PHYSICS, **METAL MATERIALS** & MACHINERY

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SLOVAK UNIVERSITY OF TECHNOLOGY IN BRATISLAVA / FACULTY OF MATERIALS SCIENCE AND TECHNOLOGY IN TRNAVA / INSTITUTE OF PRODUCTION TECHNOLOGIES / PRODUCTION TECHNOLOGIES (SK) ..... GO

SLOVAK UNIVERSITY OF TECHNOLOGY IN BRATISLAVA / FACULTY OF MECHANICAL ENGINEERING / INSTITUTE OF APPLIED MECHANICS AND MECHATRONICS (SK) ..... GO

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UNIVERSITY OF WEST-HUNGARY (UWH) AND PANNON DEVELOPMENT FOUNDATION (PDF) / TECHNOLOGY CENTER (HU) ..... GO

AC2T research GmbH

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THEMATIC RESEARCH FOCUS

RESEARCH AREA

- Tribology (friction behaviour, wear mechanisms and lubrication; lifetime assessment)
- Lubricants and lubrication technology; fuels in tribological contacts
- Material and surface investigations (design, interaction, corrosion, texture, etc.)
- Simulation of tribological processes on relevant length and time scales (theories of friction and wear, friction on (sub-)atomic scales, fluid mechanics of lubricant flow)
- Sensors for detection of tribological parameters (condition monitoring, etc.)

EXCELLENCE

A1 Lubricant and Surface Interaction

- Stability and performance of lubricants and fuels (degradation mechanisms)
- Surface interactions, e.g. wear protection
- Formulation of novel lubricants and fuels, e.g. ionic liquids

A2 Wear Processes

- Design of multiphase materials regarding tribological demands
- Design of high temperature materials with wear resistance
- Wear mechanisms in electrical contact systems

A3 Integrated Tribodiagnostics and -design

- Design of tribosystems
- Design of sensor systems for nanoscale wear detection
- Sensor systems for online oil condition monitoring

A4 Multiscale Computational Tribology

- Ab-initio prediction of friction and wear processes on functional surfaces
- Lubrication and cavitation in porous journal bearings
- Molecular dynamics of nanolayers

MISSION

- Establishing an integrated capable international well-known centre of excellence, acting as national point for international activities in the field of Tribology, by focusing of our competencies in the field of Tribology.
- Optimal support of industry and SMEs in offering advanced experience and facilities in Tribology on a cost-efficient "time sharing basis" and based on synergies in collaboration with relevant national and international research institutions.

- **Research area A1:**
  to measure (make measurable), understand, and to control lubricant as well as fuel performance over time

- **Research area A2:**
  detailed understanding and control of the wear processes in technically relevant systems

- **Research area A3:**
  to specify correlations of the tribological behaviour in model component tests and real applications; the validation of models for fundamental wear mechanisms; the definition of relevant surface parameters with regard to tribological function

- **Research area A4:**
  to bridge the gap between all the relevant length and time scales involved and hence to establish a new and self-standing research field in Austria

DEVELOPED TECHNOLOGIES

CONTENT OF RESEARCH

Research area A1:

Changes in lubricant properties due to alteration also affect chemical interactions with the surfaces. In order to design new lubricants, chemically modified surfaces with optimised performance, and maintenance tools, research is focused on

- impact of lubricant alteration (degradation) on tribosystem performance, e.g. automotive and industrial oils
- identification of degradation mechanisms of lubricants and fuel on molecular and colloidal level

THIS SME INNOVATION GUIDE HAS BEEN DEVELOPED WITHIN THE CENTROPE_TT PROJECT AND WAS FUNDED BY THE CENTRAL EUROPE PROGRAMME (EUROPEAN REGIONAL DEVELOPMENT FUND).

by simulation of application conditions in lab-based devices (artificial alteration) and by use of high-end analytical methods, e.g. mass spectrometry
- design of appropriate environmentally benign chemical structures at a very early stage of R&D
- novel sensor systems for the online oil condition monitoring in stationary machines, e.g. gas engines and oil
- maintenance systems to significantly optimise oil change intervals

Research area A2:
- surface damage effects due to cyclic loading contacts
- abrasion resistant materials and functional surfaces
- corrosion/abrasion of metals
- wear mechanisms in electrical contact systems
- wear mechanisms at high temperature
- design of high temperature materials with wear resistance
- advanced multiphase tribo-functional surfaces
- tribology in forming applications

Research area A3:
- theoretical modelling of wear mechanisms by non-equilibrium thermodynamics
- wavelet based multi range analysis (MRA) for simultaneous detection and characterisation of surface structure and local defects
- ab-inito determination of the optical properties based on layer-resolved permittivities

Research area A4:
Tribological processes, e.g. friction and wear, are multiscale phenomena in their nature, i.e. hierarchical in length and time. Therefore, tribological systems can be realistically modelled/simulated only in a multiscale manner, namely by coupling different computational methods, which are highly accurate in their typical length/time scales. Advanced theoretical/numerical activities will yield novel insights and findings, which in turn will further promote other closely related scientific and technological developments. The area also supports all the computational efforts of the centre by providing adequate theoretical models, numerical algorithms, and software tools. Approaches and methods well-established in the mother disciplines are adopted and extended for the first time to understand important tribological mechanisms. In particular, different techniques which are deemed as appropriate on a specific time/length scale are combined into new schemes to cover all hierarchical aspects of the various processes involved.

MAIN CAPABILITIES

BASIC RESEARCH

Research area A1:
- identification of degradation mechanisms with mass spectroscopy
- novel sensor concepts for online oil condition monitoring
- design of ionic liquids as lubricants

Research area A2:
- high temperature tribology test equipment
- powder transferred arc welding processing for specific material development
- detection of near surface damaging effects

Research area A3:
- new methods for characterisation of fundamental wear and friction mechanisms
- definition and understanding of energy transfer and chemical reactions in surface layers

Research area A4:
- ab-initio prediction of friction and wear processes on functional surfaces
- Non-classical effects in hydrodynamical/mixed lubrication
- Mathematical description of functional surfaces
- Molecular dynamics of nanolayers
- Establishment of a generic theory of wear

APPLICATION-ORIENTED RESEARCH

Research area A1:
- lab-based devices adapted to real application conditions for the artificial alteration (degradation) of lubricants and fuels, e.g., engine oils, turbine oils
- additive-surface interactions in fuel lubricated sliding contacts
- ionic liquids and nano-particles in lubricants for special environments
- stick-slip behaviour of frictional disks in wet clutches

Research area A2:
- tribo-optimised surfaces for different applications
- prediction of tribological effects in switching contacts
- wear processes in forming applications
- development of abrasive and impact wear test equipment

Research area A3
- continuous nanoscopic wear measurement of engine components in tribometer tests and real application
- characterisation of surface failures such as scratches and orange peel effect due to surface finishing
- development and optimisation of materials for electrically loaded sliding systems

Research area A4:
- cavitation in massive and porous journal bearings

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- prediction of physical properties of engineering surfaces
- prediction of the tribological behaviour of synovial fluids (e.g. in artificial hip joints)

FIELDS OF RESEARCH RESULTS APPLICATION

- **Research area A1:** petrochemistry, chemical industry, automotive and transport industry, energy producers
- **Research area A2:** steel and material industry, automotive and electrical industry, mechanical engineering
- **Research area A3:** measuring instruments, all industries with tribological requirements
- **Research area A4:** mechanical engineering, surface engineering, aerospace engineering, sensor technology, life sciences (biomechanics, biophysics)

ALUMNI PROFILE

Our scientific staff, supervised by principal scientists in strong collaboration with our academic partners (e.g. Vienna University of Technology), achieve superior knowledge in all fields of theoretical tribology and specifically in the associated mother disciplines (e.g. solid-state physics, fluid mechanics, structural mechanics, organic and analytical chemistry, mechatronics, electronics) in the course of their activities at AC²T.

NUMBER OF RESEARCH POSITIONS

SENIOR RESEARCH STAFF 20/20

JUNIOR RESEARCH POSITIONS (INCL . PH.D. STUDENTS)
60/70

KEY RESEARCH EQUIPMENT

LIST OF DEVICES

- fully equipped laboratory for lubricant analysis
- lab-based devices adapted to real application conditions for the artificial alteration (degradation) of lubricants and fuels
- clean room laboratory
- highly accurate mass spectrometer coupled with high performance liquid chromatograph (HPLC Orbitrap MS)
- small-spot angle resolved X-ray photoelectron spectrometer (AR-XPS) for the chemical characterisation of thin films (nm)
- triple-quadruple mass spectrometer coupled with gas chromatograph (GC-MS)
- nanoindenter
- high temperature hardness measuring equipment
- Radio Isotope Concentration (RIC) method for nanoscopic wear measurement
- tribometer for simulation of linear oscillating movement
- Leica DCM 3D microscope equipped with confocal and interferometric sensor systems
- high temperature pin-on-disk tribometer
- high-performance-computing cluster
- modelling and simulation software (e.g. COMSOL, SIMULINK, etc.)
- software for chemometrics

BUDGET

TOTAL (MIL. EUR)
12 mil. EUR/year

PART OF THE TOTAL BUD GET FROM PRI VATE RE SOURCE S (%)
40 %

PART OF THE TOTAL BUDGET FROM FOREIGN RESOURCES (%)
21 %

MAIN PROJECTS

- **2003–2015:** Stick-slip behaviour of frictional disks in wet clutches (funded by Austrian K*plus* and COMET program)
- **2006–2015:** Identification of lubricant degradation products (funded by Austrian K*plus* and by COMET program)
- **2006–2010:** Characterisation of wear mechanisms and surface functionalities with regard to life time prediction and quality criteria - from micro to the nano range (EU MRTN-CT-2006-035589 WEMESURF)
- **2010–2015:** Nanoscopic wear particles and their fundamental wear mechanisms (funded by Austrian COMET program)
- **2010–2015:** Multiscale modelling and simulation of friction and wear processes (funded by Austrian COMET program)

ACHIEVEMENTS

EUROPEAN PATENT

- Jech, Martin; Vorlaufer, Georg; Pauschitz, Andreas; Wopelka, Thomas: Method and Measuring Arrangement for Calibrating the Tribometric Determination of Wear by Means of Radioactive Isotopes, AC²T research GmbH, EP 2126543 (A2), Publication date 2009-12-02.

NATIONAL PATENT

- Schneider A., Franek F., Dörr N., Pauschitz A., Lebersorger T.: Verwendung einer ionischen Flüssigkeit, Patentschrift, AT 507.362 A1, AC²T research GmbH, Österr. Patentamt, Wien (A), Anmeldenr. 1435/2008, 2010.
- Agoston A., Jakoby B.: Korrosionssensor, Patentschrift, WO2007/051216 A2, A3, Weltorganisation für geistiges Eigentum, Wien (A), PCT/AT2006/000446, 30.10.2006, 2006.

***NATIONAL AWARDS**

- Innovation award Country of Niederösterreich 2008
- Innovation award Country of Niederösterreich 2009
- Dr. Erwin Pröll future award „Milestone 2010“, category „Innovation“

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- Kirchgassner M., Badisch E., Franek F.: Behaviour of iron-based hardfacing alloys under abrasion and impact, Wear, Vol 265, Elsevier B.V., Oxford (UK), doi 10.1016/j.wear.2008.01.004 , p 772-779, 2008.
- Eder S., Vernes A., Vorlaufer G., Betz G.: Molecular dynamics simulations of mixed lubrication with smooth particle post-processing, Journal of Physics: Condensed Matter, Vol. 23, IOP Science, Bristol (UK), doi: 10.1088/0953-8984/23/17/175004, 2011.
- Ilincic S. , Tungkunagorn N., Vernes A.,Vorlaufer G. , Fotiu P. A., Franek F. : FEM-BEM contact mechanics on rough, artificial hip joints, J. Engineering Tribology: Proc. IMechE, Vol. 225, Part J,SAGE (UK), doi: 10.1177/1350650111406776, 2011

MAIN COLLABORATING PARTNERS

COLLABORATION WITH ACADEMIC SELECTED PARTNERS

- Donau-Universität Krems (Krems, Austria)
- Hochschule Mannheim (Mannheim, Germany)
- Johannes Kepler Universität Linz (Linz, Austria)
- Luleå University of Technology (Lulea, Sweden)
- Metal Polymer Research Institute, National Academy of Sciences of Belarus (Gomel, Belarus)
- Tallinn University of Technology (Tallinn, Estonia)
- University of Saarland (Saarbrücken, Germany)
- University of Ljubljana (Ljubljana, Slovenia)
- University of Pisa (Pisa, Italy)
- Vienna University of Technology (Wien, Austria)

COLLABORATION WITH COMPANIES

Selected companies (of more than 100):

- AVL List GmbH (Graz, Austria)
- Berndorf Band GmbH (Berndorf, Austria)
- BMW Motoren GmbH (Steyr, Austria)
- Borealis Agrolinz Melamine GmbH (Linz, Austria)
- buntmetall amstetten Ges.m.b.H. (Enzesfeld, Austria)
- Busatis GmbH (Purgstall, Austria)
- Castolin Österreich GmbH (Wien, Austria)
- Collini Wien GmbH (Wien, Austria)
- Doppelmayr Seilbahnen GmbH (Wolfurt, Austria)
- ebm-papst St. Georgen GmbH & Co KG (St. Georgen/Schwarzwald, Germany)
- Evonik RohMax Additives GmbH (Darmstadt, Germany)
- GKN Sinter Metals AG (Bruneck, Italy)
- High Tech Coatings GmbH (Vorchdorf, Austria)
- Hoffmann Elektrokohle AG (Bad Goisern, Austria)
- Jabil Circuit Austria GmbH (Wien, Austria)
- Klüber Lubrication München KG (München, Germany)
- Knorr-Bremse GmbH (Mödling, Austria)
- Leobersdorfer Maschinenfabrik GmbH & Co KG (Leobersdorf, Austria)
- Liebherr Machines Bulle SA (Buille, Switzerland)
- LMT Fette Werkzeugtechnik GmbH & Co. KG (Schwarzenbek, Germany)
- Magna Powertrain AG&Co KG (Lannach, Austria)
- Magna Presstec AG (Weiz, Austria)
- Messer Group GmbH (Krefeld, Germany)
- OMV Exploration & Production GmbH (Wien, Austria)
- OMV Refining & Marketing GmbH (Wien, Austria)
- Pronic s.a. (Marignier Cedex, France)
- Robert Bosch GmbH (Gerlingen, Germany)
- Sandvik Mining and Construction G.m.b.H. (Zeltweg, Austria)
- Schoeller Bleckmann Oilfield Technology GesmbH (Ternitz, Austria)
- Shell Global Solutions Deutschland GmbH (Hamburg, Germany)
- SKF Österreich AG (Steyr, Austria)
- TeroLab Surface GmbH (Wien, Austria)
- Tyco Electronics Austria GmbH (Waidhofen/Thaya, Austria)
- VAT Vakuumventile AG (Haag, Switzerland)
- Vautid Austria GmbH (Marchtrenk, Austria)
- voestalpine Schiene GmbH (Leobendorf, Austria)
- voestalpine Stahl GmbH (Linz, Austria)
- voestalpine Tubulars GmbH & CoKG (Kindberg, Austria)

EXPECTATIONS

OFFERS

- partnership in international projects in the interdisciplinary field of Tribology

