

University of Augsburg

Department of Physics

The Augsburg Institute of Physics comprises one of the largest groups in solid state physics in Germany. The different chairs are not only known for their high-quality basic research but also for their application-oriented research and development activities.

The excellence in basic research as a main pillar of the physics department is reflected for example by the collaborative research centre SFB484. This covers the specific research area of "Metal-Insulator transitions and the ordering of microscopic degrees of freedom". Another example is its participation in the German excellence initiative, through the research cluster for multiscale design of oxidic functional materials – "FOROXID".

Based on a detailed knowledge of advanced physical and chemical analysis, thin film technology, hard coatings, catalysis, nanoscience, surface science, oxide materials and life cycle analysis, there is - via the centre for Materials- and Environmental Research (AMU) - a close collaboration with industrial and institutional laboratories on a wide variety of topics.

These collaborations include medical implants, luminescent materials, catalytic converters, biocompatibility, antireflection coatings, dielectric materials, shape memory alloys, surface acoustic waves, hydrogen storage, and water resources.

The physics of interfaces is a unique research area of research. The study of interfaces can lead to important insights into basic research topics as well as giving new impulses for the development of new technologies. For example it assists:

- the fabrication of new electronic components
- the development of nano technology
- the solution of materials science problems in fields such as adhesion, friction, surface upgrading, catalysis or molecular sensors.
- the design of functional materials with optimized combination of (sometimes contradictory) mechanical, electronic, magnetic or other properties.

Disciplines

- Thin films
- Nanomaterials
- Biomaterials
- Superconductors
- Organic Polymers
- Composites
- Smart Materials
- Magnetic and Dielectric Materials
- Multiferroica

FAME Master format

Each year, 40 students will be recruited for Year 1 of the program and will start at INP Grenoble (France) or Augsburg (Germany). Half of the students will come from non-European countries and half from within Europe. Year 1 will provide a multidisciplinary teaching in the field of Functional Materials.

In Year 2 each student will specialize in scientific area offered by one of the 7 consortium universities. Students will have to study in at least two different universities and European countries.

Curriculum offered in Augsburg

As member of the FAME Erasmus Mundus Consortium, the University of Augsburg will admit students for Year 1 (General curriculum in Materials Science) and Year 2 (Specialization) of the FAME Master.

Students who choose to spend Year 2 (semester 3) in Augsburg will choose the **Materials Interfaces - Surfaces, Composites and Coatings specialization** for the final part of their Master's program and will graduate with a **double-diploma**.

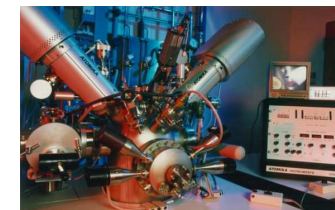
The following areas are specifically taught by the University of Augsburg: Fundamental and applied research in solid state physics and materials science with focus on:

- Thin films and coatings
- Micro- and Nanostructuring
- Nano- and biomaterials
- Magnetic and dielectric materials
- Semi- and superconductors
- Strongly correlated electrons
- Composites and interface dominated materials

Students who do not apply for the official Erasmus Mundus Master of Science curriculum and wish to attend Year 1 must have earned a Bachelor's degree in Science (Physics, Chemistry, Metallurgy, Materials Science, Electrochemistry).

Those who wish to attend Year 2 (Semester 3) must have passed Year 1 of a Master degree in the Materials Science area of a high-standing university.

At the end of their studies, such students will only be awarded a national diploma and not the official Erasmus Mundus FAME Master of Science label.



Course description (Semester 1) 30 ECTS*

*ECTS: European Credit Transfer System

Fundamentals in Materials Science 1

-Introduction to materials (Seminar)	4 ECTS
-Material physics 1 (Structure, Defects, thermodynamics of materials)	6 ECTS
-Material chemistry	6 ECTS
-Characterization of materials	6 ECTS
-Method course 1 (Practical work accompanied by lectures)	8 ECTS

