

## 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 modelling 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.

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, 01277 Dresden (Germany)

and

**Fraunhofer-Institut für Keramische Technologien und Systeme IKTS**, Winterbergstraße 28, 01277 Dresden (Germany)

## Registration

Nano-scale Materials - Characterization-Techniques and Applications  
August 27<sup>th</sup> - 29<sup>th</sup>, 2018 in Dresden (Germany)

## Participation Fees

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

- Members:** 1.190 EUR incl. 19% VAT  
Personal DGM- or FEMS member | (1.100 € VAT-free plus 90 € per diem meal allowance incl. 19% VAT. )
- Young Members (< 30 years old):** 595 EUR incl. 19% VAT  
Personal DGM- or FEMS member | 505 € VAT-free plus 90 € per diem meal allowance incl. 19% VAT. )
- Normal price:** 1.290 EUR incl. 19% VAT  
(1.200 € VAT-free plus 90 € per diem meal allowance incl. 19% VAT. ) | Employees of a DGM member company / institute get 5% discount on the participation fee.
- Young entrants (< 30 years old):** 775 EUR incl. 19% VAT  
(685 € VAT-free plus 90 € per diem meal allowance incl. 19% VAT. )

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Title · Firstname · Surname

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Department · Institute

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Street

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ZIP-Code · City · Country

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DGM-Membership Number

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Date of birth

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Phone · Fax

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E-Mail

.....  
Date, Signature

### Registration | Registration policy | Further Information

Online: [www.dgm.de/2801](http://www.dgm.de/2801) E-Mail: [fortbildung@dgm.de](mailto: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](http://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.**  
c/o **INVENTUM GmbH** · Marie-Curie-Straße 11-17 · D-53757 Sankt Augustin (Mailingaddress)  
**Deutsche Gesellschaft für Materialkunde e.V.**  
Wallstraße 58/59 · D-10179 Berlin (Visiting address)

European Advanced  
Training Course

# Nano-scale Materials

Characterization Techniques and Applications

August 27<sup>th</sup> - 29<sup>th</sup> 2018, Dresden

Dresden Fraunhofer Cluster Nanoanalysis



**Prof. Dr.  
Ehrenfried Zschech**  
Chairman

**incl. practical lab training in small groups**

endorsed by



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**DGM**

# Monday

August 27<sup>th</sup>, 2018

(Fraunhofer IKTS Dresden, Maria-Reiche-Strasse 2, 01277 Dresden)

## Microscopy: Imaging and element analysis

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 multiscale materials characterization

13:45 Dr. Markus Löffler, Dr. Uwe Mühle  
(Technische Universität Dresden)

### High-resolution imaging and element analysis of materials: Scanning electron microscopy/ focused ion beam technique and transmission electron microscopy

- Imaging: Setup and contrast mechanisms
- Element analysis: EDX and EELS/EFTM
- Tomography studies

14:45 Coffee Break

15:15 Prof. Dr. Ehrenfried Zschech  
(Fraunhofer IKTS Dresden, Germany)

### Nondestructive 2D and 3D imaging of materials and structures: Transmission X-ray microscopy and X-ray computed tomography

- 2D and 3D imaging: Setup and contrast mechanisms
- In-situ studies of crack propagation in composites and microelectronic products
- Applications in battery and fuel cell R&D and biology

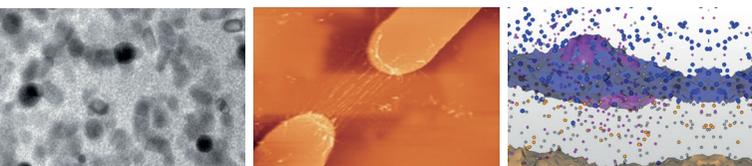
16:15 Dr. Florian Vogel (Helmholtz Zentrum Berlin)

### 3D atomic structures in nanoscale materials: Atom probe tomography

- Experimental and analysis techniques
- Sample preparation with focused ion beam
- Application in materials science and nanoelectronics

17:15 Lab tour 1

18:15 End of course day 1



# Tuesday

August 28<sup>th</sup>, 2018

(Fraunhofer IKTS Dresden, Maria-Reiche-Strasse 2, 01277 Dresden)

## Stress and mechanical properties

9:00 Dr. Andre Clausner (Fraunhofer IKTS Dresden)

### Mechanical properties of nano-scale materials and thin films: Nanoindentation and related techniques

- Hardness, Young's modulus and yield stress of nano-structures
- Nano-scale behavior of metals, ceramics, and glasses
- Properties and structure of nano-porous materials

10:00 Prof. Dr. David Rafaja (Technical University Bergakademie Freiberg, Germany)

### Microstructure analysis of nano-crystalline materials: Diffraction techniques

- X-ray diffraction: Texture and stress
- Electron backscatter diffraction: Crystal orientation
- Structure-properties relationships

11:00 Coffee Break

11:30 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

12:30 Lunch Break

## 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 29<sup>th</sup>, 2018

(Fraunhofer IKTS Dresden, Winterbergstrasse 28, 01277 Dresden)

## Process control and quality assessment

9:00 Dr. Eckhard Langer (GLOBALFOUNDRIES, Dresden),  
Dipl.-Ing. Sylvia Mucke (Plastic Logic, Dresden)

### 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 Dr. Annegret Potthoff (Fraunhofer IKTS Dresden)

### Characterization of nanoparticles: Chemical and physical analysis techniques

- X-ray tomography: from micro to nano
- Resolution and field of view
- Lab-based systems vs. synchrotron research
- Applications in materials science, electronics and biology

12:00 Prof. Dr. Ehrenfried Zschech  
(Dresden Fraunhofer Cluster Nanoanalysis, Germany)

### Final remarks

12:30 Lunch Break

13:30 Lab tour 2

14:30 End of the training course

