FAME Master
Functionalized Advanced Materials and Engineering

FAME partner presentation
TU Darmstadt

February 2019
Darmstadt - Germany

Known as Materials Valley

http://www.fame-master.com
Darmstadt a Scientific City

... with over 30 research and academic working institutions, among others:

- European Space Association ESA/ESOC
- European Organisation for the Exploitation of Meterological Satellites EUMESAT
- GSI Helmholtz Center for Heavy Ion Research
- German Institute for Polymers
- Three Fraunhofer Institutes
- European Center for Aviation Development
- Hochschule Darmstadt / University of Applied Sciences
GSI Gesellschaft für Schwerionenforschung
large-scale accelerator for heavy ions

Elements made by GSI

<table>
<thead>
<tr>
<th>Atomic number</th>
<th>Name</th>
<th>Symbol</th>
</tr>
</thead>
<tbody>
<tr>
<td>107</td>
<td>Bohrium</td>
<td>Bh</td>
</tr>
<tr>
<td>108</td>
<td>Hassium</td>
<td>Hs</td>
</tr>
<tr>
<td>109</td>
<td>Meitnerium</td>
<td>Mt</td>
</tr>
<tr>
<td>110</td>
<td>Darmstadtium</td>
<td>Ds</td>
</tr>
<tr>
<td>111</td>
<td>Roentgenium</td>
<td>Rg</td>
</tr>
<tr>
<td>112</td>
<td>Copernicium</td>
<td>Cn</td>
</tr>
</tbody>
</table>

Costs: 1.600.000.000,00 Euro
Darmstadt

Population:
140000 habitants

Aria: 12200 ha

We are one of Germany's leading universities of technology

http://www.fame-master.com
### TU Darmstadt in numbers

<table>
<thead>
<tr>
<th>Category</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Students</td>
<td>26,200</td>
</tr>
<tr>
<td>Professors</td>
<td>380</td>
</tr>
<tr>
<td>Scientists</td>
<td>2,400</td>
</tr>
<tr>
<td>Staff</td>
<td>1,850</td>
</tr>
</tbody>
</table>

- Female 31%, Male 69%
- The first autonomous University in Germany
Global Reputation

TU Darmstadt is the most attractive German university for foreign visiting scholars and researchers in the field of engineering science.

"A top spot in the Humboldt Ranking is an important indicator of international contacts and reputation."

(Alexander von Humboldt Foundation)
1989 foundation of the Department Material Sciences – own building since 1996

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20 Research Groups

- Dispersive Solids
- Advanced Thin Films Technology
- Material Design by Synthesis
- Structure Research
- Materials Analysis
- Catalysts and Electrocatalysts
- Physics of Surfaces
- Molecular Nanostructures
- Ion-Beam-Modified Materials
- Ceramics
- Surface Science
- Electronic Materials
- Physical Metallurgy
- Nano Materials
- Functional Materials
- Mechanics of Functional Materials
- Theory of Magnetic Materials
- Materials Modelling
Surface Science
Thin film Solar Cells
Research Groups

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- Electronic Materials
- Physical Metallurgy
- Nano Materials
- Functional Materials
- Mechanics of Functional Materials
- Theory of Magnetic Materials
- Materials Modelling

Research Topics
- Permanent Magnets
- Magnetocaloric Materials
- Magnetic Shape Memory
- Hydrogen Storage
- Substitution of rare earth elements

The circuit of hydrogen

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Year 2 specialization details

Coupling of different Functional properties

- optical
- mechanical
- magnetically
- electrical
- thermal
- chemical

New functional Materials und Effects

- Inorganic Electronic
- Composite electronic
- Spintronic
- Nano electronic
- Piezomaterials, Multiferroiks, etc.

Application: Electronic, Energy technique, Actoric und Sensory, etc.

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Organic Semiconductors

Electrical Fatigue

Electron- and Ion conductor

Ferroelectrics

Fuel injector

Inkjets

Piezo motor

Li-Ion battery

Laptop

Mobile Phone

Car radio

Mobile Phone

Contact-material

SFB 595

Speaker J. Rödel
### Courses and lectures

#### 3. Semester

**Lectures (mandatory)**
- Quantum Mechanics for Materials Science or Micromechanics for Materials Science 6 ECTS

**Lab Courses (mandatory)**
- Research Lab I 4 ECTS

**Lectures (elective, recommended)**
- Ceramic Materials: Syntheses and Properties. Part II 4 ECTS
- Fundamentals and Techniques of Modern Surface Science 4 ECTS
- Semiconductor Interfaces 4 ECTS
- Magnetism and magnetic materials 4 ECTS

