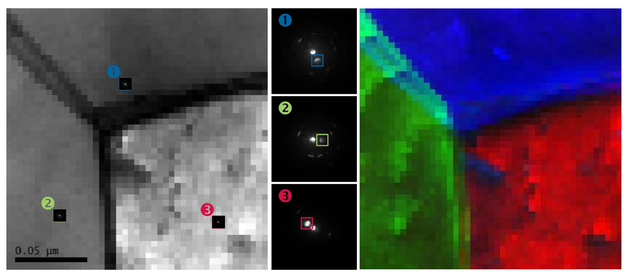
Elemental quantification of an ELL spectrum
Analysis of cubic BN via multiple linear least squares fitting

Comprehensive set of STEM detectors

- 4 imaging detectors combined with 2 spectrometers and diffraction imaging for comprehensive STEM analysis
- Annular Bright Field (ABF) detector for direct visualization on an atomistic length scale of light chemical elements, Annular Dark Field (ADF) detector for heavy elements
- enhanced light atom contrast by e-ABF (JEOL)
- Additional SE/BSE detectors providing also topographical information e.g. beneficial for imaging of nano particles
- 4D STEM Diffraction Mapping with up to 300fps (Gatan STEM X) for mapping of local strains and crystal orientation
- Spectral imaging with up to 8000 EEL spectra/s and up to 3000 EDX spectra/s for mapping of concentration distributions and phase compositions



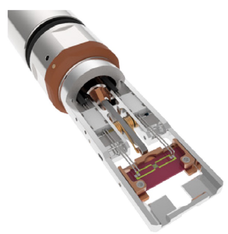
STEM ADF and ABF image
visualization of the atomic arrangement at a phase boundary in a Pt-Ti-Al alloy



STEM 4D diffraction map with constructed dark filed image
grain boundary triple junction in Cu

in-situ heating experiments

- *in-situ* observation of phase transformations at temperatures up to 1300°C
- double tilt heating holder (DensSolutions)
  - tilt range: x ± 25°, y ± 15°
  - heating rates: < $2 \cdot 10^6$K/s
  - temperature accuracy < 5%
- single control interface:
  acquire, store, and analyze data of different sources (imaging and heating holder) using the same software
- 4k x 4k CMOS camera (Gatan OneView)
  - recording of *in-situ* image stacks with 4k x 4k at 25fps and 512 x 512 at 300fps
  - LookBack streaming and drift correction function



Tip of specimen holder including heating chip

FRIEDRICH-SCHILLER-UNIVERSITÄT JENA

Gefördert durch
DFG Deutsche Forschungsgemeinschaft
Forschungsgroßgeräteprogramm
Elektronenmikroskope in Materialwissenschaft & Physik
Inst 275/391-1

Metallische Werkstoffe