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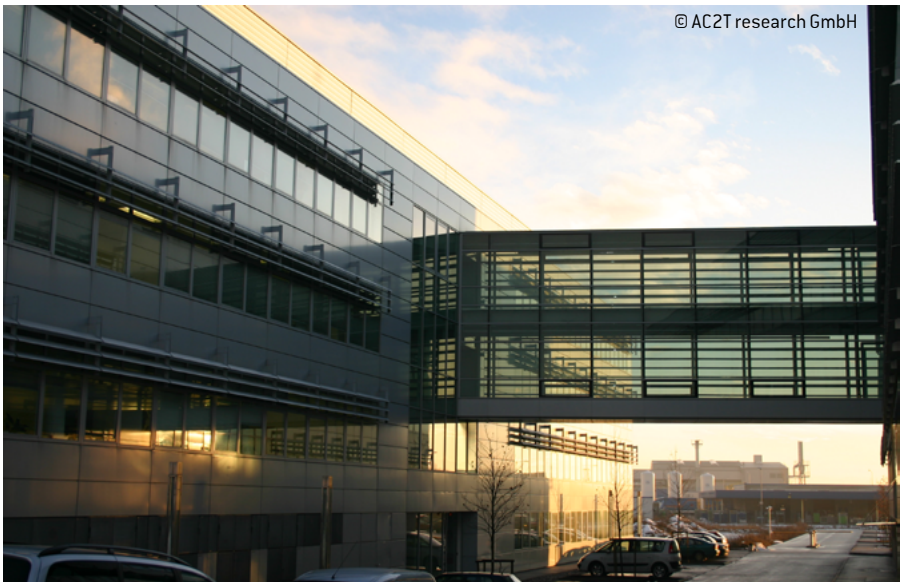
- automotive components and lubrication – characterisation and optimisation of wearing engine parts
- lubricant formulations with enhanced life-time, e.g. in engines driven by fuels with bio-components
- development of online oil sensor systems
- implementation of ionic liquids and nano-particles in lubricated systems
- development and application of novel sensor principles in the field of acoustic emission and/or wear particle analysis for wear characterisation
- electrically loaded sliding contacts
- friction reduction in human joints
- establishing engineering software tools for the effective solution of tribological problems in the broadest sense (machinery design, bearing technology)

and others

REQUIREMENTS

- generally, all partners dealing with wearing parts under harsh environments
- partners for research projects in the field of forming applications, steel production, raw materials supplier, waste incinerator
- partners for research projects in the field of tribological behaviour of engine-, bearing-, and gear components
- collaboration with industrial partners in the field of wear characterisation by acoustic emission and wear particle analysis
- pharmaceutical industry – production of friction modifiers and inflammatory inhibitors for human joints
- partners working in material production and surface finishing for low friction or low wear machine parts
- lubricant or fuel suppliers interested in the impact of their product on friction and wear performance of a tribosystem
- partners for European research project in tribology
- collaboration with industrial partners in common projects dedicated to applied science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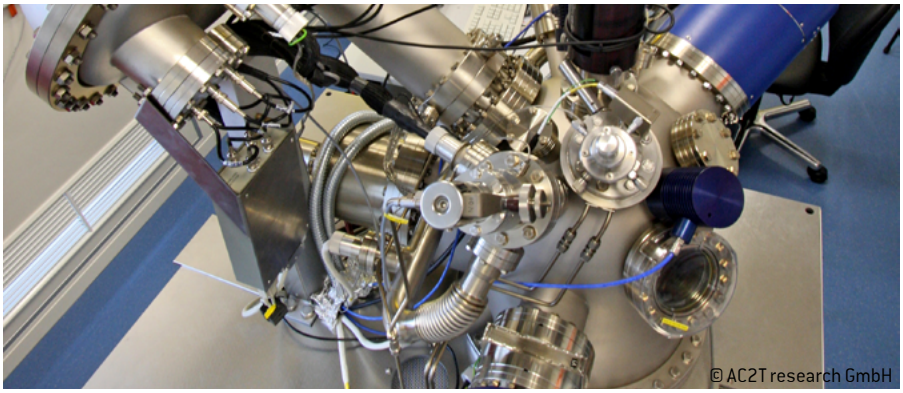
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BRNO UNIVERSITY OF TECHNOLOGY

ADVANCED NANOTECHNOLOGIES AND MICROTECHNOLOGIES

CEITEC central european institute of technology BRNO | CZECH REPUBLIC

/ CENTRAL EUROPEAN INSTITUTE OF TECHNOLOGY OF BRNO UNIVERSITY OF TECHNOLOGY / BRNO UNIVERSITY OF TECHNOLOGY

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THEMATIC RESEARCH FOCUS

RESEARCH AREA

Nanotechnologies and nanoscience covering materials and functional structures suitable for nanoelectronics and nanophotonics, generally. The research consider semiconductor nanostructures, metallic and magnetic nanostructures, nanotubes and nanowires, supramolecular structures and novel nanoelectronic circuits.

EXCELLENCE

- Preparation and analysis of nanostructures for applications in nanotechnology and biosensors
- Deposition of magnetic and nonmagnetic thin films
- Development of analytical and measurements method

MISSION

- Creation of a centre of excellence in the field of nano and microtechnology

DEVELOPED TECHNOLOGIES

CONTENT OF RESEARCH

- Fabrication of nanostructures by "bottom-up" methods
- Fabrication of nanostructures by "top-down" methods (nanolithography)
- Investigation of the functional properties of nanostructures
- The development of submicron devices and nanostructures
- The development of analytical and measurement methods

MAIN CAPABILITIES

- Acquiring the methods for the fabrication of a wide range of metallic, semiconducting and dielectric structures, including their functional combinations
- Understanding the basic principles of nanostructures, discovering their specific properties and finding their correlation with geometrical/ structural parameters of nanostructures and operational parameters
- Design and realization of final products as advanced materials, nanostructures, nanodevices and systems with applications in electronics, photonics, (bio)sensing, etc.
- The development of the techniques and methods for microscopy, analysis and metrology of nanomaterials and nanostructures. The newly developed, or at least extended or upgraded methods will be, as a rule, offered to manufacturers, including domestic ones. Some parts of the research will be performed as contractual or collaborative research with manufacturers
- New diagnostic and therapeutic applications
- The development of novel small molecules. Understanding molecular mechanisms involved in RNA surveillance and gene regulation mechanisms that occur at the RNA level

FIELDS OF RESEARCH RESULTS APPLICATION

- Nanotechnology
- Nanostructure properties
- Magnetism
- Spintronics
- Plasmonics
- Coatings, sensors

NUMBER OF RESEARCH POSITIONS

SENIOR RESEARCH STAFF
44

JUNIOR RESEARCH POSITIONS (INCL. PH.D. STUDENTS)
116

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KEY RESEARCH EQUIPMENT

LIST OF DEVICES

Nanofabrication (Core Facility)
- E-Beam Lithography, Photolithography
- Chemical and Thermal Processing
- Deposition
- Etching
- Packaging and Testing
- Design and Simulation

Nanocharacterisation (Core Facility)
- Electrical and Magnetical Measurements
- X-ray Analysis
- Microscopy/Analysis
- Nanolithography and Nanomanipulation
- Optical Characterization
- Fabrication and in situ Characterisation I - II
- Experimental PECVD

Other Technology Units
- Confocal Microscopy
- Metrology
- NMR and Mass Spectrometry
- Micromechanical/Morphology Testing
- Tomography
- Molecular Chemistry and Bioelectrochemistry
- Electrical and Thermal Properties of Nanomaterials

BUDGET

TOTAL (MIL. CZK/ MIL. EUR)
65 / 2.6

PART OF THE TOTAL BUDGET FROM PRIVATE RESOURCES (%)
5

PART OF THE TOTAL BUDGET FROM FOREIGN RESOURCES (%)
10

MAIN PROJECTS

2007-2011: Functional hybrid nanosystems of semiconductors and metals with organic materials (FUNS) (project KAN400100701 financed by the programme Nanotechnologies for Society, Academy of Sciences of the Czech Republic)
2006-2011: Structures for Nanophotonics and Nanoelectronics (project LC06040 financed by the Ministry of Education, Youth and Sports)
2008-2010: Multifunctional Nanomaterials Characterisation Exploiting Elipsometry and Polarimetry (project 218570 financed by the 7th Specific RTD Programme - Cooperation)

MAIN COLLABORATING PARTNERS

COLLABORATION WITH ACADEMIC PARTNERS
- Institut für Angewandte Physik, Vienna University of Technology (Vienna, AT)
- Elettra Synchrotron Light Laboratory (Trieste, IT)
- Max-Planck-Institut für Eisenforschung (Düsseldorf, DE)
- University of Cologne (Cologne, DE)
- Technische Universität Wien (Vienna, AT)
- Geballe Laboratory of Advanced Materials, Stanford University (Stanford, US)
- Imperial College London, United Kingdom of Great Britain and Northern Ireland (London, GB)
- University of Fribourg, (Fribourg, CH)
- Max Planck Institute for Solid State Research (Stuttgart, DE)
- Institute of Physics, Academy of Sciences of the Czech Republic (Prague, CZ)
- Department of Macromolecular Physics, Faculty of Mathematics and Physics, Charles University in Prague (Prague, CZ)
- Centre for Nanomaterials Research, Faculty of Science, Palacky University Olomouc (Olomouc, CZ)

COLLABORATION WITH COMPANIES
- FEI Czech Republic (Brno, CZ)
- ON Semiconductor Czech Republic (Brno, CZ)
- Tescan (Brno, CZ)
- Vakuum Praha (Prague, CZ)
- DIGITAL PRO (Prague, CZ)
- BVT Technologies (Brno, CZ)

EXPECTATIONS

REQUIREMENTS
- Partners for FP7 research project in the field of nanotechnology
- Company contribution in basic research and PhD. work
- Partners for utilization of nanotechnology research outputs

OFFERS
- Expertise in nanotechnology
- Surface analysis
- Preparation and analysis of nanostructures
- Equipment utilization

04 / 2011

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BRITTLE FRACTURE GROUP

/ DEPARTMENT OF MECHANICAL PROPERTIES / INSTITUTE OF PHYSICS OF MATERIALS
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THEMATIC RESEARCH FOCUS

RESEARCH AREA

Experimental fracture mechanics and fracture of steels, ceramics, intermetallics and composites excellence Wider world-top, 3 researchers (from 6) are in the best 25 % of this field in the world

MISSION

To maintain our current position in world science and progress further to be considered among the best

DEVELOPED TECHNOLOGIES

CONTENT OF RESEARCH

- Research on initiation and fracture micromechanisms in advanced metallic materials, influence of microstructure and selected production parameters
- Investigation of the principles of experimental fracture mechanics, development of new test approaches enabling better understanding of deformation and fracture of (heterogeneous, composite) materials
- Fracture behaviour of new advanced materials (ceramic matrix composites reinforced e.g. by ceramic fibres, particles, silicon carbide nanoparticles, carbon nanotubes etc.)
- Experimental research focused on and failure analyses connected with practical and/or industrial problems including participation in Euroatom materials development and evaluation activities

MAIN CAPABILITIES

The brittle fracture group is able successfully deal with / contribute to solving the material problems generated by industrial practice, but 90 % of the team activity is focused on basic research.
The following topics may be solved in collaboration with industrial partners – development centres:
Fracture behaviour/resistance of steel - the verification and modification of knowledge for transferability of laboratory data to real components.
There are good results in the field of fracture resistance prediction (for steels) applicable for commercial use which we can complete in the case of a real offer and/or support from industry.
Based on fracture toughness evaluation of about 10 different types of ceramic matrix composites, further investigation in this field including possible application of knowledge is possible. Assistance in evaluation/ quantification of ceramics and ceramic matrix composites degradation is also possible.
The knowledge obtained with TiAl intermetallics enables effective assistance in the further development of these materials; recently an attempt was made to modify microstructure through mechanicalthermal treatment of this intermetallic alloy (in collaboration with Yokohama University).

FIELDS OF RESEARCH RESULTS APPLICATION

Basic Research:

- Transferability of fracture mechanical data for steels
- Evaluation and explanation of fracture behaviour of ceramic matrix composites
- Explanation and knowledge systemisation on low temperature fracture of titanium aluminides
-

Applied research:

- Biomedicine / prosthetics (biocompatible highly porous glass for tissue engineering – collaboration with Imperial College London)
- Aerospace industry (glass for extreme conditions: glass ceramics reinforced by fibres, transparent armour)
- Fracture resistance of containers for spent nuclear fuel (NATO project coordinated by the group leader)
- Railway crossing points – bainitic steel and fracture resistance evaluation (DT – Vyhýbkárna a strojírna, Prostejov)

NUMBER OF RESEARCH POSITIONS

SENIOR RE SEARCH STAFF
5

JUNIOR RESEARCH POSITIONS (INCL . PH.D. STUDENTS):
6

THIS SME INNOVATION GUIDE HAS BEEN DEVELOPED WITHIN THE CENTROPE_TT PROJECT AND WAS FUNDED BY THE CENTRAL EUROPE PROGRAMME (EUROPEAN REGIONAL DEVELOPMENT FUND).

KEY RESEARCH EQUIPMENT

LIST OF DEVICES

- 3 Screw driven testing machine (ZWICK, Instron) for loadings up to 200 kN, temperatures from -198 to +1200 °C, fixtures for tensile, three/ four point bend test, compact tension, compression etc. for steels, ceramics, intermetallics and their composites, selection of different extensometers and strain gauges
- 1 hydraulic test machine for loading rates up 6 m/s
- 3 instrumented impact pendulums with different impact energy and devices for testing different materials
- Instrumented indentation tester (including ball indentation test)
- MTS microtester for loadings from mN to 200 N
- Measuring work-station, universal test and evaluation software, both commercial and developed by laboratory
- Image analysis and digital image correlation techniques for local deformation determinations
- Confocal microscope with built-in atomic force microscope

BUDGET

TOTAL (MIL. CZK/ MIL. EUR)

7 / 0.28

PART OF THE TOTAL BUDGET FROM PRIVATE RESOURCES (%)

5

PART OF THE TOTAL BUDGET FROM FOREIGN RESOURCES (%)

10

MAIN PROJECTS

2010–2012: Fracture behaviour prediction based on quantification of local material response (Czech Science Foundation, GAP108/10/0466)
2010–2012: Microstructural design of high toughness materials (Czech Science Foundation, GAP107/10/0361)
2009–2012: Mechanical and fracture properties of multilayered ceramic/ceramic and ceramic/metal materials with graded layers (Czech Science Foundation, GA101/09/1821)
2009–2011: Development of new matrix types based on pyrolysed resins for composites reinforced with ceramic fibres (Czech Science Foundation, GA106/09/1101)
2008: Study of the micromechanisms of cleavage fracture of 14% Cr ODS ferritic steels (Euratom EFDA project)
2011-2014: GlaCERCo: Glass and Ceramic Composites for High Technology Applications – Initial Training Network (project 264526 financed by the 7FP EU)

MAIN COLLABORATING PARTNERS

COLLABORATION WITH ACADEMIC PARTNERS

- Faculty of Mechanical Engineering, Brno University of Technology (NETME Centre, Brno, CZ)
- Faculty of Chemistry, Brno University of Technology (Brno, CZ)
- University of Mining - Technical University (Ostrava, CZ)
- Faculty of Mechanical Engineering, Czech Technical University (Prague, CZ)
- University of Metz (FR)
- University of Miscolc (HU)
- Imperial College London (GB)
- University of Erlangen (DE)
- Institute of Inorganic Chemistry, Slovak Academy of research (SK)

COLLABORATION WITH COMPANIES

- Schottglass Meinz (DE)
- Siemens (Brno, CZ, DE)
- DT – Výhybkárna a strojírna (Prostějov, CZ)
- KMM Vin (Virtual European Institute)
- EURATOM (EFDA, F4E)

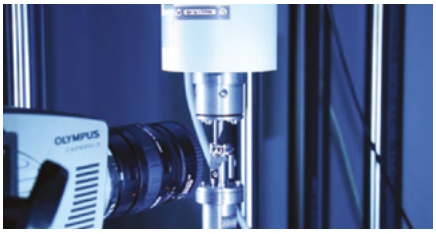
EXPECTATIONS

REQUIREMENTS

We are looking for collaboration with academic and industrial partners (Czech and foreign too) in the field of advanced materials including ceramic matrix composites.

OFFERS

- High quality research work in the field of materials fracture linked to advanced materials development and/or operational degradation analyses. Research of basic and applied type. We can mainly offer service for development centres and specialized firms
- Contacts to other laboratories (including laboratories joined in KMMVIN Virtual European Institute
- Excellent conditions for training through research of PhD students and young scientist



04 / 2011

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CEST CENTRE OF ELECTROCHEMICAL SURFACE TECHNOLOGY

RESEARCH GROUP CONTACT

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THEMATIC RESEARCH FOCUS

RESEARCH AREA
- Electrodeposition and dissolution
- Corrosion research
- Modelling and simulation
- Surface Analytics

EXCELLENCE
- Replacement of Cr(VI)
- Advanced functional layers
- Non-aqueous electrolytes
- Development of in-situ methods

MISSION
The CEST Competence Centre for Electrochemical Surface Technology researches with its partners from academia and industry for the benefit of production companies.

It is the goal of all concerned to transfer research and development success into innovative commercial products and processes. During the Comet K1 programme, CEST GmbH is to establish itself as a top institute for electrochemical surface technology within Europe.

The research work is done in close cooperation with domestic and foreign universities, primarily to ensure a high scientific quality and to utilise the know-how of the scientists there.

DEVELOPED TECHNOLOGIES

CONTENT OF RESEARCH
- Development of deposition processes of hard Cr for wear resistant surfaces from electroplating bath basing on Cr(III)
- Alternative technology for the corrosion protection of steel and light alloys using Cr-free conversion treatment
- Development of non-Cr electrodeposits for corrosion protection
- Direct electrodeposition of alloys with defined composition and structure
- Electrodeposition of metallic layers with embedded particles
- Structured layers
- Sparc anodisation of light metals

MAIN CAPABILITIES

Basic research
- Development of new in-situ electrochemical methods
- Electrochemical Surface Technology in non-aqueous electrolytes

Application research
- advanced functional layers
- replacement of Cr(VI) in surface technology
- corrosion research

FIELDS OF RESEARCH RESULTS APPLICATION
- Electronics industry
- Steel industry
- Material science
- Life-sciences
- Measuring instruments
- Renewable energy
- Glass, ceramics
- Air and Space Industry

ALUMNI PROFILE
Our graduates are fluent in using a wide range of experimental devices in classic electrochemical methods as well as spectroscopic or surface analytic methods (such as REM, XRD, FIB, FTIR) In addition, theoretical knowledge of the natural laws governing modern processes for the treatment of surfaces or the development of in-situ methods is also part of the skills acquired by our graduates in the course of their Ph.D. studies.

