

We Innovate Materials

# Scanning Electron Microscopy

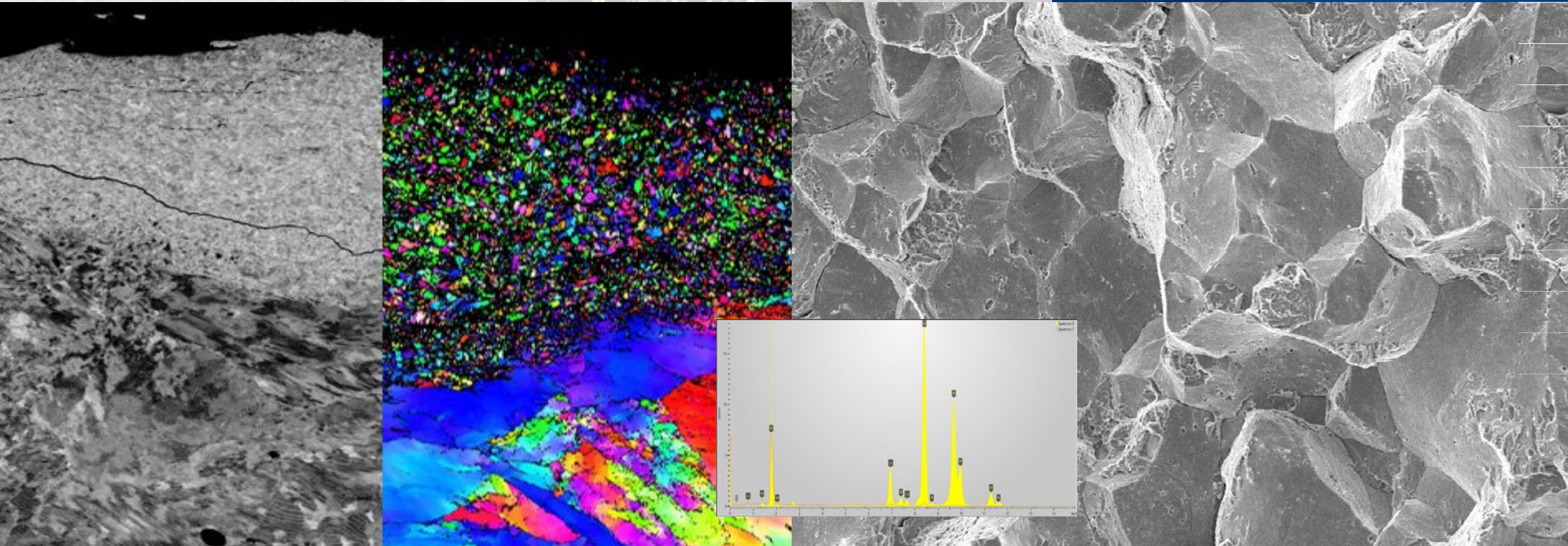


Material and Damage Investigation  
3D Microstructure and Contour Analysis  
High Resolution Scanning Electron Spectroscopy  
Precise Chemical and Structural Analysis  
Focus Ion Beam Micromachining  
Insitu - Micromechanical Investigations  
Insitu - Temperatur Transformation Analytics  
Insitu - Temperatur Transformation Analytics  
Ex-/Insitu - AFM-Measurements



COMPETENCE & RELIABILITY

# Material and Damage Investigation



High resolution examination of material sections, surfaces or fracture surfaces incl. local chemical and crystallographic analysis

Contact:



Dr. Petri Prevedel  
T: +43-676 848883 440



Dr. Angelika Spalek  
T: +43-676 848883 461

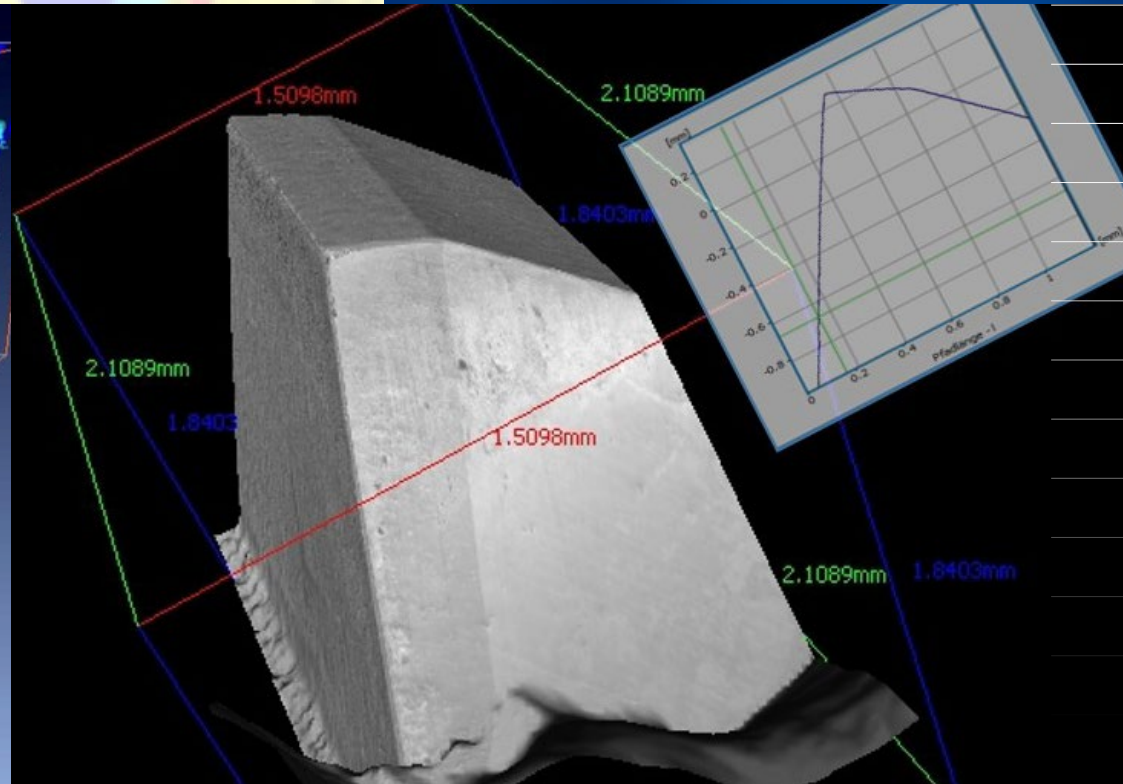
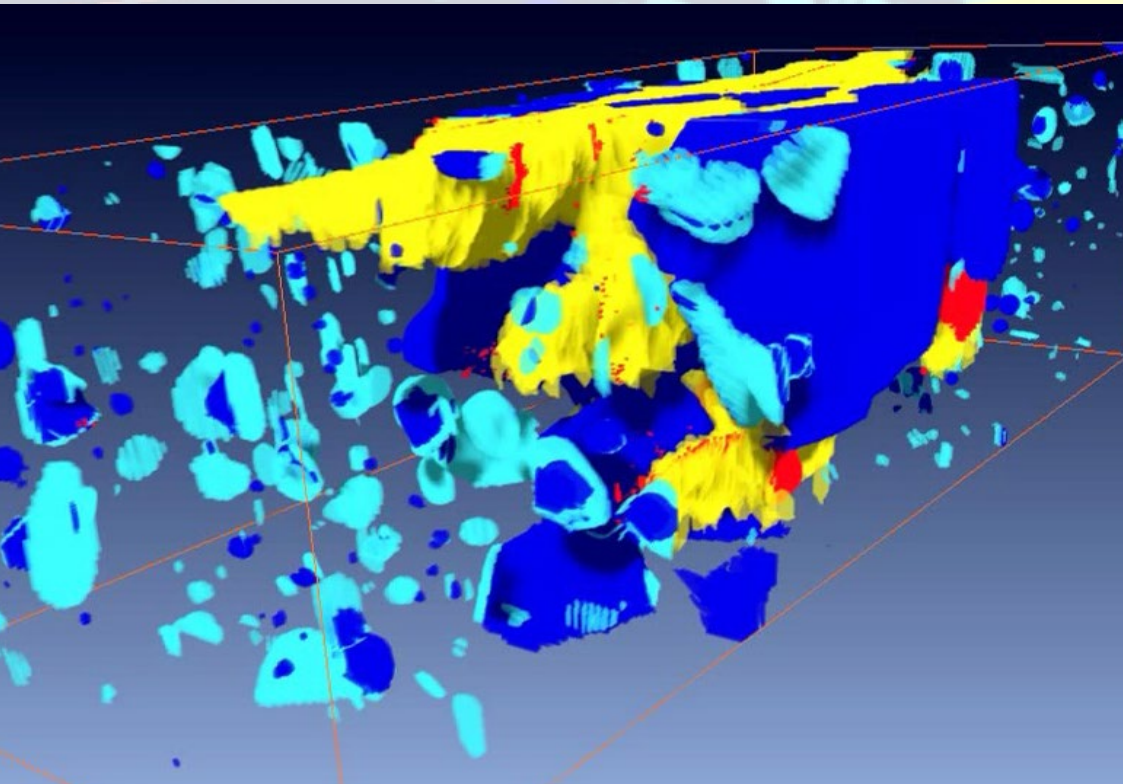
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## Our Focus / Competences:

- surface analyses, fracture surface analyses, damage analyses
- analysis of large or difficult-to-clean components (up to 3kg), from microsections up to microelectronic components
- SEM analysis of non-conductive components without additional vapor deposition (e.g. ceramic components, metal/plastic composites)
- local chemical and crystallographic analyses



# 3D Microstructure and Contour Analysis



High resolution 3-dimensional examination and measurement of contours or structural components

Contact:



Bernhard Sartory  
T: +43-676 848883 450



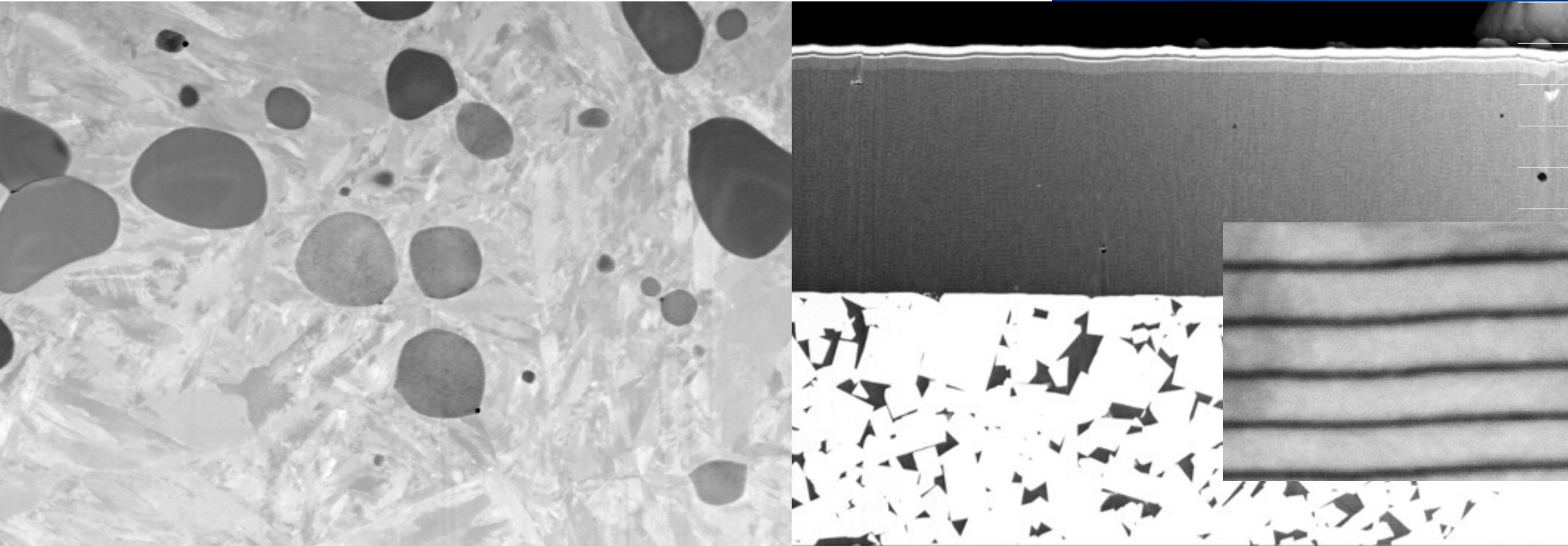
Dr. Angelika Spalek  
T +43-676 848883 461

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## Our Focus / Competences:

- 3D topography of contours, damage, etc. incl. measurement in the mm to sub- $\mu\text{m}$  range
- 3D tomography of microstructural components by the Slive&View method incl. measurement of local chemistry and structure
- different electron and ion contrasts, EBSD crystal information measurement, 3D chemical element distributions and depth profiles (EDX, EBSD and FIB-SIMS (TOF))

# High Resolution Scanning Electron Spectroscopy



## High resolution microstructure characterization

Contact:



Bernhard Sartory  
T: +43-676 848883 450



Dr. Angelika Spalek  
T +43-676 848883 461

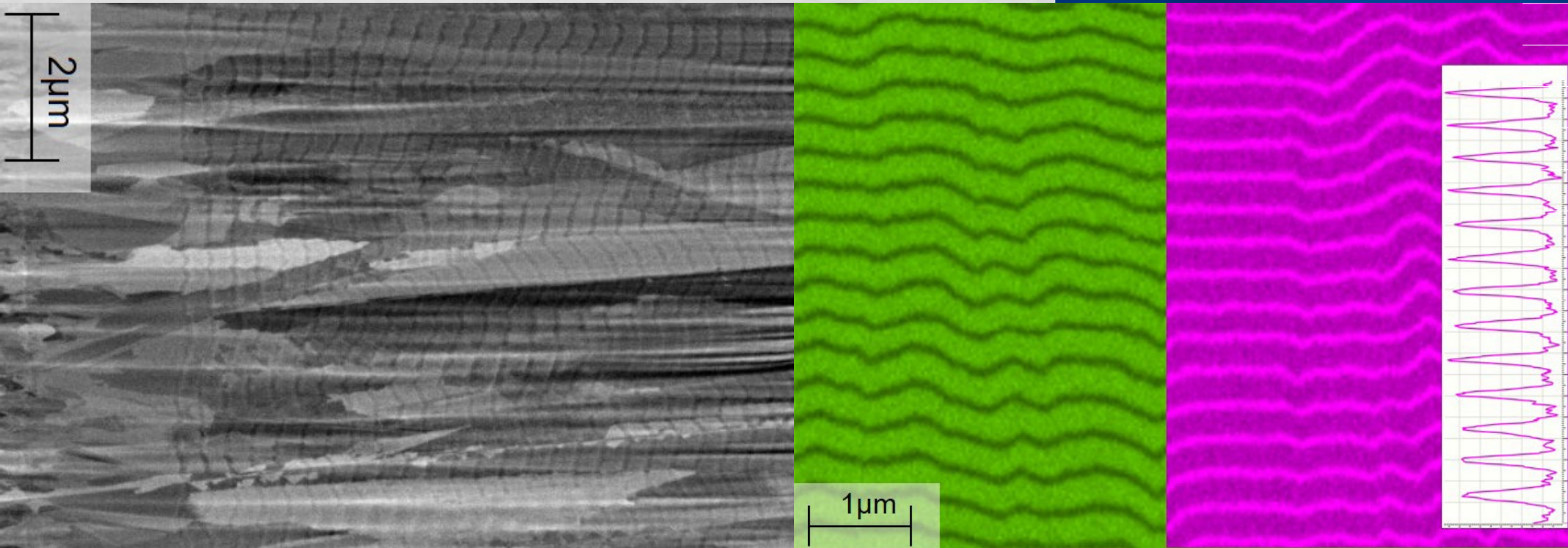
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### Our Focus / Competences:

- high resolution microstructure characterization with resolutions up to 1,000,000x
- different electron and ion contrasts, EBSD crystal information measurement
- measurement of the crystal structure by EBSD from the cm range down to 20-30nm small structures
- measurement of the local chemical composition as well as element distributions and particle analyses (EDX, WDX, RFA, FIB-SIMS (TOF))



# Precise Chemical and Structural Analysis



Precise chemical and structural analysis of finest structural elements down to a few 10nm in size

Contact:



Bernhard Sartory  
T: +43-676 848883 129



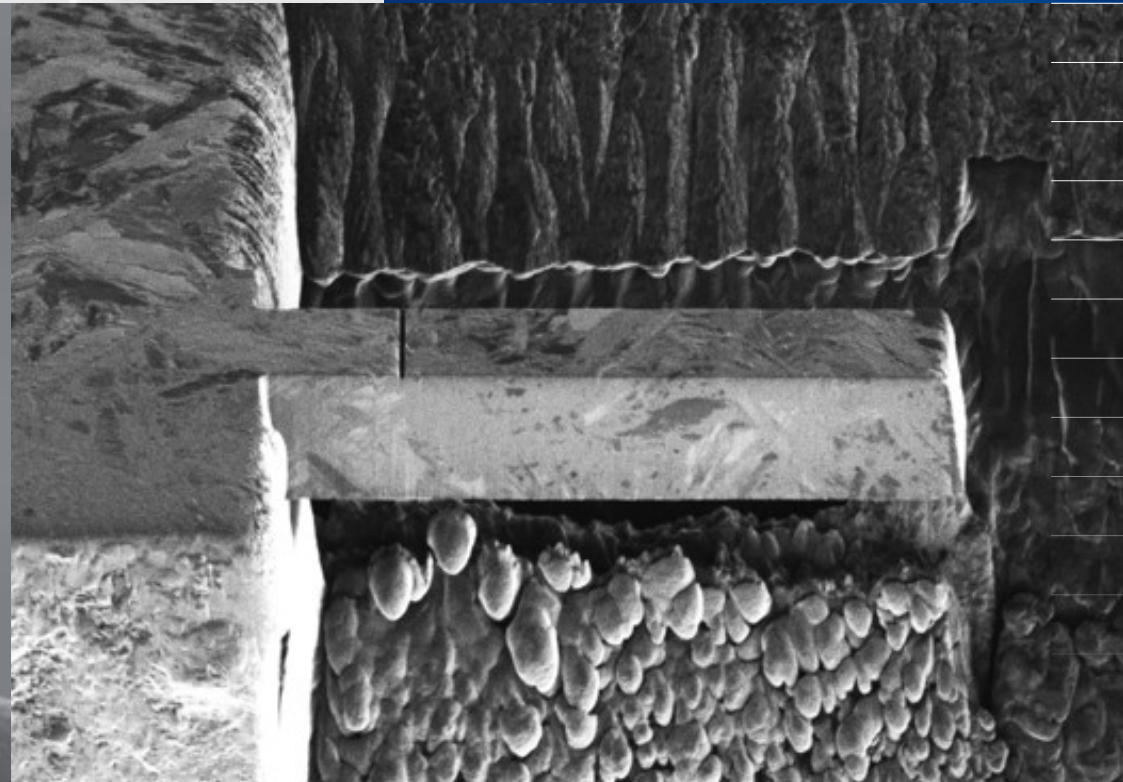
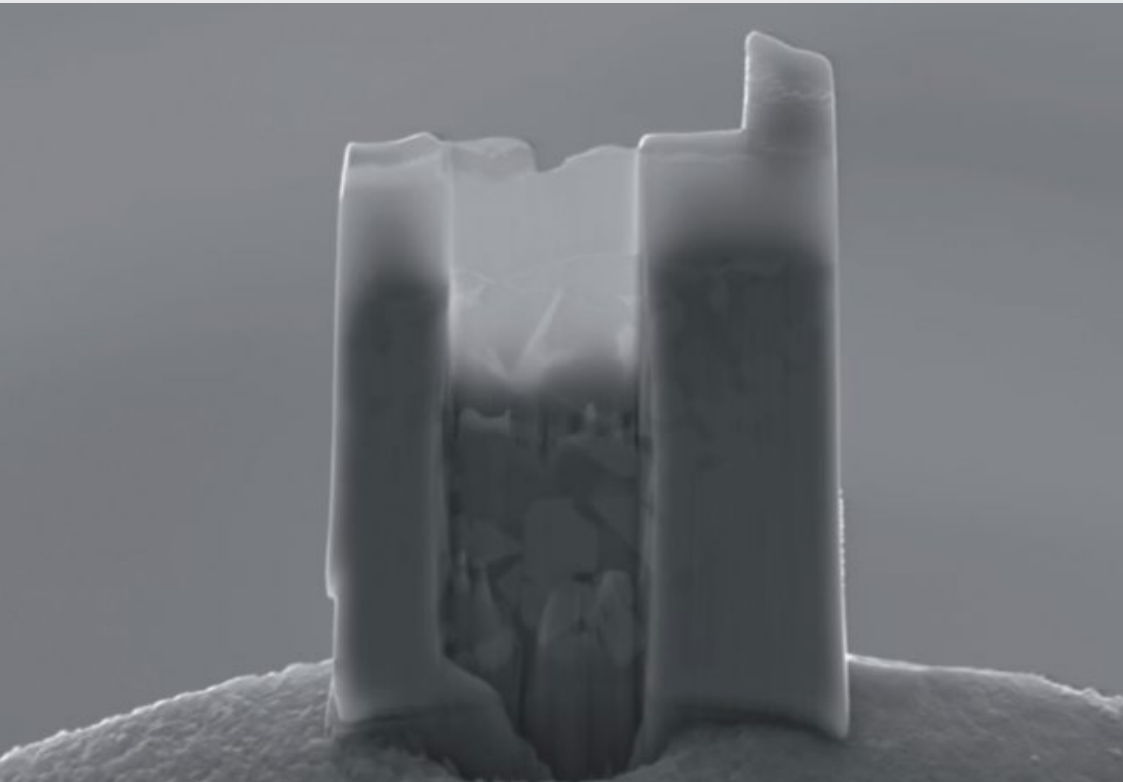
Dr. Stefan Marsoner  
T: +43-676 848883 102

