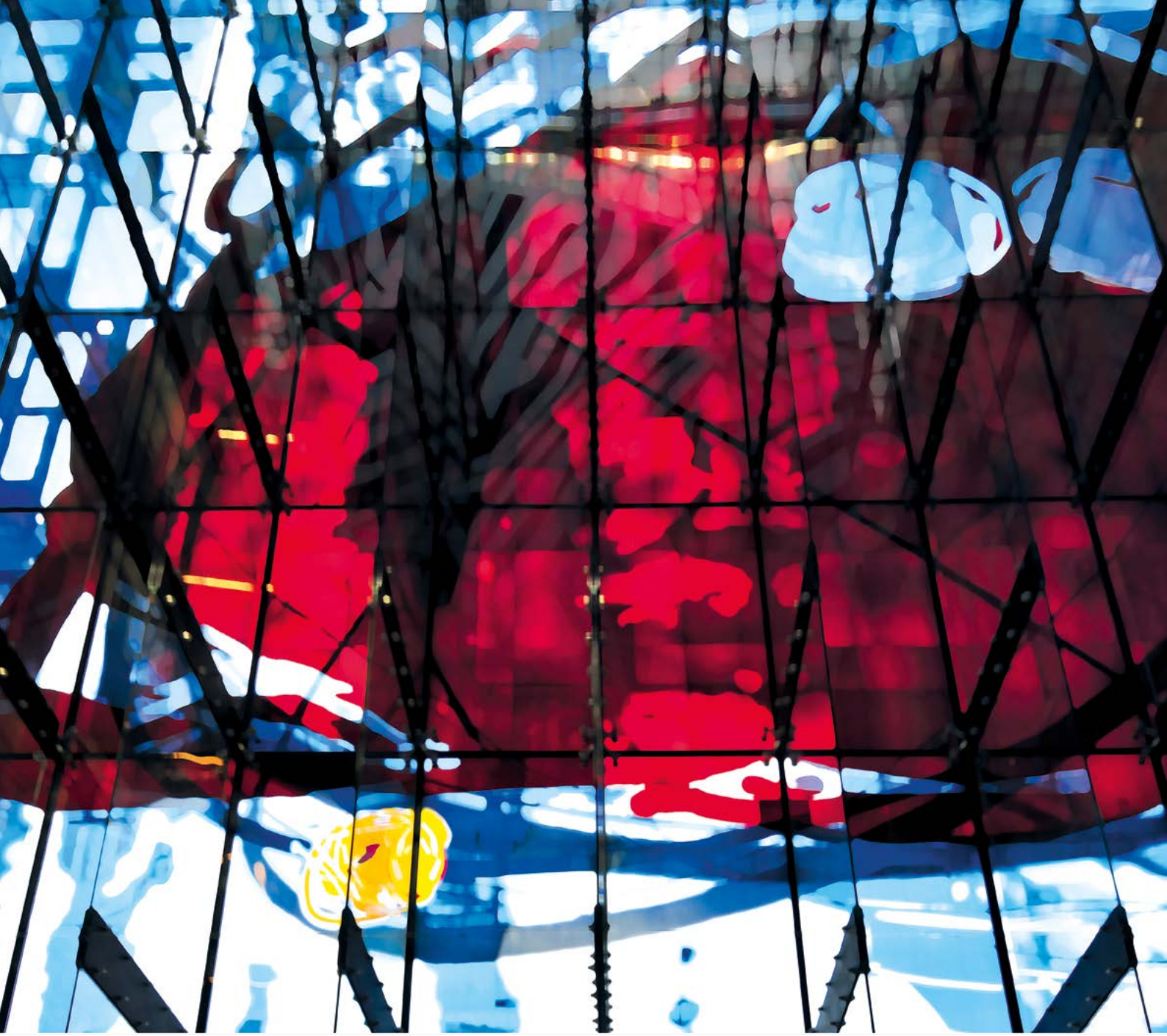

BIENNIAL REPORT 2014-2015

INSTITUTE OF FUNDAMENTAL TECHNOLOGICAL RESEARCH
POLISH ACADEMY OF SCIENCES

IPPT PAN

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Director's note

We present to you a synthetic report on scientific activities of the Institute of Fundamental Technological Research, Polish Academy of Sciences, for the years 2014 and 2015.

It contains a short, substantive description of studies conducted at the Institute's research units, the research projects currently under way, the most important events connected with scientific and publishing activities, and a list of works of the Institute's employees published in that period.

The Institute of Fundamental Technological Research is the largest institute of the Polish Academy of Sciences in the field of engineering sciences and has the highest scientific category A+. The Institute's mission is to conduct scientific studies at the highest scientific level. Such studies extend beyond the scope of engineering sciences, including also issues in biology and medicine.

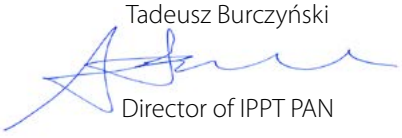
The Institute is a member of the scientific consortium Biocentrum Ochota and, together with other institutes of the consortium, forms the largest and the strongest group of scientific experts of the Polish Academy of Sciences comprised of specialists highly valued in Poland and abroad.

Since 2014, the Institute performs the role of the National Contact Point for the EU Horizon 2020 scientific programmes. A synthetic summary of those activities can be found in the report.

In conclusion, I would like to add that we have decided to regularly issue such reports because they summarize our scientific activities and constitute valuable documentation of the Institute's work.

We wish you a pleasant and interesting read.

Tadeusz Burczyński



Director of IPPT PAN

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1. PRESENTATION OF THE INSTITUTE

The Institute of Fundamental Technological Research, Polish Academy of Sciences (IPPT PAN), was founded in 1953. The history and tradition of the Institute formed the foundations for its present. The Institute's main focus is to conduct high-quality research in the areas of interest of world's science and technology. The most important fields of the Institute's expertise include theoretical and applied mechanics, theory of coupled mechanical and physical fields, theoretical and experimental mechanics of materials and structures, computational sciences, acoustoelectronics, and ultrasonic medical diagnostics. Extensive research is also conducted in several branches of fundamental science and technology, such as physics and thermodynamics of continua, plasma physics, stochastic dynamics, fluid mechanics, laser beam interaction with metal surfaces, nanophotonics, applied mathematics, applied informatics, and bio-informatics.

MISSION

To be the reference centre for scientific and technological excellence, radical innovation, and implementation of technology achievements in Polish scientific and industrial environment.

To start up and participate in activities related to multifunctional materials, polymers, smart materials and technologies, biomedical applications of ultrasound and microfluidic technologies, applied information science, and innovation technologies.

To provide first-rate Ph.D. education in contemporary technology, mechanics, acoustics, computing, and its advances related to biomedical applications, enhanced by internationalisation, links with industry, and the encouragement of the spirit of discovery.

The Institute has been very active in operating its own postgraduate school (established in 1968).

To promote, support, drive and implement research and technology transfer Initiatives and activities, and links with industry and commerce to contribute to the sustainable development of society.

During its more than a 60-year history, IPPT PAN employed 137 professors, out of which 29 were honoured with the membership of the Polish Academy of Sciences.

2. SCIENTIFIC COUNCIL OF THE INSTITUTE

On January 22, 2015, the newly elected members of the Institute's Scientific Council gathered for their first session in the new 2015-2018 term of office. Among the invited guests were Prof. Marek Chmielewski, Vice-President of the Polish Academy of Sciences (PAN) and Prof. Krzysztof Malinowski, Chair of the Council of Provosts at the PAN's Department of Technological Research. Professor Chmielewski presented the nomination letters to each of the members.

Fig. 2.1. Commemorative photo from the first session of the Scientific Council (2015-2018)

During the meeting, the members elected the new Council's authorities:

- Prof. HENRYK PETRYK - Chairman
- Prof. JANUSZ KACPRZYK - Vice-Chairman
- Prof. TOMASZ A. KOWALEWSKI - Vice-Chairman
- Assoc. Prof. JERZY ROJEK - Vice-Chairman
- Assoc. Prof. ZBIGNIEW RANACHOWSKI - Secretary

THE LIST OF THE COUNCIL'S MEMBERS:

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Assoc. Prof. Michał Basista
Prof. Romuald Będziński
Prof. Tadeusz Burczyński
Prof. Paweł Dłużewski
Prof. Maria Ekiel-Jeżewska
Prof. Grabska Ewa
Prof. Witold Gutkowski
Prof. Jan Holnicki-Szulc
Assoc. Prof. Łukasz Jankowski
Prof. Leszek Jarecki
Prof. Janusz Kacprzyk
Prof. Tomasz Kapitaniak
Assoc. Prof. Piotr Kiełczyński
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Prof. Józef Korbicz
Prof. Witold Kosiński
Prof. Zbigniew Kotulski
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Prof. Jerzy Litniewski
Prof. Bogusław Major
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Prof. Andrzej Nowicki
Prof. Wiera Oliferuk
Prof. Ryszard Pęcherski
Prof. Henryk Petryk
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Assoc. Prof. Katarzyna Pietrzak
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Assoc. Prof. Paweł Sajkiewicz
Prof. Stanisław Stupkiewicz
Prof. Janusz Szczepański
Assoc. Prof. Tomasz Szolc
Prof. Zygmunt Szymański
Prof. Eligiusz Wajnryb
Michał Wichrowski, M.Sc.
Prof. Krzysztof Wiśniewski

Scientific Council Secretary:

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e-mail: radanauk@ippt.pan.pl

The Council has the right to confer PHD and habilitation degrees in:

1. Mechanics
2. Electronics
3. Informatics
4. Materials Engineering

3. MAIN RESEARCH UNITS

DEPARTMENT OF MECHANICS AND PHYSICS OF FLUIDS

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Deputy Head: Prof. Tomasz A. Kowalewski

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DEPARTMENT OF COMPUTATIONAL SCIENCE

Head: Prof. Michał Kleiber, Full Member of PAN
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4. RESEARCH AND DEVELOPMENT

4. 1. DEPARTMENT OF MECHANICS AND PHYSICS OF FLUIDS

Basic laws of microparticle dynamics in fluids

Systems of nano and microparticles moving in fluids are common in nature and modern technology. To understand the fundamental principles of their dynamics, we use the theoretically and numerically advanced methods of solving the Stokes and Smoluchowski equations. In particular, we have recently investigated the following two problems: how flexibility of elongated objects that are subjected to linear shear flow affects their dynamics, and how to explain long life-times and break-up of particle groups settling under gravity. In both such non-Brownian systems, we observe the existence of translating periodic solutions which transform into chaotic scattering when a system parameter or initial conditions are changed.