NUMBER OF RESEARCH POSITIONS

SENIOR RESEARCH STAFF
17/54

JUNIOR RESEARCH POSITIONS (INCL . PH.D. STUDENTS)
25/54

THIS SME INNOVATION GUIDE HAS BEEN DEVELOPED WITHIN THE CENTROPE_TT PROJECT AND WAS FUNDED BY THE CENTRAL EUROPE PROGRAMME (EUROPEAN REGIONAL DEVELOPMENT FUND).

KEY RESEARCH EQUIPMENT

LIST OF DEVICES

- Atomic Force Microscope (AFM)
- Potentiostats-Rotating Cylinder Electrode
- Rotating Ring/Disk Electrode
- Function Generator and Oscilloscope
- Polarography, Metrohm 797 VA Computrace
- Focused Ion Beam Quanta (FIB)
- Galvanic Unit
- GDOES
- High Temperature Cell
- Infrared Spectroscopy
- Ion Chromatography
- Contact Angle Measurement
- Raman Spectroscopy
- Scanning Electron Microscope (SEM)
- X-Ray Diffraction (XRD)
- TOC Determination-Zeta Potential

ACHIEVEMENTS

PATENTS

- Verfahren zur Herstellung strukturierter Chromschichten, patent AT 507785 by Vienna University of Technology; inventors: H. Kronberger, G. Wolf, W. Polydoros, M. Schubert (2010)
- Layer Coatings of Polyaniline and Polyaniline Derivatives on Zinc Surfaces, WO 2010/010134 (granted at AT national stage) by voestalpine Stahl GmbH, Vienna University of Technology, ECHEM GmbH, Henkel AG & Co. KGaA, A. Laskos, G. Fafilek, M. Fleischanderl, J. Sander (2010)
- Verfahren zur Abscheidung von Hartchrom aus Cr(VI)- freien Elektrolyten, AT A1817/2010, by CEST GmbH and Vienna University of Technology; inventors: H.Kronberger, G. Wolf (2010)

Scientific results of the team members are regularly published in high profile scientific journals

- Y. Andriyko, A. Andriiko, O. Babushkina, G. E. Nauer „Electrochemistry of TiF4 in 1-Butyl-2, 3-dimethylimidazolium Tetrafluoroborate“ Electrochimica Acta Volume 55, Issue 3, (2010) Pages 1081-1089 “
- P. Raffelstetter, B. Mollay „On the Modeling of Shape Evolution in Through-Mask Electrochemical Micromachining of Complex Patterned Substrates“ Electrochimica Acta 55 (2010) 2149–2157
- Tz. Boiadjieva, M. Monev, H. Kronberger, A. Tomandl, K. Petrov, and P. Angerer „Effect of PEG 400 on Zn-Cr alloy electrodeposition“ Journal of The Electrochemical Society 157 (3) (2010) D159-D167
- N. Nasir,N. Melnychenko-Koblyuk,A. Grytsiv,P. Rogl,G. Giester,J. Wosik, G. E.Nauer „Ternary systems Sr–{Ni,Cu}–Si: Phase equilibria and crystal structure of ternary phases“ Journal of Solid State Chemistry 183 (3) (2010) 565-574 doi:10.1016/j.jssc.2009.12.023
- A. H. Whitehead, M. Pölzler, B. Gollas „Zinc Electrodeposition from a Deep Eutectic System Containing Choline Chloride and Ethylene Glycol“ Journal of The Electrochemical Society, 157 (6) (2010) D328-D334
- N. Godja, N. Kiss, Ch. Löcker, A. Schindel, A. Gavrilovic, J. Wosik, R. Mann, J. Wendrinsky, A. Merstallinger, G.E Nauer „Preparation and Characterisation of Spark-anodized Al-alloys: Physical, Chemical and Tribological Properties“ Tribology International 43 (7) (2010) 1253 - 1261, doi: 10.1016/j.triboint.2010.01.007
- M. Pölzler, A.H. Whitehead, B. Gollas „A Study of Zinc Electrodeposition From Zinc Chloride: Choline Chloride: Ethylene Glycol“ ECS Transactions, 25 (39) 43-55 (2010)
- L. D. Rafailovič, D. M. Minič, H. P. Karnthaler, J. Wosik, T. Trišovič, and G. E. Nauer „Study of the Dendritic Growth of Ni-Co Alloys Electrodeposited on Cu Substrates“ Journal of The Electrochemical Society, 157 (5) (2010) D295-D301
- Franz Weitzer, Masaaki Naka, Nataliya Krendelsberger, Frank Stein, Cuiyun He, Yong Du, Julius C. Schuster „The Ternary System Nickel/Silicon/Titanium Revisited“ Z. Anorg. Allg. Chem. 2010, 636, 982–990
- H. VanParys, G.Telias, V.Nedashkivskyi, B.Mollay, I.Vandendael, S. VanDamme, J.Deconinck, A.Hubin „On the modeling of electrochemical systems with simultaneous gas evolution. Case study: The zinc deposition mechanism“ Electrochimica Acta 55 (2010) 5709–5718
- A. Gavrilovič, D. Minič, L.D. Rafailovič, P. Angerer, J. Wosik, A. Maričič, D.M. Minič „Phase transformations in Fe73.5Cu1Nb3Si15.5B7 amorphous alloy upon thermal treatment“ Journal of Alloys and Compounds 504 (2010) 462-467
- S. Ilo, Ch.Just, E.Badisch, J.Wosik, H.Danninger „Effects of interface formation kinetics on the microstructural properties of wear-resistant metal–matrixcomposites“ Materials Science and Engineering A in press
- A. Stadler, J. Brenner, A. Schindel, A. Pauschitz, F. Franek, Z. Keszthelyi, M.Hofer, J. Wosik „Effects of phosphorus on friction behaviour in wet clutch systems: a comparison of various coatings“ Proc. IMechE Vol. 224 Part J. Engineering Tribology
- R. Wiesinger, M. Schreiner, Ch. Kleber „Investigations of the interactions of CO2, O3 and UV light with silver surfaces by in situ IRRAS/QCM and ex situ TOF-SIMS“ Applied Surface Science 256

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(2010) 2735–2741
- R. Wiesinger, Ch. Kleber, M. Schreiner „Surface and interface analytics as a tool in atmospheric corrosion research“ Global Journal of Physical Chemistry Volume 1, Issue 1, August 2010, pp. 59-78
- G. Wolf, E. Halwax, H. Kronberger „Effect of current density and temperature on the morphology of electrodeposited chromium“ Metal Finishing, Volume 108, Issue 1, January 2010, Pages 19-27
- N. Rybakova, O. Babushkina, W. Artner, and G. E. Nauer „Electrochemical Synthesis of TiB2 Layers Out of FLiNaKElectrolyte in the Presence of TaCl5 Additive“ Journal of The Electrochemical Society, 157 11 1 2010
- A. Habib, N. Stelzer, P. Angerer, R. Haubner „Effect of temperature and time on the solvothermal synthesis of tetragonal BaTiO3“ Bulletin of material Science
- E. Neubauer, M. Kitzmantel, M. Hulman, P. Angerer „Potential and challenges of metal-matrix-composites reinforced with carbon nanofibers and carbon nanotubes“ Composites Science and Technology 70 (2010) 2228–2236
- A. Gavrilovič, L.D. Rafailovič, J. Wosik, P. Angerer, D. Minič „Influence of thermal treatment on structure development and mechanical properties of amorphous Fe73.5Cu1Nb3Si15.5B7 ribbon“ Journal of Alloys and Compounds in press
- B. Dittert, A. Gavrilovič, S. Schwarz, P. Angerer, H. Steiner, and R. Schöftner Phase Content Controlled TiO2 Nanoparticles Using The MicroJetReactor Technology Journal of the European Ceramic Society in press

MAIN COLLABORATING PARTNERS

COLLABORATIONS WITH ACADEMIC PARTNERS

- AC^{2}T research GmbH
- AIT Austrian Institute of Technology
- Austrian Academy of Sciences
- Bulgarian Academy of Sciences
- Fraunhofer Institut Manufacturing Engineering and Automation
- Graz University of Techology
- Hungarian Academy of Sciences
- IMA Integrated Microsystems Austria GmbH
- Innovent e.V.
- Institut National Polytechnique de Grenoble
- Laboratory on Mechanics of Strenght and Fracture of Materials and Structures
- National Technical University of Ukraine “Kyiv Polytechnical Institute
- Norwegian University of Science and Technology
- Profactor GmbH
- Russian Academy of Science
- The Russian Academy of Sciences
- The University of Nottingham
- Ukrainian Academy of Sciences
- University of Bern
- University of Innsbruck
- University of Paderborn
- Universitatea “Politehnica” DIN Timisoara
- University of Southampton
- University of Vienna
- Vienna University of Technology

COLLABORATIONS WITH COMPANIES

- Andritz AG
- AkzoNobel
- Atotech Deutschland GmbH
- Austro Engine GmbH
- Banner GmbH
- BASF SE
- Berndorf Band GmbH
- Cardec GmbH
- Collini Holding AG
- Doka Industries
- EADS Deutschland GmbH
- EPG AG
- Fronius International GmbH
- GEWA Wärmetechnische Anlagen GmbH
- Glanzstoff Austria GmbH
- Hauser GmbH
- Henkel AG & Co KGaA
- Infineon Technologies Austria AG
- INGENIA GmbH
- J. Christof Gesellschaft m.b.H.
- Magna Steyr Fahrzeugtechnik AG & Co KG
- Maschinenfabrik KBA-Mödling AG
- Mondi Uncoated Fine & Kraft Paper GmbH
- OKA-TECH GmbH
- Sagemcom Austria GmbH
- Schleifring und Apparatebau GmbH
- Schloetter GmbH
- Umicore Galvanotechnik GmbH
- Verzinkerei Herzlake GmbH & Co. KG
- voestalpine Stahl GmbH
- Welser Profile

EXPECTATIONS

OFFERS

The CEST Competence Centre concentrates on electrochemical surface technology, corrosion research and surface characterisation. The results of our research will enable us to

- Develop novel layer systems and metal layers (e.g. nanocrystalline metal layers)
- Lower the cost of producing functional layers and make their creation more environmentally friendly

Our researchers have expertise in the fields of electrochemistry, surface analysis, physical and theoretical chemistry resulting in multidisciplinary knowledge in the areas of corrosion, electrochemical plating and structuring.

CEST has a large range of scientific instruments with which to perform research and analysis. Among them are a well equipped metallographic laboratory with two scanning electron microscopes, GDOES, AFM, XRD, contact angle measurement, IR- and Raman

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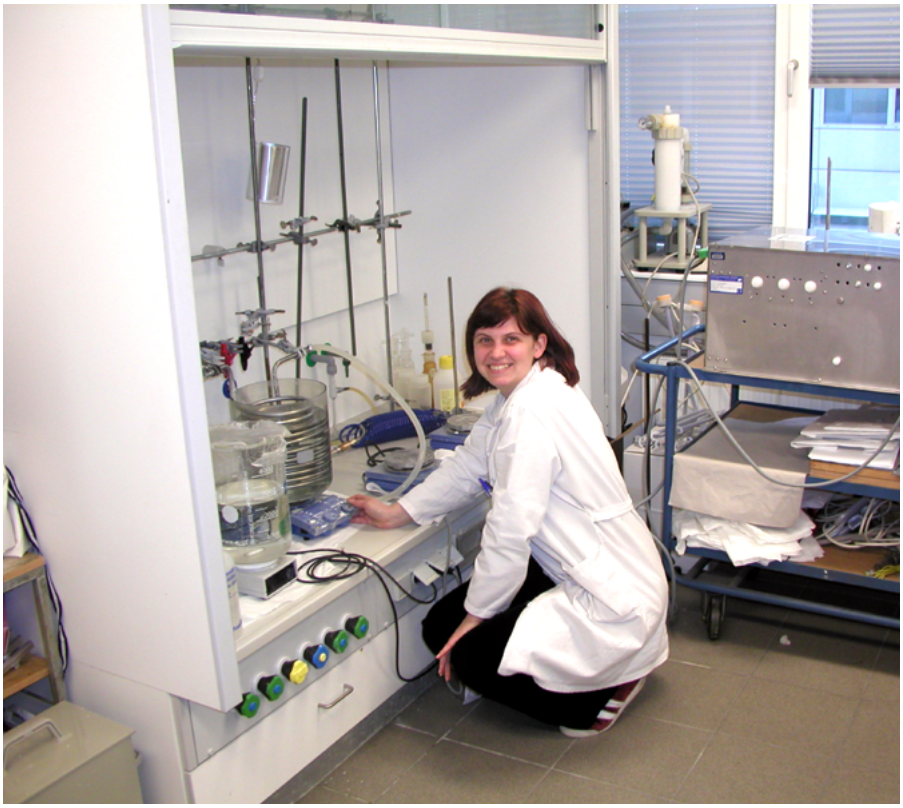
spectroscopy for surface characterisation and several electrochemical instruments (potentiostats and galvanostats, rotating ring-disc-electrodes, impedance measurement workstations). In addition to this we have a pilot-scale galvanic plant.

The CEST Competence Centre offers the following services:

- Research, development and analysis
- Optimisation of processes and production
- Feasibility studies
- Development of instruments
- Projects



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DEPARTMENT OF PHYSICAL ELECTRONICS

/ FACULTY OF SCIENCE / MASARYK UNIVERSITY / KOTLÁŘSKÁ 2, 611 37 BRNO

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THEMATIC RESEARCH FOCUS

RESEARCH AREA
- Plasma Physics

EXCELLENCE
- Low temperature plasma physics

MISSION
- To be a leading Central-Europe educational and research institution raising high-quality professionals, and generating research results attractive for companies

DEVELOPED TECHNOLOGIES

CONTENT OF RESEARCH
- Research of low-temperature plasma and ionized gases
- Applications in technologies of polymer processing and thin layers (e.g. coatings of metals)
- Plasma Enhanced Chemical Vapour Deposition
- Plasma diagnostics, simulation

MAIN CAPABILITIES
- New methods for measuring the surface energy
- „Plasma Pencil" (a method of application for low-temperature plasma manufacturing technology) - USA patent
- Technology of coplanar surface discharges (a common European patent Pegas Nonwovens - a world first in that technology into practice)

Centre for Low-Cost Plasma and Nanotechnology Surface Treatment
- Research and development of new methods for plasma surface treatment for textile, glass, automotive and other traditional industries and for manufacturing of high-tech products such as solar panels and battery separators

FIELDS OF RESEARCH RESULTS APPLICATION

Basic research
- Nanotechnology

Applied research
- Plastics and chemical industry
- Electronic industry
- Construction-civil engineering
- Paper industry
- Wood industry
- Textile industry
- Chemical industry
- Automotive industry
- Air pollution treatment
- Waste treatment
- Water waste treatment
- Energy - Exploration/Production
- Materials: Iron and Steel; Plastics, Polymers; Glass, ceramics; Non ferrous materials; Building materials
- Medical Treatment
- Forestry and Wood

NUMBER OF RESEARCH POSITIONS

SENIOR RESEARCH STAFF
8

JUNIOR RESEARCH POSITIONS (INCL. PH.D. STUDENTS)
19

KEY RESEARCH EQUIPMENT

LIST OF DEVICES
- UVISEL Yobin-Ivon Ellipsometer
- Microhardness meter Fischerscope H100
- CCD spectrometers Yobin-Ivon
- FTIR spectrometer
- rf and mw generators

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BUDGET

TOTAL (MIL. CZK/ MIL. EUR)
42 / 1.68

PART OF THE TOTAL BUDGET FROM PRIVATE RESOURCES (%)
0

PART OF THE TOTAL BUDGET FROM FOREIGN RESOURCES (%)
0

MAIN PROJECTS

2008-2011: In-line plasma-treatments and surface nano-treatments of nonwoven fabrics (project 2A-3TP1/126 financed by the Ministry of Industry and Trade)
2007-2011: Deposition of thermomechanically stable nanostructured diamond-like thin films in dual frequency capacitive discharges (project GA202/07/1669 financed by the Czech Science Foundation)
2005-2011: Study and application of plasma chemical reactions in nonisothermic low temperature plasma and its interaction with solid surface (intitutional research plan MSM0021622411 financed by the Ministry of Education, Youth and Sports)

ACHIEVEMENTS

Patents:
- M. Černák: An apparatus and method for improving felting properties of animal fibres by plasma treatment. Patent PCT/CZ2009/000123
- M. Černák: Method and apparatus for treatment of textile materials EP 1 387 90

