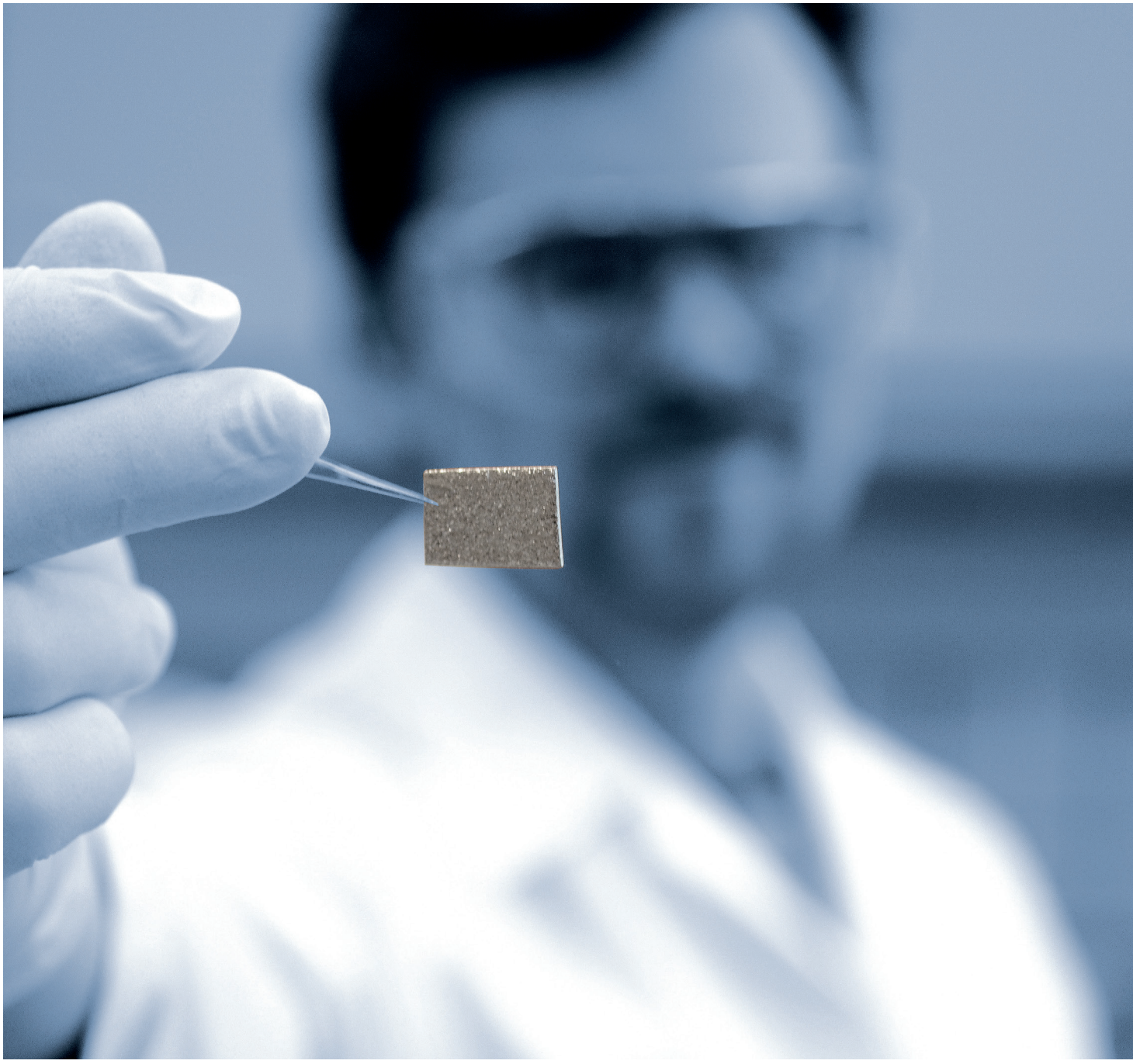
2024

FELMI-ZFE

Graz Centre for Electron Microscopy

See the invisible



Institute of Electron Microscopy and Nanoanalysis (FELMI)

Graz Centre for Electron Microscopy (ZFE)

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Austria
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www.felmi-zfe.at

FELMI-ZFE

Head of the institute

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Univ.-Prof. DI Dr.

