

University of Pannonia  
Faculty of Engineering



# Research Development Innovation

University of Pannonia Faculty of Engineering

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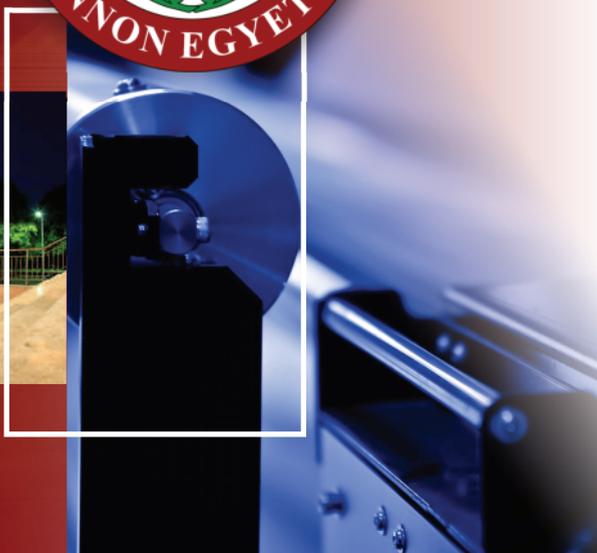
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## Welcome

The Faculty of Engineering, presented with the Excellence in Research Award for the period of 2013-2016, is renowned for its openness towards and cooperation with the stakeholders of academic and economic spheres. We are continuously striving for opportunities of collaboration with other institutions, knowledge transfer, and optimised use of our infrastructure.

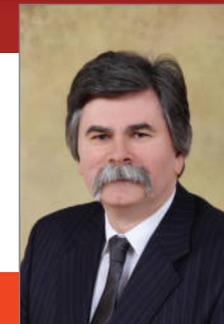
The faculty's academic profile is characterized by the network of basic and applied research activities facilitating innovation chains. Our members of academic staff and researchers are committed to explore procedures that are based on modern, efficient, and technically advanced methods and to pursue opportunities to develop technologies that can be applied, by implementing the outcomes of researches obtained in the field of chemistry and other related sciences, for multiple purposes.

The faculty's many research projects are grouped by scientific fields, detailing the activities and achievements of different facilities in reflection of contributions provided by the Faculty of Engineering.

As a dynamic, innovative teaching and research faculty, we promote constant renewal and innovation aimed at enhancing the lives of all people through knowledge transfer and education.

With this brochure, we reach out to prospective new staff, business and other stakeholders. We hope you enjoy browsing its pages.

**Dr. István Szalai**  
Dean



## History of the Faculty of Engineering at the University of Pannonia

**1949/50**

Faculty of Chemical Technology of BME was relocated to Veszprém

**1951/52**

Faculty of Chemical Technology became independent; University of Chemical Engineering was founded

**1959/60**

Doctor of Science degrees were granted for the first time at the University

**1990/91**

Faculty of Teachers' Training was founded

**1992**

Environmental Engineering courses offered for the first time in Hungary

**1996**

MTA-PE Air Chemistry Research Group was formed

## Academic and Research Activities

The Faculty of Engineering at the University of Pannonia, with its dynamic, innovative teaching and progressive approach, is competing to be one of the best engineering faculties in Hungary. It has been known over decades for its strength in offering a wide variety of graduate and research programs in the fields of engineering and science. Our aim is to explore new areas of science by conserving the traditional values of engineering training and to preserve the finest national and international standards of academic excellence. The Faculty has highly valued reputation in the industry for the quality of our graduates, research and the use of up-to-date knowledge.

Our commitment is to equip students with a deep understanding of their subjects and provide key transferable skills and attributes to be successful in employment. They are encouraged to engage creatively with new and existing ideas and to explore the applied side of engineering. Our aim is to deliver courses which meet the needs of industry and to play an important role in creating a generation of engineers that will take a lead in the development of innovative and sustainable technologies. We are constantly seeking opportunities to work closely with our existing and new strategic partners.

The Faculty of Engineering delivers a wide range of degree programs at undergraduate, postgraduate, and doctoral level. The undergraduate programmes of the Faculty provide excellent professional education in the following areas: materials engineering, bioengineering, mechanical engineering, environmental engineering, mechatronics engineering, chemical engineering, chemistry and environmental studies. Postgraduate courses are taught in six major subject areas: materials engineering, environmental engineering, mechatronics engineering, chemical engineering, chemistry and environmental engineering. The Faculty welcomes applicants for PhD in a range of disciplines in the Doctoral School of Chemistry and Environmental Sciences and in the Doctoral School of Chemical Engineering and Material Science. Our postgraduate diploma courses are designed for engineering graduates who intend to enter or enhance their career prospects.

According to numerous national surveys (examining the quality and excellence of students, academics and facilities), the Faculty of Engineering at the University of Pannonia is one of the leading research-oriented Engineering Faculties in Hungary. Optimising our environment to deliver real value is one of the key points in maximising the Faculty's effectiveness in maintaining a broad range of research facilities. Academics, researchers, and students benefit from continued investment in infrastructure. By providing a stimulating and supportive environment, we are committed to attracting the best academic and research staff. As a faculty, we take great pride in our productive and sustained collaboration with a wide range of industrial partners.

These long-standing partnerships not only enable the Faculty to offer projects to students that involve collaboration with industrial sponsors, but they also provide scholarships and vacation placements where students can work towards their final degree.

The Faculty of Engineering hosts a wide variety of research programmes. Research activities are arranged into 21 thematic Research Groups, which are in receipt of significant long-term funding from the Hungarian Academy of Sciences, industrial partners, from regional and national sources and from grants provided by the European Union. The Faculty is dedicated to produce research results of the highest quality across a broad range of disciplines, and to promote continuous innovation and improvement in the fields of science and engineering. Our expertise is extensive -- nine academic departments cover different engineering disciplines ensuring that our research responds to new and emerging challenges. Our academic staff deliver their subjects through high quality research and use up-to-date knowledge to enrich their students' learning experience. The quality of the Faculty research environment is recognised through the Excellence Award and benefits from continued investment in infrastructure. Embedded within the Faculty are a number of renowned research centres equipped with advanced apparatus and resources maintained by funding received from our strategic partners and industrial collaborators. Our research covers a full spectrum extending from photocatalysis through carbon nanotubes, process automation and vehicle control technologies to asphalt with spent tyre additives.

The Faculty's extensive expertise has provided the basis for an impressive track record of research achievements resulting in a number of disclosures and patents. We take great pride in our academic staff members with research degrees who are at the forefront of new developments and significantly contribute to the supply of graduate engineers and researchers. The extremely high number and quality of scientific publications registered in the database of Scopus reflects the intensity of scientific activities of our researchers. About 3690 research outputs of the Faculty of Engineering were published, 20% of which were disseminated in the field of chemistry, and 12.4% were written in the field of chemical engineering. Many of the Faculty's scientific and research activities are carried out in conjunction with industry and other universities worldwide.

## History of the Faculty

**2001**

Doctoral School of Environmental Sciences was founded

**2002**

Chemical Engineering courses accredited by IChemE

**2005**

Mechatronics Engineering courses offered

**2007**

BSc in Bioengineering course

**2010**

University of Pannonia was given the award University of Excellence in recognition of its achievements in the fields of chemical engineering, multidisciplinary natural sciences (energetics, environmental science)

**2011**

Quality Award of Higher Education, Gold certificate

**2013**

Excellence in Research Award for the Faculty of Engineering

MTA-PE Limnology Research Group was formed



urban ecology  
behavioural ecology  
climate change  
evolutionary biology  
birds

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## Behavioural Ecology Research Group

Our research group was established in 2004. Our group examines animal behaviour, ecology and evolution by focusing on birds as research organisms. We apply field studies and lab experiments to investigate the ecological effects habitat urbanization, including its influence on reproductive success, behavioural plasticity, and the response of birds to humans. In our other field of research, we aim to study the consequences of recent climate change, focusing on the effects of extreme meteorological events such as heat waves. This project includes the monitoring of behaviour and reproductive success of cavity nesting birds in several populations. Finally, we conduct phylogenetic comparative analyses to study the causes and consequences of evolutionary changes in behaviour. For instance, we explore the types of ecological and social factors influence phylogenetic changes in mating and parental behaviour of birds.

