UNIVERSITY OF SILESIA
IN KATOWICE

http://english.us.edu.pl
University of Silesia in Katowice: local and international

- is one of the largest universities in Poland and Europe
- consists of 12 faculties
- is present in five cities in the region: Katowice, Sosnowiec, Cieszyn, Chorzów and Rybnik
- is based in the capital of an urbanized region which is inhabited by over 4.5 million people
- educates approximately 40 thousand Polish and foreign students
- there are 43 full-time and extramural courses as well as postgraduate programs and doctoral studies
University of Silesia: tradition and modernity

- over 40 years of academic and didactic work
- unique courses and majors, including econophysics, chemistry and information technology and biomaterials
- active cooperation with international institutions, bilateral agreements on academic and research cooperation with universities from approximately 40 countries
- participation in international education and research projects
- a lot of well equipped high-standard laboratories
- University library treasures more than 1 million books
- opportunity to follow one’s academic, sport and artistic passions
- dynamic organizations, including Children’s University and University of the Third Age
University of Silesia: diversity and variety

- humanities
- fine arts
- social scenes
- science
- technology
- natural sciences
University of Silesia: masters and authorities

- excellent scholars, talented students and ambitious Ph.D. students
- prominent *Honoris Causa* Doctors: Eugene Ionesco, Jon Ove Hagen, George Bednorz, Jacques Derrida, Jerzy Buzek
- awards of the Minister of Science and Higher Education for University lecturers
August Chełkowski Institute of Physics
Laboratories of Institute of Physics

- X-ray diffraction Laboratories
- Photoelectron Spectroscopy Laboratory
  - Magnetic Laboratory
- Electron Scanning Microscope Laboratory
  - AFM/STM Laboratory
- IR and Raman Laboratories
- UV/VIS Spectroscopy Laboratory
  - PPMS Laboratory
X-ray Laboratory
Powder diffractometer D 5000 Siemens
X-ray Laboratory
RAPIDII-R Rigaku (Japan)
Photoelectron Spectroscopy Laboratory
Spektrometer PHI 5700/660 Physical Electronics
Magnetic Laboratory

SQUID QD-MPMS-XL-7AC - Quantum Design
Electron Scanning Microscope Laboratory
High resolution electronic microscope 7600F - JEOL (FE-SEM)
Electron Scanning Microscope Laboratory

Scanning electron microscope JSM-5410 firm of Jeol
Quality and quantity analysis.
Measurements ranges:
20 - 400 cm\(^{-1}\) (FIR),
360 - 4000 cm\(^{-1}\) (MIR),
4000 - 15000 cm\(^{-1}\) (NIR)
Resolution up to 0.09 cm\(^{-1}\) for MIR.
IR and Raman Laboratories
Dispersion Raman spectrometer LabRam with confocal microscope, producer Jobin-Yvone

Measurements range:
50 – 4000 cm\(^{-1}\)

Spectral resolution: 2.5 – 6 cm\(^{-1}\)

Space resolution:
3 \(\mu\)m in plane
Confocal resolution: 2 \(\mu\)m

Lasers:
argon (emission line 514 nm) and semiconducting (emission line 786 nm)
UV/VIS Spectroscopy Laboratory
PPMS Laboratory
The main research topics

- Magnetic, electric, conducting properties of the metals and alloy of the transition and rare earth metals
- Molecular dynamics of condensed matter, phase transitions of liquids crystals, molecular glasses
- Physical and biological study the new photosensitizers used in the PDT therapy
- Thin films
- Magnets with the magneto-calorimetry effect
Thin films

Thin films of the NdNiO$_3$ and NdGaO$_3$ layers

On the figure is shown the temperature and thicknesses dependence of the electronic band structure

It explains the origin of the metallic and isolator states.
Magnetocalometric effect

The crystals with the magnetocalorimetric effect may be applied in the magnetic fridges (without the freons).
Magnetocalometric effect

Berg – Barrett topography of Gd₇Pd₃ single crystal with magnetocalorimetric effect at room temperature
The process of production of polymer photoluminescence materials

During last years much attention has been paid to the development of efficient light emitting sources based on polymeric materials.

Our scientists take part in this challenge. They synthesize new photoluminescent polymers and prepare new materials having unique spectroscopic properties for light emitting technology.

Some star-shaped polymers dispersed in an optically inactive transparent polymer are investigated for blue organic light emitting devices (OLED).