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## Our Focus / Competences:

- precise chemical analysis using EDX, WDX and XRF
- high energy resolution with detection limits of 50-100 ppm
- trace element analyses down to detection limits of 10ppm
- EBSD measurements of grains less than 10nm in size for identification of microstructure or crystal structure
- FIB-SIMS (TOF) surface measurements or depth profiles with a lateral resolution of a few nanometers from main elements to trace analysis

# Focused Ion Beam Micromachining



Specimen preparation for micromechanical and microstructural investigations

Contact:



Bernhard Sartory  
T: +43-676 848883 450



Dr. Angelika Spalek  
T +43-676 848883 461

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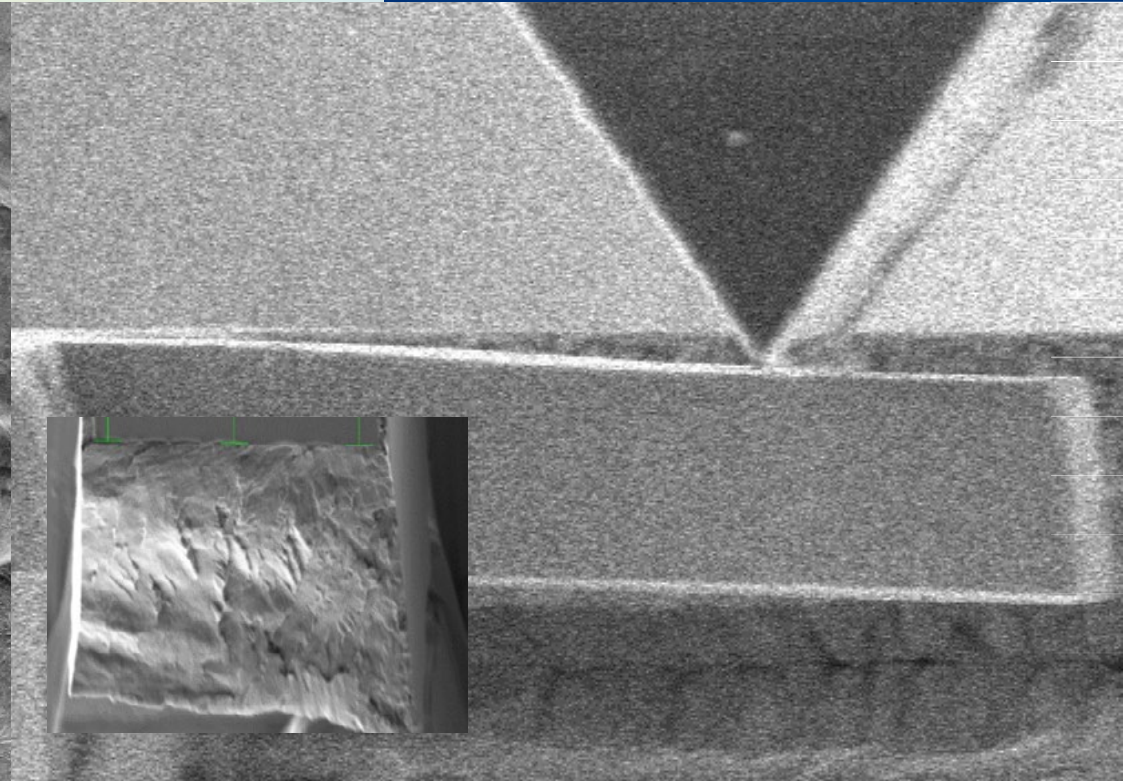
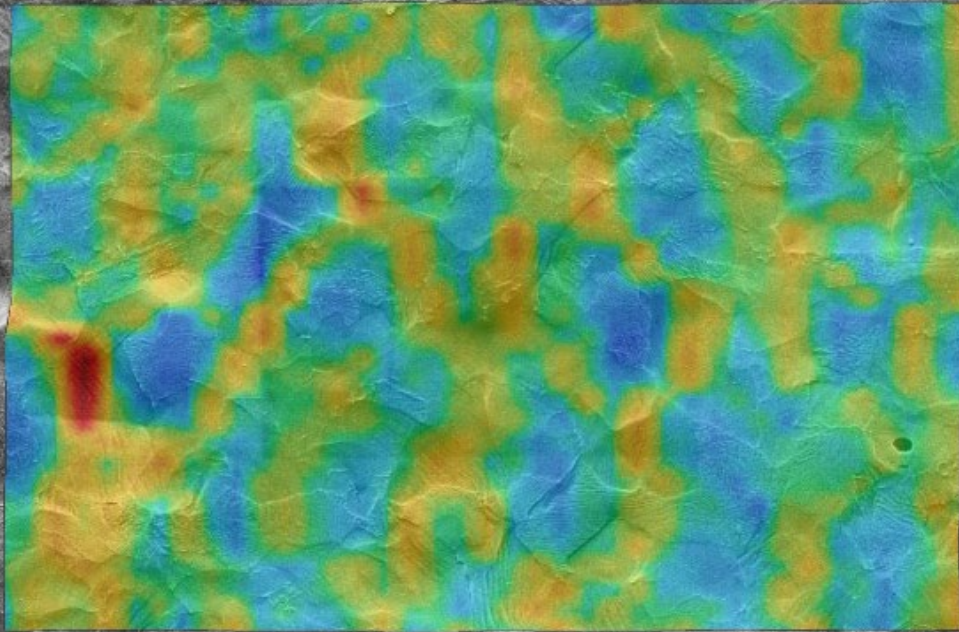
## Our Focus / Competences:

- target preparation of thin foils for subsequent electron microscopy and transmission electron microscopy examinations (\*)
- target preparation of atom probe tips for subsequent atom probe examinations
- preparation of specimens for micromechanical testing of materials (e.g. thin films or microstructural components)

*\*advanced TEM, APFIM analyses are performed in cooperation with research partners of the MCL*



# Insitu - Micromechanical Investigations



Determination of micromechanical properties of microstructural components or layers

Contact:



Bernhard Sartory  
T: +43-676 848883 450

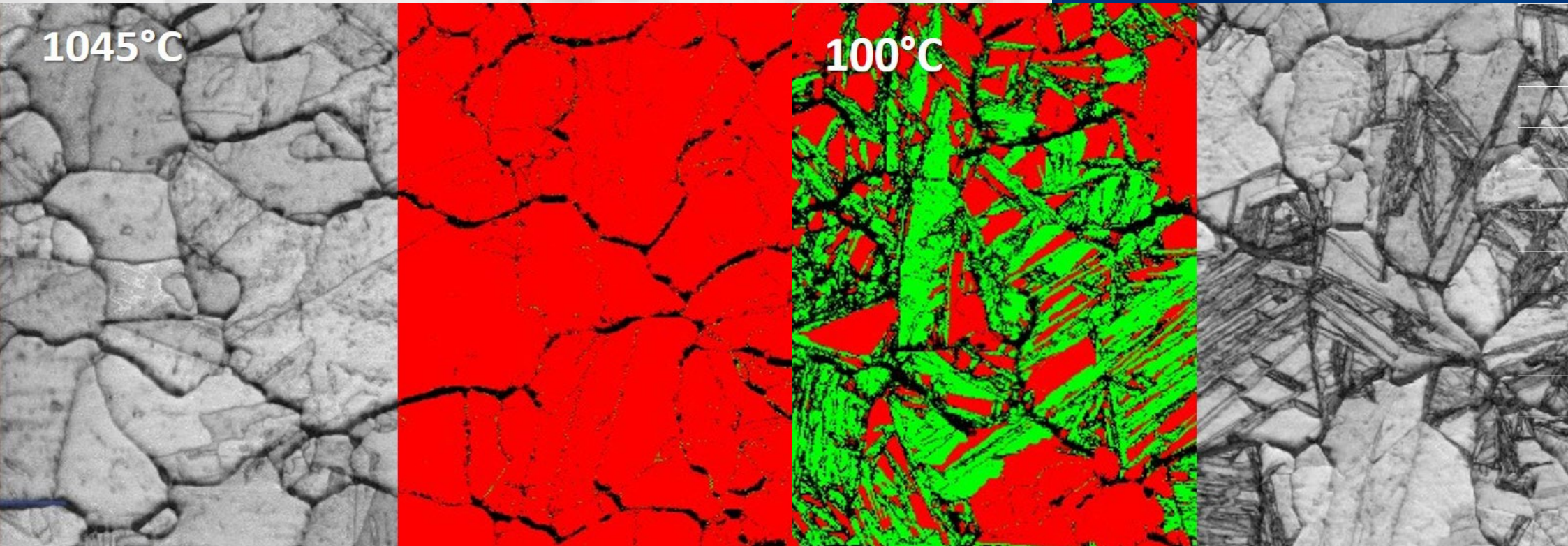
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## Our Focus / Competences:

- hardness testing of individual microstructural fractions
- Insitu tensile test to observe local strain changes
- Insitu hardness testing using nanoindenter, recording flow curves and determination of Young's modulus
- Insitu static and cyclic material testing using the nanoindenter, determination of fracture and fatigue properties
- testing of shear resistances at interfaces (e.g. interface of a coating)



# Insitu - Temperatur Transformation Analytics



High resolution documentation of the transformation kinetics of individual phase fractions

Contact:



Bernhard Sartory  
T: +43-676 848883 450

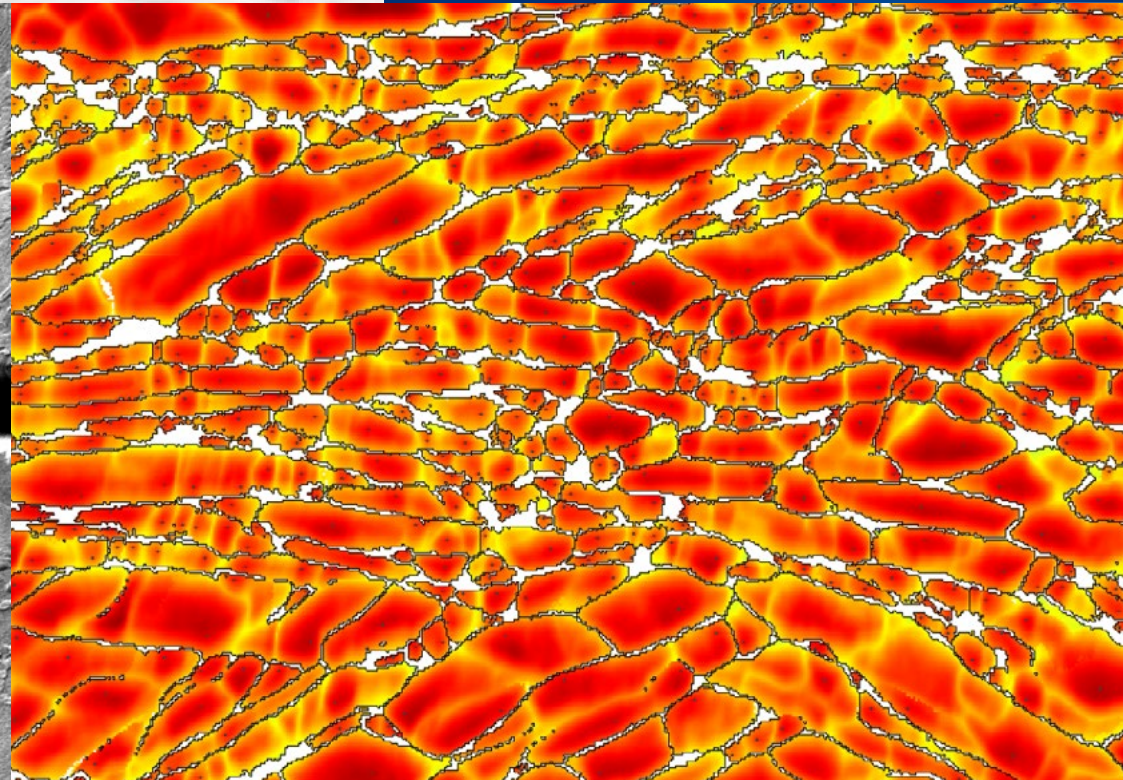
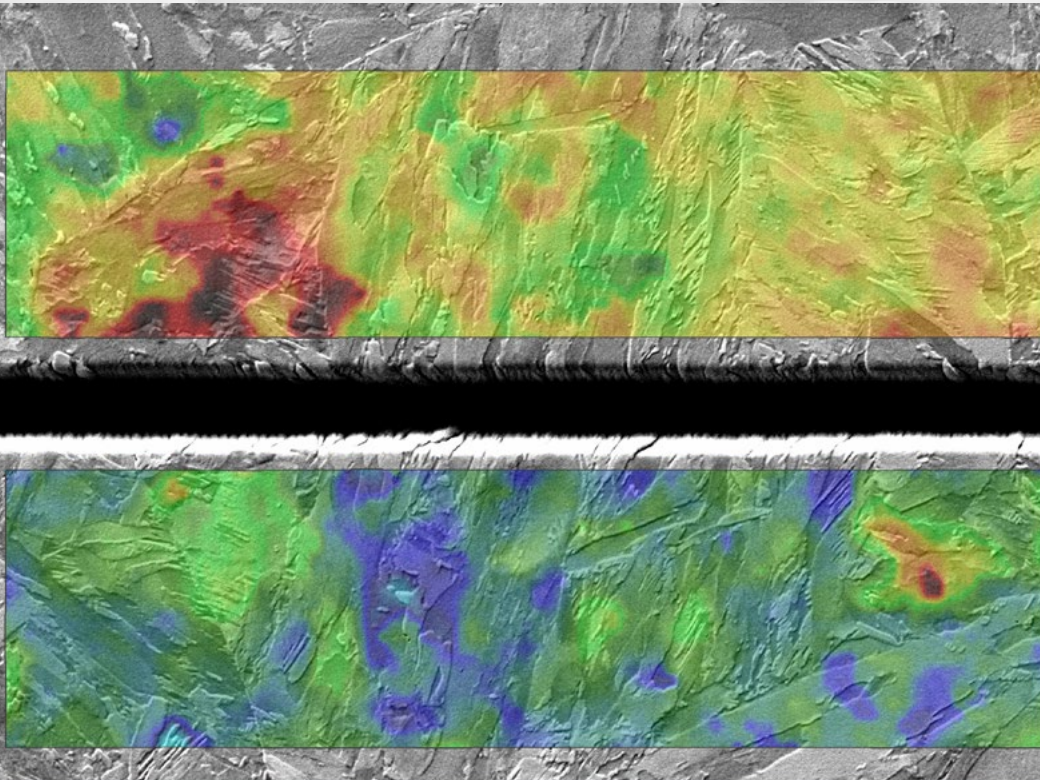
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## Our Focus / Competences:

- Insitu heating and cooling experiments in the scanning electron microscope
- temperature range -180°C to 1045°C
- heating rates: -180°C to 400°C max. 20°C/min  
250°C to 1045°C max. 250°/min
- temperature-dependent residual stress measurement on coatings
- analysis with various detectors (including EBSD)



# Residual stress measurements using electron microscopy



Determination of global and local residual stresses on bulk materials and coatings with a lateral resolution of up to 10 nm

Contact:



Bernhard Sartory  
T: +43-676 848883 450

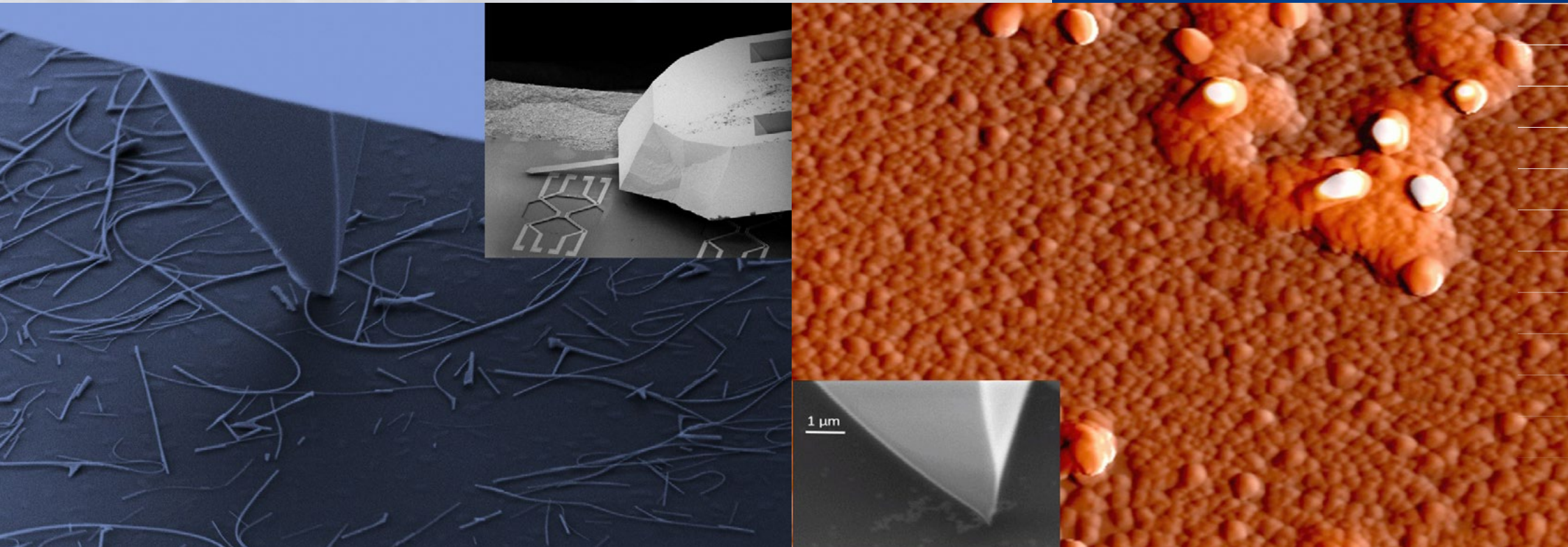
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## Our Focus / Competences:

- measurement of residual stresses and residual stress depth profiles of coatings with a depth resolution of up to 10 nm
- temperature-dependent residual stress measurements of microelectronic coatings between -180°C and +400°C
- 2D residual stress distributions of crystalline materials with an accuracy of a few 10nm incl. dislocation density analysis
- residual stress depth profiles on machined sheets, wires and other surfaces



# Ex-/Insitu-AFM Measurements



Determination of local electrical, thermal and magnetic properties  
and surface topographies

Contact:



Dr. Barbara Kosednar-Legenstein  
T +43-676 848883 650



Bernhard Sartory  
T: +43-676 848883 450

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## Our Focus / Competences:

- topography / roughness
- KPFM for the determination of local electrical properties of grains or microstructural components
- SThM for determination of thermal conductivity of grains or microstructure components
- EBIC for determination of local electrical properties and short circuits/interruptions
- MFM for determination of local magnetic properties (e.g.: retained austenite)
- STM for visualization of atoms or atomic lattice
- C-SPM for measuring electrical properties such as resistance or conductivity



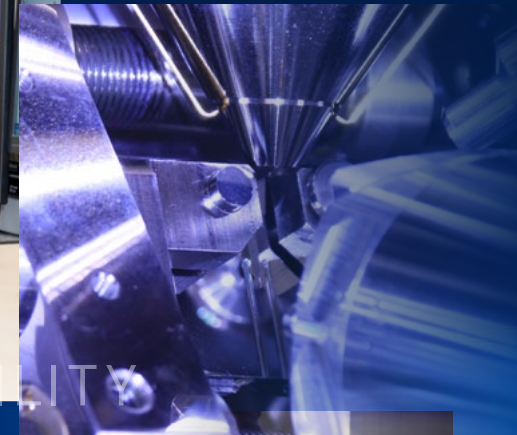
## Service Offer

- SEM characterization of surfaces, fracture surfaces, damage and microsections incl. local chemical composition
- material investigations up to 3D microstructures, topography and tomography using SEM-FIB technology
- target preparation of TEM thin films, atom probe tips for further high-resolution investigations
- preparation of microsamples for mechanical in-situ experiments with different geometries (e.g. cuboids, cylinders or micro tensile specimens and cantilever)
- investigation of TEM samples in transmission mode (STEM) incl. chemical and crystallographic analysis
- insertion of small crack-like defects (in the sub- $\mu\text{m}$  to  $\mu\text{m}$  range) to study the behavior of short cracks
- local and depth-resolved residual stress measurements
- high temperature investigations in combination with EBSD
- determination of physical parameters in combination with modules and analytics
- SPM-SEM in combination of different modules
- one to several days on-site training in electron microscopy, focused ion beam and correlative microscopy

## COMPETENCE & RELIABILITY

## Equipment

- scanning electron microscope with large sample chamber of Zeiss type EVO MA25® for the analysis of non-conductive and contaminated samples.
- NEU: Zweistrahlssystem, FE-REM (Zeiss CrossBeam® 550) inkl. Fokussierter Ionenstrahl (FIB)
- high resolution FE-SEM (Zeiss Gemini®-SEM 450) for imaging structures with a few nm and precise chemical analysis
- modular SEM (Zeiss CrossBeam®-SEM 340) with
  - tensile/compression/bending module
  - nanoindenter
  - heating/cryogenic module
  - AFM
- acquisition techniques and analytics: SE, BSD, STEM, secondary ion, InLens and EBSD detector, EDX, WDX, ED-XRF, WD-XRF, EBSD, STEM, TKD (Transmission EBSD), FIB-SIMS (TOF)
- ionslicer for sample preparation (flatmilling, cross sectioning)
- vapor deposition with different substances (graphite, platinum,...) for charge compensation and analysis of non-suffering samples





Materials Center Leoben Forschung GmbH  
Department Services  
Roseggerstraße 12 | A-8700 Leoben  
T +43-3842-45922  
[services@mcl.at](mailto:services@mcl.at) | [www.mcl.at](http://www.mcl.at)