Our research on habitat urbanization demonstrates that feeding conditions in urban areas are suboptimal for some bird populations. This results in reduced reproductive success and morphological changes detectable both in juvenile and adult birds. We showed experimentally that birds can solve simple feeding problems more successfully in larger groups, and that in some tasks urban birds are more successful than their rural conspecifics. Our phylogenetic comparative studies revealed that evolutionary changes in reproductive sex roles are strongly related to adult sex ratio of the species.

University of Bath, Bath, UK, University of Sheffield, Sheffield, UK, Szent István University, Faculty of Veterinary Science, Budapest, Babes-Bolyai University, Cluj-Napoca, Romania, University of Debrecen, Debrecen, Eötvös Loránd University, Budapest, Őrség National Park, Óriszentpéter



## Limnology Research Group

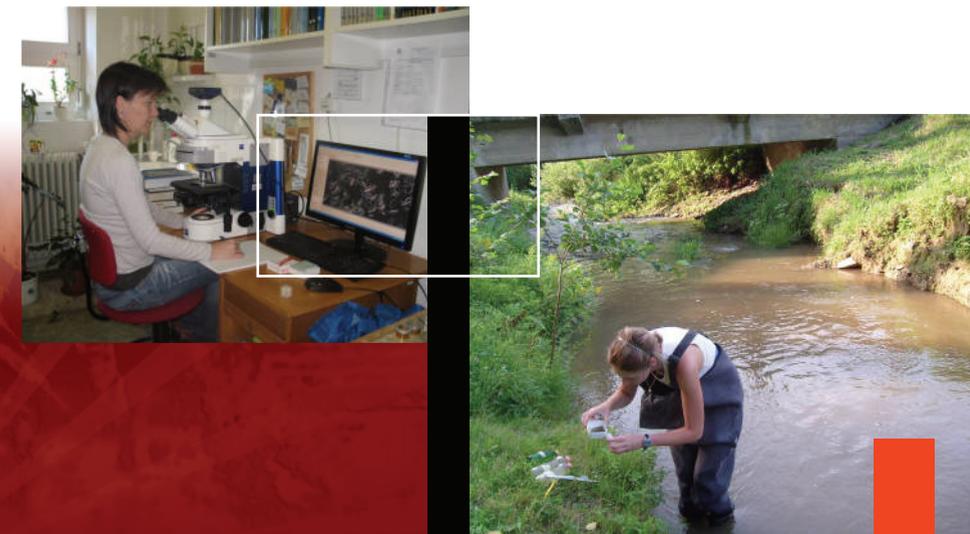
The Limnology Research Group has various research fields.

1. Research on small water bodies focuses on stream ecology (attached diatoms, macroinvertebrates, leaf litter decomposition), humic lakes in forested areas, inland saline lakes and dendrothelms.
2. Ecophysiological studies are carried out on planktonic cyanobacteria and diatoms with the aim of describing their physiological plasticity in photosynthetron and chemostat experiments.
3. Research on phytoplankton functional groups includes both field tests at different climatic and also extends to theoretical analysis of different types of functional groupings.
4. Small water bodies host a number of invertebrates that act as vectors for human diseases. Apart of field studies aiming at refinement of distributional areas, we compare distribution maps to climate envelope to predict future scenarios and level of risks to human population.
5. The research group is involved in a large scale enclosure experiment installed in Lake Stechlin, Germany.

Main results:

1. Diatom guilds are good tools to study patterns of attached diatom communities whose diversity and species number increase along stream order.
2. Heat island effect and climate change can extend the occurrence limit of the most important sand fly vectors. Large cities such as Budapest are most vulnerable. Recent distribution of WNF suggests that climate, topographical run of rivers, floods, migrating routes of birds and annual ontogeny of mosquitoes determine the occurrence of the disease.

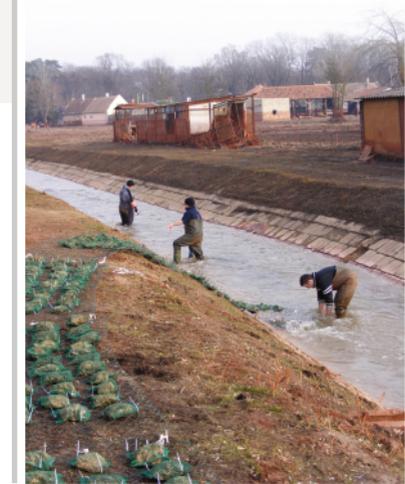
Leibniz Institute für Gewässerökologie, Neuglobsow, IASMA Research and Innovation Centre, Istituto Agrario di S. Michele all'Adige, University of Palermo, Department of Biological, Chemical and Pharmaceutical Sciences and Technologies, Palermo



phytoplankton,  
diatoms,  
water-born-diseases,  
leaf litter decomposition,  
ecophysiology of algae

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aerosol source apportionment, PM10 measurement, aerosol optical measurements, particle size-distribution measurement

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## MTA-PE Air Chemistry Research Group

The MTA-PE Air Chemistry Research Group was established at the University of Pannonia in 1995 by Professor Ernő Mészáros, an internationally renowned expert in the field of atmospheric chemistry. Since 2005, the head of the group is Professor András Gelencsér. Since its foundation, the group has been involved in the measurement and characterization of atmospheric particulate matter which is now a key atmospheric pollutant and plays an important role in fundamental atmospheric processes. The main focus of its research has been the chemistry and radiative effects of carbonaceous particles. The group has participated in several EU-funded international research projects, established fruitful co-operations with many highly renowned research institutes in Europe and overseas. Since 1995, the members of the group have published more than 200 peer-reviewed publications and received more than 4000 independent SCI citations.

- Studies on the processes leading to the formation of the photochemical smog [Gelencsér, 2003; Hoffer, 2004; Ion, 2005]
- Studies on the atmospheric light absorption of brown carbon particles in cooperation with the Max Planck Institute for Chemistry [Andreae&Gelencsér, 2006; Hoffer, 2006; Tóth, 2013]
- Studies on aerosol source apportionment, including the first combined application of organic tracer and radiocarbon measurements, in the framework of European co-operations [Gelencsér, 2007]

Max Planck Institute for Chemistry, Mainz, Germany, Vienna University of Technology, Austria, Stockholm University, Sweden, Institute for Glaciology, CNRS, Grenoble, France, National Oceanic and Atmospheric Administration, Boulder, Arizona, USA

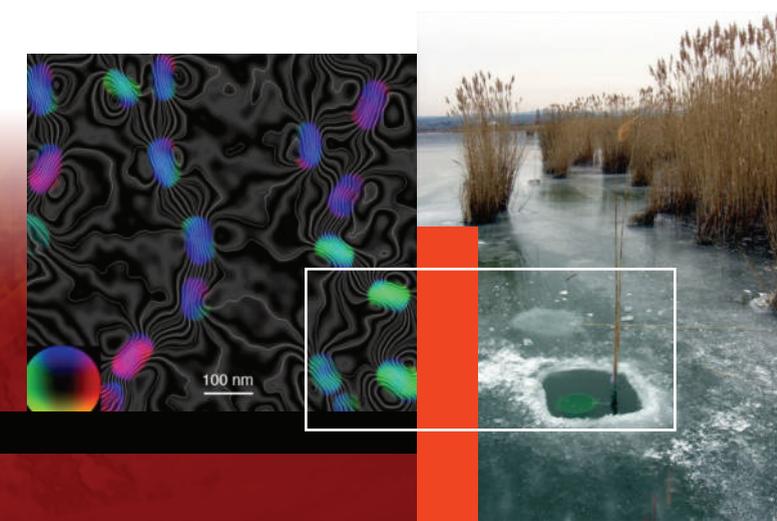


## Environmental Mineralogy Research Group

Our research focuses on diverse mineralogical problems related to the environment, using mainly electron microscopy techniques. (1) We study magnetic biominerals (iron oxides and sulfides) that form inside living organisms (in the cells of magnetotactic bacteria), with the aim of understanding the mechanisms of biological control over crystal formation. Knowledge about biomineralization processes is used for developing biomimetic synthesis methods for producing magnetic nanocrystals with strictly regulated physical properties, for practical applications. (2) The chemical and physical properties of individual atmospheric aerosol particles are examined, in collaboration with the Air Chemistry Group, in order to understand the climatic and environmental effects of the particles. (3) Recently we have been involved in studying the mineralogical composition of the carbonate sediments of Lake Balaton, with the aim of understanding the roles of sediment mineral grains in the ecosystem of the lake.