For flexible objects which tumble in shear flow, the relevant characteristic parameter A is the ratio of bending to hydrodynamic forces. The important result is that for certain values of this parameter, a shear flow can tie a knot on a long fiber (see Fig. 4.1.1a). For a critical value $A=A_c$, we discovered a sharp transition between the fibers which straighten out and those which stay coiled all the time, see Fig. 4.1.1c. For A just above A_c, fiber's deformation and motion are chaotic, see Fig. 4.1.1b.

High sensitivity to a small change of initial conditions has been also found in the dynamics of a regular cluster made of four `rings' of many non-touching point-particles which settle under gravity. The map of the cluster lifetimes for different values of the initial radii R2 and R4 of cyan and green rings is shown in Fig. 4.1.1d. We found periodic solutions. The closer the system is to these solutions, the longer the particles stay together.

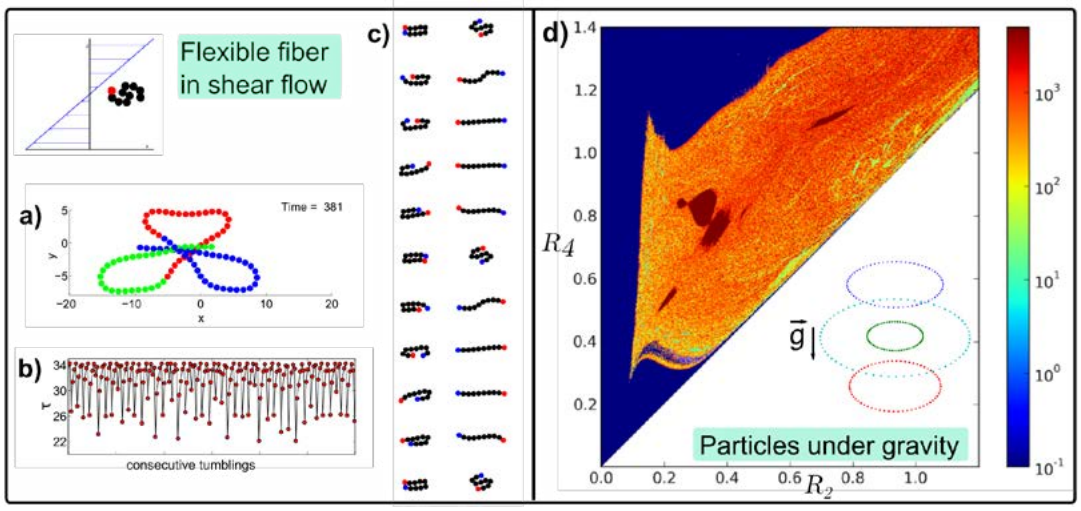


Fig. 4.1.1. Examples of micro-particle dynamics: a) knot tied by shear flow on a long fiber, b) consecutive tumbling times of fiber in chaotic mode, c) sequences of fiber shapes in coiled and straightening out modes, d) sensitivity of cluster life-time to a change of initial geometry

Mobility of highly deformable nanofilaments

Predicting behavior of deformable objects carried by the flowing fluid is necessary for understanding underlying physics of fibrous suspensions and transport properties of biological macromolecules. Evaluating conformational flexibility of long biomolecules and polymers suspended in fluid permits to determine their structure and mechanical properties. In our experimental study, the mobility of highly deformable nanofilaments suspended in liquid is investigated to gain a basic knowledge on hydrodynamic interactions influenced by Brownian fluctuations. By extracting a hydrogel core of electrospun polymeric nanofibers we are able to fabricate filaments with a typical diameter of 100 nm and a contour length ranging from single micrometers to millimeters. The composition of materials used allows for in flight modification of the hydrogel polymerization, tuning its mechanical properties to desired values. The surface topography of filaments is obtained by AFM equipped with a closed liquid cell and a rectangular silicon cantilever. Mechanical properties of the analysed filament (Young modulus) are evaluated with help of experimentally determined persistence length. Despite their relatively large diameters, a high deformability of our hydrogel filaments permits to obtain objects with mechanical properties resembling that of long biomolecules. Typical for long macromolecules effects, such as spontaneous conformational changes and cross-flow migration, are observed and evaluated (Fig. 4.1.2). It is interesting to note that despite negligibility of ionic interactions, bending followed by characteristic coiling and knots formation is observed. For long filaments their conformational changes are dominated over translational or rotational diffusion. Classical description of diffusion of long molecules using 'so called' hydrodynamic diameter appears in such case to be far from the physical phenomena. The collected experimental data can be used to validate assumptions present in numerical models describing intercellular transport of long biomolecules.

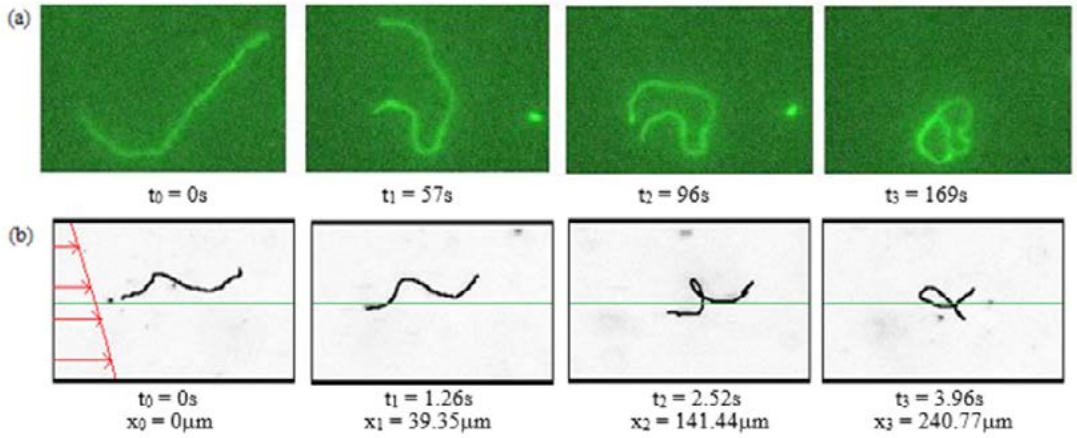


Fig. 4.1.2. Sequence of images for a single flexible nanofilament suspended in liquid: a) – Brownian motion observed for a very long filament (radius = 90 nm, length = 60 μm), b) - filament conveyed by Poiseuille's flow

Quantitative study of single-particle interaction force by combined atomic force microscopy / optical tweezers (AFM/OT)

Maintaining the particles well dispersed and avoiding the formation of aggregates are essential in all colloid system applications. Therefore, the knowledge of the forces that regulate the stability of particles in liquid is also fundamental. The equilibrium state and the hydrodynamic properties of colloid systems in an aqueous medium are affected by several environmental parameters. Total interaction force between the polystyrene spheres is due to the electric double-layer forces.

In this research, combined atomic force microscopy / optical tweezers (AFM/OT) were used to understand the interaction forces between two single polystyrene particles measured in salt aqueous solution and varying ionic strength. The experiments were carried out by approaching an optically trapped particle with an AFM particle probe and recording the OT output signals.

The hybrid AFM/OT allows to quantify the force involved in the colloid stability with femtonewton resolution miming the natural colloidal system condition and taking in account only forces relative to the two analysed particles (Fig. 4.1.3). The change of attractive and repulsive forces at various ionic strengths due to the modification of double layer structure affects the stability and the hydrodynamic properties of colloid systems.

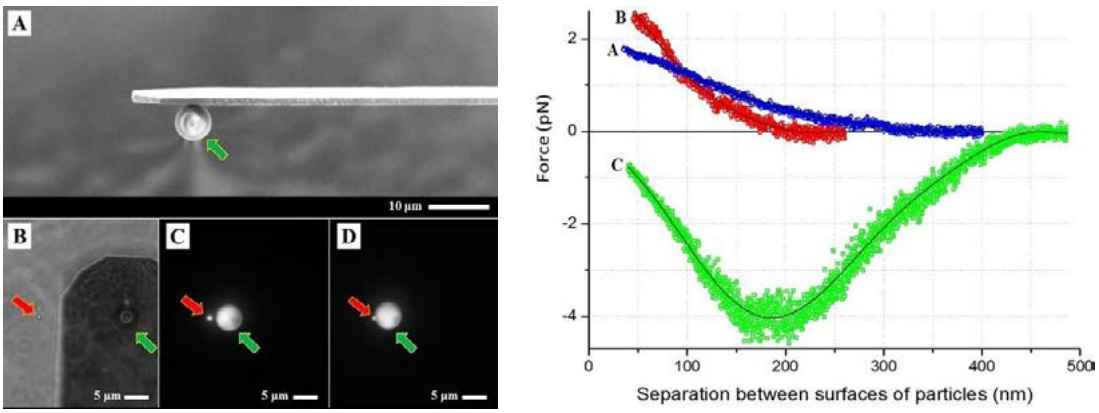


Fig. 4.1.3. Left - polystyrene particle mounted on the AFM cantilever and the second particle trapped by an OT approaching it, right - force as a function of the relative distance between a single pair of polystyrene particles for different KCl concentrations

Cell fate decisions in innate immune responses

The innate immune system processes pathogen-induced signals into cell fate decisions. By combining experimentation and mathematical modelling we demonstrated that the interactions between the three signal transduction pathways lead to binary, switch-like responses to a viral analog, poly(I: C), in contrast to pulse-like responses to a bacterial product, LPS. Each of these pathways activates potent transcription factors, namely NF-κB, IRF3, and STAT. The network topology is such that the simultaneous activation of NF-κB and IRF3 by poly(I: C) is required for the synthesis of cytokine IFNβ that induces STAT pathway in the neighbouring cells. In turn, the STAT signaling stabilises the NF-κB and IRF3 activity. This coordinates cell responses at the population level. Upon viral infection, a fraction of cells produce IFNβ that alerts other cells. The IFNβ-alerted cells shorten the live or die decision phase, switch rapidly to an antiviral state, and commit to apoptosis-restricting pathogen spread (Fig. 4.1.4).

