

Scope

High-resolution analytical techniques are essential for the development and introduction of new nanotechnologies and thin-film technologies as well as for the integration of advanced materials into high-tech products and particularly for process control and for quality assessment. A comprehensive materials analysis is more and more needed for process monitoring during manufacturing of micro- and nanostructured systems and devices as well as for the understanding of the microstructure in materials. Therefore, research and development in the field of physical analysis increasingly focused on the study of thin films as well as micro- and nanostructures. Application-specific developments show often that the combination of several analysis techniques is needed to ensure both process control in nanotechnology as well as performance and reliability of new products.

In this course, we will explain that the digital transformation in materials science and engineering requires and enables more and more the application of algorithms of artificial intelligence, particularly for new platforms, standards and technologies for data processing, data exchange and data analysis in materials and process characterization. Consequently, future tasks of scientists and engineers will include collecting and interpretation of data, in addition to the development and application of advanced techniques for materials analysis.

The course will provide knowledge in the fields of materials characterization, process control and artificial intelligence. After an introduction into materials analysis in the lab and for process monitoring as well as into artificial intelligence, advanced techniques for the characterization of thin films, nanostructures and nanoparticles will be explained. New results from fundamental research will be presented, and application-specific solutions in the fields of microelectronics, renewable energies and light-weight construction will be demonstrated. The potential of the use of algorithms of machine learning in microscopy and spectroscopy as well as for the generation of data that describe structure, morphology and properties 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 mathematics and informatics.

The course is intended for individuals who wish to expand their knowledge in the field of materials development and materials characterization for process control and reliability engineering and particularly in the use of new approaches of artificial intelligence. The subjects covered in this course extend from materials science and materials analysis as well as machine learning and neuronal networks for data analysis 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 and F&E – as well as scientists and engineers from research institutes and universities, who are interested to extend their knowledge in materials characterization as well as in the use of artificial intelligence for potential applications in experimental data analysis, will benefit from this course.

Venue



**Fraunhofer-Institut für
Keramische Technologien
und Systeme IKTS,**
Maria-Reiche-Str. 2,
01109 Dresden (Germany)

Registration

Artificial Intelligence in Materials Development and Process Control
August 26th - 28th, 2019 in Dresden (Germany)

Participation Fees

Incl. comprehensive handouts, refreshments during the coffee breaks*, lunch* and dinner* (*incl. 19% VAT.)

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| ☐ Members*:
(1.125 € VAT-free plus 100 € for catering incl. 19% VAT.) | 1.225 EUR incl. 19% VAT |
| ☐ Young Members (< 30 years old)*:
(575 € VAT-free plus 100 € for catering incl. 19% VAT.) | 675 EUR incl. 19% VAT |
| ☐ Normal price:
(1.200 € VAT-free plus 100 € for catering incl. 19% VAT.) | 1.300 EUR incl. 19% VAT |
| ☐ Young entrants (< 30 years old):
(650 € VAT-free plus 100 € for catering incl. 19% VAT.) | 750 EUR incl. 19% VAT |

*Personal DGM- or FEMS member | Employees of a DGM member company or institute.

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Company · University

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Online: **www.dgm.de/6681** 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 Deutsche Gesellschaft für Materialkunde e.V., as well as the conditions for participation in training courses, which can be found at: www.dgm.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.

Organization:
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Postanschrift: DGM e.V. c/o INVENTUM GmbH · Marie-Curie-Straße 11-17 · 53757 St. Augustin · Deutschland

European Advanced Training Course

Artificial Intelligence in Materials Development and Process Control

**August 26th - 28th, 2019
Dresden**

Dresden Fraunhofer Cluster Nanoanalysis



**Prof. Dr.
Ehrenfried Zschech**
Chairman

including visits of laboratories

endorsed by



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Monday

August 26th, 2019

Data-centric materials science and Artificial Intelligence in materials discovery, materials analysis and process monitoring