By using electronography, we characterized the magnetic properties (magnetic induction, shape- and magnetocrystalline anisotropies) of nanocrystals inside the cells of magnetotactic bacteria. We developed new methods for the laboratory synthesis of magnetite nanoparticles with controlled sizes and shapes. Individual aerosol particles produced by biomass burning were characterized and new particle types were identified.

Department of Biology, Ludwig Maximilian University, Munich, Germany, School of Earth and Space Exploration, Arizona State University, Tempe, Arizona, MTA Ecological Research Center, Balaton Limnological Institute, Tihany



nanomineralogy, electron microscopy, iron oxides and sulfides, individual aerosol particles, carbonates

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water purification,  
water analysis,  
on-line monitoring,  
photocatalysis,  
solar energy utilization

### Contact

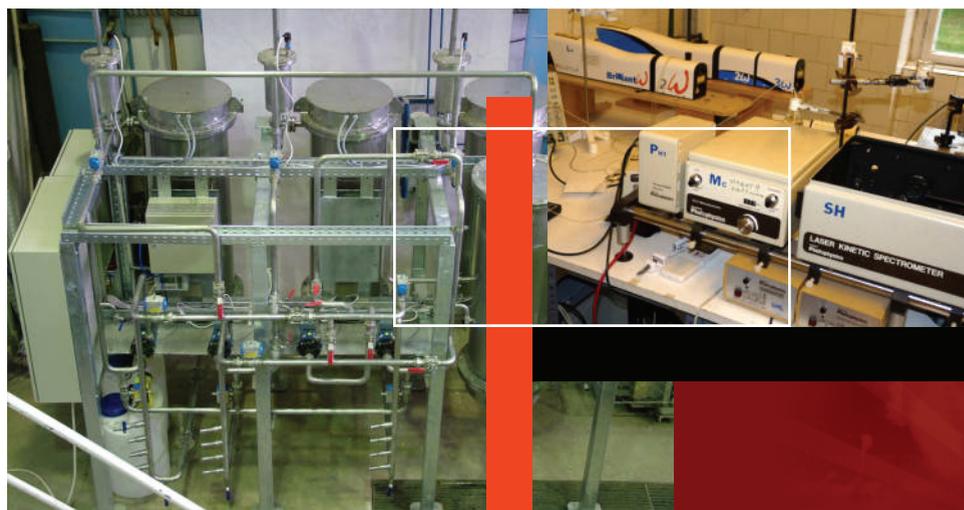
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## Environmental Photochemistry Research Group

Our main research activities focus on the development and study of photoactive compounds for degradation of pollutants and solar energy utilization. In relation to these, we also leading study on theoretical (quantum) chemistry and development of procedures for environmental analysis. Our fields of interest include water purification: oxidative degradation (mineralization) of contaminants in waters of various origins by application of homogeneous and (mostly) heterogeneous photocatalytic procedures; development of water-treating reactors based on combination of different methods. For continuous monitoring of water quality, we also build on-line analytical systems. Other areas of research focus on the utilization of solar energy: development of photocatalytic systems (based mostly on metal complexes) for water-splitting (generation of hydrogen as eco-friendly fuel). Both steady-state and time-resolved techniques are used in our studies. For determination of structures, properties, and reaction mechanisms of photoactive compounds, quantum chemical calculations are also applied.

We have realized efficient degradation of various organic pollutants by heterogeneous photocatalysis. Based on this method, we have built a process controlled pilot plant for treatment of industrial wastewaters. Heavily polluted waters were successfully purified by combination of this procedure with a thermal oxidation method. We have developed photochemical systems based on metalloporphyrins efficiently absorbing in the visible range for photochemical utilization and storage of solar energy.

Körte Környezettechnika Kft., Dunaharaszti; Henkel Magyarország Kft., Budapest; Magyar Telekom Nyrt., Budapest; University of Zagreb; Graz University of Technology; Johannes Kepler University, Linz; Ruder Bošković Insitute , Zagreb



## Organic Synthesis and Catalysis Research Group

The research projects of the group are supervised by three professors (Dr. József Bakos, Dr. József Kaizer and Dr. Rita Skoda-Földes). The main projects are as follows:

- i) Development of novel, highly active chiral catalyst systems by the fine tune of the ligand structure for selective asymmetric hydrogenation and enantioselective allylic substitution reactions.
- ii) Development of catalytic reactions for the synthesis of carboxylic acid derivatives
- iii) Improvement of the efficiency of catalytic reactions by immobilization of catalysts and/or by the use of solvents enabling biphasic reactions (such as ionic liquids or water).
- iv) Development of biomimetic catalytic processes. Preparation of synthetic models of dismutase and catalase enzymes. Investigation of dioxygen activation.
- v) The study of stoichiometric and catalytic oxidation reactions in the presence of transition metal complexes.

Various chiral synthons and biologically active molecules were synthesized in high yields. Novel steroid derivatives were obtained in new synthetic routes. Novel catalysts were developed for oxidation and hydrogenation reactions.

The results were published in leading international journals. (Catal. Commun, Dalton Trans., J. Org. Chem., Green Chem., Tetrahedron, Tetrahedron Lett., Tetrahedron: Asymm., etc. ). In the past 5 years, 85 papers were published and three patent applications were filed based on our research. Our researchers supervised 8 PhD and 16 MSc or BSc theses.

ThalesNano Nanotechnology Inc., Sanofi-Aventis Zrt., Hunstman Corporation, STREM Chemicals Inc., Chemical Works of Gedeon Richter Plc, EGIS Pharmaceuticals Plc, Budapest University of Technology and Economics, University of Pécs, University of Toulouse, University of Zagreb



synthesis,  
catalysis,  
spectroscopy,  
chromatography,  
kinetics

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nanohybrids,  
thin films,  
surface analysis,  
chemical mapping

## Surfaces and Nanostructures Research Group

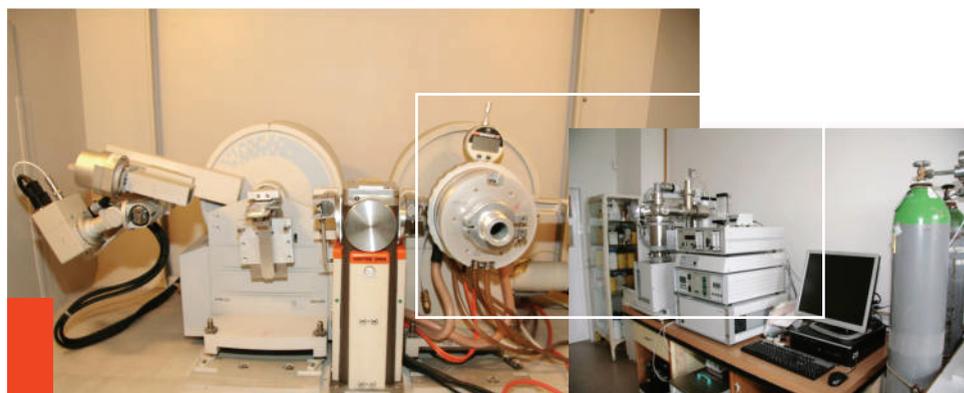
The study of the structure, properties and reactivity of oxide surfaces is of utmost importance in the light of developing high dispersity nanocomposites for applications in catalysts, sensors, special adsorbents and in surface protection as well. In certain fields, it is necessary to use complex systems with tailor-made surface properties.

Extensive research has been conducted for the development of clay-based nanostructures and hybrid (organic-inorganic) materials including their complete structural and surface characterization. The development of electrocatalytic thin films for potential use in waste water treatment and in different fields of the electrochemical industry is also highlighted. Two researchers have DSc qualification, while two others have PhD degree. The contribution of graduate/PhD students (5-7 persons each year) is essential in carrying out experimental works. Sophisticated instruments (FTIR/Raman spectrometers, thermobalances, mass spectrometers and chromatographs) can guarantee the high standard of experimental work.