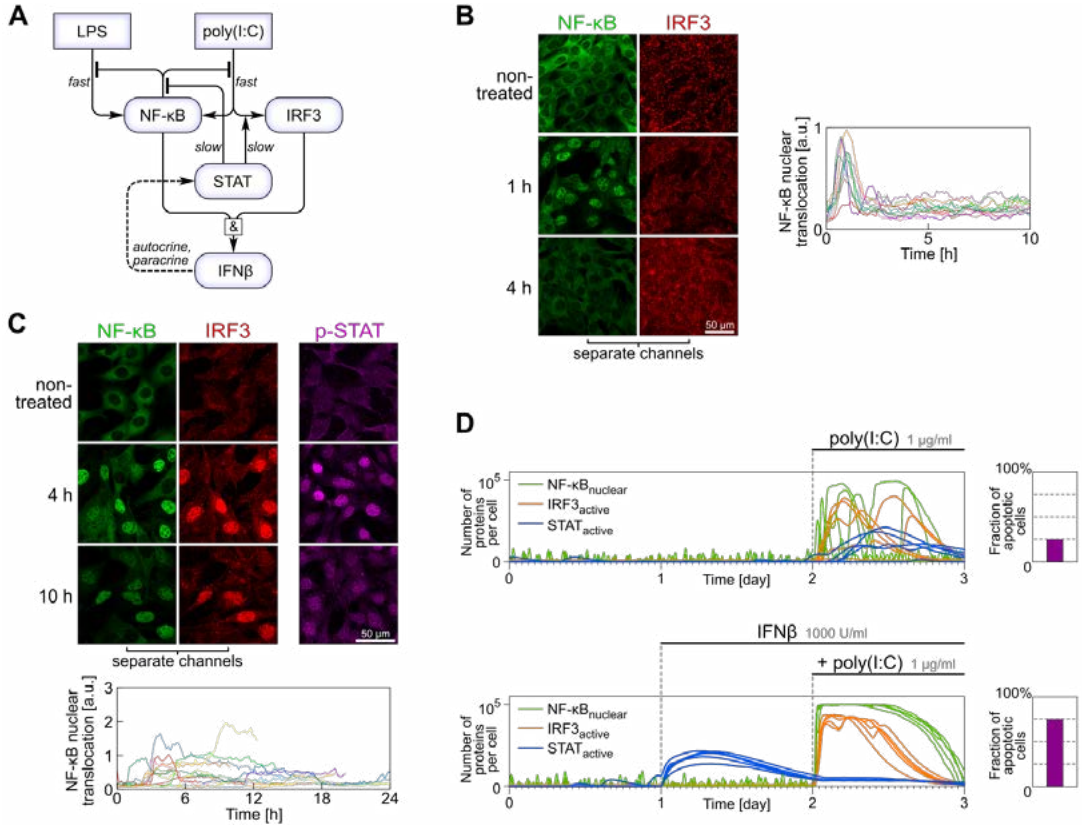


Fig. 4.1.4. a) Diagram of the studied pathway. Arrow- and hammer- headed lines denote positive and negative interactions, respectively. Negative feedback loops mediated by NF-κB are compromised by mediated IFNβ-STAT signaling, b)- immunostaining and live-images show pulse- like NF-κB activation in response to LPS, c) - switch-like binary activation NF-κB and IRF3 in response to poly(I:C) is stabilised by the STAT paracrine signaling, d) -mathematical model simulations. A 24 hour-long IFNβ prestimulation increases the strength of NF-κB and IRF3 activation and apoptosis

4.2. DEPARTMENT OF COMPUTATIONAL SCIENCE

The main research area of this department is computational science. Our research activities are to a large extent interdisciplinary as they cover informatics, mathematics and a number of disciplines that embrace the particular areas of application of the research, such as mechanics, biomechanics, materials engineering, etc. Universal character of computational methods and algorithms, which are based mainly on the finite element method (FEM), the discrete element method (DEM) and on a number of other contemporary and novel numerical methods, allows us to undertake a wide spectrum of research challenges, frequently in cooperation with other research institutions from Poland and abroad.

In the recent two years, our research activities concentrated in the following areas.

Continuum and atomistic analysis of inhomogeneity in semiconducting crystals

On the basis of experimental high-resolution transmission electron microscopy images of a (11-22) GaN/AlN heterostructure, a boundary value problem for piezoelectric material has been solved by the use of FEM. This allowed to determine residual stress, strain distributions and values as well as other coupled fields (electrostatic potential, electric field, band edge structure). Experimental evidence shows an unusual diversity in a GaN quantum dot morphology, and theoretical calculations also predict a clear and sharp diversification of coupled fields built-in to this structure.

To determine the higher-order effect in piezoelectric III-N heterostructures a dedicated thermodynamic continuum model of a piezoelectric crystal has been adopted into the finite element (FE) analysis. It uses second-order piezoelectric coefficients (elastostriction) calculated by a density functional theory.

A new algorithm for reconstruction of atomistic models of crystals with defects has been proposed and tested. Its mathematical background is based on the finite deformation theory. The algorithm was used to reconstruct the atomistic configuration of 4H-SiC crystal affected by a system of four threading dislocations.

Development of a few FEM and molecular modelling programs was continued, in particular the FEMapp code, visual editor of crystal defects (VECD) and the differential equations analysis library (deal.II). Using recent developments, new adaptive methods for solving problems within density functional theory have been completed using recent developments. Additionally, these methods were applied for the first time to study atoms under high pressure using the Hartree-Fock equations, where the important nature of this work was clearly demonstrated.

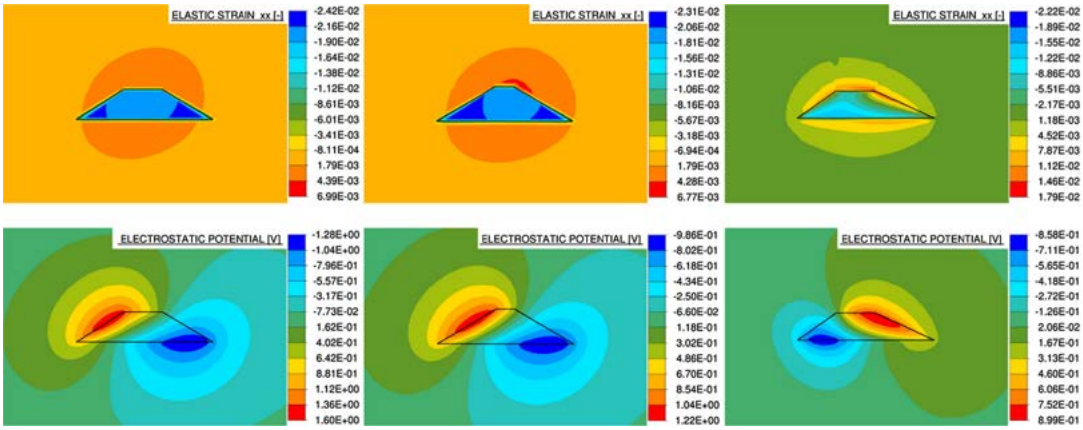


Fig. 4.2.1. The elastic strain (top) and the electrostatic potential (bottom) for QDs nucleated in (11-22) GaN/AlN heterostructure. From left to right, the cross-sections correspond to: the rectangular-based QD along (1-100), trapezoid-based QD along (1-100), and kite-based QD along (-12-10)

Computational intelligence in creating new graphene-like nanostructures

Graphene-like materials can be classified as periodic, flat atomic networks, made of stable configurations of carbon atoms in certain hybridisation states. Since the stable configurations of atoms correspond to the global minima on the potential energy surface (PES), such a task is considered as a special topology optimisation problem in which optimal material layout is searched on the nanoscale. However, the number of local minima increases almost exponentially with the number of atoms in the considered structure, thus searching for the global minimum on a PES became a non-trivial, NP-hard problem.

The hybrid computational intelligence algorithm, which combines the parallel evolutionary algorithm and the classical conjugated-gradient minimisation of the total potential energy of the atomic system, has been proposed. Since the processed structure is considered as a discrete atomic model, the behavior and the potential energy of carbon atoms are determined using the adaptive intermolecular reactive empirical bond order (AIREBO) potential developed for molecular dynamics simulations of hydrocarbons.

Chromosomes represent design variables in the form of real-valued Cartesian coordinates of each atom in the considered unit cell of the newly created atomic lattice. Each chromosome represents a certain spatial arrangement of atoms. In the initial population, atoms have randomly generated coordinates and are placed in the area of the unit cell with periodic boundaries. Dimensions, the rectangular or triclinic type of the unit cell, as well as the number of atoms, are part of a set of parameters of the simulation. Such an approach allows controlling the value of atomic density of the newly-created structure. The periodicity of the atomic structure significantly reduces the number of design variables.

In order to validate the proposed approach as well as the accuracy of the results, certain arrangements of carbon atoms already known from the literature have been examined, e.g., super graphene and graphyne. Since all the tests yield promising results, the proposed algorithm has been applied to search for new stable configurations of a given number of carbon atoms in a unit cell of given size and periodic

boundaries. For eight carbon atoms placed in the 4 Å × 7 Å rectangular unit cell a stable flat network named X was obtained (Fig. 4.2.2a), and for the same number of carbon atoms placed in the rectangular unit cell 4 Å × 6 Å a stable flat network named Y was obtained (Fig. 4.2.2b).

a) b)

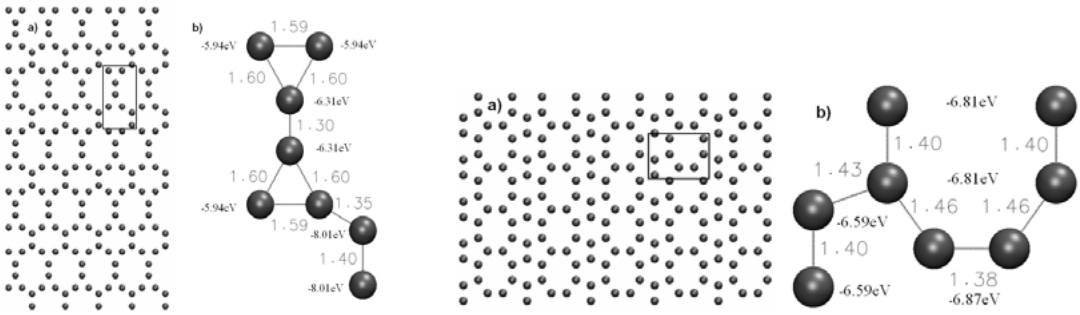


Fig. 4.2.2. Layout of new stable graphene-like nanostructures: a) X and b) Y, found by the hybrid algorithm

The proposed computational intelligence methodology applied to searching for new carbon nanostructures clearly shows that the final form and properties of optimised nanostructures depend on the assumed size, type and atomic density of the unit cell. The considered problem can be reformulated and applied to searching for a molecular structure with predefined material properties, not only in the case of carbon-based structures.