Gerald Kothleitner

As Austria's largest non-university research institution in the field of electron microscopic characterization and nanoanalytics, we at FELMI-ZFE Graz apply modern methods to understand, explain, and adjust complex functional structure-property relationships of materials. In our efforts to further develop and renew our applied methods, which we have been pursuing for over 70 years, our task is to make academic research accessible to industry and to offer customized investigative solutions. Key areas of focus include R&D services and technology transfer in various fields of materials microscopy, including methods of micro- and nanoscale characterization. An experienced, interdisciplinary team works together with industry and partners to develop sustainable solutions for specific problem settings in the fields of materials science, micro- and nanotechnology, and life sciences. Our commitment to quality in accordance with EN ISO 9001 ensures that we will continue to „**make the invisible visible**" **for you in the future.**

Content

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Main focus

- Micro- and nanoanalysis
- Functional nanofabarication
- 3D- & in situ characterization
- Biomaterials & Polymers

More than **50** published articles per year

Approx. **20** poster contributions per year

More than **50** lectures per year

Highlights

Christian Doppler Laboratory for Direct Fabrication of 3D Nanoprobes

Nanoprobes – with potential applications ranging from the measurement of toxic substances in ambient air to the analysis of materials and the detection of individual components in blood – are manufactured using complex processes and are often limited to basic research. The CD Laboratory DEFINE, led by Assistant Professor Harald Plank, takes a different approach. Known for its long-standing expertise, the institute not only focuses on the production of nanoprobes, but also uses a technique called Focused Electron Beam Induced Deposition (FEBID). Here, an electron microscope acts like a 3D printer: a special gas in the microscope's sample chamber is decomposed by the electron beam and transformed into a stable, three-dimensional deposit. By smart & skillful beam-controlling, complex nanostructures can be created step by step.

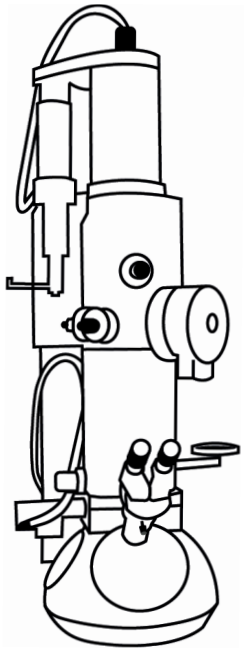
Leitung: Harald Plank

Project: ANGSTROM

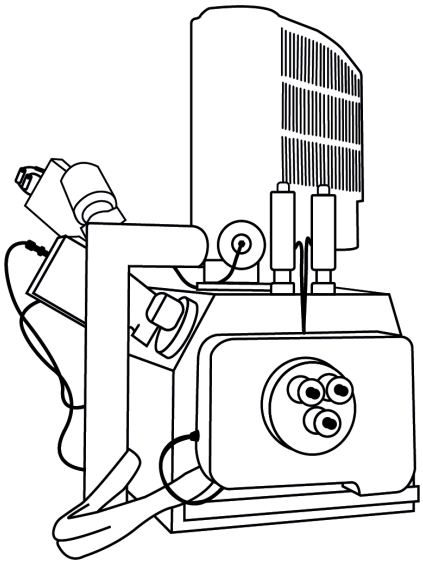
The goal is the acquisition and operation of Austria's most powerful next-generation scanning transmission electron microscope. The microscope is characterized by its exceptional configuration of high performance and flexibility, enabling entirely new research in many scientific fields. A unique combination of high spatial, energy, and impulse resolution, along with superior detector equipment, provides a significant gain in information about solids, but also about electron beam sensitive biological samples, on which structure-function relationships can than henceforth be investigated much more clearly in three dimensions. Materials sciences, life sciences, and medical research will all benefit from the acquisition, which will also ensure continued access to a flexible infrastructure. The new electron microscope will contribute significantly to the advancement of Austrian top-level research at the highest European level.