MAIN COLLABORATING PARTNERS

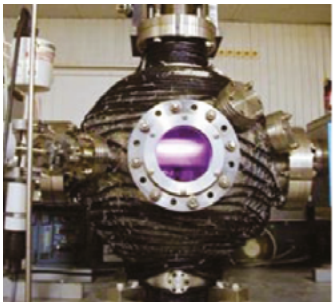
COLLABORATION WITH ACADEMIC PARTNERS
- Institute of Plasma Physics, Academy of Sciences of the Czech Republic (Prague, CZ)
- Institute of Physics of Materials, Academy of Sciences of the Czech Republic (Brno, CZ)
- Institute of Physical Chemistry, Academy of Sciences of the Czech Republic (Prague, CZ)
- Institute of Physics, Academy of Sciences of the Czech Republic (Prague, CZ)
- Faculty of Mathematics and Physics, Charles University (Prague, CZ)
- University of Greifswald (Greifswald, DE)
- Technical University (Munich, DE)
- Faculty of Chemistry, Technical University Brno (Brno, CZ)

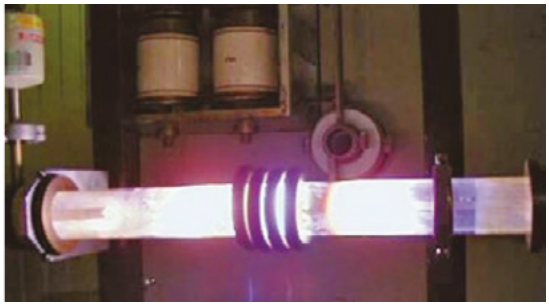
COLLABORATION WITH COMPANIES
- SHM (Šumperk, CZ)
- Pegas Nonwovens (Znojmo, CZ)
- Preciosa (Nový Jíčín, CZ)
- Tonak (Nový Jíčín, CZ)

EXPECTATIONS

REQUIREMENTS
- Cooperation with companies – based on a clear definition of the problem to be solved (e.g. surface treatment, thin film deposition, coptical and mechanical analysis of thin films)
- „Match-Making" - connecting the solution of a business requirement with the implementation of quality research and publishing highquality results

OFFERS
- Low-cost in-line plasma surface modification of flat materials as, for example, textiles, polymer films, aluminium foils, flat glass, etc.
- Deposition of hard or protective layers
- Measurement of the properties of thin films – mechanical, optical properties, chemical composition
- Experience with cooperation on patenting and in commercial applications





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ELECTRICAL AND MAGNETIC PROPERTIES GROUP

DEPARTMENT OF STRUCTURE
INSTITUTE OF PHYSICS AND MATERIALS / ACADEMY OF SCIENCES OF THE CZECH REPUBLIC

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THEMATIC RESEARCH FOCUS

RESEARCH AREA
- Material Engineering
- Magnetic Properties
- Physics of Metals

EXCELLENCE
- Mössbauer spectroscopy
- Magnetic measurements
- Ab-initio calculations of electronic structure of materials

MISSION
- To be a part of the wider top European research of nanomaterials and metal composites

DEVELOPED TECHNOLOGIES

CONTENT OF RESEARCH
- Theoretical studies of electronic and magnetic properties of disordered alloys, epitaxial multilayers, surfaces and interfaces as well as quantum-mechanical studies of extended defects in metallic materials
- Experimental investigations of relations among structural and magnetic, transport and mechanical properties in metallic materials
- Materials for hydrogen storage

MAIN CAPABILITIES
- Patent for textiles barcode and others, which can be modified for practical application – efficient storage of hydrogen, nanocrystalline iron and guidance systems for drugs place in the body
- Cooperation with medium-sized companies concerned with medical equipment, treatment technology and environmental protection

FIELDS OF RESEARCH RESULTS APPLICATION
- Metallurgy
- Metal Processing
- Engineering
- Electrical Engineering
- Environmental Protection
- Fuel Cells
- Biomedicine – e.g. Magnetic Resonance

ALUMNI PROFILE
Basic and industrial research in materials science and engineering.

NUMBER OF RESEARCH POSITIONS

SENIOR RESEARCH STAFF
10

JUNIOR RESEARCH POSITIONS (INCL. PH.D. STUDENTS)
3

KEY RESEARCH EQUIPMENT

LIST OF DEVICES
- Mössbauer spectrometers (5 – 1300K)
- VSM magnetometers (5 – 1000K)
- Coercimeter Förster (80 – 1000K)
- Equipment for measurements of electrical resistivity (300 – 1000K)
- Equipment for measurements of magnetoresistance (80 – 900K, 1T)
- Quadrupole mass spectrometer
- Spark erosion system for material synthesis

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- Vacuum (oil free) and gas furnaces for heat treatment of materials (up to 1300K)
- X-ray diffractometer X'PERT

BUDGET

TOTAL (MIL. CZK/ MIL. EUR)
5 / 0.2

PART OF THE TOTAL BUDGET FROM PRI VATE RESOURCES (%)
10

PART OF THE TOTAL BUDGET FROM FOREIGN RESOURCES (%)
0

MAIN PROJECTS

2011-2014: Theory of spin-dependent transport in magnetic solids and nanostructures (project P204/11/1228 financed by the Czech Science Foundation, Investigator: doc. RNDr. Ilja Turek, DrSc.)
2011-2014: Effects of cores and boundaries of nanograins on the structural and physical properties of ball milled and mechanically alloyed iron-based materials (project P108/11/1350 financed by the Czech Science Foundation, Investigator: Ing. Yvonna Jirásková, PhD.)
2005-2011: Research center of powdered nanomaterials (project VC 1M 0512 financed by the Ministry of Education, Youth and Sports, Investigator: Ing. Oldřich Schneeweiss, DrSc.)

ACHIEVEMENTS

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MAIN COLLABORATING PARTNERS

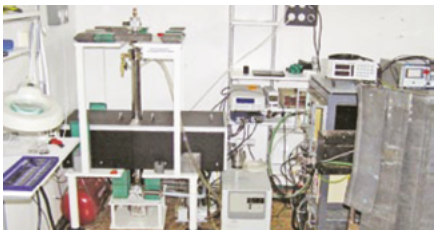
COLLABORATION WITH ACADEMIC PARTNERS
- Faculty of Science, Masaryk University (Brno, CZ) Faculty of Mechanical Engineering, Brno University of Technology (Brno, CZ) Faculty of Science, Palacky University (Olomouc, CZ)
- Textile Testing Institute (Brno, CZ)
- Faculty of Mathematics and Physics, Charles University (Prague, CZ)
- University of Uppsala (SE)
- University of Belgrade (RS)
- National Institute for Lasers, Plasma and Radiation Physics (Bucharest, RO)
- University of Ghent (Gent, BE)

COLLABORATION WITH COMPANIES
- Aquatest (Liberec, CZ)
- Nanoiron (Rajhrad, CZ)
- Messer (DE)
- SHM (Šumperk, CZ)
- Honeywell (US)
- Delong Instruments (Brno, CZ)

EXPECTATIONS

REQUIREMENTS
Collaboration with companies - clear and exact description of the task to be solved.

OFFERS
- Measurements of magnetic and electrical properties of materials.
- Structure and phase analysis using Mössbauer spectroscopy and XRD.
- Calculation of electronic structure and related properties of selected materials



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GROUP OF TOMÁŠ TYC

DIVISION OF THEORETICAL PHYSICS / INSTITUTE OF THEORETICAL PHYSICS AND ASTROPHYSICS FACULTY OF SCIENCE / MASARYK UNIVERSITY

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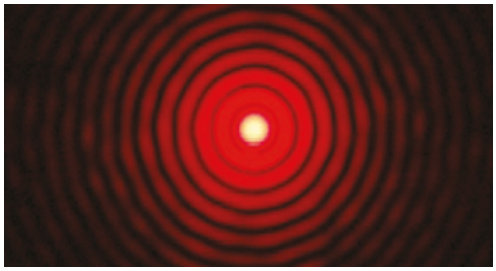

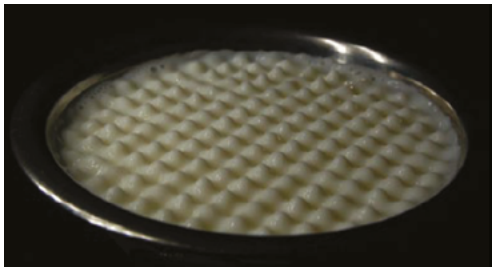

THEMATIC RESEARCH FOCUS

RESEARCH AREA
Theoretical physics, mainly optics – theory of invisibility and perfect imaging, wave propagation in optical devices, applications of geometry in optics

EXCELLENCE
Top in Central Europe

MISSION
We want to make a major contribution to the understanding of perfect imaging and propagation of waves in perfect lenses. To achieve this, we plan to extend the research team.

DEVELOPED TECHNOLOGIES

CONTENT OF RESEARCH
- Theory of invisibility
- Theory of perfect imaging
- Wave propagation in optical devices
- Applications of geometry in optics
- Problems in quantum theory and quantum information with continuous variables

MAIN CAPABILITIES

Basic research
- Transformation optics (article in Nature Materials)
- The draft of new type of invisible cloak (article in Science) Application research + protection forms
- „Perfect lens" - an international patent with colleagues of the University in St. Andrews and Cornell University

FIELDS OF RESEARCH RESULTS APPLICATION
- Optics and nano-optics
- Geometry and optics
- Electronic industry

ALUMNI PROFILE
Graduates have a solid foundation in quantum mechanics, quantum optics, optics of charged particles and modern quantum theory (the string-inspired theory, quantum theory of gravitation), on which they successfully build their future work. Graduates are adequately prepared for individual scientific research in Czech or foreign institutions.

NUMBER OF RESEARCH POSITIONS

SENIOR RESEARCH STAFF
1

JUNIOR RESEARCH POSITIONS (INCL. PH.D. STUDENTS)
3

BUDGET

TOTAL (MIL. CZK/ MIL. EUR)
1.5 / 0.06

PART OF THE TOTAL BUDGET FROM PRIVATE RESOURCES (%)
0

PART OF THE TOTAL BUDGET FROM FOREIGN RESOURCES (%)
5

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MAIN PROJECTS

2005–2011: Mathematical structures and their physical applications (Institutional research plan MSM0021622409 financed by the Ministry of Education, Youth and Sports)
2000– : Interesting physics experiments with the electromagnetic field (financed by University Development Fund); for photography of interesting physics phenomena see http://zajfyz.physics.muni.cz/en

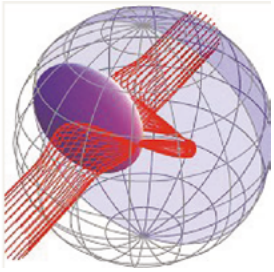
ACHIEVEMENTS

- Proposal of a new type of invisibility cloak - paper published in Science - U. Leonhardt, T. Tyc, Broadband Invisibility by Non- Euclidean Cloaking, Science 323, 110 (2009)
- Invention of a method for eliminating material singularities in certain devices. This enabled the construction of an Eaton lens, which previously was just a purely theoretical proposal - T. Tyc, U. Leonhardt, Transmutation of singularities in optical instruments, New Journal of Physics 10, 115038 (2008)
- The first proposal ever of a magnifying perfect lens for imaging regions of 3D space - T. Tyc, M. Šarbort, Magnifying perfect lens with positive refraction, arxiv:1010.3178

MAIN COLLABORATING PARTNERS

COLLABORATION WITH ACADEMIC PARTNERS

- University of St. Andrews (UK)
- Cornell University (US)
- Universities in Singapore and Hong Kong



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BRNO UNIVERSITY OF TECHNOLOGY

HEAT TRANSFER AND FLUID FLOW LABORATORY

/ FACULTY OF MECHANICAL ENGINEERING
/ BRNO UNIVERSITY OF TECHNOLOGY

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THEMATIC RESEARCH FOCUS

RESEARCH AREA
- Heat transfer
- Numerical modelling of temperature and stress fields
- Experimental heat transfer
- Cooling
- Heat treatment
- Design of cooling devices
- Expertise in heat transfer and cooling in high-temperature area

EXCELLENCE
- Research and development in the area of heat transfer and high temperature applications

MISSION
- To be the top applied centre in Europe
- Have some intensive close contacts and cooperations with industry

DEVELOPED TECHNOLOGIES

CONTENT OF RESEARCH
- Interaction of flowing liquid with hot surface and inverse heat conduction problem
- Computation of the thermal boundary conditions from experimental measurements
- Numerical models – especially for continuous casting, rolling, and disposal of dross
- Calibration of thermal sensors

MAIN CAPABILITIES

- Numerical models applied in the metallurgical industry (continuous casting, rolling, descaling, optimization of cooling systems)
- Experimental work aimed at determining heat transfer boundary conditions

FIELDS OF RESEARCH RESULTS APPLICATION
- Metallurgy
- Engineering
- Saving of energy, cost reduction

ALUMNI PROFILE
The laboratory provides training only in doctoral studies, area – heat transfer, experimental research numerical modelling, design of cooling devices.

NUMBER OF RESEARCH POSITIONS

SENIOR RESEARCH STAFF
4

JUNIOR RESEARCH POSITIONS (INCL . PH.D. STUDENTS)
10

KEY RESEARCH EQUIPMENT

LIST OF DEVICES
Laboratory of thermophysical properties of materials in conditions up to 1600°C, Test benches for heat transfer measurements on moving surfaces.

BUDGET

TOTAL (MIL. CZK/ MIL. EUR)
10 / 0.4

PART OF THE TOTAL BUDGET FROM PRIVATE RESOURCES (%)
63

PART OF THE TOTAL BUDGET FROM FOREIGN RESOURCES (%)
81

MAIN PROJECTS

2008-2012: Advanced Method To Improve Work Roll Life Time By Coupled Oil Free Lubrication And Chilling (project CHILLUB financed by the Research Fund for Coal and Steel, European Commission)
2004-2008: Effective roll cooling (project EWRCOOL financed by the Research Fund for Coal and Steel, European Commission)
2002-2005: Experimental study of the Leidenfrost effect at the impact of water droplets on heat

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surface for application in metallurgy (GA106/01/0124, Czech Science Foundation)

ACHIEVMENTS

Laboratory team has documented strong scientific potential in the last five years: total of 52 published articles, 3 prototypes (special devices for on-line Measurements of temperature in the load of rolls of hot rolling process and design of cooling units for hot and cold rolling), 14 functional samples, 1 proven technology. The team has been part of the European research environment – for the last 5 years, 4 international partner projects with a total financial extent of 7.5 million Euros. The team has had a strong relationship with the private sector in the last 5 years, contract research implemented in 112 projects in the contracted amount of 37 million CZK.

MAIN COLLABORATING PARTNERS

COLLABORATIONS WITH ACADEMIC PARTNERS

- University of Technology, Faculty of Mechanical Engineering (Brno, CZ)
- University of Technology, Faculty of Electrical Engineering and Communication (Brno, CZ)
- Institute of Physics of Materials, Academy of Science of the Czech Republic (Brno, CZ)
- Geonics Institute, Academy of Science of the Czech Republic (Ostrava, CZ)
- Arizona State University (US)

COLLABORATION S WITH COMPANIE S

- Třinecké železárny, a. s. (Třinec, CZ)
- Allnvest (Břidličná, CZ)
- Vítkovice (Ostrava, CZ)
- Arcelor Mittal OV (Ostrava, CZ)
- VUHŽ (Dobrá, CZ)
- Lechler (DE)
- Alcoa (US)
- Posco (KR)
- Comalco (NZ)
- Mannesmann (DE)
- US Steel (SK)
- ArcelorMittal (Chicago, US)

EXPECTATIONS

REQUIREMENTS

We are trying to find partners for the application of our products e.g. special cooling headers and other technologies for cooling and heat treatment. Application is the basis for our activities.

- Larger space for special use
- Cooperation with companies abroad

OFFERS

Technical help, measurements, consultation, research and design work in the area of thermal processes and cooling.

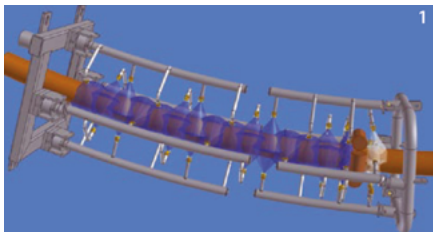

Figure 1 Design secondary cooling system of billet

Photo 1 HTC measurement: Continuous casting, secondary cooling

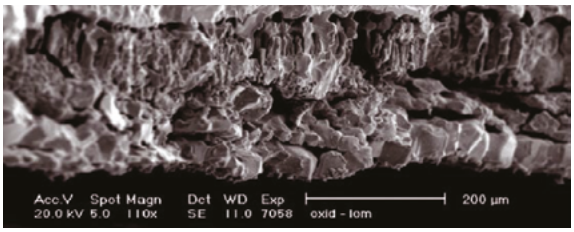

Photo 2 Structure of primary and secondary scales – electron microscope.