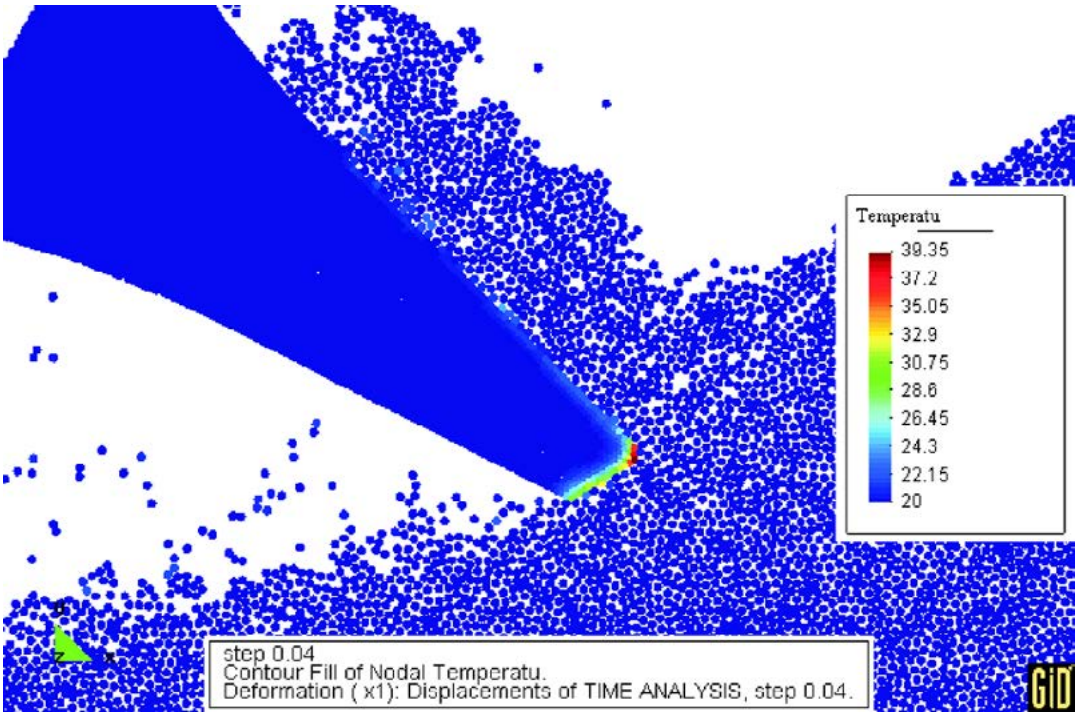
Discrete element modelling of advanced materials and material processing

The discrete element method (DEM) is a relatively new numerical method for material modelling, in which a material is represented by a large assembly of particles (discrete elements) interacting with one another by contact forces. Such a model, in a simple way, takes into account discontinuities either existing in the material or appearing under an applied loading. DEM is a powerful tool for predicting the behaviour of various natural and man-made materials such as soils, rocks, powders, granular materials, concrete, ceramics and even metals.

Our research is mainly focused on development of new models for brittle materials and powder metallurgy. The new thermomechanical formulation of DEM has been elaborated and applied to simulation of rock cutting processes accounting for thermal effects and tool wear. This analysis makes it possible to predict and optimise excavation processes in mining and civil engineering. Besides, a new viscoelastic model of sintering has been developed and applied to the analysis and optimisation of manufacturing of advanced metal-ceramic composite materials. The DEM models make it possible to analyse effects both at the micro- and macroscopic scales.

New DEM algorithms are implemented in an 'in-house' DEM/FEM computer program. This program can be applied to simulate real-life problems in many branches of industry important for economic and social development such as civil engineering, mining, chemical industry, material science, agriculture, pharmaceutical industry and many others.

Fig. 4.2.3. Thermomechanical simulation of rock cutting with evaluation of tool wear – temperature distribution



Numerical analysis of coating layer mechanics

Coating layers are usually deposited on boundary surfaces of structural elements in order to improve their mechanical response, such as wear, corrosion or fatigue resistance. Due to mismatch of the thermo-mechanical properties of film–substrate systems, residual stresses are generated both in the initial and loaded states. Damage and failure in layered structures or coatings on substrate are the most important problems for this type of composite materials, since delamination at interface and layer cracking are the main structure degradations.

Our work was aimed to provide an analytical study of the stress state in a bi-layer system and of the progressive delamination process. The cohesive zone model was applied to simulate the interface response with shear stresses related to displacement discontinuities and to the specific fracture energies in shear mode. Delamination mode growth with the related critical and post-critical response of evaluation length of the process zone as well as scale effect of the critical stress was examined. The analysis results clarify the influence of material parameters on the damage process and allow to plan experimental testing of epoxy joined ceramic elements, with specification of the connection strength, related to both the critical interface stress and the specific fracture energy.

STAND - stochastic analysis and design of structures

For several years, a semi-commercial software STAND has been developed at IPPT PAN. The system enables us to perform the advanced reliability analysis, and deterministic and robust optimisation. After installation of the HPC computer cluster GRAFEN at IPPT PAN, the software has been adapted for the parallel computing and successfully used in that form to perform: the reliability analysis and optimisation of the process of sheet-metal forming, topological optimisation in FEM as well the safety analysis of the high voltage power in the presence of uncertainties in forecasting of weather parameters.

Advanced FEM modelling of layered composite shells

Modelling of layered composite shells necessitates: (i) advanced 3D and solid-shell finite elements which are exact, effective and free of parasitic locking phenomena, and (ii) two-scale models of materials using properties of layers to generate the effective properties of the whole cross-section. The multi-layer cross-section is modeled by solid-shell elements. The layers can be made of heterogeneous materials. Their microstructure models or micro- computed tomography (CT) scans are the basis for 3D mesh generation from which effective properties are obtained via the representative volume element concept. This approach yields large numerical models which require a parallelization of the FE code. A parallel version of the finite element analysis program FEAP named ompFEAP has been developed.

Parametric constitutive models of fiber-reinforced woven fabric composites have been created by the FEM analysis and homogenisation of representative volume elements proposed for such a material. They can be used to evaluate sensitivity of composite structure response to various microstructure parameters of both geometric and material type.

Computer modelling of mechanical systems in terms of biological systems

The main goal of this research is to join the domain of computational systems biology with the field of computational mechanics. This is the elaboration of a new modelling paradigm. As an example, we aim at evaluation of stresses in the growing tissue. The state of stress is important for the correct development of the tissue, in particular for the cell signaling (mechanotransduction) involving triggering of the biochemical reactions that affect the cell cycle. Our goal is to combine the autonomous cell behaviour with the mechanical models. Cells are considered to be agents with embedded cell cycle functions, defining the actual state of the tissue in terms of mechanical properties and the internal structure of the tissue. We proved the possibility of the creation of such a coupled model, and we tested the building blocks, namely the agent program and the mechanical one. The latter is the implementation of the mixed discrete/finite element method, in which each cell consists of the membrane, cytoplasm, nucleus and cytoskeleton.

4.3. DEPARTMENT OF MECHANICS OF MATERIALS

The Department of Mechanics of Materials conducts comprehensive research – experimental, theoretical and computational – on advanced materials such as:

- Multifunctional and multicomponent materials
  (shape memory alloys, metal-ceramic composites, intermetallics, cellular materials, etc.);
- Materials of fine microstructure
  (nanocomposites, ultrafine grained materials, after severe plastic deformation, etc.);
- Thin layers and coatings
  (ion implanted materials, plastically deformed and contact layers, interfaces, etc.).

Particular emphasis is put on:

- Micromechanical and multiscale modelling;
- Experimental studies from macro- to nano-scales.

Specific topics are described in the sequel.

Processing, characterisation and modelling of metal matrix composites

The ongoing research activities include processing, characterisation and modelling of metal matrix composites (e.g., Cr/Re/Al_2O_3, NiAl/Al_2O_3) for applications in transportation and energy sectors, functionally-graded interpenetrating phase composites (Al/Al_2O_3) for automotive applications, and biodegradable composites (Mg/Hap) for orthopedic implants. Examination of material microstructure is performed by optical and electron microscopy, X-ray and synchrotron tomography. Mechanical properties, fracture parameters and residual stress measurements by neutron diffraction are the main areas of materials characterisation. The processing methods used to manufacture composite samples are those from powder metallurgy and metal infiltration of porous ceramic preforms. The main pieces of research equipment are: planetary ball mill, tube furnace, hot press, cold isostatic press, particle size analyser, polishing machine, metallurgical microscope and universal testing machine. The focus in materials modelling is on processing-induced residual thermal stresses, effective thermoelastic properties, deformation, damage and fracture processes in metal-ceramic composites with the account of real material microstructure as provided by micro-computed tomography images.

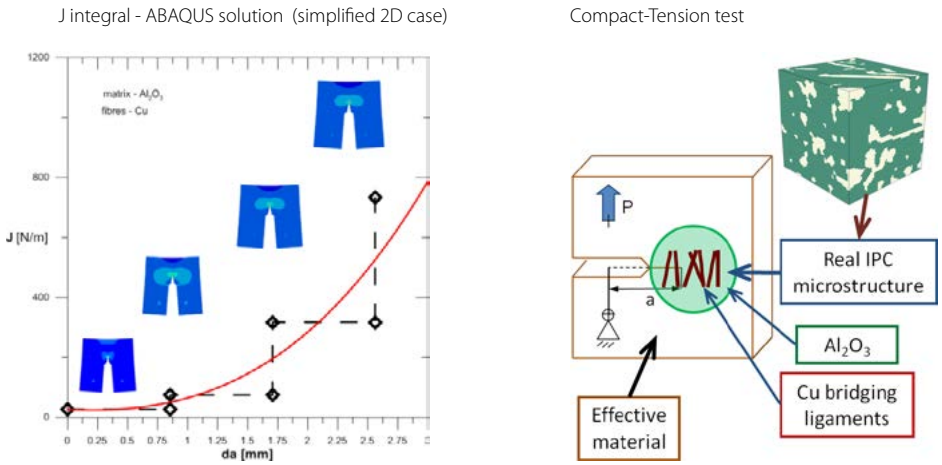


Fig.4.3.1. Compact-tension test model describing fracture behaviour of an interpenetrating phase composite

Micromechanical modelling of composite materials

Micromechanics provides the link between the microstructure, microscopic interaction mechanisms and macroscopic properties of heterogeneous materials, and thus it is a perfect tool for modelling of composite materials. As an application, classical mean-field approaches have been applied to predict thermomechanical properties of copper-graphene composites and to study the effect of out-of-plane properties of graphene platelets. Predictions of mean-field and computational homogenisation approaches have been compared for particle-reinforced elastic-viscoplastic composites showing that the former, though much simpler, are capable of accurately describing both macroscopic and local response on cyclic loading paths. The predictive capabilities of micromechanical models have also been used for multi-objective optimisation of thermomechanical properties of metal-ceramic composites.

