

Scope

Nanoscale materials are playing an increasing role in materials science and engineering, they are enabler for high-tech products. The improved understanding of structure-property relationships of new materials are essential for their applications in many branches. Basic research is needed to investigate structure and properties of advanced materials on scales from product dimensions down to the atomic level. Multi-scale materials characterization and multi-scale modeling are needed for further materials research and development.

High-resolution analytical techniques are essential for both development and introduction of new nanotechnologies and thin-film technologies as well as for the integration of advanced materials into high-tech products. Nanoanalysis is more and more needed for process and materials characterization during manufacturing of nanostructured systems and devices as well as for the understanding of nano-scale microstructure in materials. Therefore, research and development in the field of physical analysis increasingly focused on the study of thin films 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 the need and use of analytical techniques for process control and for quality assessment as well as the application of machine learning algorithms.

Numerous new developments in the field of nanoanalysis allow the imaging as well as the structural and chemical characterization of structures in the range < 100 nm, down to atomic dimensions. The suitability of a technique for research and development or for process control in manufacturing is determined by the capabilities and limits of the technique itself, particularly if the technique is destructive or non-destructive, but also from the time needed for data acquisition and data analysis ("time-to-data").

The course will provide knowledge in the field of nanoanalysis. After a short survey, 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 will be demonstrated as well. Challenges to nanoanalysis techniques in the industry will be an additional topic. Special examples for applied studies in micro-, nano- and optoelectronics as well as in the fields of renewable energies and lightweight construction will be demonstrated. Nanoanalytical studies at metallic, inorganic-nonmetallic and organic materials will be reviewed. As an integral part of the course, we are offering a practical half-day lab training in small groups in one of the following fields of research that should be chosen by the participant:

- scanning electron microscopy / focused ion beam technique
- micro- and nanomechanical characterization techniques
- techniques for particle analysis.

All lecturers are experienced experts in the field of physical and chemical analysis and are mentioned at their lecture.

The course is intended for individuals who wish to expand their knowledge in the field of nano-scale materials and nanoanalysis. The subjects covered in this course extend from fundamentals of materials science and analysis to the current nanotechnologies and challenges in industry. Scientists, engineers and technicians working in industry, research and education, who are interested to extend their knowledge in nanoanalysis, will benefit from this course.

Venue



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

Registration

Nano-scale Materials
August 26th - 28th, 2019 in Dresden (Germany)

Participation Fees

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

- | | |
|--|-------------------------|
| <input type="checkbox"/> Members**:
(1.125 € VAT-free plus 100 € for catering incl. 19% VAT.) | 1.225 EUR incl. 19% VAT |
| <input type="checkbox"/> Young Members (< 30 years old)*:
(575 € VAT-free plus 100 € for catering incl. 19% VAT.) | 675 EUR incl. 19% VAT |
| <input type="checkbox"/> Normal price:
(1.200 € VAT-free plus 100 € for catering incl. 19% VAT.) | 1.300 EUR incl. 19% VAT |
| <input type="checkbox"/> 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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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:

Deutsche Gesellschaft für Materialkunde e.V.

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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

Nano-scale Materials

incl. materials characterization
and machine learning
approaches

August 26th - 28th, 2019
Dresden

Dresden Fraunhofer Cluster Nanoanalysis



**Prof. Dr.
Ehrenfried Zschech**
Chairman

incl. practical lab training in small groups

endorsed by



DGM

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Monday

August 26th, 2019

Multi-scale materials characterization, particle and thin film analysis, 3D imaging

13:00 Prof. Dr. Ehrenfried Zschech
(Dresden Fraunhofer Cluster Nanoanalysis, Germany)

Welcome and introduction

13:15 Prof. Dr. Ehrenfried Zschech
(Dresden Fraunhofer Cluster Nanoanalysis, Germany)

Survey of analysis techniques for multi-scale materials characterization

14:00 Dr. Annegret Potthoff (Fraunhofer IKTS Dresden, Germany)

Characterization of nanoparticles: Chemical and physical analysis techniques

- Dispersion of nanomaterials
- Particle size analysis in suspensions
- Characterization of particle surfaces

15:00 Coffee Break

15:30 **Lab tour**

16:30 Dipl.-Phys. Jörg Heber | Dr. Jan-Uwe Schmidt
(Fraunhofer IPMS Dresden, Germany)

Thin film analysis:

Optical analysis and metrology, X-ray reflectometry

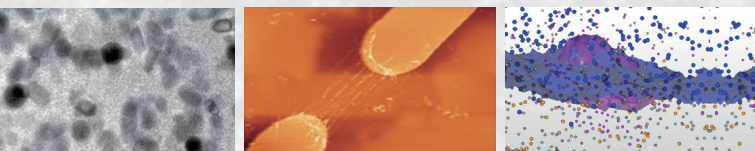
- Ellipsometry
- Interferometry
- Application to photonic microsystems

17:30 Dr. Markus Löffler (Technische Universität Dresden),
Kristina Kutukova, M.Sc. | Prof. Dr. Ehrenfried Zschech
(Fraunhofer IKTS Dresden, Germany)

Multi-scale X-ray tomography

- Micro XCT and nano XCT: Principles and applications in materials science
- 3D visualization of crack propagation in composite materials and microchips
- New developments, outlook

18:30 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/EFTM, 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

14:30 **Practical lab training in small groups**

- 1 - Dr. Eckhard Langer (GLOBALFOUNDRIES, Dresden)
Dr. Markus Löffler (Technische Universität Dresden)

Scanning Electron Microscopy/Focused Ion Beam

- 2 - Dr. Andre Clausner (Fraunhofer IKTS Dresden)

Micro- and nanomechanical characterization techniques

- 3 - Dr. Annegret Potthoff (Fraunhofer IKTS Dresden)

Techniques for particle analysis

19:00 Dinner, afterwards end of course day 2

Wednesday

August 28th, 2019

Nano-scale materials analysis in microelectronics and nano-mechanical properties

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



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