2nd German-Polish Symposium
Arbeitskreis Kohlenstoff der Deutschen Keramischen Gesellschaft e. V.
Polish Carbon Society

Prof. Dr.-Ing. Bernd Meyer
Rector

16 October 2013
An Overview of the Resource University
Facts and Figures

6 Faculties
10 Central facilities
40 Institutes

57 Courses of study
1,402 First semester students
5,727 Students

53,6 Mill. Euros in external funds in 2012

86 Professors
1,920 University employees
**History**

**Milestones and Personalities**

- **1765**
  - Michail Wassiljewitsch Lomonossow (1711-1765)
  - Russian polymath, 1739 – 1740 student in the laboratories of mining councilor Johann Friedrich Henkel

- **1769**
  - Alexander von Humboldt (1769-1859)
  - Natural scientist and humanist, studied geology with Abraham Gottlob Werner

- **1791**
  - Abraham Gottlob Werner (1749-1817)
  - Most important teacher at the Bergakademie; considered as the originator of the science of the structure and composition of the earth's crust

- **1838-1904**
  - Clemens Winkler
  - From 1873 on professor of chemistry at the Bergakademie, 1886 discovery of germanium
An Overview of the Resource University
Raw materials supply chain

University in the service of sustainable materials and energy along the raw materials supply chain

- from the exploration of new and domestic deposits
- to the development of alternative energy technology, recycling
- to the research of new materials
- with the national mission of securing raw materials – with a worldwide network
Research for the Future
Profile segments GEOMATENUM

**GEOSCIENCES**
Exploration and extraction of raw materials

**MATERIALS**
Materials for the solid-state industry, development of new materials

**ENERGY**
Energy sources and technology

**ENVIRONMENT**
Sustainability, resources
TU Bergakademie Freiberg
Academic Profile

<table>
<thead>
<tr>
<th>Fields</th>
<th>Academic Disciplines</th>
<th>Raw materials supply chain</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mathematics / Natural Sciences</td>
<td>Exploration</td>
</tr>
<tr>
<td></td>
<td>Engineering</td>
<td>Extraction</td>
</tr>
<tr>
<td></td>
<td>Business Administration</td>
<td>Preparation</td>
</tr>
<tr>
<td>GEOSCIENCES</td>
<td>Characterization Simulation Modeling Visualization Synthesis</td>
<td>Processing/Refining</td>
</tr>
<tr>
<td></td>
<td>Machines Plants Processing Technologies</td>
<td>Recycling</td>
</tr>
<tr>
<td>MATERIALS</td>
<td>Innovation management Economy / Ecology</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Value creation</td>
<td></td>
</tr>
<tr>
<td>ENERGY</td>
<td>Characterization Simulation Modeling Visualization Synthesis</td>
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<td>Value creation</td>
<td></td>
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</tbody>
</table>

Faculties 1 - 3 | Faculties 3 - 5 | Faculty 6

Faculty 1: Mathematics and Informatics, Faculty 2: Chemistry and Physics, Faculty 3: Geosciences, Geotechnology, and Mining, Faculty 4: Mechanical Engineering, Processing and Energy Technology, Faculty 5: Materials and Material Technology, Faculty 6: Business Administration
# Teaching profile