Leitung: Gerald Kothleitner

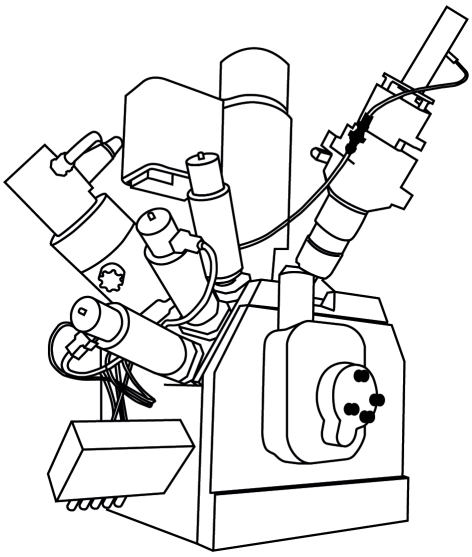
Our microscopes



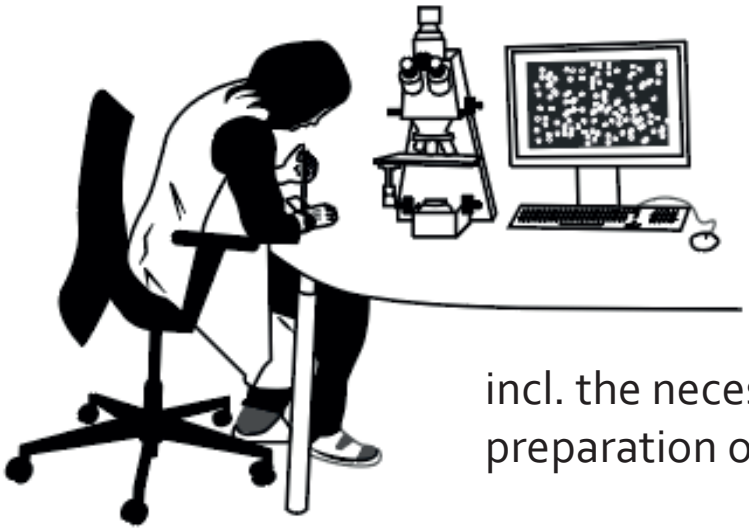
4 Transmission electron microscopes (TEM)



Scanning electron microscopes (SEM)



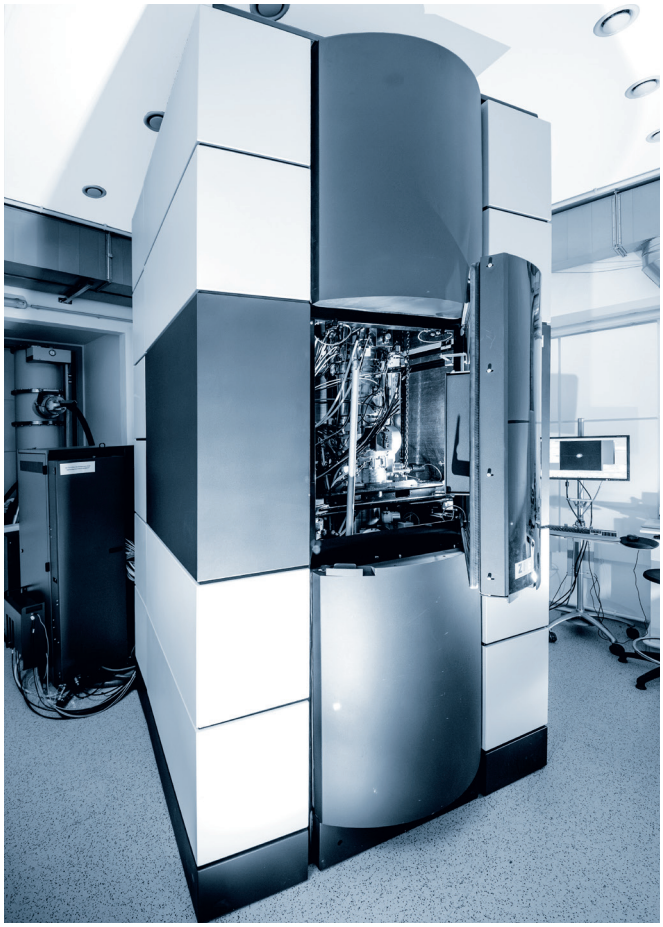
Focused ion beam devices (FIB)