Options
3. Semester

Additional elective Lectures

- Nanomaterials for catalysis and sensors
- Material Science for Renewable Energy Systems
- Organic Semiconductors
- Self-Organization in Soft Matter
- Concepts in Materials Physics
- Engineering Microstructures
- High-Pressure Synthesis of Advanced Materials
- Mechanical Properties of Ceramic Materials and Composites
- Topochemical Analysis I
- X-Ray Course: Single-Crystal Diffraction – course
- Surface and Interface Engineering
- Electrochemistry in Energy Applications
- Instrumental Chemical Analysis
- Nanomaterials: Synthesis, Size-Dependent Properties
- Chemistry for Students of Materials Science
- High-Resolution Scanning Electron Microscopy - course
- Theoretical Methods of Materials Science
- Quantum Physics for Materials Scientists
- Superconductivity and Oxide Materials
- Numerical Methods in Mechanics I
- Characterisation Methods in Materials Science
- Course Processing of Conventional and Polymer Derived Silicon Ceramics

Sections and Seminars

- Guidance for papers and theses - Section
- Colloquium: Materials Science - Colloquium
- Materials in Medicaltechnology - Seminar
- Seminar for diploma and doctoral candidates - Seminar
- Seminars for each work group - Seminar
- The Master Thesis takes **6 months**
  it can be carried out in **any of our 20 research groups**

- **Examples:**

- Optimization of the active layer morphology in small molecular weight **organic solar cells**

- Texture of segmented **Nanowires** *(in cooperation with the GSI)*

- **Electrical characterization of surface and interface** of III-V and Ge devices

- **Pulsed Laser Deposition of Self-Assembled** **Multiferroic**
  BiFeO3-CoFe2O4 Thin Film Nanostructures

- Synthesis and characterization of β-FeSi2/Si composite materials for **photovoltaic** applications

- **Metal to Ceramic Sealant Joints for**
  Planar Solid Oxide **Fuel Cells**
Additional Sections and Seminars

Guidance for Student Research Papers in Progress - Section
Guidance for papers and theses - Section
Orientation meeting: Occupational Profile of the Materials Scientist - Lecture
Seminar for Doctoral and Diploma Candidates - Seminar
Colloquium: Materials Science - Colloquium
Optional Lectures

Graphen and Carbon Nanotubes
Modern steels for automotive applications
Properties of Ferroelectrics
Fundamentals of luminescence
Fundamentals and Technology of Solarcells
Thin film Fabrication and Surface
Spintronics
Advanced Materials
Synthesis and Properties of Ceramic Materials
High Pressure synthesis of advanced Materials
Chemical Sensors: Basics and Applications
Functional Materials
Structural Materials

Materials Modification by Ion Beam Techniques
High-Pressure Synthesis of Advanced Materials
Neutron Diffraction
Principles of Crystallographical Structure Research
Topochemical Analysis
Mass/Spectrometry
Quantum Physical Foundations of Materials Science
Quantitative Analysis of Microstructures
Superconductivity and Oxide Materials
Numerical Methods in Materials Science
Theoretical Methods of Materials Science
Fuel Cells - from fundamentals to application
X-ray absorption spectroscopy
Transmission Electromicroscopy of Solid Bodies
- FAME students have to fill in the **online Application Form** until July 15\textsuperscript{th}
  movein-tu-darmstadt.moveonnet.eu/movein/portal/studyportal.php?_language=en

- FAME students can join a **language course** in September

- Each FAME students will be supported by a **tutor** helping
to open a bank account, pay fees, finding an accommodation and so on
- www.intern.tu-darmstadt.de/wohnengaestehaeuser/support/index.en.jsp

- **EU students**
can be supported from their own University by **Erasmus** (260 Euro/Month).
They can get a room in Darmstadt together with our other Erasmus students
Career perspectives

- You are welcome to stay for your Ph.D. studies if your mark is sufficient.

- Ph.D. students will get ca. 33,000,- Euros per year (gross)
Materials Science in Darmstadt is among the TOP 3 in Germany and the Number 1 for Functional Materials

.... be part of it

Contact: Dr. Joachim Brötz, broetz@tu-darmstadt.de
„In my opinion you must **definitely** go to Darmstasdt. They have a good Polytechnic School.“

Albert Einstein 1919