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BRNO UNIVERSITY OF TECHNOLOGY

INSTITUTE OF PROCESS AND ENVIRONMENTAL ENGINEERING

/ FACULTY OF MECHANICAL ENGINEERING
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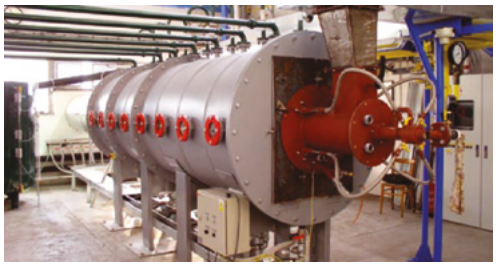

THEMATIC RESEARCH FOCUS

RESEARCH AREA
Waste/biomass to energy systems with advanced heat recovery and polluted gas cleaning subsystems - complex approach

EXCELLENCE
- Heat transfer and its application - thermal processing of waste including energy utilization (waste to energy)
- Process furnaces and heat exchangers
- Process integration
- Energy savings and emissions reduction
- Simulation calculations and optimization in the process industry
- CFD application

MISSION
Our aim is to form a Process Engineering Centre with an international reputation focusing on exploitation of waste and energy. We want to offer a high (European) standard of education, research and services for companies and penetrate the market with original and efficient solutions in the above mentioned fields. By utilizing the established NETME Centre (www.netme.cz), we aim to become one of the world's leading groups.

DEVELOPED TECHNOLOGIES

CONTENT OF RESEARCH
- Thermal and non-thermal treatment of waste
- Waste to energy systems
- Heat and power systems
- Alternative fuels
- Flue gas and polluted gas cleaning
- Experimental research of combustion
- Modelling, simulation, CFD and optimization
- Equipment design
- Heat transfer systems
- Heat exchangers
- LCA and process integration

MAIN CAPABILITIES
Research and development of unique (frequently „tailor made") solutions with direct applications in industrial practice. Our R and D products are mostly concerned with thermal and non-thermal treatment of waste, waste to energy systems, equipment design and heat exchangers (see above) and include patents concerning waste gas cleaning, various software tools for data processing , simulation systems for evaluation of process and energy parameters, computational tools for evaluation of energy recovery from waste incineration and optimization in the field of alternative fuel utilization (particularly biomass) in heating plants.
Functional samples cover areas of combustion related activities such as combustion air preheating in liquid fuels, equipment designed for homogenization of gaseous-liquid mixtures and atomization for the dosing of liquids fuels into the combustion chamber.

FIELDS OF RESEARCH RESULTS APPLICATION
- Waste/biomass to energy processes and systems
- Alternative fuels
- Devices for combustion, energy transfer, waste and biomass processing
- Process engineering – wide spectrum for utilization in various industrial fields

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- Engine construction
- Plant and apparatus engineering
- Wide scope of industrial sectors as well as the municipal sphere

ALUMNI PROFILE

Our alumni acquire a broad scope of knowledge which may be applied in various fields of engineering practice including the power industry, all the fields of process industry (e.g. food industry, chemical industry), environmental protection, engineering administration, business, etc.

NUMBER OF RESEARCH POSITIONS

SENIOR RESEARCH STAFF

18

JUNIOR RESEARCH POSITIONS (INCL. PH.D. STUDENTS)

19

KEY RESEARCH EQUIPMENT

LIST OF DEVICES

- Experimental unit for thermal and catalytic treatment of waste gases (polluted by VOC and carbon monoxide)
- Research facility for burner testing – most modern testing facility in Central Europe
- Two experimental units for flue gas cleaning by the method of filtration and/or catalytic filtration with a flowrate capacity of 1000 m3/h and 40 m3/h
- Experimental unit for flue gas cleaning by the method of two-stage absorption
- Prototype – 1MW unit for energy exploitation of various kinds of biomass (full scale reference unit in permanent operation)
- Reactors for anaerobic digestion

BUDGET

TOTAL (MIL. CZK/ MIL. EUR)

34.9 / 1.4

PART OF THE TOTAL BUDGET FROM PRIVATE RESOURCES (%)

25

PART OF THE TOTAL BUDGET FROM FOREIGN RESOURCES (%)

1.4

MAIN PROJECTS

2005–2011: Waste and Biomass Utilization focused on Environment Protection and Energy Generation (institutional research plan MSM0021630502 financed by the Ministry of Education, Youth and Sports)
2008–2011: Waste as raw material and energy source (project 2B08048 financed by the Ministry of Education, Youth and Sports)
2009–2013: NETME Centre (New Technologies for Mechanical Engineering) (project ED0002/01/01 financed by the EU)

ACHIEVEMENTS

- Patent Homogenization of gas-liquid mixture used in cleaning of industrial waste gases and its homogenization equipment
- W2E „Waste-to-energy“ Simulation system for evaluation of process and energy parameters

MAIN COLLABORATING PARTNERS

COLLABORATION WITH ACADEMIC PARTNERS

- UoM – University of Manchester Institute of Science and Technology (UK)
- University of Maryland (US)
- CERTH/CPERI - Centre for Research and Technology – Hellas (GR)
- Universität Dortmund (DE)
- Kharkov State Polytechnic University (UA)
- Polytechnic University of Bucharest (RO)
- University of Pannonia (HU)
- Brno University of Technology (FIT, FCh, FAST, CZ)
- Karlsruhe Institute of Technology (DE)

COLLABORATION WITH COMPANIES

- W. L. GORE & Assoc. (US)
- Koch-Glitsch (US)
- ABB Lummus Global (CZ)
- Procter & Gamble (US)
- PBS Industry Engineering (CZ)
- ZVVZ Enven (CZ)
- Phosphoric Fertilizers Industry s. a. (GR)
- EVECO Brno, s.r.o. (CZ)
- Kannegiesser (DE)
- Česká rafinérská, a.s. (CZ)
- Královopolská SAG, s.r.o. (CZ)
- Královopolská RIA, a.s. (CZ)
- Ústav aplikované mechaniky, s.r.o. (CZ)
- Vítkovice ÚAM, a.s. (CZ)
- Elya Solutions, s.r.o. (CZ)
- Chart Ferox, a.s. (CZ)
- Moravská energetická, a.s. (CZ)
- Vítkovice Power Engineering (CZ)

EXPECTATIONS

REQUIREMENTS

- Professional and reliable collaboration
- »Cooperation based on mutual profitability

OFFERS

R&D common projects and common business in the fields specified above, e.g.:

- Burner and jet testing
- Design of systems for cleaning and combustion
- Design and computing of atypical heat exchangers
- Energy and mass balance of industrial units
- Technical measurements of emissions incl. determination of dioxine concentrations
- Analyses
- Conceptual proposals of processes and devices
- Analyses and optimization of heat and power plants, incineration plants, industrial processes

04 / 2011

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INSTITUTE OF INDUSTRIAL ENGINEERING, MANAGEMENT AND QUALITY

/ FACULTY OF MATERIALS SCIENCE AND TECHNOLOGY

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THEMATIC RESEARCH FOCUS

RESEARCH AREA

- Progressive approaches in the area of the organisation management
- Corporate Culture
- Knowledge management
- Logistics and production management
- Quality management
- Product and processes certification
- Marketing
- Human resources management
- Development of managerial competencies
- Project management
- Ergonomics
- Quality management
- Process management

EXCELLENCE

Education / training with a focus on planning, designing, implementing and managing production systems and in particular on developing creativity in the field of civil engineering works or processes.

MISSION

Progressive approaches in the area of organisation management, human resources management, development of managerial competences, knowledge management, project management, sustainable development, ergonomics, logistics, production, marketing, quality management, operations research, corporate social responsibility.

DEVELOPED TECHNOLOGIES

CONTENT OF RESEARCH

- Research and pedagogical projects within VEGA & KEGA grant agencies:
- Quality management development in accordance with the requirements of the Slovak Republic's market
- Key manager competence in the range of specific functional management areas and their applicable development concept
- Project management processes of maturity control as a tool for the improvement of mechanical engineering enterprise competitiveness
- International programs and projects:
- Education and research organisations with suppliers and other organisations active in the automobile industry
- Internally funded projects
- Contractual research and development projects funded by business and industry

MAIN CAPABILITIES

Basic Research:

- Quality management
- Environment
- Human resources
- Operation research
- Knowledge management
- Ergonomics
- Innovation management
- Corporate culture

FIELDS OF RESEARCH RESULTS APPLICATION

- Industrial Management
- Production Quality Engineering

ALUMNI PROFILE

TThe graduate has complete university education focused on planning, designing, implementing and managing production systems and also creativity development in engineering projects or processes. He has extensive knowledge of natural sciences, technical, technological disciplines and humanities with expertise in industrial management, enterprise management, production management and plant economy, theoretical knowledge of operation and system analysis, personnel, investment, finance, innovation, information, knowledge and project management. The graduate is ready either to continue his study in postgraduate degree and develop his research career in industrial management, or to enter the job market immediately. He will successfully perform as a middle or top manager in organisations within various sectors of industry requiring the synergy of managerial, economical, technical and soft skill knowledge.

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NUMBER OF RESEARCH POSITIONS

SENIOR RESEARCH STAFF
23

JUNIOR RESEARCH POSITIONS (INCL. PH.D. STUDENTS):
84

KEY RESEARCH EQUIPMENT

LIST OF DEVICES
- Laboratory of ergonomics
- QSB system
- SW Expert Choice 11.5
- EPI6
- SW MS Project

MAIN PROJECTS

- South East Europe Transnational Co-operation Programme: "The international cooperation network of educational and research institution with subcontractors and other bodies active in Automotive Industry" (1.12.2009-28.2.2012)
- ERDC (01.06.2008-30.05.2010) Emergence of Research Driven Clusters in Central Europe
- 7th Framework Programme (01.01.2009 - 31.12.2011) DIVERSITY. Improving the gender diversity of management in materials research institutions

MAIN COLLABORATING PARTNERS

- Technical University in Zvolen
- University of Economics in Bratislava
- Technical University in Zvolen
- Brno University of Technology, Czech Republic
- University of Zielona Góra, Poland
- IFW Dresden, Germany
- Brandenburg University of Technology, Cottbus, Germany

COLLABORATIONS WITH COMPANIES

- PSA Peugeot Citroën Slovakia
- Bekaert Slovakia, s.r.o.
- VW Slovakia
- VUJE Trnava
- Samsung Electronics Slovakia s.r.o.

EXPECTATIONS

REQUIREMENTS
- Stabilization of the research team
- Internationalisation of the research team through foreign post doctorial positions and Ph.D.s

OFFERS
- Professional knowledge and stabilisation of research team
- Knowledge management
- SW tools

09/2011

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S T U
M T F

INSTITUTE OF MATERIALS SCIENCE

/ FACULTY OF MATERIALS SCIENCE AND TECHNOLOGY IN TRNAVA

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THEMATIC RESEARCH FOCUS

RESEARCH AREA
The research and expertise activities of the Institute are aimed at the crystallization of metals and alloys, tool material and nickel-based alloys, powder metallurgy, biocompatible materials, stainless steels, steels for power plants, weldability of steels, magnetic materials, thermal treatments and surface modification of materials, complex metallic alloys, grain boundary engineering as well as ceramic and polymer materials.

EXCELLENCE

CENTRE OF EXCELLENCE
Center for Development and Application of Advanced Diagnostic Methods in Processing of Metallic and Non-metallic Materials
The main focus of the project is the establishment of a centre of excellence with emphasis on the development and application of advanced diagnostic methods in the processing of metal and non-metal materials. This is provided within the framework of item number 2.1 of the operation program oriented to the research and development entitled "Increasing the quality of the workplace and support of excellent research, with a focus on the strategic areas important for next developments of economy and society". Therefore, the main aim of the project, which has been approved, is to build a research infrastructure in accordance with the Innovation policy of the second generation, meaning the regional level and in accordance with priority No.1 of the Innovation strategy of the Slovak Republic: „Infrastructure with a high quality and an effective system for innovation development". This way, the proposed centre of excellence will support realization of the strategy of competitiveness in the Slovak Republic in 2010, which is an important transfer to innovation policy of the third generation, with the task of integrating innovations into all policies.

We plan to create a modern dynamic centre of excellence. The centre will focus on analytical methods for applying the most contemporary knowledge on the interaction of electron and laser energies with masses of various types. It will also focus on advanced detection systems with high sensitivity, modern mechanical processes, and observation of electrical and non-electrical variables oriented to the evaluation of specific properties, especially progressive metal and non-metal materials prepared by the most modern technological processes. We expect that the project will help to improve the research infrastructure in the Trnava region, and provide a direct connection to the rest of Slovakia (the Faculty of Materials Science and Technology co-operates with numerous production companies throughout Slovakia and with other education and research institutes). The project will also connect the Faculty to other European and Asian research bodies (we co-operate with POSTECH - Pohang University of Science and Technology, South Korea, IFW and FZD in Dresden, Germany, Bekaert in Zwevegem, Belgium). Finally, the project will improve the quality of education and popularise science and technology among unspecialised people.

The project has the aim of supporting a concentration of the best faculty employees in a monothematic centre based on the application of the most modern experimental processes associated with specific material properties, consistent with the objectives of the Materials study program and the study field of Physical Metallurgy. Activities are focused on the attraction of secondary school students who will potentially study fields of technical materials. The project will also provide an access to modern technical equipment in the centre for all interested specialists, as well as the organisation of seminars and summer schools and expansion of materials' research and its successful representation in the media.

The centre will be equipped with the following modern technical equipment:

- High Resolution Scanning Electron Microscope operating with a thermal FEG cathode and equipped with compatible detection systems of

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EDS, WDS and EBSD along with particular equipment for preparation of samples by ion milling
- Laser Confocal Microscope with two independent beams for wavelengths 400 and 600 nm
- Universal Testing Machine for evaluation of mechanical properties of metal and non-metal materials
- Testing equipment for the observation of dynamic failure processes
- Equipment for the measurement of direct and alternating conductivity of non-metal materials at high temperatures
- Spectral analyser for the measurement of direct and alternating impedance and modular spectra of non-metal materials and composites
- Rotation Viscosimeter
- Vulcanisation Measurement Equipment

MISSION

To perform basic and industry-oriented research and education in the field of Materials Science.

DEVELOPED TECHNOLOGIES

CONTENT OF RESEARCH

The research group is mainly oriented to the materials' characterisation. Outputs of the research activities concern mostly the corrosion properties of stainless steels, the preparation of functional boride-based coatings, the structural characterisation of ferrite steels strengthened with oxidic nanoparticles, the phase evolution in complex metallic alloys, and the diagnostics of transitions in non-ordered structures by electrical conductivity.

MAIN CAPABILITIES

The results are either contributing to the extension of the basic knowledge of various kinds of materials or they are used to increase the confidence in power machinery, electronics and chemical industries. Research and development are mainly oriented to the partners in the engineering industry. A wide range of analytical activities is performed to control the manufacturing process, improving the quality of materials and technological processes.

FIELDS OF RESEARCH RESULTS APPLICATION

The obtained results are mainly applied to the power generating and machinery industries.

ALUMNI PROFILE

The Alumni have extensive knowledge of the types, characteristics and use of a wide range of conventional and advanced engineering materials. They made experimental study of the structure and methods of evaluation of materials as well as the link between chemical composition, production technology, structure and technological properties of materials. The Alumni has expertise in production, technological processing, testing, operational diagnostics, degradation and recycling of materials. They have the competence to assess the nature and impact of technological parameters on the mechanical processing of materials, technology and performance of intermediate products. The Alumni are able to propose solutions to materials in various technical fields by facing the challenges of engineering practice. Finally, the Alumni found applications in industrial companies, particularly in the field of material production and processing technology for semi-finished products for technical or management staff.