- Atomic force microscopy
- Light microscopy
- Infrared & Raman - microspectrometry

incl. the necessary physical and chemical preparation of samples

High-end devices



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Austrian Scanning Transmission Electron Microscope

With the high-resolution transmission electron microscope ASTEM, we have one of the world's most powerful analytical electron microscopes. The device enables measurements of incredible accuracy: an unimaginably fine electron beam of 70 picometers - one picometer corresponds to one billionth of a millimeter

FEI Titan³ G2 60 –300

© NAWI Graz / Lunghammer

Raman- SEM & EDX in one device

In 2017, we installed a world innovation. It is a high-resolution scanning electron microscope that is equipped with a Raman spectrometer and an energy-dispersive X-ray spectrometer, enabling straightforward sequential microscopic imaging and spectroscopic investigations. This allows the efficient examination of a wide range of samples (polymers, biomaterials, semiconductor materials, minerals, coatings, composite materials, etc.).

Our partners at a glance

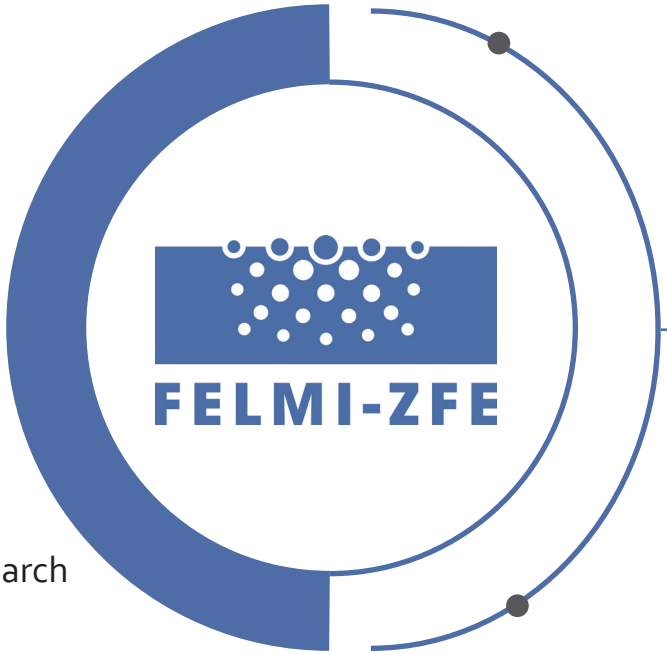
4
Continents

24
Countries

Member in
5
networks

More than
60
universities and research facilities

More than
120
companies



Guest researchers

Support for theses and dissertations at the TU Graz

Fostering cooperation – both national and international - is the key to scientific and economic success. Different perspectives and experiences may initially require more effort, but the ultimate outcome is of greater significance: better publications, successful joint projects and international experience for the next generation.

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Gerald Kothleitner, Head of the institute

