

# Registration

Laboratory x-ray techniques for materials  
development and process control

Date: March 7<sup>th</sup> - 9<sup>th</sup>, 2022 **Online**

## Participation Fees

- DGM- Member online\***      **675 €**  
 Normal price **online\***      **750 €**

\*) Personal DGM- or FEMS member | Employees of a DGM member company or institute.  
Please enter your personal membership number or company membership number when registering.

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DGM-Membership Number

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**Date, Signature**

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Online: **www.dgm.de/8336**      E-Mail: **fortbildung@dgm.de**  
Phone: **+49 (0) 69 75306-757**      Fax: **+ 49 (0) 69 75306-733**

After your registration you will receive a confirmation of registration. Only the General Terms and Conditions of the DGM e.V., as well as the conditions for participation in training courses, which can be found at: [www.dgm-inventum.de/agb](http://www.dgm-inventum.de/agb) apply. By registering, you agree to the storage of your personal data for the purposes of the event and future transmission of information by the DGM. Data storage is subject to data protection regulations.

Organizer:  
**German Materials Society (DGM):**  
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# Laboratory X-ray techniques for materials development and process control

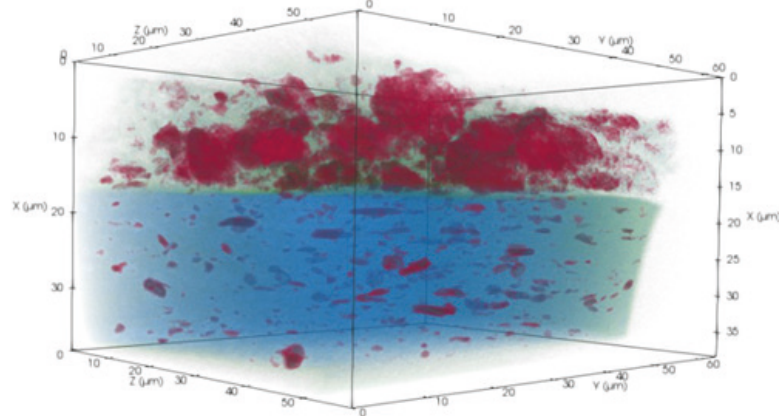
March 7<sup>th</sup> - 9<sup>th</sup>, 2022 Online



Chairman

**Prof. Dr. Ehrenfried Zschock**  
BTU Cottbus - Senftenberg

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# SCOPE

Advanced materials are increasingly enablers for high-tech products. The improved understanding of structure-property relationships of these materials is essential for their applications in many branches. Materials characterization provides the needed information about atomic structure, chemical binding and the 3D microstructure of advanced materials. Within this context, high-resolution X-ray techniques are playing an important role for the development and introduction of new technologies as well as for the integration of advanced materials into high-tech products, and particularly for process control and for quality assessment. One unique advantage of the X-ray techniques is that they deliver – generally integral – data for bulk materials and thin films nondestructively.

# YOUR BENEFIT

- ✓ The course will provide the knowledge needed for materials characterization using X-ray techniques:
  - Fundamentals of X-ray physics
  - X-ray diffraction for phase, texture and stress analysis of materials
  - X-ray spectroscopy for the determination of materials composition and chemical binding
  - X-ray microscopy and X-ray computed tomography for 3D morphology and microstructure analysis of materials
  - Advanced concepts for data analysis including Artificial Intelligence algorithms.
- ✓ Capabilities and limits of the experimental techniques, including spatial resolution, detection limit and the time needed for data acquisition and data analysis (“time-to-data”) will be discussed for specific use-cases in basic research and application.
- ✓ Data acquisition, data processing and data analysis, including the application of machine learning algorithms, will be demonstrated.
- ✓ New results from fundamental research will be presented, and application-specific solutions in the fields of metallurgy, renewable energies, biomimetics and microelectronics will be provided.
- ✓ In-situ and operando studies of kinetic processes, e.g. micro-crack propagation and fracture of materials as well as electrochemical reactions for energy storage and conversion, will be demonstrated.
- ✓ The potential of X-ray techniques for materials characterization as well as for the generation of data that describe structure, composition and chemical binding as well as 3D morphology and microstructure of materials will be explained by an experienced team of lecturers from academia and industry with knowledge in the fields of materials science, physical and chemical materials analysis as well as advanced data analysis.