NUMBER OF RESEARCH POSITIONS

SENIOR RESEARCH STAFF

8

JUNIOR RESEARCH POSITIONS (INCL. PH.D. STUDENTS):

20

KEY RESEARCH EQUIPMENT

LIST OF DEVICES

- High resolution transmission electron microscope Philips CM 300 with EDS detector
- Transmission electron microscope JEOL CX200
- High resolution scanning electron microscope JEOL JSM 7600F with EDS, WDS and EBSD detectors
- Laser confocal light microscope ZEISS LSM700
- Light microscope ZEISS NEOPHOT 32
- Macroscope ZEISS STEMI 2000
- Microhardness tester BUEHLER INDENTAMENT 1105
- X-ray diffractometer PHILIPS PW 1710
- X-ray diffractometer HZG 4
- Ion mill BALTEC RES 100
- Cross section polisher JEOL SM 090
- Vacuum Evaporating System B32
- Hardness testers Brinnell, Rockwell and Vickers
- Optical emission spectrometer SPECTROCAST
- Glow discharge optical emission spectrometer SPECTRUMA GDA 700
- UV/VIS spectrometer Perkin Elmer LAMBDA
- FTIR spectrometer Perkin Elmer
- Rotary viskosimeter GEMINI
- TSDC SYSTEM CONCEPT 90 with extension QATRO CRYOSYSTÉM
- Vulcanograph D-MDR 3000
- Impedance analyzator Solatron 1260A
- Laser Flash Analyser NETZSCH
- High and low temperature dilatometer NETZSCH
- Simultaneous thermoanalyzer NETZSCH STA 409 with Mass Spectrometer
- Instrumented Charpy impact tester LABORTECH CHK3000
- Universal testing machine LABORTECH LabTest 5.250SP1

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MAIN PROJECTS

- **05.08.2008-15.05.2011:** COST MP0602 Preparation and characterisation of lead-free solders
- **04.07.2008-31.12.2010:** Investigation of fine structures in metallic materials using TEM
- **01.01.2009-31.12.2010:** Metal matrix composites reinforced with complex metallic alloys
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MAIN COLLABORATING PARTNERS

COLLABORATION WITH ACADEMIC PARTNERS

In areas of research and education, the Institute has established intensive co-operation with local and foreign institutes. It became a part of a network of foreign academic and commercial institutes, which gives an opportunity for extensive exchange of students and academic staff members of the Institute, contributing to dynamic and sustainable professional growth. The most prestigious academic institutes which could be mentioned are the Leibnitz Institute of Solid State and Materials Research Dresden (Germany), the Institute Jožef Stefan, Ljubljana (Slovenia), Vienna University of Technology (Austria), the Research Center Dresden-Rossendorf (Germany), the Institute of Physics of Materials, the Academy of Sciences of the Czech Republic, Brno (Czech Republic), the Faculty of Mechanical Engineering, University of Ljubljana (Slovenia), University of Rennes (France), Faculty of Physics, University of Bucharest (Romania) and other Slovak universities and institutes of the Slovak Academy of Sciences. From the list of industrial partners the most recognized ones are Bekaert SA (Belgium), Böhler - Edelstahl and Branson div. Emerson.

COLLABORATION WITH COMPANIES

The Institute has a long term tradition of co-operation with regional industrial partners such as: INA Skalica, Ltd., Skalica, VUJE corp., Jaslovské Bohunice, ZF Sachs Slovakia, corp., Trnava, Zlievareň, corp., Trnava, HKS Forge Ltd. Trnava; MANZ, corp. Nové MestonadVáhom; SONY Slovakia, Nitra; Samsung Electronics Slovakia, Galanta, Voderady; FaureciaTrnava; PSA Peugeot Citroen, Trnava; Noble International, Ltd. Senica; TRW Steering System Slovakia Ltd., Nové MestonadVáhom; Hella Lighting Slovakia, Kočovce; Kinex-KLF, corp., KysuckéNovéMesto; PSL, corp. PovažskáBystrica; EMO, corp. Mochovce; Johns Manville, corp. Trnava; Sauer Danfoss, corp., PovažskáBystrica; ŽOS corp., Trnava; PFS, corp., Brezová pod Bradlom; KompozitumTopoľČany; Fremach, Trnava; Slovalco, corp. ŽiarnadHronom; IMS Kupa, corp. Nováky, VIPO Partizánske.

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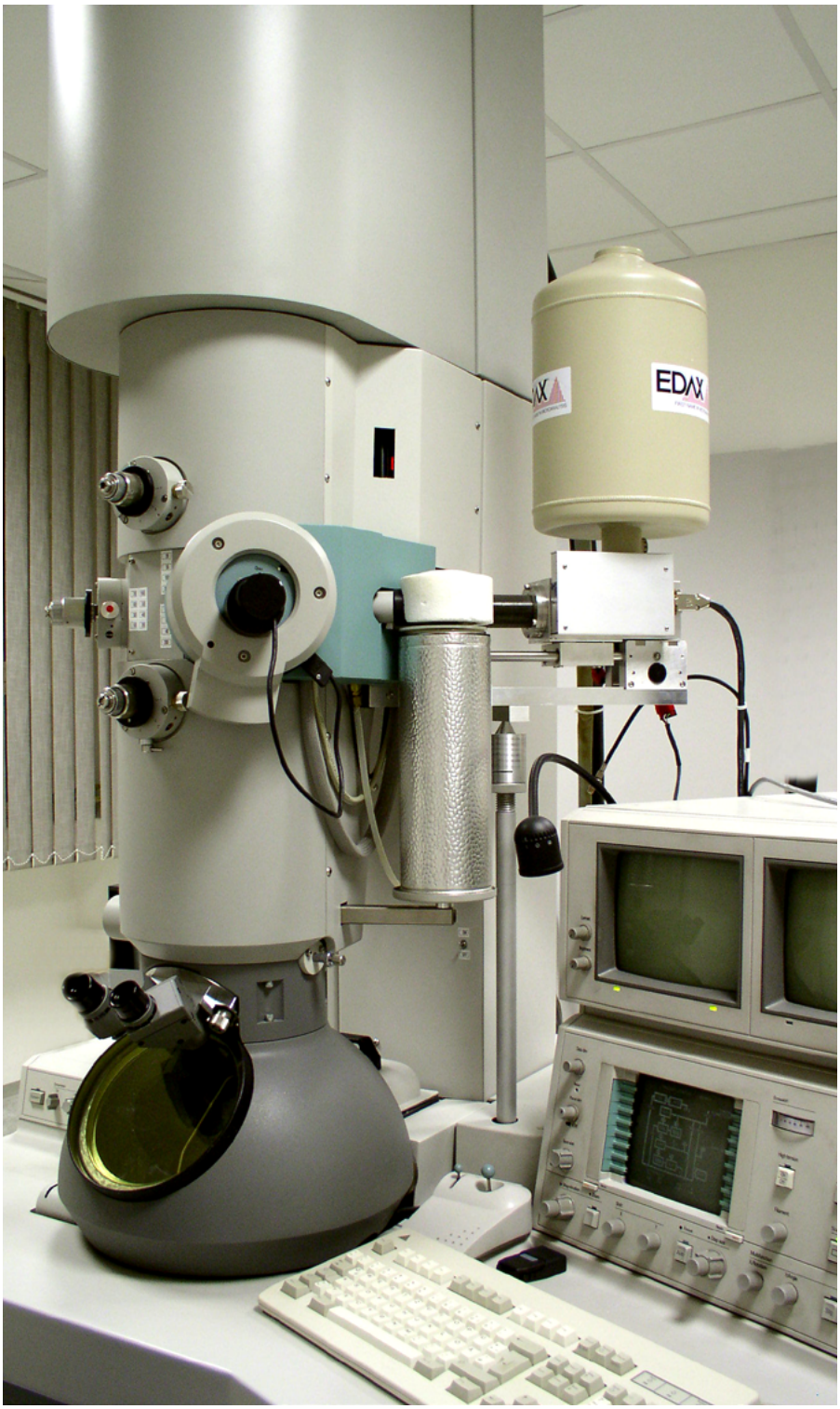
EXPECTATIONS

REQUIREMENTS

- Stabilization of the research team
- Internationalisation of the research team through foreign post doctorial positions and Ph.D.s
- Specialised instruments for experiments in the materials science

OFFERS

- Supporting research and development
- Co-financing for projects
- Transfer of science and research knowledge into practice



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INSTITUTE OF PRODUCTION TECHNOLOGIES
/ FACULTY OF MATERIALS SCIENCE AND TECHNOLOGY IN TRNAVA

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THEMATIC RESEARCH FOCUS

RESEARCH AREA
The research activities of the Institute of Production Technologies are oriented to the industrial technologies with respect to research and development in the sphere of high-tech technologies. Key directions of the scientific research activity at the Institute are focused on the support of the development of individual science and educational branches. The attention is devoted first to the actual and prospective questions related to industrial technologies in conditions of Slovak Republic, at which provisions are made for international trends as well as for the integration processes to the European Research Area. The Institute is oriented to the transregional pedagogic and scientific activity in many aspects, co-operates with and enlarges the co-operation with the more renowned scientific research institutes abroad. International co-operation in research is implemented mainly with the exchange of information, results, and knowledge for the education of Ph.D. students (fellowships, educational visits, and workshops).

The research and expertise activities of the Institute are mainly aimed at:
- Classical and advanced methods of machining, sheet metal and bulk forming, casting and joining of metallic and non/metallic materials
- Mathematical modelling and simulation of the manufacturing processes
- Tribology and surface engineering
- Advanced methods of machine parts measurement
- CA-x technologies

Research Targets:
- theory of machine parts manufacturing, creatics, measurement and assembly
- CIM, CAD/CAM, CAPP, CAQ, CAA, RE
- computer modelling and simulation
- 3D art engraving
- formability of new materials
- high parametrical forming
- manufacturing of dies
- experimental methods of forming
- soldering and brazing
- explosion welding
- weldability of steels
- welding of dissimilar materials
- surfacing and tribology
- adhesive bonding
- foundry technology – preparation of molten metal
- preparation of moulding materials
- powder metallurgy – technology of powder processing
- art foundry development of new foundry alloys
- plasma-electrolytic technology – surface treatment of metals
- surface layer hardening

EXCELLENCE
Centre of Excellence of Five Axis Machining
The aim of the project is to support mould and die manufacturers (designers, developers, technologists, quality control persons, young starting engineers and also skilled senior engineers) to solve the theoretical and practical tasks relevant to five axis machining.

The Centre has the opportunity to perform the basic research of Five Axis Machining of complex shape parts, including inspection and measurement and cutting fluids and cutting processes monitoring. The Centre is able to provide education for all levels of university study together with establishing an experimental base for doctoral research for Slovak and foreign universities and also practitioners.

Five axis machining is one of the main trends in cutting technology used for mould production. The term five axis machining means application of cutting machine tools through which the movements are carried out in five different axes simultaneously. The benefit of five axis machining is the ability to produce complex shapes in a single clamping and achieve a fine surface finish.

High-technologies:
multi-axis machining, 5-axis milling, FFS – Free Form Surfaces, HSM and HSC technologies, HSM –

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High Speed Machining and HSC – High Speed Cutting in combination with CA (Computer Aided) Technologies as CAD – CA Design, CAM - CA Manufacturing, CNC – Computer Numerical Control, CAE – CA Engineering and CA Ins – CA Inspection

MISSION

The main aim of the project of Centre of Excellence of Five Axis Machining is to build a technological basement for research oriented to technological possibilities of free form surface machining using five axis and non-conventional machining technologies.

DEVELOPED TECHNOLOGIES

CONTENT OF RESEARCH

The project of Centre of Excellence of Five Axis Machining is oriented to the following research topics:

- Research in machining strategies of five axis machining to find and define theoretical assumptions and optimise cutting processes.
- Research in five axis machining of thin walled parts in order to verify its benefits for thin walled parts machining.
- Research in five axis high-speed cutting to reveal its possibilities and technological characteristics.
- Research in turning with counter spindle focused on thin parts machining in order to find the best machining strategies for these parts.
- Research in Ultrasonic five axis machining from the aspect of technological possibilities and process optimisation and characteristics as well as edge chipping reduction and cutting process characteristics definition.
- Research in tool cutting geometry, wear and hardness characteristics in order to find the best tool characteristics for the required material.
- Research in cutting process characteristics, such as cutting forces and vibrations, especially in milling and turning of thin walled parts.
- Research in CAD/CAM/CNC/CAQ and CA technologies, its benefits related to machining.
- Research in cutting fluids characteristics and its impact on cutting process as well as Minimum Quantity Liquid and Dry Machining processes.

MAIN CAPABILITIES

The main capabilities gained through research are the following:

- new knowledge and skills in the field of free form surfaces production by conventional and advanced methods of machining, particularly milling, ultrasound and laser beam machining
- new knowledge about advanced methods of Computer Aided Process Design and Computer Aided Manufacturing

FIELDS OF RESEARCH RESULTS APPLICATION

- The main fields of research results application are the following:
- automotive industry
- bio-medical manufacturing industry
- aerospace industry
- industry of forming tool production and production of tools for plastic material processing

ALUMNI PROFILE

The graduates are able to prepare and realise sophisticated tasks connected to the process design and production of complex 3D machine parts.

NUMBER OF RESEARCH POSITIONS

SENIOR RESEARCH STAFF

7

JUNIOR RESEARCH POSITIONS (INCL. PH.D. STUDENTS):

58

KEY RESEARCH EQUIPMENT

LIST OF DEVICES

- Centre of Excellence for Five-Axis Machining
- DECKEL MAHO HSC 105 Linear
- DECKEL MAHO SAUER ULTRASONIC 20 Linear
- GILDEMEISTER CTX alpha 500

MAIN PROJECTS

- 01.10.2008-31.12.2011: Towards a common research project
- 01.09.2009 - 31.12.2011: Multivariate optimization of the metal spinning processes – R&D
- 02.06.2008-31.12.2010:Research of Welding and Forming of Nitrooxidatively Treated Steel Sheets

ACHIEVEMENTS

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MAIN COLLABORATING PARTNERS

COLLABORATIONS WITH ACADEMIC PARTNERS

The most prestigious academic institutes that could be mentioned are the following:

- DELCAM PLC Birmingham UK and Delcam Brno Czech Republic
- Vienna University of Technology (Austria)
- Research Center Dresden-Rossendorf (Germany)
- Academy of Sciences of the Czech Republic, Brno (Czech Republic)
- Faculty of Mechanical Engineering University of Ljubljana (Slovenia),
- other Slovakian universities and institutes of the Slovak Academy of Sciences.
- From the list of industrial partners the most recognised one is the Bekaert SA (Belgium).

COLLABORATIONS WITH COMPANIES

The Institute has a long term tradition of co-operation with regional industrial partners, such as: EntoKošice, Technex Mont Trnava, KeramingTrnava, ZF Sachs Slovakia, corp., Trnava, Zlievareň, corp., Trnava, HKS Forge Ltd. Trnava; MANZ, corp. Nové MestonadVáhom; SONY Slovakia, Nitra; Samsung Electronics Slovakia, Galanta, Voderady; FaureciaTrnava; PSA Peugeot Citroen, Trnava; Noble International, Ltd. Senica; TRW Steering System Slovakia Ltd., Nové MestonadVáhom; Hella Lighting Slovakia, Kočovce; Kinex-KLF, corp., KysuckéNovéMesto; PSL, corp. PovažskáBystrica; EMO, corp. Mochovce; Johns Manville, corp. Trnava; Sauer Danfoss, corp., PovažskáBystrica; ŽOS corp., Trnava; PFS, corp., Brezová pod Bradlom; KompozitumTopoľčany; Fremach, Trnava; Slovalco, corp. ŽiarnadHronom.

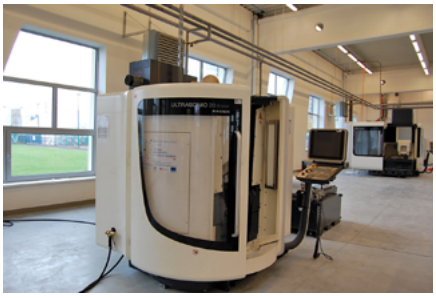
EXPECTATIONS

REQUIREMENTS

- Stabilization of the research team
- Internationalisation of the research team through foreign post doctorial positions and Ph.D.s
- Specialised instruments for experiments in the production technologies

OFFERS

Education, training, research and technological development in the field of Computer Aided Process Design and Production of complex 3D machine parts.