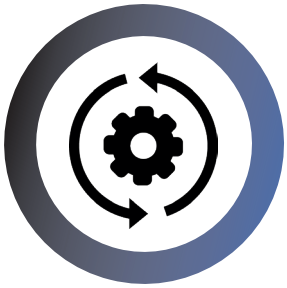
Worldwide **network**

ACR projects

Lectures of international guest speakers

Stays abroad lasting several weeks

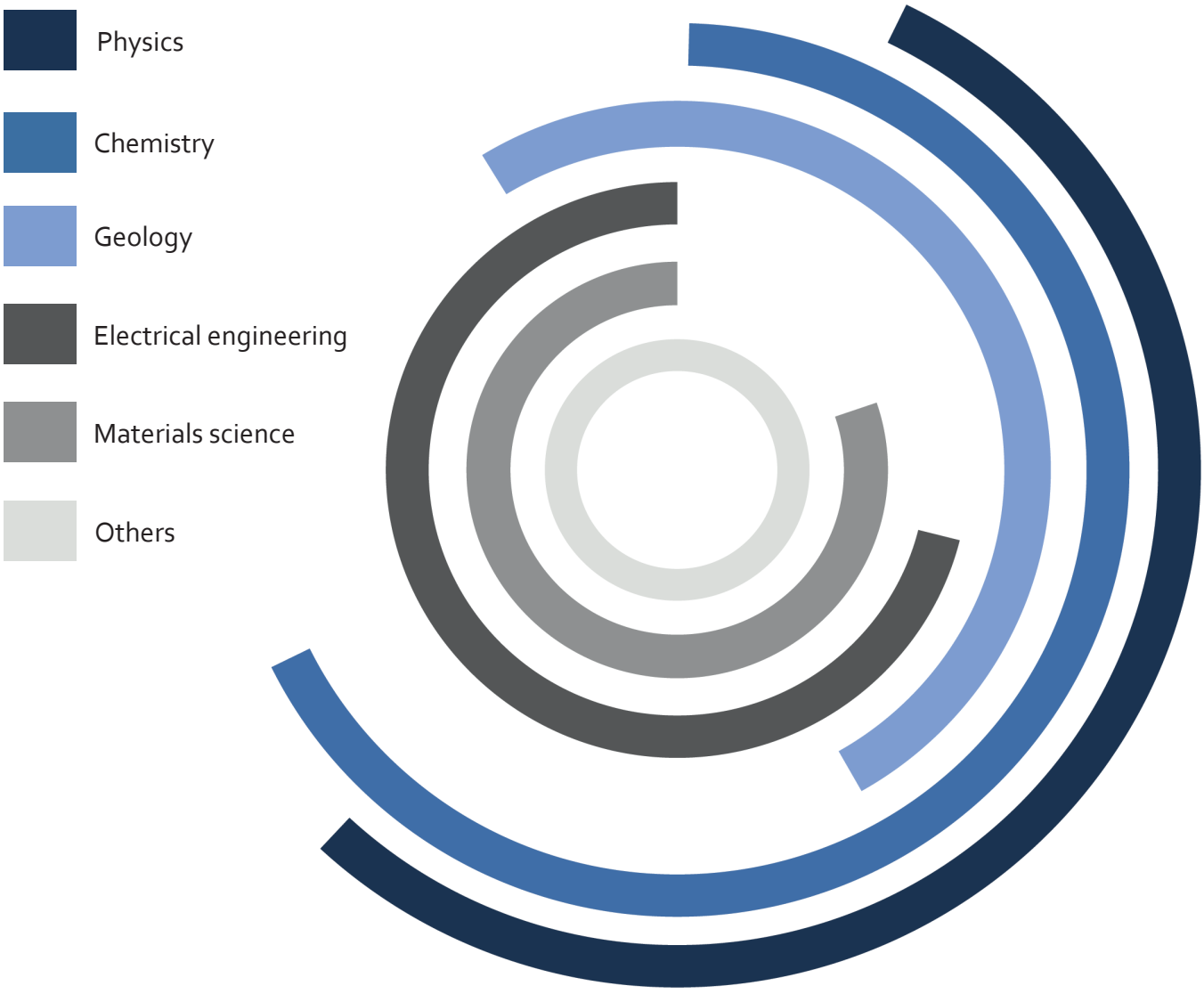
Association for the Promotion of Electron Microscopy and Fine Structure Research



Involved in EU-projects: ESTEEM3, FET Open...