Complex investigation of the formation mechanism (reaction pathways) of mixed-oxide thin films by thermal analysis, mass- and vibrational spectroscopy; studies on segregation phenomena by SIMS method.

Structural and surface characterization of clay mineral organo-complexes. Elaboration of novel synthesis methods for the preparation of kaolinite nanostructures/nanohybrids using multiple intercalation. Study of the role of experimental parameters on the synthesis routes and characteristics of nanomaterials formed.

Chemistry Discipline, Faculty of Science and Technology, Queensland University of Technology, Brisbane, Australia, Department of Chemistry, Montana State University, Bozeman, USA, Chemical Research Center of the HAS, Budapest



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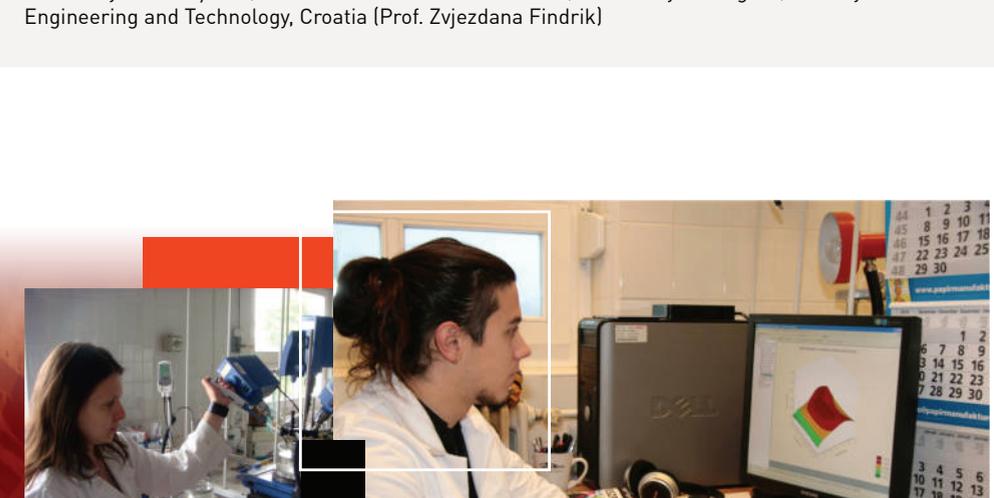
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## Non-Conventional Media Research Group

The principal aim of the Research Group is to explore, develop and understand the role of non-conventional media for enzymatic catalysis so that current commercial processes using water or conventional molecular organic solvents may be replaced by clean, green processes using solvent-free, supercritical fluid or ionic liquid technology. The effects of various reaction parameters on enzyme activity, selectivity and stability are investigated by using response surface methodology. As the amount of enzyme-bound water is one of the most important parameters, special attention is paid to the control of water activity, which may influence the enantioselectivity of the enzyme. For controlling water activity during the enzymatic reactions, pervaporation unit was integrated in the system to remove excess water and to construct a reactor operating at stable and optimal reaction rate. Combination of ionic liquids and supercritical fluids results new possibilities for enzymatic reactions and separations.

Starting from natural initial compounds various natural esters were produced (e.g. flavour esters, biolubricants, emulsifiers) using enzymatic esterifications in non-conventional media. Continuous process was developed for the production of ethyl acetate using a double pervaporation system for removal of both product ester and by-product water. The enantioselective enzymatic esterification of lactic acid was carried out under microwave radiation in ionic liquids and supercritical carbon dioxide.

Universidad de Murcia, Department of Biochemistry, Spain (Prof. Pedro Lozano), "Politehnica" University of Timișoara, Romania (Prof. Peter Francisc), University of Zagreb, Faculty of Chemical Engineering and Technology, Croatia (Prof. Zvezdana Findrik)



bioconversion,  
non-conventional media,  
enzymatic esterification,  
lipase,  
enantioselective  
separation

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Materials Testing,  
Scanning Electron  
Microscopy,  
Waste Recycling,  
Ceramics,  
X-Ray Analysis

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## Non-Metallic Inorganic Materials Research Group

Based on the decades-long traditions of research and education in silicate chemistry and materials science, the main activities of the Research Group of Non-metallic Inorganic Materials of the Institute of Materials Engineering focuses on the utilization of waste as a secondary raw material for the production of new structural and functional materials with better properties. While preserving traditional topics, the research profile of the Institute has been changing to fulfil the requirements of the 21st century, therefore – besides the research in high-tech ceramics, non-metallic structural materials, composites, binding materials, bioceramics, and superconductors – it is also focusing on the development of materials testing methods, especially light- and electron microscopy, and X-ray analysis. As a result of our research in materials science and materials engineering, the Institute of Materials Engineering is renowned both in Hungary and abroad and participates in many national and international projects.

Biologically active glass ceramics implant coatings of high thermal expansion were manufactured from heat treated animal bones. A superconducting materials system showing significantly higher levitation force was developed. Research of inorganic polymers resulted in a geopolymer outperforming the strength of traditional concrete. Tile glazes were developed using white glass refuse as raw material. A method was developed to manufacture concrete containing fibre reinforced plastic waste.

Bakony Technical Ceramics Ltd, Veszprém (<http://www.bakonycer.hu>)  
Duna-Dráva Cement, Vác (<http://www.heidelbergcement.com/hu/hu/country/home.htm>)  
Herend Porcelain Manufacture, Herend (<http://herend.com/en/>)

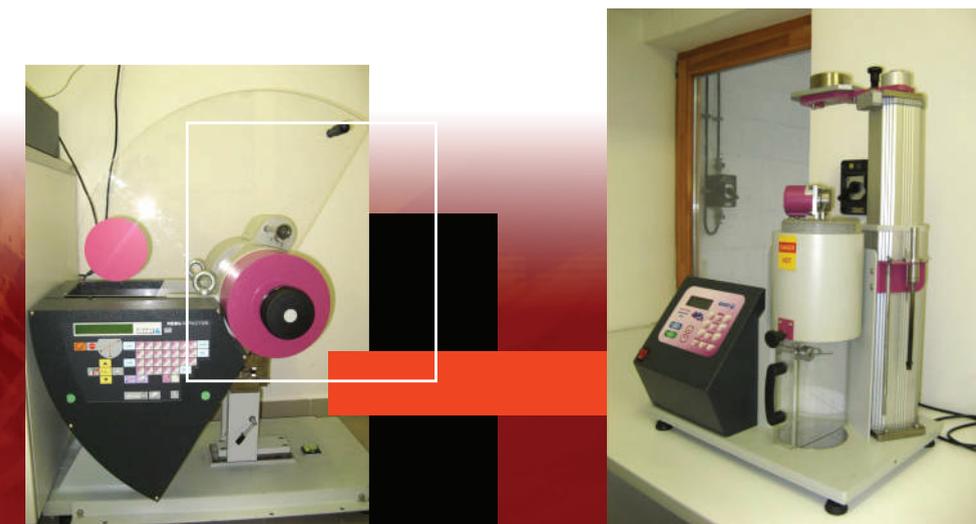


## Plastic composites Research Group: Composite Development and Mechanical Recycling

The aims of our research include development of fibre reinforced, filled and nanocomposites based either on commercially available and waste plastics. Selectively collected or well-selected plastics (e.g. polyolefins, PET) are mainly used to carry out research. For development of the composites, a patented additive package is applied because of the wide variety of plastic and rubber raw materials. Structure of the additives is adjusted to the chemical composition of the composite parts due to the synthesis in order to improve mechanical and other properties of the composite products. Our group is the only one that explores the synthesis of the new compatibilizing additives among domestic research groups; therefore, unique knowledge base is continuously used and developed. Experience in composite processing and measurements is gained on a database making pre-selection of composites possible for given requirements.

Hungarian Patent for additive package for improving compatibility, registered patent specifications for biodegradable filler/PP, and for carbon nanotube containing PET composites  
several successful projects with industrial partners  
Synthesis of the additives larger than laboratory scale has been conducted in cooperation with MOL-LUB Ltd. for years. Due to the intensive infrastructural development, not only the measurements of the composites, but also the production of them can be carried out.