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INSTITUTE OF APPLIED MECHANICS AND MECHATRONICS

/ FACULTY OF MECHANICAL ENGINEERING

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THEMATIC RESEARCH FOCUS

RESEARCH AREA

Fatigue, Monitoring, Measurement, Diagnostic, Stress-Strain Analysis, FEM, Computational mechanics, Finite/Discrete Element Method, Grid Computing, Multiphysic problems, Welding simulations, Vibration of Mechanical Systems, Identification of dynamic properties of car, Fluid simulation, Kinesiology

EXCELLENCE

Monitoring of fatigue damage of structures in operation, Solution of welding process simulation (in program SYSWeld), mechanical and thermal in program ANSYS, design of composite material; Fluid flow simulation in FLUENT, Heat treatment simulation, Development of the on-line fatigue damage monitoring systems for structures, measurement in operation; Filling facilities with mechanisms for compressing the municipal waste in special vehicles for waste disposal, Optimisation of parameters of elastic attachments of power unit (engine and gearbox) in the towing vehicle, Analysis of bottom group of dryierT20 with MSC.ADAMS, Verification and tuning of testrig for determination of forces transmission from road to the hub of a car wheel and to the car body, Determination of optimum geometric, kinematic and dynamic parameters of working mechanisms with Z structure and telescopic structure for swivel loader HON 200, Improved thermal-structural analyses, Thermal stresses, Simulation of human body motion, Measuring of forces in a human body, Renewable energy storage system, Inverse Problem in Vibration

MISSION

- Development of algorithms of the fast method for a car system identification based on car measurements, application of algorithms of multicriterial optimisation of an elastic shock absorber mounting, and hydraulic mounts of engine from the point of view of the ride comfort and driving safety
- Verification and tuning of testrig for the forces transmission from road to the hub of a car wheel and then to the car body.
- Development and validation of new computational models
- Development of new measurement techniques and devices
- Validation of theoretical models in the field of biomechanics
- BLDC motor /generator design
- Development of the condition for modal date to protect eigenvectors towards changes during design process
- Validation of theoretical models in the field of control of vibration

DEVELOPED TECHNOLOGIES

CONTENT OF RESEARCH

- Remote on-line monitoring system for fatigue damage cummulation
- Remote on-line monitoring system for the safety of structures with corrosion defects under service loading
- Geometric characteristics of wheel suspension
- Robust optimisation of parameterised multibody systems
- Dynamic balancing of spatial mechanisms
- Heat exchange and thermal stresses in grained materials
- Welding simulation (MIG, MAG, friction stir welding)
- Flow of medium (between two walls, around some machine parts, blood in the vessel)
- Stability analysis of frame and solids models
- Solution of gas, water pipeline system on elastic and inelastic foundation
- Design machine part using optimisation method
- Identification of mechanical parameters for human tissues
- Development of controlling systems for upper limb prosthesis
- Different mechanical properties of arteries for normal and hyper-tensional rats
- Problems of biomechatronical measuring devices using MEMS and NEMS
- Development of formulas for determining equation of motion in the matrix form (mass, damping and stiffness matrices) for symmetric, positive definite and symmetric matrices

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- Differential pumping as well as gas flow computation in a microscopes VP-SEM and ESEM
- Problems of electron scatter in the dependence on the gas medium pressure

MAIN CAPABILITIES

BASIC RESEARCH

Multiaxial fatigue in operation

- Study of transmission of forces in multibody systems, semigroups for development of mechanisms with parallel topology of structure, laws of inventive thinking, matrix properties, matrix polynomial properties, theory of grammians
- Creation and development of new element for FEA, for example, new pipeline element with elastic foundation, development and implementation of new material model (steel or not steel material) to FEA (plasticity model, creep model, electromagnetic model, contact model)
- Study of mechanical properties of rat arteries in vitro, basic kinematics of upper limb
- Study of experiments in vivo

APPLICATION RESEARCH

- Development of on-line systems for remote monitoring of health and damage of structures
- Development of method for determination of geometric characteristics of wheel suspension based on theory of screw motion of wheel carrier, optimisation of parameterised multibody systems based on theory of random inspection, dynamic balancing of spatial mechanisms based on the method of inspection of mass distribution, welding processes simulation, high temperatures and pressures of technological equipment, self-strengthening of pressure vessels, new types and features of prosthetics, monitoring systems for fatigue damage, undesirable vibrations and corroded structures
- Improvement of the therapy for hypertension diseases and orthopaedic diseases
- Design of seismic resistant construction especially for nuclear power plant

FIELDS OF RESEARCH RESULTS APPLICATION

- Automotive industry
- Material sciences (iron and non-iron metal)
- Optimisation of various technological processes in any industry
- Reliability, safety and lifetime of structures
- Engineering construction
- Railway transportation
- Water and gas transportation
- Biotechnology
- Life-sciences (biomechanics, medicine)
- Measuring instruments

ALUMNI PROFILE

Our graduates (masters, Ph.D.s) are fluent in using a wide range of experimental devices in FTIR and UV VIS spectroscopes, SEM, OM and CLSM microscopes, thermoanalysis (DSC, TGA, DMA), mechanical testing (tensile testers, impact pendulums, rheoviscosimeters) and master a range of specific synthetic techniques (ROMP, ATRP), biomechanics and biomechatronics. In addition, they have the theoretical knowledge of the natural laws governing thermodynamic transitions in polymer-based systems, as well as morphology formation in polymer composites.

NUMBER OF RESEARCH POSITIONS

SENIOR RESEARCH STAFF

15

JUNIOR RESEARCH POSITIONS (INCL. PH.D. STUDENTS):

30

KEY RESEARCH EQUIPMENT

LIST OF DEVICES

- ANSYS, SYSWELD
- SW: Motion Bundle and FEA Bundle from MSC.Software
- ADAMS, Anybody – software
- Electrohydraulic pulsator 4 channels
- Electrohydraulic frame for material testing
- 16-channels tensometric and 4-channels accelerometric apparatus
- Optical microhardness and hardness apparatus
- LabView full development system
- TI Motor control Dev DSP TMS320F28335
- Luminometer Orion II (BERTHOLD Detection Systems, Germany) for chemiluminescence measurements in microtitre plates or strips in a temperature controlled chamber (20 - 37 °C)
- ISO-NO Mark II potentiostat (World Precision Instruments) for the determination of nitric oxide synthesis
- HPLC Agilent 1100 with diode array and electrochemical detectors
- Flow cytometer FACS CALIBUR system (Becton Dickinson) and equipment for real time RT-PCR (Rotorgene) are shared and available at the Institute of Biophysics
- ELISA photometer Spectra-Rainbow for spectrophotometric laboratory measurements
- Multifunctional monochromator reader INFINITE M200 (TECAN) for fluorometrical analyses
- Leica TCS SP5X inverted confocal microscope system (equipped with white laser and acousto-optical beam splitter)
- High-speed sorter BD Aria II Sorp (equipped with 355, 405, 488 & 633 nm lasers)
- Coulter Counter for cell number determination

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BUDGET

TOTAL: 0,5mil. EUR

PART OF THE TOTAL BUDGET FROM PRIVATE RESOURCES (%): 70 %

PART OF THE TOTAL BUDGET FROM FOREIGN RESOURCES (%): 30 %

MAIN PROJECTS

- Determination of optimum geometric, kinematic and dynamic parameters of working mechanisms with Z structure and telescopic structure for swivel loader HON 200
- Examination of physical abuse and exposure of extremities with regard to their possible use for the new prosthesis
- Investigation of movements dependencies and loading of limbs resulting into application for new prosthesis (project VEGA 1/0571/11)
- Investigation of movement dependencies in specific motion patterns of hand and
- forearm (Otto Bock R&D Wien, FME SUT – common project)
- Development of monitoring system for simultaneous corrosion processes and mechanical loading of the pipelines (Industry project)
- Monitoring system of safety in operation of the pipelines (EKOFOND)

ACHIEVEMENTS

- Patent: Palčák, F., Élesztös, P., Gerthoffer, A., Nemček, M., Lenárt, M., Palčák, D.: Filling facility for vehicles dedicated for collection and removal of municipal waste. AO č.225343, 1983.
- Patent: Palčák, F., Élesztös, P., Gerthoffer, A., Nemček, M., Lenárt, M., Palčák, D.: Continuous filling facility for vehicles dedicated for collection and removal of municipal waste. AO č.245517,1986.
- Patent: Neděla, Vilém; Jirák, Josef: Ionisation detector of an environmental scanning electron microscope, Institute of Scientic Instruments, Academy of Sciences of the Czech Republic, EP2195822 (A2), Publication date 2010-06-16
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- Frydrýšek, Karel - Nikodým, Marek (Jančo, Roland) Beams and frames on elastic foundation 3, VŠB-Technická univerzita Ostrava, 2010. - 611 s. - ISBN 978-80-248-2257-0
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COLLABORATION WITH ACADEMIC PARTNERS

- TU Graz, Austria
- UAS Regensburg, Germany
- University of Michigan, USA
- TU Budapest
- TU Miskolc
- VŠB-TU Ostrava (Czech republic)
- Palacký University (Olomouc, CzR)
- Instituto Superiot Técnico (Lisbon, P)
- Virginia Polytechnic Institute, Blackburg, US
- University of Cambridge (Cambridge, GB)

COLLABORATION WITH COMPANIES

- Škoda Auto, Mladá Boleslav, Czech republic
- PPS Group, Detva, SK
- Contitech Vibration Control, Dolné Vestenice, SK
- SOVA Digital, Inc. Bratislava, SK
- MSC.Software, Brno, Czech republic,
- Imos-Systemair, Ltd, Kalinkovo, SK
- Slovnaft a.s. Bratislava
- Welding Research Institute – Industrial Institute of SR, Bratislava
- DLR Wessling Germany
- Otto Bock, (Wien, AT)
- OSSUR, (Frýdek- Místek, CzR)
- Delong Instruments (Brno, CZ)
- SPP, a.s. (Bratislava, SVK)
- eustream, a.s. (Bratislava, SVK)
- Knott, s.r.o. (SVK, DE)
- FGS, Gmbh. (DE)
- Inergy automotive systems Slovakia (SVK, FR)

EXPECTATIONS

REQUIREMENTS

- Partners for FP7 research project in the field of applied mechanics and mechatronics
- Collaboration with industrial partners in common projects dedicated to applied science
- Partners for FP8 research project in the field of biomechanics and biomechatronics
- Collaboration with industrial partners in common projects dedicated to applied science
- New complementary technologies
- New models for arteries and other human tissues

OFFERS

- Health of structures
- Development of mechanisms according to defined properties for output part (path generation, motion generation, function generation)
- Virtual testing of functional properties and optimisation of vehicles and production machines
- Partnership in international projects in the area of applied mechanics and mechatronics

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- Training in application of SW MD.ADAMS (Authorised Training Centre for ADAMS, SjF STU Bratislava)
- Computational model development and its validation
- Numerical simulations using own and commercial codes
- Technological process optimisation using computational mechanics
- Testing of functional properties developed device

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SZÉCHENYI ISTVÁN EGYETEM

REGIONAL UNIVERSITY KNOWLEDGE CENTRE FOR VEHICLE INDUSTRY (JRET)

/ FACULTY OF ENGINEERING SCIENCES

RESEARCH GROUP CONTACT

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THEMATIC RESEARCH FOCUS

RESEARCH AREA

- Computer Aided Design and Product Development (CAD-FEM)
- Computer Aided Production and Technology Development (CAM)
- Computer Aided Quality Management and Development of Quality Management Tools (CAQ)
- Experimental Analysis of Manufacturing Processes and Materials

EXCELLENCE

- Laboratory equipment for vehicle industrial research, development and services
- Strong hardware and software background for manufacturing process simulation and analysis
- Experienced research and service staff

MISSION

The mission of the Knowledge Center is to act as a scientific and technological innovation center in the field of vehicle industry in cooperation with the economic sector, to operate an outstanding research and development network in the region and thereby enhance the competitiveness of the country and to support the economic development of the region.

DEVELOPED TECHNOLOGIES

CONTENT OF RESEARCH

- New measuring methods for digital optical systems, CT-evaluation and reverse engineering
- New optimisation algorithms for production processes
- Friction and wear of engine components – from the point of view of surface parameters
- Effect of surface treatments on behaviour of components

MAIN CAPABILITIES

- Design and diagnostics of vehicle industrial units (finite element analyses, sound- and vibration diagnostics)
- Improvement of efficiency and quality of production
- Computer simulation of manufacturing processes (sheet-, volume-, and polymer forming)

FIELDS OF RESEARCH RESULTS APPLICATION

- Optimisation and development of forming processes and tools
- Optimisation of production and logistics
- Development of manufacturing operations for vehicle unit and part production
- Testing equipment for combustion engine assembly, gear box testing

NUMBER OF RESEARCH POSITIONS

SENIOR RESEARCH STAFF

13

JUNIOR RESEARCH POSITIONS (INCL . PH.D. STUDENTS)

6

KEY RESEARCH EQUIPMENT

LIST OF DEVICES

- Digital Optical System (GOM), 3D Coordinate measuring equipment (Mahr), Roundness geometry (Taylor Hobson), Surface roughness (Talysurf CLI)
- Tensile Test (Instron 5582 and 3344), Hardness (KB Prüftechnik), Microhardness (Buehler), Charpy tester
- Microscope (NICON ECLIPSE; ZEISS Axio Imager A1), Scanning Electron Microscope (Hitachi), Chemical composition (WAS Foundry master)
- CT X-ray system (YXILON CT Modular), Phased Array Ultrasonic Testing Equipment (Olympus Omni Scan MX), Magneto-inductive testing equipment (Foerster Magnatest ECM), Ferrotest magnetic crack detector (TIEDE Ferrotest)
- Polymer tests: Rheometer (Ceast), Fire test (TBB), Twin screw extruder (Labtech), Injection molding machine (Arborg)

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- 5D machining (Deckel Maho 70 eVolution), 4D CNC turning (Gildemeister), Water Jet Cutting (Flow IFB)
- Nanotechnology: Laboratory attritors (Model01-HD/HDDM; Model 1-S for CRYOGENIC grinding - Union Process), MiniSpray Dryer (BÜHI), Selective Laser Sintering for Metals (EOS)

BUDGET

TOTAL: 3,000.000. Euro/year

PART OF THE TOTAL BUDGET COMING FROM PRIVATE RESOURCES (%): 70 %

PART OF THE TOTAL BUDGET COMING FROM FOREIGN RESOURCES (%): 30 %

MAIN PROJECTS

2009-2012: Integrated Vehicle Industrial Product and Technology Development System (IJTTR_08)
Type: NKTH (National Office for Research and Technology) National Technological Programme
Aim: To develop CAD-CAM-CAQ-IPD
Tasks performed by the Knowledge-centre: Technological simulation, heat treatment, CNC machining, measurement, quality management

2009-2012: Development of Integrated Mechatronics and Information Technology Environment for Home Care of Children having Chronic Illnesses (INFCARE8)
Type: NKTH (National Office for Research and Technology) National Technological Programme
Aim: To develop the AAL – „Ambient Assisted Living" programme for promoting life style, with the assistance of info communication tools
Tasks performed by the Knowledge-centre: Video-surveillance system, intelligent sick-bed modules, development of mobile diagnostic head assembly, Middleware system shell

2010-2012: Mobility and Environment: vehicle industrial, energetic and environment researches in the Central- and West-Transdanubian region
Type: TÁMOP (Social Renewal Operative Programme) 4.2.1.B. Programme
Aim: To perform basic research of materials science and vehicle mechatronics researches in the field of internal combustion engines and fuels
Tasks performed by the Knowledge-centre: Scientific coordination of the project

ACHIEVEMENTS

About 30 publications/year, 5-10 new designs and production technologies
PUBLICATIONS:

- Reti T., Czinege I. et al: Selection of tool materials for cold forming operations using a computerized decision support system, Journal of The Japan Society for Heat Treatment, Vol. 49 (2009) p. 773-775.
- Czinege I, Réti T, Csizmazia Fné.: Nodular Cast Iron in Combustion Engines: Advantages and Difficulties, FISITA 2010 World Automotive Congress, Budapest, 30 May-4 June.
- Czinege, I., Kardos, K. Szalai Sz.: Modelling and Simulation of Formability Tests, IDDRG Conference, Graz, 2010. 31 May-2 June.
- Haller, B., Kardos, K., Czinege, I., Buczkó A.: Measuring and Simulation of Deformations on Sheet Metal Forming Die, IDDRG Conference, Graz, 2010. 31 May-2 June.
- Á. Bajáki, J. Lábár, Á. Csanády, O. Geszti, H. Hargitai, F. H. Kármán: Investigation of noble metal nanoparticles (Ag, Au, Pd, Pt) produced by chemical reduction, Materials Science Forum, Vol. 659 (2010) 115-120
- Z.Szakál, I.Zsoldos: Shape features of 2D figures, Mater. Sci. Forum, Vol. 659, (2010) pp 459-466.
- I.Zsoldos: Planar trivalentpolygonal networks constructed from carbon nanotube Y-junctions, J. of Geom. and Phys., Vol. 61 (2011) pp. 37-45.
- Z.Szakál, I.Zsoldos: Sorting algorithm by shape independently from geometrical measures, in: Computers and Simulation in Modern Science, Vol. 3. (2010) pp. 404-412
- Jósvai János, Production Process Modeling and Planing with Simulation Method, Mounting Process Optimisation, The International Conference on Modeling and Applied Simulation, Spain, 23-25.09.2009
- Jósvai János, Perger József: Digital Factory, Methods and Applications in Audi Hungaria Motor Ltd., FISITA 2010 Conference, 2010.05.30-06.04., Budapest.
- MOLNÁRKA, G., VARJASI, N.: A Simultaneous Solution for General Linear Equations with Subspace Decomposition. Proc. of Conf. PARENG2011: The Second International Conference on Parallel, Distributed, Grid and Cloud Computing for Engineering, Ajaccio, Corsica, France, 12-15 April 2011.
- F. Gyimesi, Z. Füzessy, V. Borbély, B. Ráczkevi, Gy. Molnár, A. Citrovszky, A.T. Nagy, Gy. Molnárka, A. Lotfi, A. Nagy, I. Harmati, D. Szigeti: Half-magnitude extensions of resolution and field of view in digital holography by scanning and magnification", in Applied Optics, Vol. 48, Issue 31, 2009, pp. 6026-6034.
- I. Szénásy : Improved energie-management of capacitive energy storage in metro railcar by simulation. Proceeding of Int. Conf.on Renewable Energies and Power Quality (ICREPQ'10'), Granada, Spain 2010 23-25 nov.
- Fullér, Róbert, Harmati, István and Várlaki, Péter, On Possibilistic Correlation Coefficient and Ratio for Triangular Fuzzy Numbers with Multiplicative