More than 40 cooperations with foreign universities and research facilities

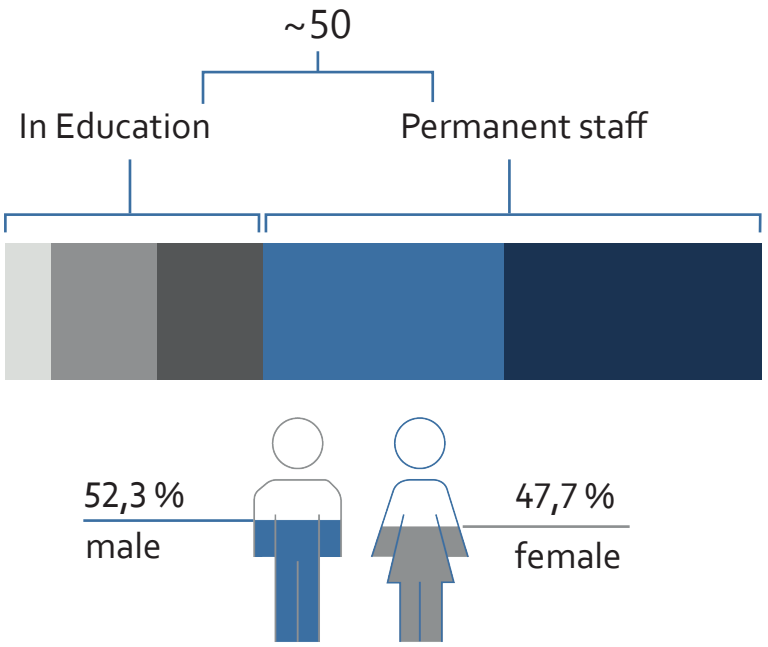
Scientific background



„Our institute employs about 50 employees. The foundation for our research is constituted by our permanent staff, which guarantees continuity and transfer of knowledge over time and guarantees the quality of our work. Furthermore, we place particular emphasis on training and continuing education. Each year we supervise up to 15 dissertations and master theses. We train young people to become laboratory technicians and offer a media design apprenticeship."

Werner Grogger, Deputy head of the institute

General information



- Scientific employees
- Non-scientific employees
- PhD students
- Graduate students
- Apprentices

TU Graz

acr austrian cooperative research

Faculty of Mathematics, Physics & Geodesy

Association for the Promotion of Electron Microscopy and Fine Structure Research

Presidential Committee
President: Prof. Helmut List
Vice President: Prof. Werner Grogger

FELMI
Institute of Electron Microscopy and Nanoanalysis
Head: Prof. Gerald Kothleitner
Deputy: Prof. Werner Grogger
Deputy: Prof. Harald Plank
Secretary: Verica Bursac

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Deputy: Prof. Werner Grogger
Deputy: Prof. Harald Plank
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Members from University and Industry

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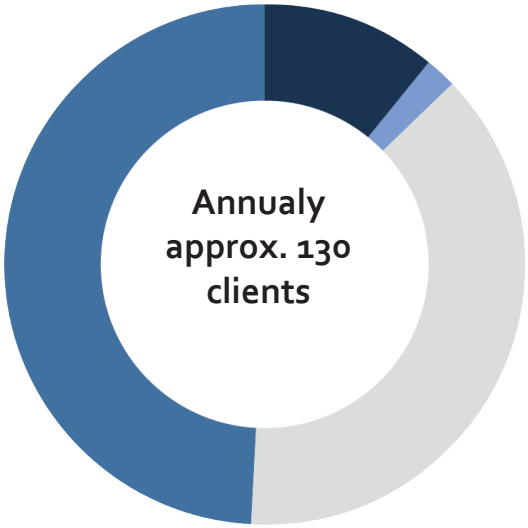
Ing. Hartmuth Schröttner

High Resolution Imaging
Groupeleader:
Dr. Evelin Fisslthaler
Dr. Daniel Knez

Beam Sensitive Materials/ Dynamic Microscopy
Groupeleader:
Dr. Ilse Letofsky-Papst

Functional Nanofabrication
Groupeleader:
Prof. Harald Plank

Customer structure



- Large companies: 38 %
- Small and medium-sized companies: 49%
- Public sector: 2 %
- Universities, universities of applied sciences, research facilities, individuals: 11 %

Nearly
1/5
of all orders come from abroad

Material focus

- Paper & cellulose
- Metals, alloys & 3D print
- Ceramics
- Pharmaceutical products
- Polymers
- Semiconductors
- Energy materials
- Environmental analysis & construction sector
- Automotive & mobility sector

Life Long Learning: Courses and Consulting

EELS/EFTEM- Course

This intensive course is organized by FELMI-ZFE and the company Gatan and explains step-by-step how to generate and interpret EFTEM and STEM-EELS data. During the sessions, you have the opportunity to use the high-end equipment at FELMI-ZFE, including the aberration-corrected transmission electron microscope ASTEM (FEI Titan³ G2 60-300).

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"It is always an exciting experience to exchange ideas with the international participants."