## Study programmes along the raw materials supply chain

<table>
<thead>
<tr>
<th>Raw materials supply chain</th>
<th>Exploration</th>
<th>Extraction</th>
<th>Processing</th>
<th>Refining/Finishing</th>
<th>Recycling</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Geoscience</strong></td>
<td><strong>Geo-Engineering and Mining</strong></td>
<td><strong>Geoscience</strong></td>
<td><strong>Mechanical Engineering</strong> (Processing machines*, Environmental Technology)</td>
<td><strong>Materials Science and Technology</strong></td>
<td><strong>Materials Science and Technology</strong></td>
</tr>
<tr>
<td><strong>Mine Surveying and Applied Geodesy</strong></td>
<td><strong>Geoinformatics and Geophysics</strong></td>
<td><strong>Mechanical Engineering</strong> (Excavation and special heavy construction machinery*)</td>
<td><strong>Process Engineering</strong> (Chemical Engineering, Energy Engineering*, Environmental and materials engineering)</td>
<td><strong>Foundry Technology</strong></td>
<td><strong>Electronic and Sensor Materials</strong></td>
</tr>
<tr>
<td><strong>Geoinformatics</strong> and Geophysics</td>
<td><strong>Groundwater Management</strong></td>
<td><strong>Medical Engineering</strong></td>
<td><strong>Materials Science and Technology</strong></td>
<td><strong>Ceramics, Glass and Construction Technology</strong>*</td>
<td><strong>Thermotechnical Plants</strong></td>
</tr>
<tr>
<td><strong>Groundwater Management</strong></td>
<td><strong>Exploration</strong></td>
<td><strong>Extraction</strong></td>
<td><strong>Processing</strong></td>
<td><strong>Refining/Finishing</strong></td>
<td><strong>Recycling</strong></td>
</tr>
</tbody>
</table>

* Unique study programmes in the field of resource technologies

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- **Natural sciences**: Chemistry, Applied Natural Sciences

Fac. 1  Faculty of Mathematics und Informatics
      5 Institutes, 16 Professors

Fac. 2  Faculty of Chemistry and Physics
      9 Institutes, 13 Professors

Fac. 3  Faculty of Geosciences, Geotechnology and Mining
      7 Institutes, 26 Professors

Fac. 4  Faculty of Mechanical Engineering and Processing
and Energy Technology  11 Institutes, 20 Professors

Fac. 5  Faculty of Materials and Material Technology
      7 Institutes, 9 Professors

Fac. 6  Faculty of Business Administration
      1 Institute, 15 Professors
Students
Increasing number of students between WS 95/96 (2.013 students) until WS 12/13 (7.129 students)

Students according to disciplines / newly enrolled students / international students

International students

<table>
<thead>
<tr>
<th></th>
<th>China</th>
<th>Commonwealth of Independent States</th>
<th>Vietnam</th>
</tr>
</thead>
<tbody>
<tr>
<td>International students</td>
<td>99</td>
<td>81</td>
<td>29</td>
</tr>
</tbody>
</table>
### Research profile

#### Selected projects

<table>
<thead>
<tr>
<th>Source</th>
<th>Project Name</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>DFG</strong></td>
<td>SFB 799</td>
<td>“TRIP-Matrix Composite”</td>
</tr>
<tr>
<td><strong>DFG</strong></td>
<td>SFB 920</td>
<td>“Multifunctional Filter for the Metal Melt Filtration”</td>
</tr>
<tr>
<td><strong>DFG</strong></td>
<td>SPP 1418</td>
<td>“Refractories - Innovation for Reduction of Emissions” (FIRE)</td>
</tr>
<tr>
<td><strong>DFG</strong></td>
<td>SPP 1204</td>
<td>“Algorithms for Fast, Adaptive Process Chain Design and Analysis in Metal Forming”</td>
</tr>
<tr>
<td><strong>BMBF</strong></td>
<td>Virtual High Temperature Conversion Processes</td>
<td>(Virtuhcon)</td>
</tr>
<tr>
<td><strong>BMBF</strong></td>
<td>German Energy Raw Materials Centre</td>
<td>(DER)</td>
</tr>
<tr>
<td><strong>State Excellence Initiative</strong></td>
<td>Functional structure design of new high performance materials</td>
<td>via atomic design and defect engineering (ADDE)</td>
</tr>
<tr>
<td><strong>Industry/Foundations/Other sources</strong></td>
<td>Syngas-to-Fuel</td>
<td>(STF)</td>
</tr>
<tr>
<td><strong>Industry/Foundations/Other sources</strong></td>
<td>Freiberg High Pressure Research Centre</td>
<td></td>
</tr>
<tr>
<td><strong>Industry/Foundations/Other sources</strong></td>
<td>Mine Water Research Centre</td>
<td></td>
</tr>
</tbody>
</table>
Research profile
Selected Research Centres