Possibilities of the materials obtained are immense and the cost of such devices is expected to be significantly lower than those of the traditional types like cathode ray tube (CRT), liquid crystal display (LCD) or plasma.
The process of production of polymer photoluminescence materials

The invention consists in the fact that the polymerization of thiirane or oxirane monomers with the substituent containing an optically active group, favorably the carbazolyl one, is carried out in the presence of oligo(potassium glycidoxide) as the cyclic macroinitiator activated 18-crown-6, and the obtained polymers are dispersed in an optically inactive transparent polymer. The advantages of these cheap and useful materials, such as strong luminescence at low energy consumption, lightness, and low energy manufacturing, make them to be really environmental friendly.
Structure of star-shaped polymers and luminescence spectra of their solid solutions in poly(methyl methacrylate)

Luminescence spectra of the new materials emitted blue light

Poly((9-carbazolyl)methyl)thiirane)

Poly(((1-(9-carbazolyl)-3-diphenylamino)propan-2-oxymethyl)oxirane)
„True color of Silesia region” – Research & Development activities at the University focus at protection of natural environment in the region heavily impacted by the „coal and steel” driven economy in the past.
University of Silesia initiated in 1995 at European level research on geothermal resources abandoned coal mines, where after flooding underground spaces man-made geothermal reservoirs are created. The first international conference on this subject was organized in Silesia in 2001 titled „Geothermal Energy in Underground Mines”
University of Silesia develops environmentally friendly heating solutions – as a partner in project GROUNDHIT; Ground coupled heat pumps of high technology, 6 Framework programme
University of Silesia establishes of a supply of renewable geothermal energy in former coal-mining areas – as a partner in the project REMINING-LOWEX; Redevelopment of European Mining Areas into Sustainable Communities by Integrating Supply and Demand Side based on Low Exergy Principles, 6 Framework programme
University of Silesia is one of the leading members of the community of 25 institutions from 9 countries aiming to collect and disseminate the available knowledge about geothermal energy in mine water to all mining areas in Europe in an expert network, building upon the experience from previous and ongoing initiatives. The network aims to accelerate ongoing minewater projects as well as to start new ones by making gathered knowledge broadly available.

University of Silesia
Faculty of Earth Sciences

Integrated System for Reducing Energy Consumption in the Maintenance of Buildings

University of Silesia is involved in the strategic project of the Polish National Centre for Research and Development. One of 7 R&D tasks of the project is titled „Recommendation for increase of Renewable Energy use in Buildings”. Activities of the University are related in the task to assessment of renewable energy resources available locally for potential use in rational and sustainable way to increase of energy performance of existing and developed buildings.
Application of coal to gasification studies

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Coal properties for gasification

Diagram:
- Proximate and ultimate analysis
- Particle size distribution
- Thermal fragmentation
- Caking propensity
- Pore size and surface area of chars
- Petrographic properties
Coal petrography and gasification

- Coal petrographic properties for gasification
  - Maceral and mineral composition
  - Microlithotype and carbominerite composition
  - Coal reflectance
Analytical apparatus at Faculty of Earth Sciences, University of Silesia

- Optical microscope Axioplan II
- Scanning electron microscope Philips XL 30
- X’Pert Philips PW 3710 diffractometer with graphite monochromator
Projects:

- Improvement of coal carbonization through the optimization of fuel in coking coal blends (RATIO-COAL).
- Innovative carbon products for substituting coke on BF operation (INNOCARB).
- The investigations of rocks and caustobiolithes.
- Organic matter in slag and fly ash from coal combustion processes from the Będzin Power Station.
- Alterations of organic matter in rocks deposited in coal waste dumps.
Innovative carbon products for substituting coke on BF operation (INNOCARB) was prepared by the following partners:

VDEh-Betriebs-forschungsinstitut GmbH (Coordinator) (Germany),
DK Recycling und Roheisen GmbH (Germany),
Luossavaara-Kiirunavaara AB (Sweden),
Swerea MEFOS AB (Sweden),
Thyssen Krupp Steel AG (Germany),
Voestalpine AG (Austria),
University of Silesia (Poland).

The INNOCARB start date – 1 July 2010
The total costs – 2 641 239 Euro
The EU financial contribution – 1 584 743 Euro
The project proposals

*Improvement of coal carbonization through the optimization of fuel in coking coal blends (RATIO-COAL)*

*An Innovative carbon products for substituting coke on BF operation (INNOCARB)*

are the research projects that are going to be realized in the framework of the Research Fund for Coal
Proposal summary (RATIO-COAL)

The main objective of the project is an improvement of coal carbonization process through the optimization of fuel in coking coal blends. The dependence between petrographic properties of coal, alternative fuels addition and coke quality will be determined. New method of prognosis of metallurgical coke quality based on reactive/inert ratio of coal fuel blends will be proposed. An innovative monitoring, control and optimization system for preparation of coking fuel blends will be designed and implemented. A number of tests demonstrating the system feasibility and effectiveness at full scale industrial process will be provided.