Gerald Kothleitner, Course Leader

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SEM-Course

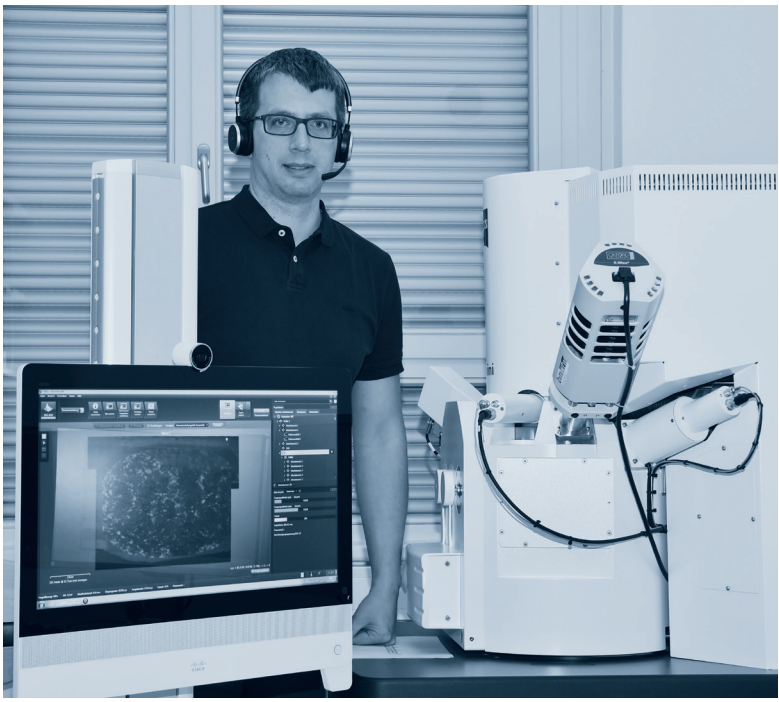
Are you coming from science, industry, or teaching? This course is designed for individuals who want to solve material analysis problems. Additionally, we are pleased to offer a range of customized courses that meet the needs of our clients. We explain step-by-step how to operate the scanning electron microscope. After the three-day intensive course, participants will be able to conduct their own investigations and interpret the results.

Stefan Mitsche, Course Leader

Online Microscopy

Clients can participate in investigations remotely via the Internet

The TIMELY ("mulTIMedia basEd online microscopY") project is a virtual research platform that enables project participants to work together even at a distance, expands the correlative analysis possibilities of the ZFE and further develops computer-aided data evaluation, also using AI-based systems. Within the contecst context of national and international collaboration of ZFE, a multitude of travel activities were indispensable so far. Multimedia online microscopy, as part of the strategic project TIMELY, should become effective here, saving costs and time, and enable research in direct contact with people despite „Social Distancing". In doing so, the image of the electron microscope in high resolution, end-to-end encrypted, is transmitted live to the client in the framework of a video conference. Thus, clients are able to directly monitor analyses, discuss results, define new positions for analysis, etc. In many areas of material analysis using electron microscopy, applications based on highly specialized software are already state-of-the-art, however there is considerable potential for more detailed analysis with the assistance of artificial intelligence (AI). Within the TIMELY project, new routines should be established, which enable faster and repeatable data evaluation. Furthermore, these new routines should improve demanding evaluations of correlative datasets. When solving complex analytical questions, it is often unavoidable to link different electron microscopes and measuring devices. Scanning Electron Microscopy (SEM), Atomic Force Microscopy (AFM), Focused-Ion-Beam Processing (FIB), Energy Dispersive X-ray Spectroscopy (EDX) and Raman Microscopy should be combined, as the best results can only be achieved by combining all these methods.