SZEMES Tömítéstechnika Kft, Balatonalmádi, Palotás-MIX Gumiipari Kft, Kemeneshőgyész, Krajcár Csomagolóipari Kft, Rábapaty, Continental Automotive Hungary Kft, Veszprém, Kecskeméti Főiskola, Anyagtechnológia Tanszék, MOL-LUB Kft



compatibility  
improvement,  
mechanical recycling,  
biodegradable fillers,  
nano- and fibre reinforced  
composites,  
composite properties

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fuels, additives,  
chemical recycling of  
polymers,  
energetical products,  
lubricants

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## Sustainable Mobility Research Group (Recycling of Waste Polymers Research Group)

Mobility is one of the main pillars of sustainable development. For its realization, modern fuels, lubricants, structural materials and roads are needed. The main objective of the research group is the research and development of fuels, engine oils and their additives from fossil and alternative sources, and their feedstock and energy saving, environmentally friendly and economic production. In the frame of it, the objective is the development of the current materials, and the development and realization of new, original products and the development of processes for their production. Besides the crude oil based fuels (gasoline, diesel gas oil, jet fuel), base oils and additives, products from alternative sources (for example natural and waste triglycerides, biomass based synthesis gas, thermal and/or catalytic cracking of polyolefins, etc.) have a significant share as well. The production and use of components from waste polymers in asphalts became an important new research area.

Main achievements:

Contribution to the development of environmentally friendly (practically sulphur free, reduced aromatic content) fuels (gasoline, diesel gas oil) with high energy content, and their additives. Participation in the development of biocomponent containing (ethanol, biodiesel) fuels. Development of new fuel components and their production processes from triglycerides. Expansion of the range of biodiesel feedstock options. Development of multifunctional additives with new structures, which can be used in fuels. Development of processes for the thermal and/or catalytic cracking of polyolefins. Asphalt additives.

MOL Plc. Budapest; MOL-LUB Inc., Almásfüzitő; ÁMEI Plc., Budaörs; OLAJTERV Group, Budapest; MGI Gödöllő; KITE, Nádudvar; Rossi Biofuel, Komárom, Hungarian Academy of Sciences – Centre For Energy Research, Budapest; Hungarian Academy of Sciences – Research Centre for Natural Sciences, Budapest



## Environmental Radiation Research Group: Radiological Survey of NORM-TENORM Materials, Radon Measurements

The group consist of 3 full-time university instructors and 3-6 PhD students.

Main areas of research:

Possibilities of radiological surveys in buildings and building area, measurement development (radon and gamma dose, radon in soil gas and radon exhalation measurements). Radiological investigation of building materials, TENORM's (red mud, coal slag, waste rocks) in building material. Determination of radon emanation influencing parameters, investigation of emanation capability reducing possibilities. Investigation of radon and thoron daughter elements equilibrium and bounding effects. Investigation of radioisotope transfer of plants. Alpha spectroscopic investigation of natural radioisotopes. Modelling of environmental migration of radioisotopes in environment. Dose assessment.

Main results:

The dose surplus was surveyed in several settlements caused by the elevated radon and gamma dose rate originated from the inbuilt coal slag. Participation in radiological investigation of TENORM's material was examined.

Procedures were elaborated for determination of radioisotopes in plants, drinking water, etc. and dose assessment methods. Due to the research activities 11 PhD thesis has been written and defended.

MecsekOre Ltd., Pécs, Hungary, Mecsek ÖKO Ltd., Pécs, Hungary, Manganese mine of Úrkút, Úrkút, Hungary, Hirosaki University, Hirosaki, Japan, NIRS, Tokio, Japan, Babes-Boyai University, Cluj, Romania, Franz Josef Institute, Ljubljana, Slovenia, Institute for nuclear science and technology, Hanoi Vietnam



Radioecology,  
radiation, radon,  
TENORM materials

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**Institute of Radiochemistry**  
**and Radioecology**  
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pollution prevention,  
expertise systems,  
environmental impact  
assessment,  
utilization of wastes

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[http://mk.uni-pannon.hu/  
kornyezettechnologia](http://mk.uni-pannon.hu/kornyezettechnologia)

## Environmental Technology Research Group

Our research aims at the practical implementation of the sustainable development in the field of industrial technologies with the primary objective to produce utilizable raw materials from communal and industrial wastes. In order to decrease the emissions and discharges into the environment, it is a basic requirement to investigate the utilization (MBH, RDF) of the wastes generating in significant amounts that are basically secondary raw materials. The research activity is focused on environmental technologies. Waste water treatment technologies, air pollution control (deNO<sub>x</sub>, catalytic tail gas treatment), decontamination technologies (utilization of red mud) are examined. Optimization methods and environmental impact assessment (GIS, remote sensing, LCA) techniques are studied to verify the results as well.

Waste water expertise system has been developed and accredited air monitoring mobile laboratory was installed. Complex environmental assessment protocol and qualification system have been generated. Method was devised for producing mixed oxide decontamination catalysts. The group is leading a study in processing of red mud with acidic wastes to generate secondary raw materials for the industry. Our research also focuses on the development of mechanical and biological technologies for utilization of wastes.

University of Toronto, Canada, Montana State University, Bozeman, USA, Babes-Bolyai University of Science, Cluj-Napoca, Romania, Institute of Catalysis, University of Lyon, France, Gheorghe Asachi Technical University of Iasi, Romania



## Complex Liquids Research Group

The number of new materials with extreme physical properties is continuously increasing with the development of nanotechnology. Examples are the supra- and paramagnetic ferrofluids, liquid crystals, magnetorheological (MR) and electrorheological (ER) liquids. Our basic research focuses on the investigation of the structural, transport, and thermodynamic properties of these fluids. We also study the practical usability of these materials in industrial, environmental, and medical applications. We examine the dependence of the phase equilibrium properties of these complex fluids on external electric and magnetic fields. Our theoretical arsenal includes statistical mechanical methods such as perturbation theories, density functional theories, and computer simulations. Our work in experimental research and development is aided by impedance spectroscopy, rheological, and optical techniques. In addition to these facilities, we build our own experimental research instruments using electronic and mechatronic measuring technique methods.

We proposed a theoretically-based analytic equation for the description of the magnetization and magnetic susceptibility of monodisperse and polydisperse liquids. We developed particle-dynamics simulation methods (and programs) to model the viscosity of ER and MR liquids. We developed an experimental procedure to measure the nonlinear dielectric permittivities of liquids. We developed a measuring technique to determine the hyperthermia effect of magnetic colloids in an alternating applied magnetic field.

University of Szeged, Semmelweis University, Research Centre for Natural Sciences of Hungarian Academy of Sciences, Max Planck Institute for Intelligent Systems (Stuttgart), The University of Hong Kong, University of Stuttgart



magnetic liquids,  
ER and MR fluids,  
dielectric and magnetic  
susceptibility,  
measuring techniques

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[http://mk.uni-pannon.hu/  
komplexfolyadekok](http://mk.uni-pannon.hu/komplexfolyadekok)



water analysis,  
ion / liquid /  
multidimensional  
chromatography,  
ion exchange chemistry,  
complex ions,  
bioactive molecules