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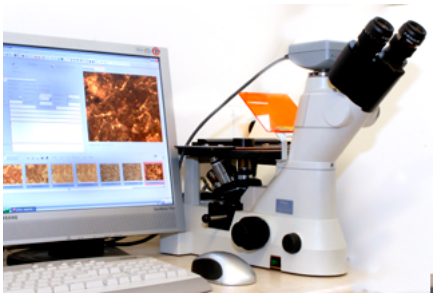
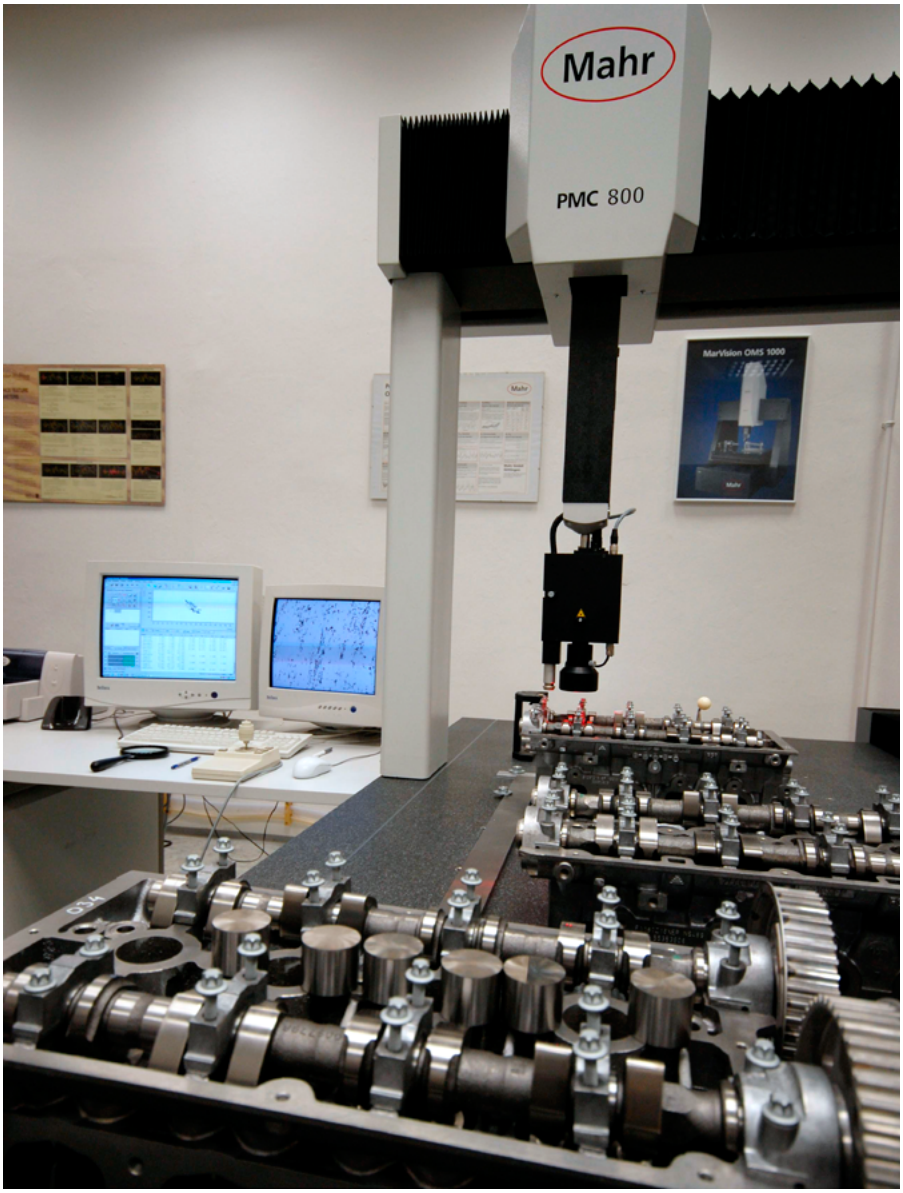
Joint Distribution, Proceedings of the Eleventh IEEE International Symposium on Computational Intelligence and Informatics (CINTI 2010), pages 103-108, Budapest, Hungary, 2010.
- Németh, Péter, Földesi, Péter and Csík, Árpád, The Concept of Logistic Space in the Modelling of Supply Chain Performance, Proceedings of the 22nd Annual Production and Operations Management Society Conference, Reno, Nevada, United States of America, 2011.





MAIN COLLABORATING PARTNERS

COLLABORATION WITH ACADEMIC PARTNERS

- Pannon University (Veszprém, HU)
- Technical and Economical University (Budapest, HU)
- Computer and Automation Research Institute (Budapest, HU)

COLLABORATION WITH COMPANIES

- Rába Axle Ltd. (Győr, HU)
- Audi Hungaria Motor Ltd. (Győr, HU)
- HNS Ltd. (Győr, HU)
- Borsodi Műhely Ltd. (Győr, HU)
- HUMANsoft Ltd., SMR Lp. (Budapest, HU)
- GM Powertrain Hungary Ltd, (Szentgotthard, HU)
- Linamar Hungary Ltd, (Békéscsaba, HU)
- Alcoa Köfém Ltd. (Székesfehérvár, HU)
- Nemak Hungary Ltd (Győr, HU)
- BorgWarner Turbo Systems Hungary Ltd (Oroszlány, HU)
- DANA Hungary Ltd. (Győr, HU)

EXPECTATIONS

REQUIREMENTS

Mutually beneficiary co-operation with partners.

OFFERS

Laboratory and human resources, involvement of students.

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TRIBOLOGY RESEARCH GROUP

BRNO UNIVERSITY OF TECHNOLOGY

/ INSTITUTE OF MACHINE AND INDUSTRIAL DESIGN
/ FACULTY OF MECHANICAL ENGINEERING
/ BRNO UNIVERSITY OF TECHNOLOGY

RESEARCH GROUP CONTACT

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THEMATIC RESEARCH FOCUS

RESEARCH AREA

- Tribology – biotribology, nanotribology, surface texturing, starved lubrication, speed and load changes in elaestohydrodynamic contact, oil degradation measurements, and transient behaviour of elastohydrodynamic contact
- Experimental study of real roughness attenuation in rolling/sliding concentrated contacts
- Mechanical Degradation of the Liquid in an Operating EHL Contact
- Effect of surface texturing on elastohydrodynamically lubricated contact under transient speed conditions

EXCELLENCE

- Tribology – very thin EHD films measurement
- Behaviour of surface roughness inside an elastohydrodynamic contact
- Transient behaviour of elastohydrodynamic contact using a very high-speed camera

MISSION

- Friction and wear reduction with respect to ecology
- Development of new measurement techniques in tribology
- The validation of theoretical models in the field of elastohydrodynamic lubrication, used for the design of highly loaded machine parts (esp. rolling bearings)

DEVELOPED TECHNOLOGIES

CONTENT OF RESEARCH

- Elastohydrodynamic Lubrication (EHL), Contact Mechanics
- Transient behaviour of elastohydrodynamic contacts.
- Behaviour of surface roughness inside a elastohydrodynamic contact.
- Biotribology
- Nanotribology

MAIN CAPABILITIES

The Tribology Laboratory has history of more than 12 years and is recognized as a distinguished lab in specific field. A new experimental technique for the study of thin lubricant films by means of colorimetric interferometry has been developed here. This technique is able to provide real time data for thin lubricant film shape studies.
The essential part of the lab is represented by an experimental apparatus for the study of elastohydrodynamic lubricant films based on a computer controlled dynamic Fizeau interferometer. Recently, a 3D optical profilometer based on phase shifting interferometry has been incorporated to measure in-situ initial undeformed real surface topography.
Latest results published in scientific journals have proved the combination of thin film colorimetric interferometry with phase shifting interferometry to be one of the most powerful tools for the investigation of mixed lubrication of real surfaces in situ.
This laboratory enables practice verification experiments to be performed in precisely known conditions and ensure true and repeatable results. About 80 percent of machines are disabled as a result of the damage of thin surface layers caused, among other things, by the local breakdown of elastohydrodynamic lubrication films. It is in the close relation to the lubricant capability to create coherent protective film. It is mostly characterised by the film thickness dependence on operation conditions (speed, load, temperature etc.) and rubbing surfaces topography.

FIELDS OF RESEARCH RESULTS APPLICATION

All fields of engineering (in production mainly industrial design)

- Construction - civil engineering
- Electrical Engineering
- Engine construction
- Automotive industry
- Railway transport
- Energy saving

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- Materials - Iron and Steel, Non ferrous materials, Plastics, Polymers
- Software
- Medical Equipment

ALUMNI PROFILE

The mission is to provide a high quality education, research and service to the industry in the field of modern machine design including integration of computer and information technology into products and processes.
Advantages of specialization are progressive technology, versatility, flexibility and a theoretical base. Graduates from this specialization can be employed mainly in design, in research and development departments or as project engineers, manufacturing, members and leaders of project teams, businessmen in the area of mechanical engineering and CAD applications.

NUMBER OF RESEARCH POSITIONS

SENIOR RE SEARCH STAFF
6

JUNIOR RESEARCH POSITIONS (INCL . PH.D. STUDENTS)
8

KEY RESEARCH EQUIPMENT

LIST OF DEVICES

- Tribometer to study the behaviour of very thin lubricant films
- 3D optical profilometer
- Instruments for lubricant diagnostics

Laboratories:

- Very high-speed camera
- Digital viscosimeter
- Refractometer
- Contact fatigue
- Bearing life
- Fatigue of machine parts

BUDGET

TOTAL (MIL. CZK/ MIL. EUR)
6 / 0.24

PART OF THE TOTAL BUD GET FROM PRI VATE RE SOURCE S (%)
40

PART OF THE TOTAL BUDGET FROM FOREIGN RESOURCES (%)
10

MAIN PROJECTS

2009-2011: Experimental study of elastohydrodynamic and mixed lubrication of hypoid gears (project GC101/09/J003 financed by the Czech Science Foundation)
2007-2011: Effect of surface topography modifications on lubrication films efficiency to diminish friction and wear of machine parts (project ME 905 financed by the ME – KONTAKT programme, Ministry of Education, Youth and Sports)
2005-2007: Influence of surface topography on lubricated contacts (project 1P050C009 financed by the Ministry of Education, Youth and Sports)

ACHIEVEMENTS

KŘUPKA, I.; HARTL, M.; BAIR, S.; KUMAR, P.; KHONSARI, MM. (2010) The Effect of Load (Pressure) for Quantitative EHL Film Thickness, TRIBOLOGY LETTERS, 37(3), 613 – 622.
KŘUPKA, I.; HARTL, M.; BAIR, S.; KUMAR, P.; KHONSARI, MM. (2009) An Experimental Validation of the Recently Discovered Scale Effect in Generalized Newtonian EHL. TRIBOLOGY LETTERS, 33(2): 127 – 135.
KŘUPKA, I.; HARTL, M.; SVOBODA, P. Effects of surface topography on lubrication film formation within elastohydrodynamic and mixed lubricated non-conformal contacts. PROCEEDINGS OF THE INSTITUTION OF MECHANICAL ENGINEERS PART J-JOURNAL OF ENGINEERING TRIBOLOGY. 2009. 223(6). p. 1 – 9.

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KŘUPKA, I.; SVOBODA, P.; HARTL, M. Effect of surface topography on mixed lubrication film formation during start up under rolling/sliding conditions. Tribology International. 2009. 43(4). p. 1 - 9.
KŘUPKA, I.; HARTL, M. (2007) The influence of Thin Boundary Films on Real Surface Roughness in Thin Film, Mixed EHD Contact. TRIBOLOGY INTERNATIONAL, 40 (10-12): 1553-1560.
Maurice Godet Award ffl Leeds Lyon 2009 – award for the best presentation / paper by a young scientist.

MAIN COLLABORATING PARTNERS

COLLABORATION WITH ACADEMIC PARTNER S

- University of Munich (Munich, DE)
- University of Seoul (Seoul, KR)
- University of Shanghai (Shanghai, CN)
- Georgia Institute of Technology (Atlanta, US)
- Kyushu Institute of Technology (Kitakyushu, JP)
- Tsinghua University (Beijing, CN)
- INSA (Lyon, FR)
- Kookmin University (Seoul, KR)
- Northwestern University (Chicago, US)

COLLABORATION WITH COMPANIE S

- Škoda-auto (Mladá Boleslav, CZ)
- Eaton Corp. (US)
- Koyo Bearings (JP)
- Tribotec (Brno, CZ)
- ZKL (Brno, CZ)
- Bosch Rexroth Czech Republic (Brno, CZ)
- Timken Czech Republic (Brno, CZ)
- INA Schaeffler (DE)

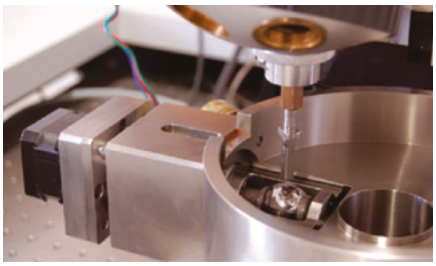
EXPECTATIONS

REQUIREMENTS

- Rational project plan
- Ambitious and realistic requests for scientific services – challenge for further research development
- Direct support of research for industry, focused on specific requirements of the company. Long-term projects will be preferred, short term projects are also possible

OFFERS

- Comprehensive development services for firms – in relation with NETME Centre
- Research activities include contact fatigue, bearing life, fatigue of machine parts, nanotechnology
- Machine and industrial design including 3D models
- Utilization of university capacities and acquisition of new specific equipment, operated by university staff
- Products for commercialization (we cannot be more factual because of competition)



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PANNON DEVELOPMENT FOUNDATION & UNIVERSITY OF WEST-HUNGARY „INSTITUTE OF MACHINERY AND MECHATRONICS" / TECHNOLOGY CENTER

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THEMATIC RESEARCH FOCUS

RESEARCH AREA
- Mechanical design (machines & equipment)
- Mechanical manufacturing technologies
- Automatization and mechatronics
- Energetics
- Renewal energy sources

EXCELLENCE
The business & operation model of the Technology Center is optimised for increased R&D value, flexibility and reliability together.

MISSION
Mission if the TC is to provide value-for-money services to clients through end-to-end research services without any compromise with respect to scientific background, professional competence or response time.

DEVELOPED TECHNOLOGIES

CONTENT OF RESEARCH
- **Mechanical design (machines & equipment)**
  new and innovative mechanical solutions for the clients' specific needs (mainly experimental research)
- **Mechanical manufacturing technologies**
  new technology optimisation methodologies (experimental and industrial research)
- **Automatization and mechatronics**
  application of modern mechatronics in marketable products (mainly experimental research)
- **Energetics**
  new mechanisms in energy supply systems while operating machines and factories (experimental and industrial research)
- **Renewal energy sources**
  new system concepts and their realization in the field of renewal energy sources (experimental and industrial research)

MAIN CAPABILITIES

- Core R&D team
- University staff
- Network of specialists
- Own laboratory capacities
- Shopfloor capacity for empiric testing
- [DJ2]

FIELDS OF RESEARCH RESULTS APPLICATION
Industry:
- mass production
- mechanical-automotive-electronics industry
- utility service companies
- innovative SME's

NUMBER OF RESEARCH POSITIONS

SENIOR RESEARCH STAFF
2+2+4

JUNIOR RESEARCH POSITIONS (INCL . PH.D. STUDENTS)
4+4

KEY RESEARCH EQUIPMENT

LIST OF DEVICES
- Equipment for material analysis
- Geometry measuring equipment
- Process evaluation systems
- Manual measurement tools

BUDGET

TOTAL: 0,4 mil. EUR

PART OF THE TOTAL BUDGET COMING FROM PRIVATE RESOURCES (%): 70 %

PART OF THE TOTAL BUDGET COMING FROM FOREIGN RESOURCES (%): 0 %

MAIN PROJECTS

- New mechanical solutions
- New measurement equipment
- New renewable-energy-related systems
- Solutions for lost energy re-usage
- Manufacturing technology optimisation models

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ACHIEVEMENTS

Projects still running

MAIN COLLABORATING PARTNERS

COLLABORATION WITH ACADEMIC PARTNERS

- University of West Hungary (Zalaegerszeg/Sopron, Hungary)
- Budapest University of Technology and Economics (Budapest, Hungary)
- Miskolc University (Miskolc, Hungary)

COLLABORATION WITH COMPANIES

Approximately 20 companies

EXPECTATIONS

REQUIREMENTS

Intention for long-term co-operation.

OFFERS

Professional, value-for-money R&D services.

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