# TARGET AUDIENCE AND VENUE

- ✓ The course is intended for individuals who wish to expand their knowledge in the field of X-ray techniques for materials characterization, both in research and in practical applications for process control and reliability engineering. The subjects covered in this course extend from materials science and materials analysis up to the current challenges in industry, particularly in process monitoring and quality assurance.
- ✓ Scientists, engineers and technicians working in industry – in manufacturing, process and quality control
- ✓ This event will be held as a **online event**

# PROGRAM

## WELCOME AND INTRODUCTION: FUNDAMENTALS OF X-RAY PHYSICS

- Historical development, major inventions
- X-rays: Refraction, reflection, diffraction
- X-ray diffraction, spectroscopy, radiography/tomography
- Status and expected future developments

*PROF. DR. EHRENFRIED ZSCHECH (BTU COTTBUS-SENFTENBERG, GERMANY)*

## X-RAY EXPERIMENTS:

### LABORATORY SOURCES VS. SYNCHROTRON

- Generation of X-rays
- Bremsstrahlung and characteristic radiation
- The integrated setup: Laboratory tool vs. synchrotron beamline

*DR. JÖRG GRENZER (HELMHOLTZ ZENTRUM DRESDEN-ROSSENDORF, GERMANY)*

## X-RAY EXPERIMENTS: OPTICS AND DETECTORS

- X-ray optics: Reflective and diffractive optics
- X-ray detectors: 0D, 1D, 2D

*DR. JÖRG GRENZER (HELMHOLTZ ZENTRUM DRESDEN-ROSSENDORF, GERMANY)*

## X-RAY DIFFRACTION:

### STRUCTURE AND MICROSTRUCTURE OF CRYSTALLINE MATERIALS

- Fundamentals of X-ray diffraction
- X-ray structure and microstructure analysis
- Texture and stress analysis | Applications in materials science

*PROF. DR. DAVID RAFAJA (TECHNICAL UNIVERSITY BERGAKADEMIE FREIBERG, GERMANY)*

## X-RAY TOMOGRAPHY: 3D MORPHOLOGY AND MICROSTRUCTURE OF MATERIALS

- Fundamentals of X-ray microscopy
- Radiography and high-resolution computed X-ray tomography
- Data analysis including AI algorithms
- Applications in materials science and biology

*PROF. DR. EHRENFRIED ZSCHECH (BTU COTTBUS-SENFTENBERG, GERMANY)*

## IN-SITU AND OPERANDO X-RAY MICROSCOPY STUDIES

- X-ray microscopy at several photon energies
- In-situ mechanical studies at composites and microchips
- Operando studies at systems for energy storage and conversion

*KRISTINA KUTUKOVA, M.Sc. (FRAUNHOFER IKTS DRESDEN, GERMANY)*

*PROF. DR. EHRENFRIED ZSCHECH (BTU COTTBUS-SENFTENBERG, GERMANY)*

## X-RAY FLUORESCENCE SPECTROSCOPY: ELEMENTAL COMPOSITION

- Fundamentals of X-ray absorption spectroscopy
- From point analysis to elemental mapping
- Scanning micro-XRF - a technique for qualitative and quantitative materials analysis

*DR. ROALD TAGLE, BRUKER NANO GMBH*

## X-RAY ABSORPTION SPECTROSCOPY: LOCAL ATOMIC AND ELECTRONIC STRUCTURES OF NANOSTRUCTURED MATERIALS

- Fundamentals of X-ray absorption spectroscopy, EXAFS and XANES analysis
- From ex-situ to operando XAS studies
- Applications in battery research, catalysis and biomedicine

*PROF. DR. ALEXANDER V. SOLDATOV (UNIVERSITY ROSTOV-ON-DON, RUSSIA)*

## BIG DATA AND AI ALGORITHMS FOR THE ANALYSIS OF X-RAY SPECTROSCOPY DATA

- The need of Big Data
- Machine learning (ML) benefits
- Examples of ML applications in materials characterization
- Challenges and limits of the AI technologies.

*PROF. DR. ALEXANDER V. SOLDATOV (UNIVERSITY ROSTOV-ON-DON, RUSSIA)*

## SUMMARY AND FINAL REMARKS

*PROF. DR. EHRENFRIED ZSCHECH (BTU COTTBUS-SENFTENBERG, GERMANY)*

DAY ONE | 9 AM - 1 PM

DAY TWO | 9 AM - 1 PM

DAY THREE | 9 AM - 1:30 PM