University
- DBI Bergakademie – Energie bündeln im Deutschen Brennstoff Institut/ German Combustible Material Institute
- Geothermal Research Center (GRC)
- Lithium Initiative
- European Center for High-strength and Ductile Magnesium Alloys
- Process Control, Optimization and Uncertainty Quantification Competence Center
- Interdisciplinary Ecological Centre (IÖZ)
- Mine Water Research Center
- GEOARC – Asia Geosciences Research Center

External
- Geocompetence Center Freiberg e.V.
- International University of Resources
Large Scale Plant Technology
A characteristic of resources research

- ISASMELT-Pilot plant
- Shock wave laboratory
- Melting furnace for NF metals
- Hot rolling mill
- Reprocessing unit
- Casting rolling line
- Vacuum precision casting furnace
- Drilling technology
- Research and Teaching mine „Reiche Zeche”
- STF-Petrol plant
- HP-POX-plant
- Konti rolling line (wire)
Strategic Cooperations
excluding Universities

Industry, e.g.
- Siemens AG select university partner
- Thyssen Krupp select university partner
- RWE select university partner

Large scale research, e.g.
- Helmholtz Centres (particularly HIF)
- Fraunhofer Institutes
- Leibniz Institutes
- Federal Institute for Geosciences and Natural Resources (BGR)

International cooperations, e.g.
- German Russian Raw Materials Forum
Research Funds
Highest specific third-party funding

Third-party funding

Budget

Funded by DFG (€ Million)
Helmholtz Institute Freiberg for Resource Technology

17.12.2010
BMBF decision in favour of the Ressource Technology Institute

28.03.2011
Signing of the cooperation contract HZDR-TUBAF

09.05.2011/06.06.2011
Assessment by the HGF commission and approval of the HGF senate

29.08.2011
Grand foundation; attended by former federal minister Schavan and state premier Tillich

Today
45 employees, Infrastructure development

Moving into the building at Chemnitzer Str. 40
Planned for the end of 2013/ beginning of 2014

Management
Director: Prof. Gutzmer (management team: 6 employees)

Departments
- Department of Exploration (W3 professor) NN 2 employees
- Extracting technology (W3 professor) NN
- Processing Prof. Peuker¹ W3 call 2 employees
- Metallurgy and Recycling Prof. Stelter¹ W3 call 10 employees
- Modeling and Evaluation Prof. van den Boogaart 3 employees
- Analytics Prof. Gutzmer 6 employees

Groups
- Remote sensing
- Robotics/automation
- Bio Technology Dr. Pollmann 10 MA
- Pyro-/Hydro-Metallurgy Prof. Stelter¹
- Ressourcenwirtschaft 1 MA
- Ion beam analytics Dr. Renno 4 MA

¹: provisional
11 June 2012: Founding event in Freiberg - by 80 resource universities from over 50 countries

Goals
- Responsibility for a new awareness of raw materials: Principle of sustainable development
- Education: Sustainability-oriented minimum standards in teaching and training
- International exchange for unlimited access to knowledge and experience through global networks and suitable platforms

Next Conference: 10-12 November 2013 Trondheim, Norway
**Institute of Energy Process Engineering and Chemical Engineering (IEC)**

**Director of the Institute: Prof. Dr. Ing. B. Meyer**

<table>
<thead>
<tr>
<th>Chair of Energy Process Engineering and Thermal Waste Treatment</th>
<th>Chair of Reaction Engineering</th>
<th>Chair of Numerical Thermo Fluid Dynamics</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Prof. Dr.-Ing. B. Meyer</strong></td>
<td><strong>Prof. Dr. rer. nat. S. Kureti</strong></td>
<td><strong>Prof. Dr.-Ing. C. Hasse</strong></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>136 employees (July 2013)</th>
</tr>
</thead>
<tbody>
<tr>
<td>engineers, chemists, mathematicians, mineralogists, economists, lab and technical staff</td>
</tr>
</tbody>
</table>

- Largest institute at the TU Bergakademie Freiberg
- Highest third-party funds for fossil fuel research in Germany
Research groups at the IEC

Institute of Energy Process Engineering and Chemical Engineering

Chair of Energy Process Engineering and Thermal Waste Treatment
Prof. Dr.-Ing. Bernd Meyer