### Contact

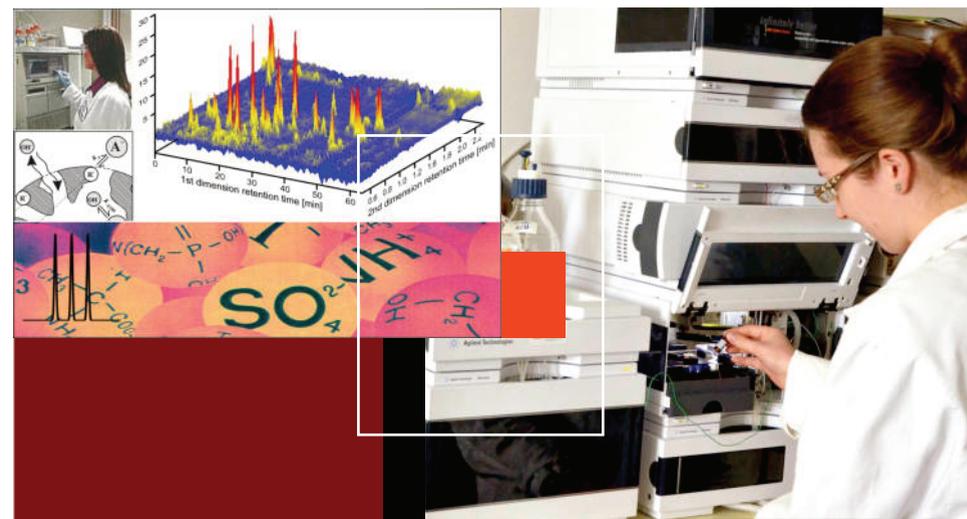
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## Analytical Separation Science Research Group

Analytical separation science is a field of scientific endeavour that covers high performance methodologies for the analysis of components in complex mixtures. Separation of chemical components in different sciences advances our knowledge of the composition of materials, and of chemical, biological, environmental and technological processes. Our primary task is to produce fundamental research in the field of development of new methods for control of separation selectivity and innovative utilization of the separation chemistry. Our research group has 40 years of experience and active platform traditionally in the separation sciences, mainly in the fields of ion exchange chemistry, ion/liquid chromatography, retention modelling, water analysis, complex equilibria, physico-chemical principles and theories of analytical separations. Currently there are 5 diploma, PhD and postgraduate students in the research group and 2 staff members. The laboratory is well equipped with state-of-the-art instrumentation. The activities of Research Group are also financed by the Hungarian Scientific Research Fund (OTKA K81843 and OTKA PD104818).

Method for High Performance Ion Chromatography of Transition Metal Chelate Complexes and Ligands (J. Chrom.2013). New strategies and applications of multi-dimensional chromatography for separation of bioactive molecules (Anal. Chem., 2009). Ionization Control in Ion Chromatography (The Royal Society of Chemistry, Cambridge, 1997). New theory of retention mechanism (Advances in Chromatography, Marcel Dekker, New York, 1998). Novel Separation Method of Haloacetic Acids in Waters using Macrocyclic Cryptand (J. Chrom. 2008.).

University of Torino, Department of Analytical Chemistry, Italy,  
University of Tennessee, Department of Chemistry, Knoxville, USA,  
University of Geneva, Pharmaceutical Department, Switzerland



## Molecular Interactions Research Group

The research activities of the Molecular Interactions Research Group focus on the experimental determination of molecular interactions, which are relevant to the calculations of phase equilibria and the design of separation processes. Estimations of phase equilibria and transport characteristics are performed by semi-empirical models and in-house developed routines based on quantum-chemical calculations. The aims of the method developments are the improvements of techniques suitable for surface energetic and calorimetric characterization of matrices and reinforcements of composites. The experimental methods applied in our labs are the inverse gas chromatography (IGC, measuring of surface energy and interactions, surface characterization of solids, surface energy analysis, SEA, adsorption) and the calorimetry (measurements of heat and pressure changes of phase transformations, chemical reactions, decompositions, explosions, adsorption, heat capacities, thermal analysis, TA, TG, DSC).

A process was developed for the determination of absolute retention characteristics by capillary gas chromatograph using Kováts' indices. GC based LSER correlations were determined for estimations of physico-chemical parameters. A novel method was developed for modelling the evaporation of real liquid mixtures. New QSPR multivariate nonlinear model based on artificial neural network was developed for prediction of Hansen solubility parameters using COSMO sigma-moments as molecular descriptors.

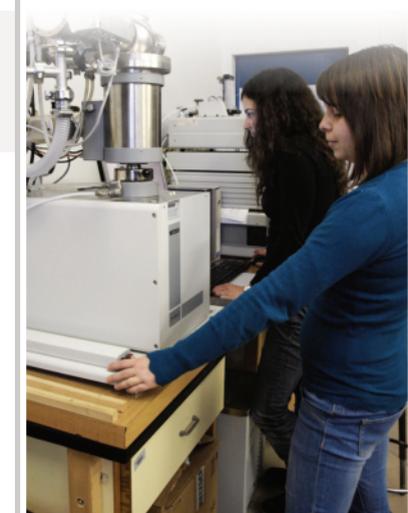
Surface Measurement Systems Ltd. (London, United Kingdom), Givaudan Dübendorf AG, Zürich-Dübendorf, Switzerland, Nanotechnology and Molecular Science Discipline, School of Chemistry, Queensland University of Technology, Brisbane, Australia



surface energy analysis,  
inverse gas  
chromatography,  
high pressure reaction-  
calorimetry,  
simultaneous thermo-  
analysis,  
modelling of phase  
equilibria of  
multicomponent mixtures

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modelling  
simulation  
selectivity  
transport  
thermodynamics

## Contact

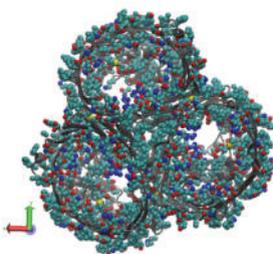
**Dr Dezső Boda, DSc**  
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<http://mk.uni-pannon.hu/modellezes>

## Computer Modelling Research Group - Simulation and Theoretical Studies of Selectivity and Transport Properties of Porous Materials

The macroscopic (measurable) properties of many-particle systems are determined by microscopic processes. Understanding these processes is possible by modelling the particles and their interactions on the molecular level and by studying these models with statistical mechanical methods. The research group (Kristóf Tamás, Varga Szabolcs, Valiskó Mónika, Gurin Péter, Ható Zoltán) uses both analytic theories and computer simulations (molecular dynamics, Monte Carlo) for this purpose. The systems studied by the group include selective silicates (zeolites) usable for component separation processes, ion channels of the cell membrane, ion-selective and rectifying nanopores, and complex liquids (showing ordering and phase transitions). Novel simulation methods are being developed in order to study these systems. A 104-core computer cluster is available to run the time-consuming calculations.

The members of the research group are recognized experts in the field of their research interest having diverse network of collaborators all over the world. They won several OTKA and other grants; they are keen on expanding the financial background for their research. They regularly present their results at international conferences and publish them in prestigious scientific journals. The members of the research group published about 190 papers so far in indexed journals of 425 total impact factors. They got about 1900 independent citations for these papers.

Universidad Autonoma de Madrid, Spain, Mexican Petroleum Institute, Mexico City, Rush University Medical Center, Chicago, USA, Brigham Young University, Provo, USA, German Research School for Simulation Sciences, Juelich, Germany, University of Paderborn, Germany, German Research School for Simulation Science GmbH, Germany

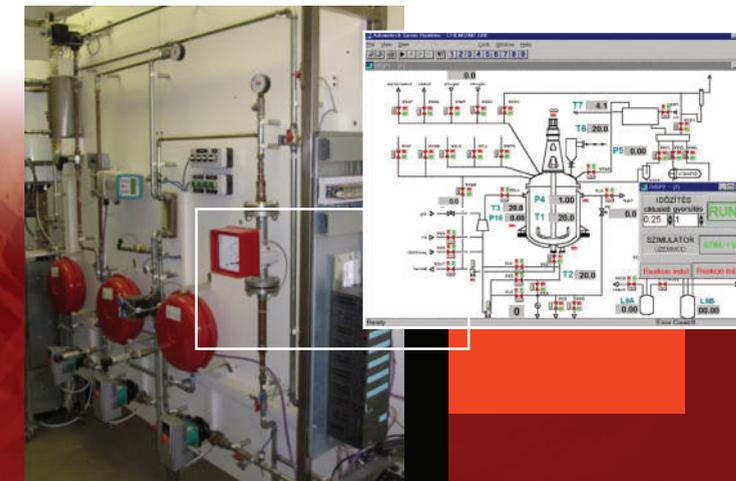


## Process Engineering Research Group

The Department of Process Engineering is one of the leading research centres in Hungary dealing with chemical process engineering, data mining and process development. Our department has been teaching and studying tools and methods of process engineering for more than 30 years. The main research and development areas are: modelling and simulation, model-based process analysis, performance monitoring, optimization, advanced control algorithms (adaptive, model-predictive, fuzzy, neural), data reconciliation, data mining: visualization, regression and classification models, time-series analysis, clustering, and process mining – log mining (extraction process models from log files), business process modelling and operational management. We focus on both the sound theoretical foundation and industrial applications of these techniques. The Department of Process Engineering has a wide range of tools to support process development (e.g. ASPEN, UniSim, PI, Matlab/Simulink, Comsol, Simul8, Bizag...etc.). Available human resources involve 8 faculty members with PhD degree and 5 PhD students.