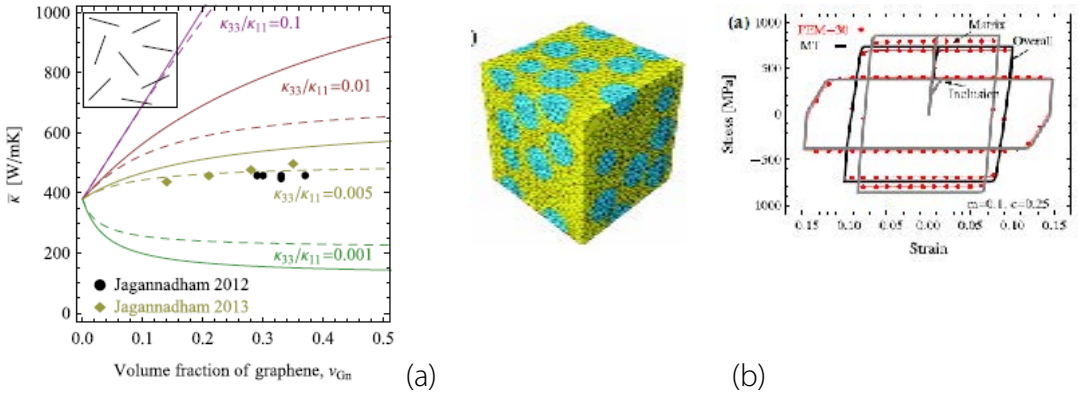


Fig. 4.3.2. Micromechanical modelling of composites: a) cooper-graphene and b) metal-ceramic

Modelling and simulation of ceramic powder compaction

Ceramic powder compaction, which is one of the essential steps in ceramic technologies, is accompanied by drastic changes of overall properties of the material during the process. Adequate modelling of plastic hardening and the related elasto-plastic coupling still constitutes a challenge, particularly if large deformations are additionally accounted for. An advanced model of ceramic powder compaction has been generalised to the finite deformation regime. Efficient computational algorithms have also been developed that allow application of the model in finite element simulations of ceramic powder forming processes.

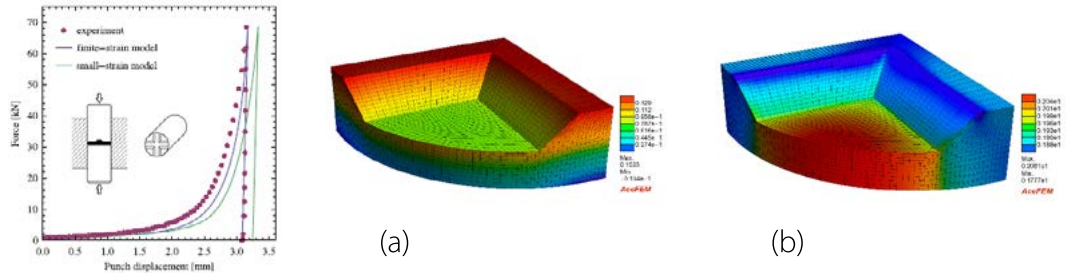


Fig. 4.3.3. Finite element simulation of compaction of cross-shaped piece (one quarter shown):
a) density after spring-back, b) vertical displacement during spring-back

Reconstruction methods of foams and cellular materials structure

Two numerical models of materials structure have been developed: a) based on the impacted bubbles simulation resulting in random cell structure, b) based on the CT image analysis revealing the real structure of the cellular skeleton.

a) random cell structure

b) CT - convex cell structure

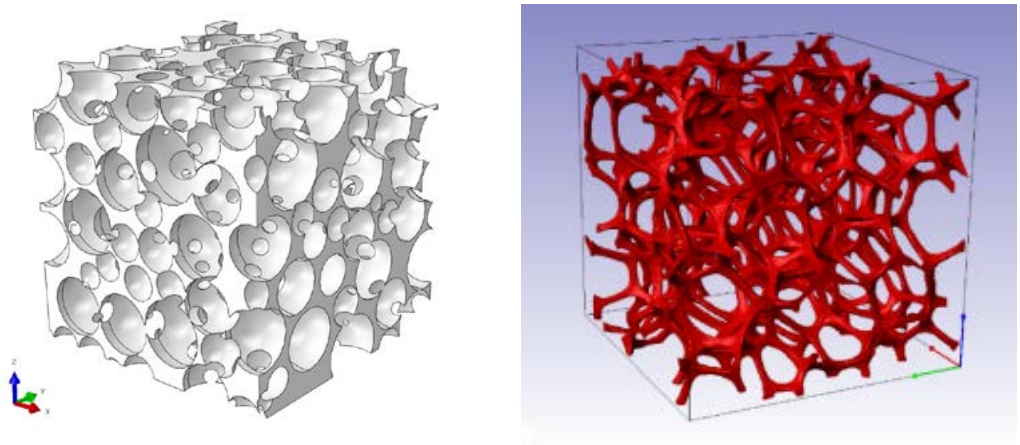


Fig. 4.3.4. Examples of reconstructed cell structures

The presented results found the application in the design of composites produced in the infiltration process of a molten metal or polymers into a porous ceramic preform. The other application concerns the novel technologies of manufacturing functional materials. A new method of computer-aided design of foams and cellular materials with desired properties has been elaborated as an innovative solution to the commercialisation procedure for closed and open-cell foams with convex or re-entrant cell structure. The material of the skeleton can be polymer, ceramic or any metallic solid. The workflow for the preparation of final input file for manufacturer to obtain the foams or cellular materials with tailored properties was proposed.

Micromechanics of contact phenomena

Contact phenomena, such as friction, wear, lubrication, heat transfer, are governed by local interactions at the scale of surface asperities. Micromechanics, which provides the link between the macroscopic properties and microscopic interaction mechanisms, is a natural approach to develop refined models of these phenomena. Accordingly, contact homogenisation approaches have been derived that rely on formulating and solving microscopic boundary value problems which are formulated for representative unit cells of rough interfaces with underlying contact layers. Recent applications of the micromechanical approach include the analysis of friction anisotropy resulting from roughness anisotropy and the multiscale modelling of thin-film elastohydrodynamic lubrication in soft contacts.

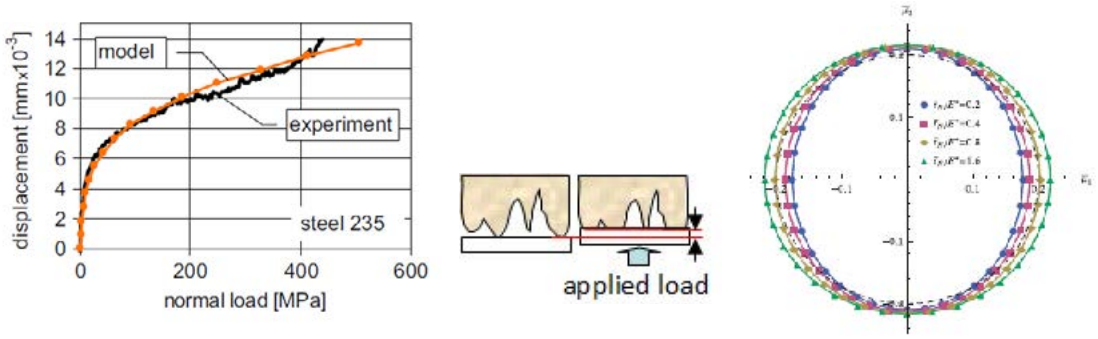


Fig. 4.3.5. a) Experimental and numerical results of asperity flattening, b) friction anisotropy prediction

Identification of material properties by means of micro- and nano- indentation tests

The indentation test is used to investigate the mechanical properties of material at different length scales. The identification methods based on micro- and nanoindentation tests have been developed that enable specification of the work hardening curve and anisotropy coefficients for a small amount of bulk material or a thin layer. In those methods, the mechanical response of material is represented by load-penetration curves and complex residual imprint topography. The current research is focused on analysis of the differences of material response at micro, nano and ultra-nano observation scales.

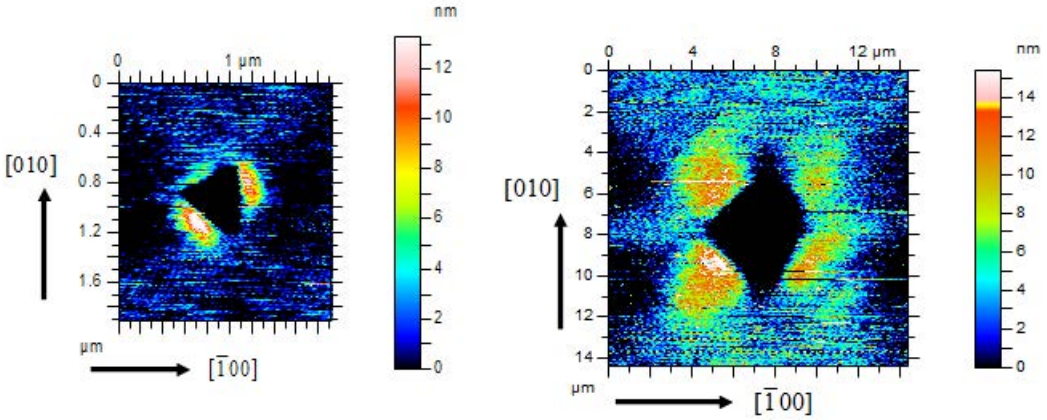


Fig. 4.3.6. Different characters of Berkovich tip impression in copper single crystal: a) low penetration depth (70nm), b) large penetration depth (700 nm)

Generation of thin surface layers by means of ion beam techniques

The ion implantation technology is applied to produce thin surface layers (<600 nm) that are fatigue and corrosion resistant. There are new perspectives for bio-medical application of implanted layers, e.g., surface treatment of bone implants. The implanted gradient layers are developed on modern materials (shape memory alloys, high speed steels, Ti alloys). Recently, the mechanical properties (hardness, fatigue, and wear and corrosion resistance) of implanted structural elements have been investigated in cooperation with other research institutions.