Thermo-chemical Conversion of Coal and Biomass
High-Pressure Gasification / POX / Gasoline Synthesis
Gasifier Development
Flow Sheet Simulation
Mineral Matter Reactions
German Energy Raw Materials Centre (DER)

Chair of Reaction Engineering
Prof. Dr. rer. nat. Sven Kureti

Environment-related Catalysis
Energy-related Catalysis and CO₂ Reduction
Refining of Petrochemical Products

VIRTUHCON group: Multi-phase Systems
VIRTUHCON group: Interphase Phenomena

Chair of Numerical Thermo-Fluid Dynamics
Prof. Dr.-Ing. C. Hasse

Modeling of Gasification Processes
Engine Combustion
Turbulence Modeling

Refining of Petrochemical Products
Mineral Matter Reactions
German Energy Raw Materials Centre (DER)
**IEC research on fuel utilization**

**Modeling-based research at IEC:**
- **CFD**
  - Gaseous and liquid fuels: POX
  - Coal: Fixed bed, entrained flow and fluidized bed
- **Flow Sheet**
  - Comprehensive stationary and dynamic modelling, concept development and technological, energetic, ecological and economic evaluation

**Experimental research at IEC:**
- **Lab Scale**
  - Low and high-temperature conversion of coal and biomass
- **Large Scale**
  - POX + ATR of gaseous and liquid fuels
  - Slagging fixed bed + fluidized bed coal gasif.
  - Syngas-to-Fuels plant

Dependent on:
- Fuel characteristics and conversion behaviour
- Process conditions
- Process technology
IEC large-scale test plants

**High Pressure Partial Oxidation (HP POX®)**
- Test plant for high pressure partial oxidation (HP POX) of liquid and gaseous hydrocarbons

**Syngas-to-Fuel (STF)**
- Development of a new technology for production of high-octane gasoline from synthesis gas

**BGL Slagging Gasifier**
- Investigation of liquid slag behavior under high pressure
- Characterization of slag from different ash compositions
- Testing of coals to demonstrate application of “unknown” feedstock
Lösungsansatz: \( E^2 \Leftrightarrow MC \)

Transformationsgleichung

\[ E^2 \Leftrightarrow MC \]

Masse-Energie-Äquivalenz in einer neuen Dimension
Lösungsansatz: $E^2 \leftrightarrow MC$

Rohstoff

energetisch

stofflich

fossil sekundär

erneuerbar sekundär

fossil primär

erneuerbar primär

Energie

Basisinnovation

Elektro-Thermochemie
z. B. MW-Plasma-Reaktionen, SOEC, rev. Chloralkali-Elektrolyse, STF, Ionische Flüssigkeiten, Reaktivextraktion...

Neue Industriebranche

Energie-Stoff-Transformation

• Power2Chemicals
• Power2Metals
• Carbon4Metals

Nutzung
Zukünftiger Markt IIC (Mrd. € p. a.)*

<table>
<thead>
<tr>
<th>Sektor</th>
<th>Welt</th>
<th>EU</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energie</td>
<td>15,0</td>
<td>2,5</td>
</tr>
<tr>
<td>Metallurgie</td>
<td>21,5</td>
<td>3,6</td>
</tr>
<tr>
<td>Chemie</td>
<td>11,2</td>
<td>1,9</td>
</tr>
<tr>
<td>Gebäude</td>
<td>10,4</td>
<td>1,7</td>
</tr>
<tr>
<td>Forst</td>
<td>4,3</td>
<td>0,7</td>
</tr>
<tr>
<td>Abfall</td>
<td>3,0</td>
<td>0,5</td>
</tr>
<tr>
<td><strong>Summe</strong></td>
<td><strong>65,3</strong></td>
<td><strong>11,0</strong></td>
</tr>
</tbody>
</table>

- Für 2°-Klimaziel sind bis 2030 ca. 860 Mrd. € p. a. Zusatzinvestitionen erforderlich (McKinsey)!
- Davon adressiert IIC 12 %.

Thank you for your attention!

Mineral collection at Schloss Freudenstein in Freiberg

www.tu-freiberg.de