- Process monitoring, soft sensors and energy monitoring, SPC (MOL)
- Process modeling, simulation, data warehouse and process development (TVK)
- Multi-scale modeling and simulation of complex processes
  - crystallization (EGIS),
  - polymerization (Borsodchem, TVK)
  - mixing processes
- Optimization of supply chains and business processes (E.On)
- Early warning risk management system [KürtZRt]
- Batch process development (BatchControl)

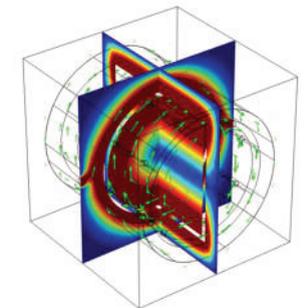
TVK NyRt, Tiszaújváros, MOL NyRt, Százhalombatta, Sil4S Kft., Veszprém, BatchControl Kft, Budapest Egis Gyógyszergyár, Budapest, Babes-Bolyai Tudományegyetem, Kolozsvár, FinnishMicroarray and Sequencing Centre, Turku, Finland



modelling, identification  
and simulation,  
process control and  
optimization,  
risk analysis and process  
safety,  
datamining, process  
mining,  
process and product  
(quality) development

## Contact

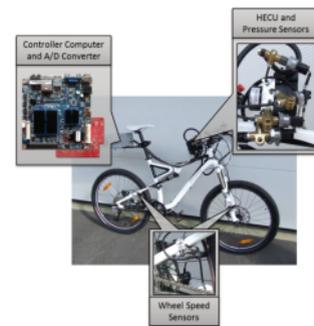
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Measurement and test automation, HIL/SIL technologies (automotive communication protocols, ECU testing, diagnostics, verification, validation) software sensor methods and sensorless technologies Automatic code generation tools, Prototype development

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<http://mk.uni-pannon.hu/szoftverszenzor>



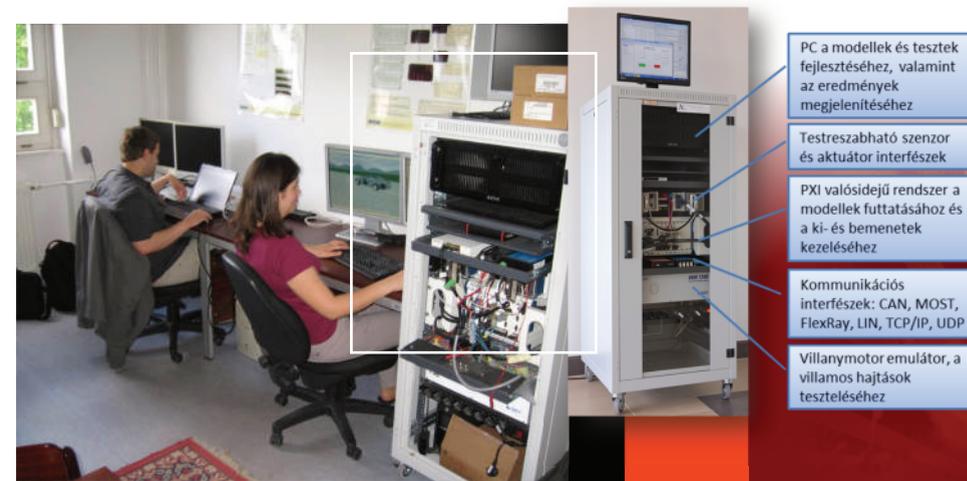
## Software sensors Research Group: Automotive Mechatronics and Automotive Electronics Systems

The main activity of the research group is to promote research in software sensors related to the field of automotive mechatronics, automotive electronics and automotive informatics. Supplying the ever increasing needs of safety, comfort and environmental issues of the ECUs (Electronic Control Units) of today's more and more complex vehicles. The efficiency of controlling algorithms of active safety systems (i.e. ABS – Anti-lock Braking System, ESC - Electronic Stabilizing Control, TCS -Traction Control System, etc.) can be considerably improved with the knowledge of some characteristic parameters (i.e.: value of friction coefficient, side slip angle, tire pressure, etc.) that cannot be measured directly, or their measurement is too difficult or expensive. The main purpose of the group is to investigate the estimation of parameters complicated to measure via indirect software sensor methods with the intelligent processing of sensor signals used by regular ECU's available in mass produced cars (i.e.: wheel speed sensors, acceleration sensors, etc.).

Main research interest: development of HIL simulation environment, CAN error generation systems development, ABS ECU HIL test automation environment development, ESP Sensor Cluster HIL test environment development, Battery Test-bench: Electronic Battery Sensor HIL testing tool, Permanent Magnet Synchronous Motors sensorless control methodology.

Industrial References: Universal automotive communication tool development (Bosch), Sensorless methods for slotless PMSM motors (Maxonmotors), Universal CAN diagnostic tool development, Automated ECU testing in a HIL/SIL environment (Continental), Bicycle ABS prototype development (patent pending).

Continental Automotive Hungary Ltd., Veszprém, Robert Bosch Ltd., Budapest Development Centre, Budapest, National Instruments Hungary Ltd., Budapest



## Technical Optimization Research Group

Research in the field of optimal design has been conducted for more than 30 years. They are extended to develop the optimization of different structures and equipment of energetic. In this field, we organized many national and international works (OTKA, Ukraine-Hungary Tét, RET, University of Darmstadt and some Hungarian company). We have published a number of scientific works (papers and part of books) in Hungary and abroad as well.

The results of optimal design appeared in form of scientific dissertations (candidates, PhD theses and habilitation). In the latest, we have initiated research in the field of solar energy. This activity includes the discovering the collection, the storage and utilization of solar energy.

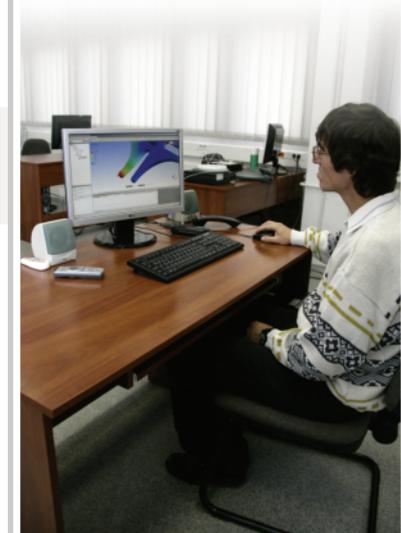
Main research topics:

- Optimal design of sandwich construction (beams, plates and shells)
- Optimal design of truss-girder
- Optimizations of isolation pipe lines and equipment of energetic. Discover of utilizing of sun energy and the mathematical modelling of utilize of storage.
- Develop of heat accumulator in optimal form. The optimal geometry of the welded freight bogie structure considering the relevant standards - EN 13749:2011 and EUROCODE 3 is designed. DFMA methods to explore the determination of fabrication costs are utilized.

Design of the optimal structures, minimising energy loss, solar energy utilization

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University of Miskolc, Hungary; Technical University of Cluj-Napoca, Romania; Poppe+Potthoff, Ajka, Hungary; Herendi Porcelán Manufactura, Herend, Hungary.



unit operations,  
gas purification,  
algae technology,  
carbon nanotubes,  
preparative liquid  
chromatography

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## Unit Operations Research Group

The Department of Chemical Engineering has been carrying out research in cooperation with a number of industrial partners for over 50 years. The main profile of the research group includes pharmaceutical production, bio- and nanotechnology and gas purification. The main task of the research group is to solve newly emerging problems in the chemical industry related to separation and up-scaling with the development of efficient and advanced technologies. The objective of the research projects is to characterize the unit operations and transport phenomena, develop up-scaled technologies, and solve problems of unit operations both in laboratory and industrial settings. As a result of the successful research projects carried out in the past years, a number of industrial-scale devices are in operation and the group holds a number of patents. The results are regularly presented in national and international conferences as well.