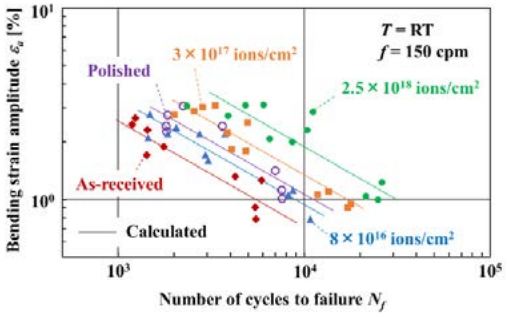


Fig. 4.3.7. Effect of ion implantation on fatigue life of shape memory alloy

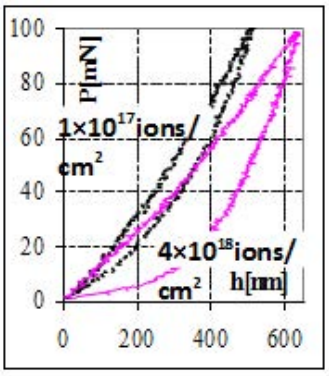


Fig. 4.3.8. Change of pseudo-elastic effect in thin layer implanted on shape memory alloy

Characterisation of adhesive layer in metal matrix composite

The method has been proposed for measurement of the adhesion force and fracture strength of the interface between ceramic particles and metal matrix in ceramic reinforced metal matrix composites. The micro-wires (~20μm of diameter) that contain a few ceramic particles were produced by means of electro-etching and then tested with the use of the unique microtensile tester. The micro-wires usually break exactly at the metal-ceramic interface.

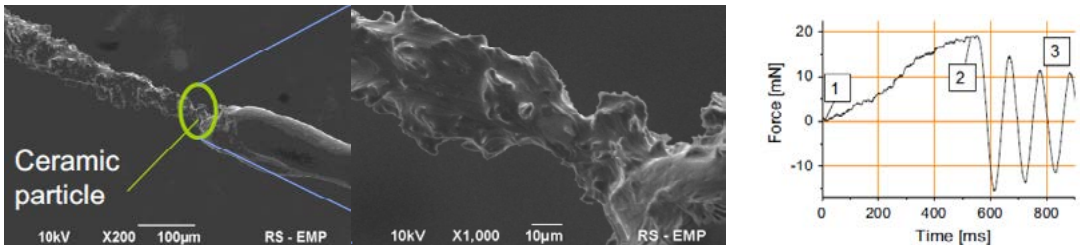


Fig. 4.3.9. Images of microwire before the experiment using a unique microtensile tester (right figure)

Modelling of crystalline metals at large plastic deformation

A new constitutive algorithm for the rate-independent crystal plasticity at large deformation has been developed by using the incremental work minimisation for selecting active slip-systems and determining the incremental slips. Effectiveness of the algorithm has been demonstrated by the examples of simple shear of a face-centered cubic crystal and rolling texture in a polycrystal. The effects of deformation path on the texture in the ultra-fine grained material obtained after severe plastic deformation processing have been simulated numerically using the self-consistent viscoplastic method of grain-to-polycrystal scale transition. The basic components of the experimentally observed texture are reasonably well reproduced in the modelling.

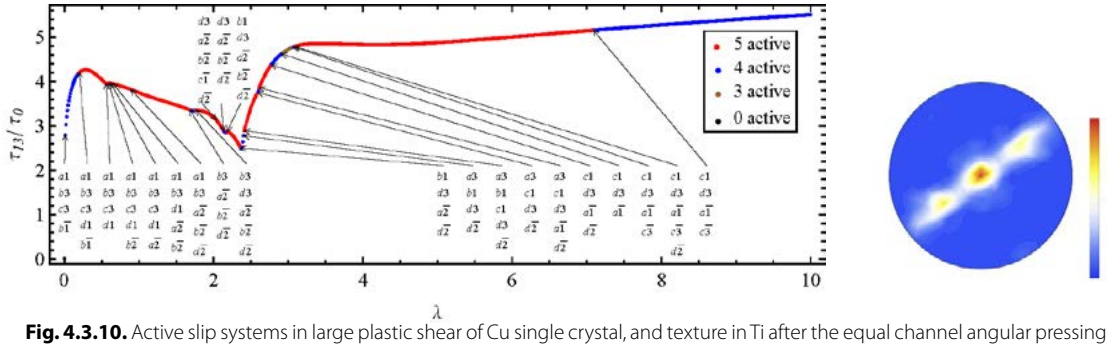


Fig. 4.3.10. Active slip systems in large plastic shear of Cu single crystal, and texture in Ti after the equal channel angular pressing (ECAP) process

Experimental analysis of mechanical and thermal fields at micro- and macro-scales

The macroscopic behaviour of materials during deformation processes is a result of structural changes at the level of the microstructure. The current research is focused on the experimental analysis of mechanical and thermal fields during deformation of crystalline materials in both macro- and microscale. The coupled displacement and temperature fields are determined using non-contact optical methods, i.e., digital image correlation (DIC) and infrared thermography (IRT). One of the tasks is to determine the relation between the energy dissipated as heat and crystallographic orientation of the deformed material.

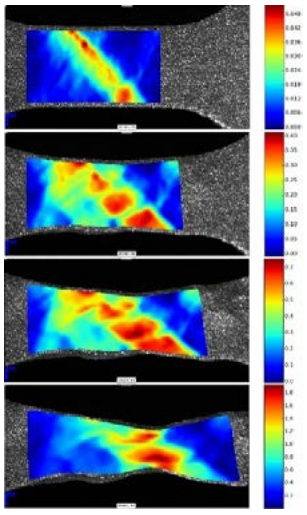


Fig. 4.3.11. Evolution of the strain field during uniaxial tension of Al multicrystal

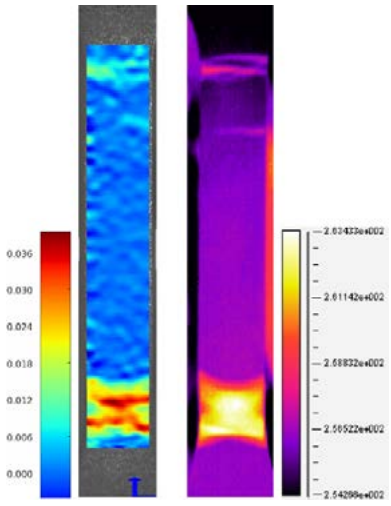


Fig. 4.3.12. Analysis of strain localisation in steel using digital image correlation (left) and infrared thermography (right)

4.4. DEPARTMENT OF INTELLIGENT TECHNOLOGIES

Structural health monitoring (SHM)

An SHM system implements a damage identification strategy for a civil, aerospace or mechanical structure based on measured structural responses. The damage is defined as a change in the material or geometric properties of the system that influences its current or future performance. Many failures of real engineering facilities start with a deterioration of structural joints. Therefore, it is important to identify their defect as early as possible. Figure 4.4.1 compares frequency response functions obtained for the same lab-scale frame structure with healthy and damaged joints; perturbations are revealed in a narrow frequency band. Another activity is focused on developing of a monitoring system for bridges with the spans exceeding 30 m. The main task is to develop an integrated transducer for indirect measurement of displacement under dynamic loads, based on a data fusion approach (inclinometers, accelerometers, and strain gauges).

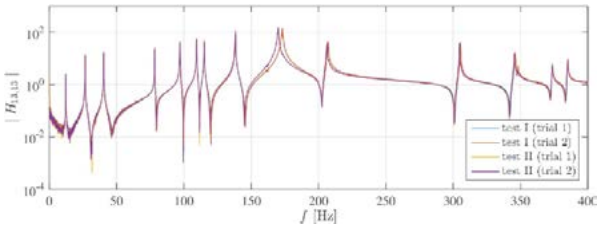


Fig. 4.4.1. Frequency response functions of a lab-scale frame structure with healthy and damaged joints

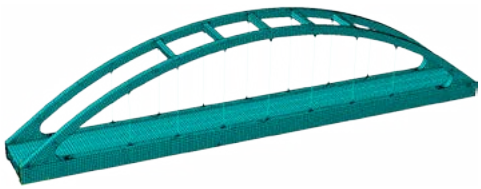


Fig. 4.4.2. A numerical model of the 52 meter long bridge over Pilica river

Adaptive inflatable structures (AIS)

Increasing safety standards requires innovative solutions for efficient absorption of impact loadings. Adaptive inflatable structures (AIS) are rigid or deformable structures divided into sealed chambers filled with compressed gas and equipped with fast inflators and controllable discharge valves. Adaptation of such pneumatic structure for an impact is performed in two stages. After the impact detection and identification, each chamber is inflated to the optimal initial pressure to ensure the optimal initial stiffness of the structure. Then, during the impact process, the valves manage the flow of the gas between the chambers and to the environment. This way, the pressure inside the structure can be controlled in order to adjust its dynamic characteristics to the recognised impact scenario. Such a control methodology can be implemented by the innovative high performance valves we develop: a bistable valve, which utilises the elastic snap-through effect, and a flow-driven dual membrane valve (Fig. 4.4.3 and Fig. 4.4.9). The patent-protected operating principles of both valves are completely novel and substantially different from the other currently applied solutions.