TIMELY

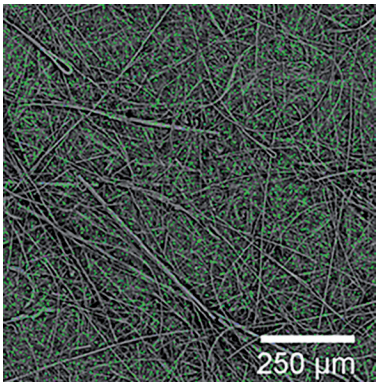
Title: mulTIMedia basEd onLine microscopY (TIMELY)
Project manager: Johannes Rattenberger

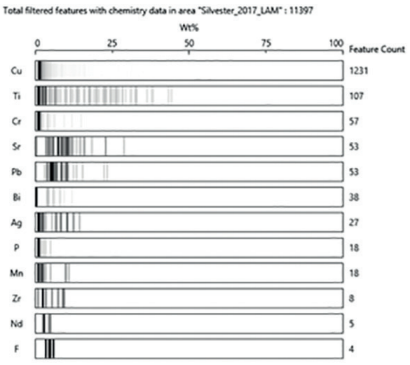
News in the field of environmental analysis

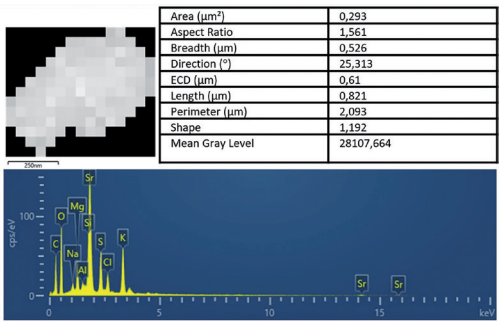
Automated analysis of particles using energy dispersive X-ray spectroscopy

Energy dispersive X-ray spectroscopy (EDX) in combination with scanning electron microscopy (SEM) represents a powerful tool for material analysis at high resolution. Especially when analysing the living environment, it is often insufficient to examine only a few sample areas or single particles. A quantitatively reliable statement needs solid statistics, for which it is necessary to morphologically and chemically characterize a very large number of particles. The Centre for Electron Microscopy Graz has high-resolution field emission scanning microscopes combined with very powerful High-End-EDX detectors, which together with special software enable automated analysis on a large scale. As an illustrative example, the analysis of one filter for fine dust during the New Year's Eve 2017/2018 is presented. A total of 11,397 particles were identified and characterized in 166 image fields, covering an area of 1.2 mm2.

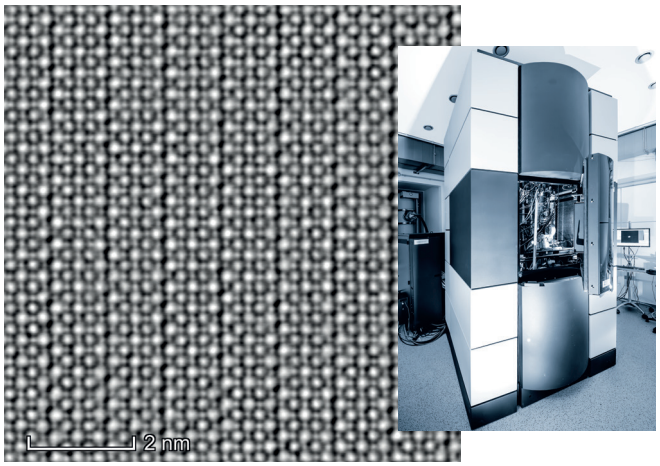
Contact: Manfred Nachtnebel







Nanocharacterization of light elements



Title: Detection and Dynamics of Light Elements (INSIGHT)

Project manager: Evelin Fisslthaler

Materials containing light chemical elements have gained significant importance in recent years - particularly in the development of new alloys, materials for batteries, and electronic components. The INSIGHT project connects innovative high-resolution imaging methods and optimized spectroscopy methods with techniques from computer-aided microscopy aiming the detection of low-order elements using a scanning transmission electron microscope, thereby providing our partners with a valuable tool for the development of new materials.

Association for the Promotion of Electron Microscopy and Fine Structure Research

The Association for the Promotion of Electron Microscopy and Fine Structure Research was founded in 1959 with the goal of promoting research and scientific teaching in the field of electron microscopy and making scientific results and special techniques accessible to industry and business.
Over 30 members of the Association from all sectors of industry enable the long-term development of scientific and technical know-how. Embedded in various networks successful collaborations and flagship projects emerge.

Members of the Association

Our network

Status: July 2024