The most important achievements of the research group include: the industrial-scale synthesis of multi-walled carbon nanotubes; supplying data with special distillation techniques for the design of industrial-scale devices; development of liquid chromatography techniques; preparation of purified gases; hydrogen sulfide removal from natural gases; development of algae technology; treatment and deposition of liquid and solid radioactive waste

MOL Hungarian Oil Plc (Budapest), MVM Paks Nuclear Power Plant Limited (Paks), Gedeon Richter Pharmaceuticals Plc (Budapest and Dorog), Nitrogénművek Limited (Pét)



## Postgraduate Study

Postgraduate courses are suited towards graduates who are wishing to further their education and professional development. A distinctive feature of our Faculty is the commitment to offer a comprehensive range of courses reflecting the changing needs of industry and to adapt to the demands of the labour market. Our academic staff, who are leaders in their fields, train and engage students to acquire advanced education in engineering science. This is reflected in the number of programmes and courses offered each year. The portfolio of postgraduate courses covers advanced and specialised areas of engineering and areas where competences required in technology based professions are emphasised.

The Faculty maintains excellent relations with the industry and many postgraduate students work on projects that involve collaboration with industrial sponsors.

### Courses:

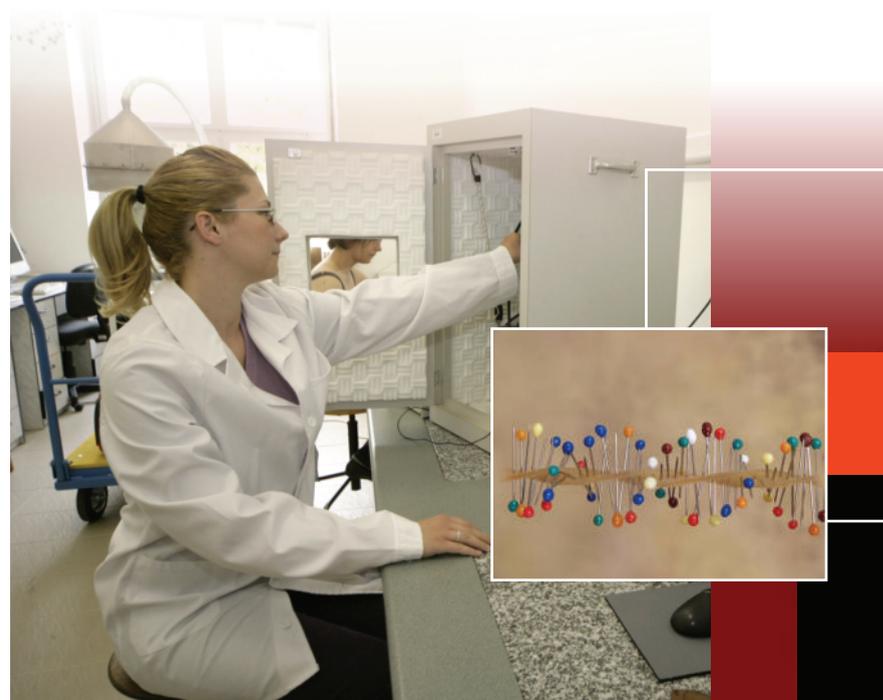
- Automotive Quality Management
- Sustainable Development
- Corrosion Protection
- Environmental Management
- Environmental Protection
- Engineering in Research and Development
- Hydrocarbon Process Engineering
- Hydrocarbon Technology Development Engineering
- Explosives Engineering
- Water and Waste Water Treatment System Operation



## Research Facilities

The Faculty of Engineering maintains an impressive range of facilities tailored to support high quality research. These facilities are available to all staff and students and also serve as great resource for companies looking for specialist research services. Our major equipment, high performance computing and instrumentation facilities provide a strong foundation for our research in science and engineering. As part of our research strategy and vision, we spend about 200m HUF each year on reinforcing our existing research infrastructure and building world-class environment for our outstanding researchers, teachers and internationally acclaimed research teams. Funding for the purchase, replacement and upgrade of research equipment is mostly obtained from research partnerships with a range of companies from the industrial sector.

Research in the Institute of Materials Engineering is supported by one of the largest and best-equipped facilities of the Faculty. The range of systems covers up-to-date instrumentation for materials science (e.g. laser particle sizer, Bruker Avance II NMR spectrometer, Philips PW 3710 X-ray diffractometer, PW 2404 X-ray fluorescence spectrometer, Oxford ARC-MET 8000-es metal analyser, Philips XL30 ESEM environmental scanning electron microscope Netzsch-Balzers TG-MS, Bio-Rad FTS-185 FTIR, Agilent Technologies1100 Series LC/MSD Trap VL Liquid chromatograph-mass spectrometer, Agilent Technologies1100 Series GC 6890N, MS 5973 Gas chromatograph-mass spectrometer, ELAN DRC II. Perkin Elmer ICP-MS). The SETARAM C80D high-pressure reaction calorimeter is unique in Hungary. Research in environmental science uses a range of state-of-the-art technology for dating biological and mineral deposits; for tracing the evolution of atmospheric gases, groundwater, surface water, soils, and a range of fauna; for selecting sites and analysing these samples. This technology includes: stable and radiogenic isotope and high-resolution trace element analysis by mass spectrometry; inorganic and organic geochemical analysis; computed X-ray tomography; a microbeam laboratory;



computer modelling of the global hydrologic cycle and groundwater flow; remote sensing of changes in the Earth's surface and atmosphere; undersea sampling/analysis; aerogeophysics; and modelling and inversion.

The Institute of Physics and Mechatronics houses one of the region's leading centres for research in mechatronical measurement technics. Research in mechatronics is supported with modern laser instrumentation (e.g. LOTIS TII LS-2137U Nd:YAG impulse laser), CNC units, modern car simulator (real-time for use of designing and testing automotive control units(ABS, ESP, ACC) HIL (Hardware-In-the-Loop) Research in chemical and environmental technologies is supported with pilot water and wastewater plants, Dest-Star Advance automated batch distillation unit, 50-litre monofluid batch reactor cascade (Siemens PCS7-es DCS process control and a variety of process development tools (ASPEN, UniSim, PI, Matlab/Simulink, Comsol, Simul8, Bizagi), including a 104-core computer cluster. Funded largely from MOL Group, the Pignat high-pressure reactor system is a modern and well-equipped pilot-scale unit of the Faculty.

The Institute of Radiochemistry and Radioecology has an excellent reputation for quality research undertaken in radiochemistry labs and lab facilities with spectroscopic and analytical equipment for radioactive samples. Within these state of the art radiochemistry laboratories there is a range of dedicated spectroscopic and radioanalytical equipment including controlled atmosphere facilities; equipment for thermal and elemental analysis; UV/vis/nIR and IR/Raman spectrometers, with fibre optic dipping optodes for in situ measurements; electrochemical equipment for cyclic voltammetry and controlled potential coulometry; and comprehensive radioanalytical facilities including alpha-spectroscopy, low background liquid scintillation counting and low background gamma-spectroscopy. We also have access to an ICPMS facility suitable for the analysis of transuranium elements.

The RS-03 automated dose meter transmits its signal to OSJER-network. The Institute of Chemistry is equipped with a 400MHz NMR spectrometer that contributes significantly to our scientific research.



## Contacts

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Surfaces and Nanostructures Research Group	Dr János Kristóf	kristof@almos.uni-pannon.hu	Department of Analytical Chemistry Veszprém H-8200 Hungary
Technical Optimization Research Group: Optimal design of metal structures and equipment of energetic	Dr Imre Timár	timari@almos.uni-pannon.hu	Institution of Mechanical Engineering Veszprém H-8200 Hungary
Unit Operations Research Group	Dr Dóra Rippel-Pethő	pethod@almos.uni-pannon.hu	Institutional Department of Chemical Engineering Science Veszprém H-8200 Hungary

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