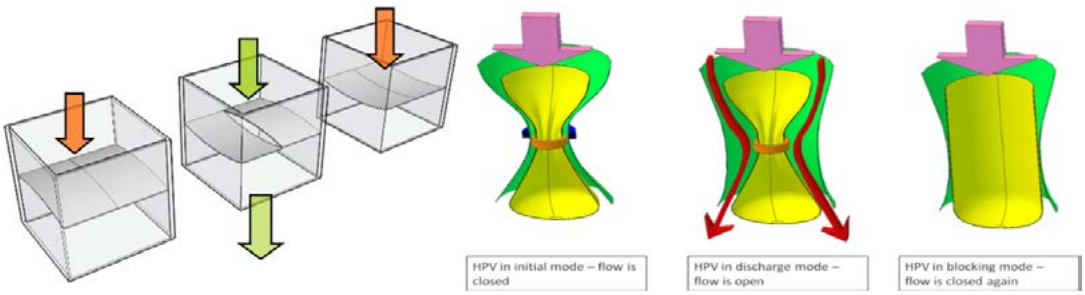


Fig. 4.4.3. The investigated valves: a bistable valve (left) and a membrane valve (right)

Dynamics of the rotating machinery and electro-mechanical coupling of vibrations

Currently, a process of a significant rise of nominal rotational speeds of rotating machinery, reaching even 100 000 rpm, is observed. Such speeds require deep knowledge of rotor dynamics as well as advanced models and efficient computational techniques. Here, the investigations are focused on new active and passive touchless bearing support technologies and dynamic unbalance identification. The main objects of research are high-speed rotor-shafts of gas turbines, turbochargers as well as of beater mills and crushers. Transient and steady-state operation properties of drive systems are also significantly influenced by the electro-mechanical coupling between the mechanical vibrations of the shafts and the electrical vibrations in the driving motors. The dynamic behaviors of the mechanical and electrical parts should be considered simultaneously for effective minimisation of oscillation amplitudes of the entire electromechanical systems and to reduce the associated noise level.

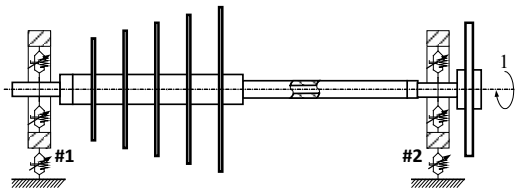


Fig. 4.4.4. Hybrid model of the single-spool gas turbine rotor-shaft-bearing system

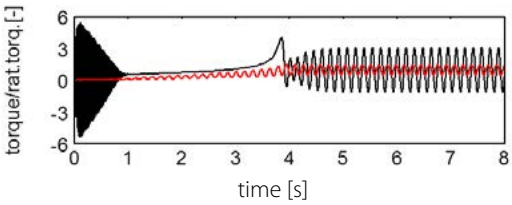


Fig. 4.4.5. Dynamic transient response of the coupled electromechanical system

Dynamics of railway infrastructures

The cost of maintenance and the safety of railway operations depend on the vehicle-track interaction. The dynamic behavior of train-track systems must be thus investigated and improved. High speed trains with an increasing weight adversely affect the environment, increase noise and paraseismic vibrations, and damage vulnerable historic buildings. The generated vibrations cause corrugations of wheels and rails, ballast deterioration, wear, a squealing or grumbling noise, etc. We develop vehicle-track interaction models and adaptive control technologies. The aim is to reduce deflections and accelerations, increase the load carrying capacity, decrease the fatigue and the energy consumption and modern technologies can prevent these harmful factors. Our present goal is to develop a state feedback control strategy that is relatively insensitive to changes of system parameters and simple for practical and easy implementation, including the design of the controller's distributed architecture for easier assembly and maintenance.

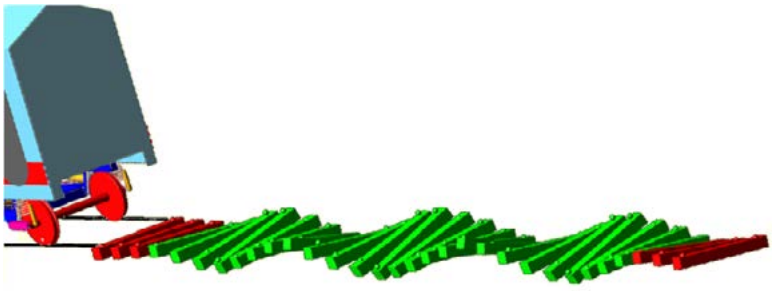


Fig. 4.4.6. Dynamic phenomena in railway infrastructures

Fig. 4.4.7. Control of structures subjected to traveling loads

Vibroacoustics of sound absorbing porous media

We research active, passive and adaptive systems for noise reduction. This requires modelling and design of materials for sound absorption and acoustic insulation, including porous media such as foams, fibrous and granular materials, which usually possess excellent sound proofing characteristics. Rigid-frame models and dual-phase poro-elastic models are applied to optimise the designs of porous composites with embedded passive and active piezoelectric elements for improved acoustic insulation. Effective macroscopic characteristics are derived from the very microstructure of the porous medium using the homogenisation approach, periodic representative volume elements and finite element analyses of the viscous flow, heat transfer, and electric conduction. Inverse techniques for identification of micro-geometrical parameters, based on the acoustical measurements, are developed and should become useful also in other fields involving porous media, including bio-engineering, medicine and geotechnics.

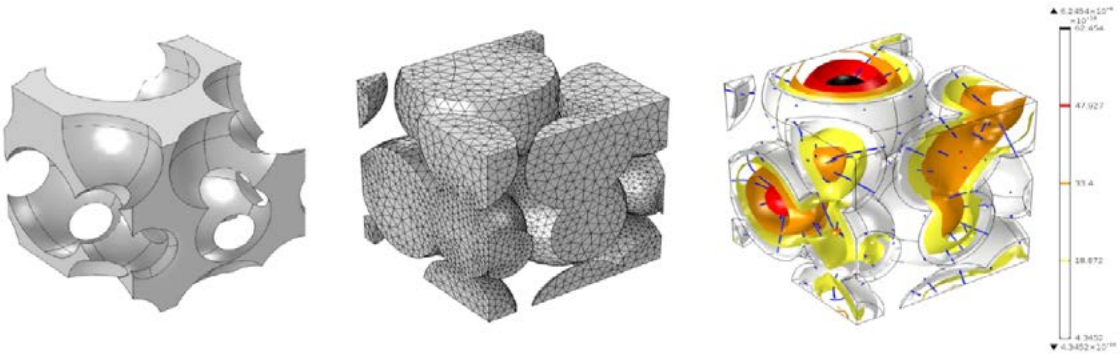


Fig. 4.4.8. A randomly generated representative volume element for foam with open porosity of 70%: the periodic skeleton, the finite element mesh on the fluid domain, and the thermal permeability field

Mobile robotics

Navigation is required for any autonomous device which controls its movement in some kind of environment. Today, there is a tremendous growth of practical application of such devices, ranging from robotic vacuum cleaners, through mobile robots to driverless cars or unmanned aerial vehicles. Any such device uses its sensors to position itself on a map, which is its internal representation of the environment. Such maps can be created during movement, known as simultaneous localisation and mapping (SLAM). We work on SLAM techniques for a variety of devices: mobile robots, unmanned vehicles, portable platforms for building environmental maps, aerial vehicles used to create 3D models of various structures, etc. Such devices are equipped with sensors such as laser range finders, visual cameras, inertial measurement units, GPS, and accelerometers. Our aim is to efficiently gather and process all the data to obtain the maps and positions with desired accuracy.

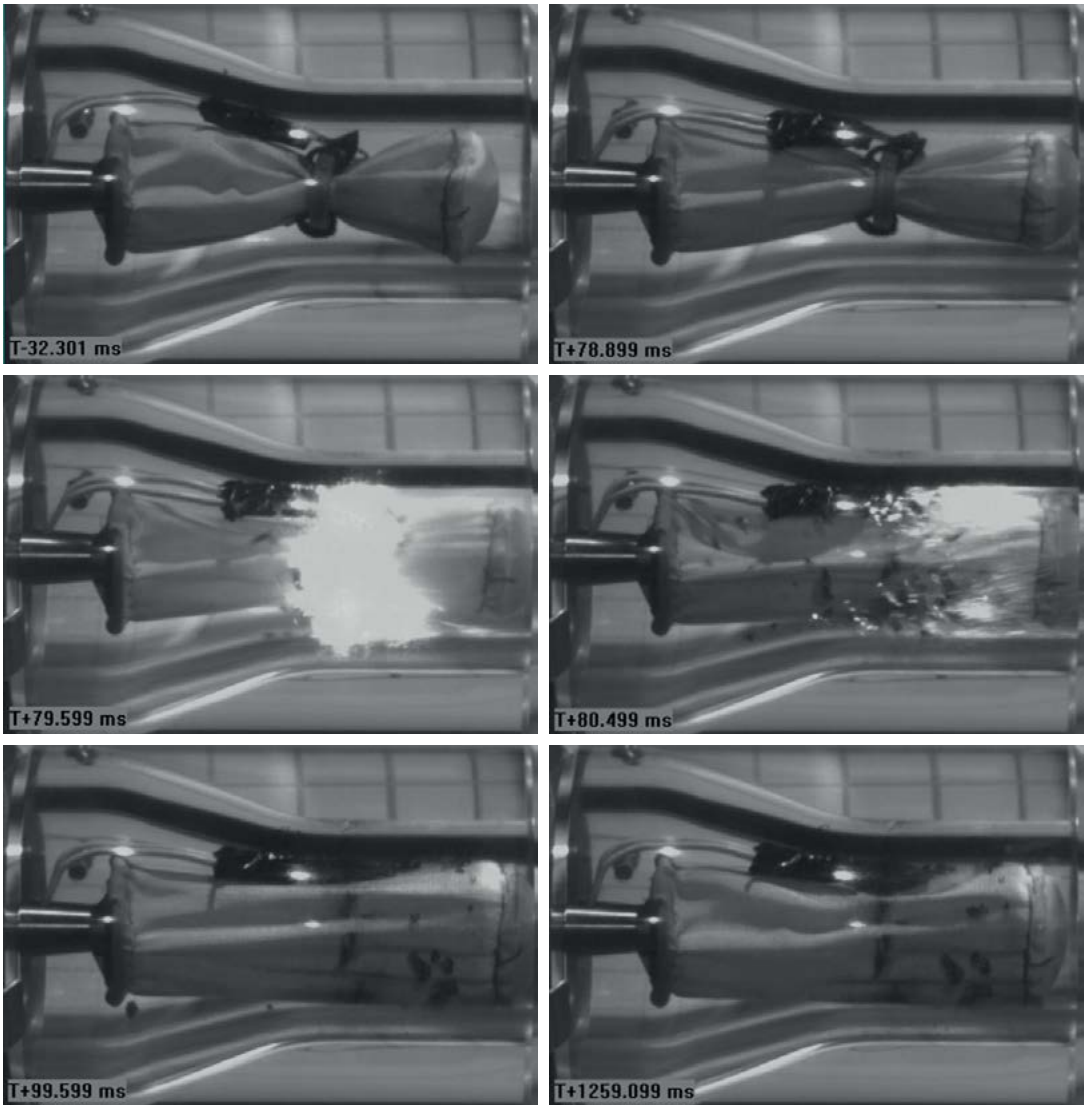


Fig. 4.4.9. Fast-camera recorded sequence of operation of a laboratory model of the membrane valve