- 14:00 Prof. Dr. Ehrenfried Zschech
(Dresden Fraunhofer Cluster Nanoanalysis, Germany)
Welcome and introduction:
Materials analysis in the lab and process monitoring
- 14:15 Prof. Dr. Ehrenfried Zschech
(Dresden Fraunhofer Cluster Nanoanalysis, Germany)
Strategies for accelerating materials research, development and innovation
- Global and European initiatives
- Deep learning models and digital reality
- Experimental big data analysis and databases
- 15:00 Coffee Break
- 15:30 Dr. Matthias Kraatz (Fraunhofer IKTS Dresden, Germany)
Artificial Intelligence in materials data and image processing
- Concepts, terminology, methods
- Applications in science and engineering
- Challenges and outlook
- 16:45 Dr. Karl Schlagenhauf (ADI Innovation Karlsruhe, Germany;
Co-author of the book „The Brain & AI“)
Artificial Intelligence: Computer vs. brain
- How brain-like should or can Machine Learning and AI be?
- AI in materials science beyond computer vision
- 18:00 End of course day 1

Tuesday

August 27th, 2019

Materials characterization: Microscopy, Spectroscopy, Diffraction

- 9:00 Dr. Zhongquan Liao (Fraunhofer IKTS Dresden, Germany)
High-resolution imaging: Microscopy and Tomography
- Imaging: Setup and contrast mechanisms
- Tomography: 3D imaging of materials and structures
- Applications: 3D microstructure analysis, defect localization
- 10:00 Prof. Dr. Ehrenfried Zschech
(Dresden Fraunhofer Cluster Nanoanalysis, Germany)
Chemical analysis of materials: Spectroscopy
- High-resolution element analysis: EDX, EELS/EFTEM, XRF
- Short-range order and chemical analysis:
Fine structure in EELS and XAS
- Applications in energy conversion technologies
- 11:00 Coffee Break
- 11:30 Prof. Dr. Ellen Hieckmann (Technische Universität Dresden)
Microstructure analysis of crystalline materials: Diffraction techniques
- X-ray and synchrotron radiation diffraction:
Residual stresses and textures
- Electron backscatter diffraction: Crystal structure, crystal orientation and internal strains
- 12:30 Lunch Break
- Artificial Intelligence in materials development and materials characterization**
- 14:00 Prof. Dr. Stefan Sandfeld
(Technical University Bergakademie Freiberg, Germany)
Computational materials science
- New paradigms in materials science and engineering
- Challenges and perspectives of materials science
- Potential and limitations of machine learning
- 15:00 Coffee Break
- 15:30 Emre Topal, M. Sc. (Technische Universität Dresden, Germany) |
Prof. Dr. Ehrenfried Zschech
(Dresden Fraunhofer Cluster Nanoanalysis, Germany)
Artificial Intelligence for microscopy and tomography
- Machine learning in image processing
- Application in microscopy and tomography:
Artefact reduction, noise reduction and pattern recognition
- Challenges and outlook

Tuesday

August 27th, 2019

- 16:30 Dr. Carlos Viol Barbosa
(Science Desk, Freital, Germany)
From Structured Queries to Data Mining: Application of modern database technologies in the experimental research
- Flexible data structures for materials
- New tools for pattern extraction from experimental spectroscopy data
- Learning from interaction with customers
- 17:30 **Lab tour**
- 19:00 Dinner, afterwards end of course day 2

Wednesday

August 28th, 2019

Process monitoring and quality assessment

- 9:00 Dr. Eckhard Langer (GLOBALFOUNDRIES, Dresden, Germany),
Dipl.-Ing. Sylvia Mucke (Plastic Logic, Dresden, Germany)
Process control and physical failure analysis in industry
- In-line process control vs. out-of-fab physical failure analysis
- Application in industry: Si-based and organic microelectronics
- Challenges and limits of the techniques
- 10:30 Coffee Break
- 11:00 A. Clausner (Fraunhofer IKTS Dresden)
Application of neuronal networks in materials characterization using nanoindentation
- Mechanical properties of nano-scale materials and thin films: Nanoindentation and related techniques
- Mathematical limits in the analysis of nanoindentation data
- Use of neuronal networks for improved extraction of materials parameters from nanoindentation
- 12:30 Lunch Break
- 13:30 Prof. Dr. Ehrenfried Zschech
(Dresden Fraunhofer Cluster Nanoanalysis, Germany)
Final remarks
- 14:00 End of the training course