Course description (Semester 2) 30 ECTS

Fundamentals in Materials Science 2

-Material physics 2 (Electronic properties)	6 ECTS
-Processing of materials (Metals, ceramics, polymers; coatings, thin films; structuring, electro chemical methods)	6 ECTS
-Surfaces and Interfaces	5 ECTS
-Numerical methods & simulation, theoretical concepts	5 ECTS
-Method course 2 (Practical work accompanied by lectures)	8 ECTS

Course description (Semester 3) 30 ECTS

Coatings and thin films 7,5 ECTS

Physical Vapor Deposition (PVD)
Molecular Beam Epitaxy (MBE)
Plasma Enhanced Chemical Vapor Deposition (PECVD)
Ion Implantation
Plasma Immersion Ion Implantation & Deposition (PIII&D)
Spin Coating

High resolution imaging of interfaces 7,5 ECTS

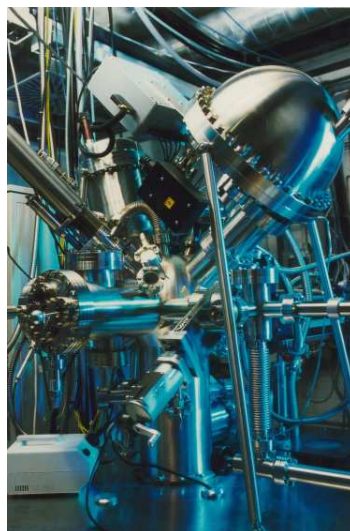
Scanning probe microscopy
Physical basis of STM and AFM
Technical basis of STM and AFM
Other SPM-type techniques
Applications

Interfaces in composites 7,5 ECTS

Interface dominated materials 7,5 ECTS

Staff involved in the FAME Master

- Prof. Dr. Wolfgang Brütting
- Prof. Dr. Ulrich Eckern
- Prof. Dr. Ferdinand Haider
- Prof. Dr. Siegfried Horn
- Priv.-Doz. Dr. Jörg Lindner
- Prof. Dr. Alois Loidl
- Prof. Dr. Armin Reller
- Prof. Dr. Bernd Stritzker
- Prof. Dr. Achim Wixforth



Research partners



Augsburg has active collaboration with the following partners (large facilities):

- FAME European partners (Germany, UK, Belgium, Spain, Portugal)
- Neutron diffraction facilities:
 - FRM-II, Munich, Germany
 - ILL, Grenoble, France
- Synchrotron radiation facilities:
 - ANKA, Forschungszentrum Karlsruhe, Germany
 - ASTRID / ISA, Aarhus, Denmark
 - BESSY, Berlin, Germany
 - DESY, Hamburg, Germany
 - ESRF, Grenoble, France
 - NSLS, Brookhaven, USA

Selected industry partners

- ArvinMeritor Light Vehicle Systems
- BMW AG
- EADS
- Fujitsu Siemens Computers GmbH
- MAN Roland Druckmaschinen AG
- MT Aerospace
- OSRAM GmbH

Facilities used for research

- Thin film production: sputtering techniques, electron beam evaporation, laser ablation
- Nano structured materials: clean room facilities, micro structuring, nano particle preparation
- Surface characterization:
 - Electron microscopy: SEM/EDX, TEM
 - Photo electron spectroscopy: XPS, UPS
 - Scanning probe microscopy: AFM STM
 - Chemical depth profiles: RBS, SIMS

Other equipment used at the University of Augsburg

- All types of structural characterization methods like: XRD, TEM, NMR, EXAFS
- Chemical composition analysis: RBS, SIMS, EDX, XPS, UPS, ICP/OES, NMR, GC-MS, FT-IR, NMR
- Functional properties (mechanic, electronic, magnetic): hardness (HV), resistance, magnetization, SQUID, ESR
- Thermal properties: TG, DTA, DSC
- Low temperature cryostats (~mK), high pressure cells (DAC, ~ 50GPa), high magnetic fields (~17T)



Typical Master Thesis projects/subjects

- High-dose ion implantation into TiO₂ and SiO₂ thin films: structural and optical properties
- Defined remineralization of Apo-Ferritin for the preparation of iron oxide nanoparticles
- Electrical characterization of free-standing carbon nanotubes
- Resistance measurements on doped grain boundaries in high-T_C superconductors
- Carbon nanotubes on non-piezoelectric substrates aligned by surface acoustic waves