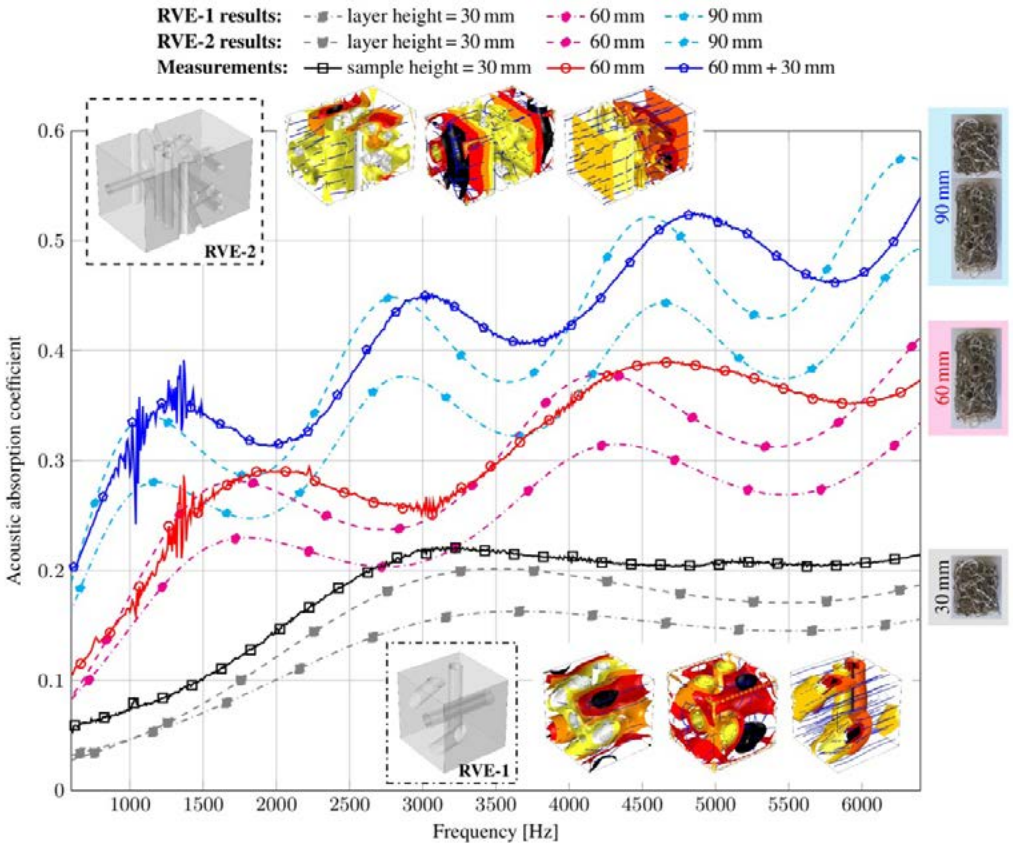


Fig. 4.4.10. Sound absorption measured for two fibrous samples and the corresponding curves calculated from the multi-scale numerical analyses based on two periodic representative volume elements proposed for the fibrous microstructure: RVE-1 (with a weak representation of three straight fibres) and RVE-2 (better representation with grouped fibres as in real samples)

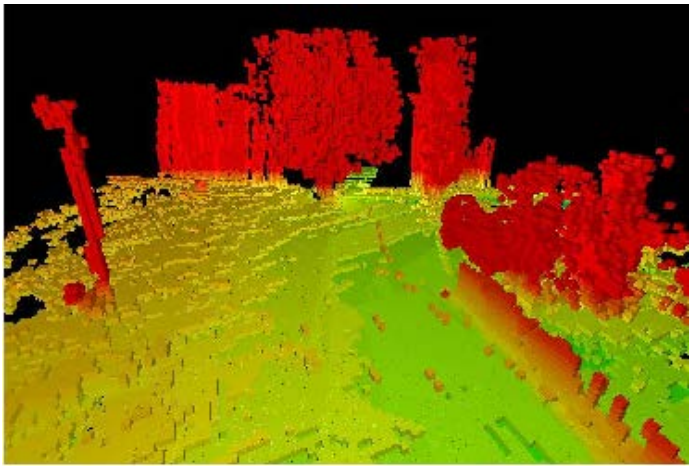


Fig. 4.4.11. A 3D representation of the environment of an unmanned vehicle. The red color denotes the obstacles (a part of a streetlight on the left, a tree and a part of a building in the centre, a fence with some plants be hind it on the right)

4.5. DEPARTMENT OF ULTRASOUND

Differentiation of benign and malignant lesions in skin and breast

The main goal of this research was to find the robust ultrasonic algorithm allowing for unambiguous differentiation of the precancerous state (actinic keratosis) and the cancerous lesions basal cell carcinoma. The analysis of the skin's backscattered signals showed that multiparametric approach is able to characterise the state of the skin tissues. The statistical analysis – the K and Nakagami distributions– of the skin radio frequency (RF) echoes together with the attenuation distribution allowed to determine the state of skin with the accuracy equal to 100%.

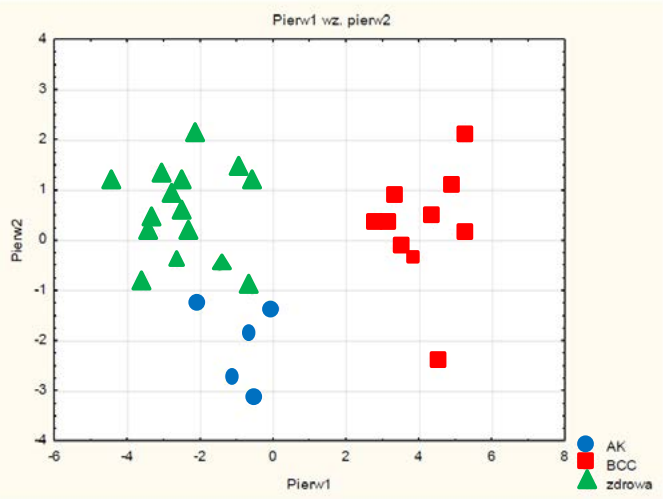


Fig. 4.5.1. Scatter plot of the canonical variables obtained as a result of the performed canonical correlation analysis of parameters (attenuation coefficient and effective number of scatterers) which were determined for healthy skin (green marker), basal cell carcinoma (red marker) and actinic keratosis (blue marker)

Figure 4.5.1 presents the scatter plot of the canonical variables obtained as a result of the performed canonical correlation analysis of the determined parameters (for K distribution, the shape parameter – effective number of scatterers and the values of attenuation coefficient). Additionally, in our dermatological project, the parametric maps were created and analysed. The examples of the images, which show the distribution of the attenuation and the value of the shape parameter of the Nakagami distribution in the skin with melanoma, are shown below (Fig. 4.5.2).

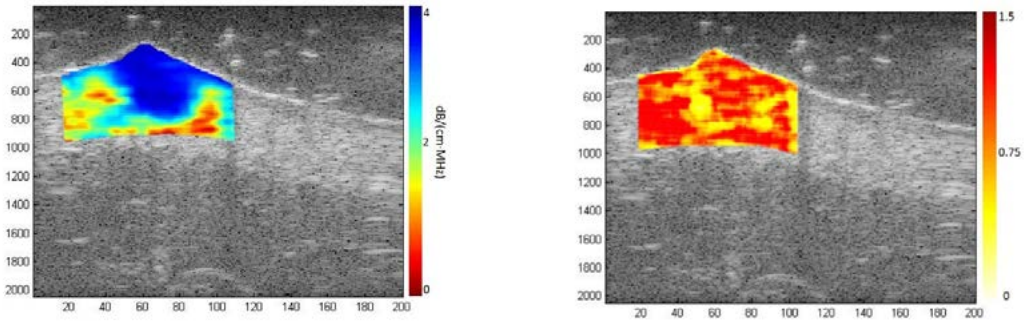


Fig. 4.5.2. The parameter images were generated using a square sliding window to process the signals of the whole region of interest (ROI): a) attenuation image; cancerous lesion in blue, b) Nakagami image; low value of Nakagami distribution (in yellow to orange) is characteristic for cancerous lesion

The statistical analysis of ultrasound (US) RF images of breast is considered as an important factor in differentiation of various types of the breast lesions. The preliminary results confirm the value of quantitative US in diagnosing malignant and/or benign breast lesions and may contribute to decrease the number of biopsies in the group of patients with benign lesions. The analysis of signals was performed by modelling the statistics of US RF echoes using two probability density functions: K and Nakagami distributions. The results were analysed taking into account the quantitative US and BIRADS scale classification. The group of 163 women with 199 lesions was examined and the results were very encouraging. It was proved that this new approach could decrease even up to 33% the number of biopsied lesions, when the multiparametric analysis was used in comparison to the number of biopsies designated on the US B-mode imaging only. Quantitative analysis, which complements conventional B-mode imaging, has the potential of providing key imaging signatures for the ultrasonic characterisation of lesions in the breast. These procedures remove measurement artifacts and provide objective quantitative descriptions of tissue microstructure. The pilot study demonstrated its clinical feasibility and showed significant differences in values of parameters determined for the breast and skin tissues in the various histological states. Therefore, quantitative US may provide a useful, low-cost tool for initial assessment of the type of lesion.

Table 4.5.1. Statistical analysis of BIRADS classification and combined model (BIRADS + quantitative ultrasounds QUS) for the diagnosis of malignant and benign lesions

	Sensitivity %	Specificity %	ACC
BIRADS	100%	60.31%	73.87%
BIRADS +QUS	89.71%	93.13%	91.96%

The effect of sonodynamic therapy on the viability of RG2 rat glioma cells

Sonodynamic therapy (SDT) is a promising technique based on the ability of certain substances, called sonosensitisers, to sensitise cancer cells to non-thermal effects of low- energy US waves, allowing their destruction. Sonosensitisation is thought to induce cell death by direct effects such as cavitation and by complementary chemical reactions generating oxygen free radicals. One of the promising sonosensitisers is 5-aminolevulinic acid (ALA) which upon its selective uptake by cancer cells is metabolised to and accumulated as protoporphyrin IX. The objective of this study was to describe ALA-mediated sonodynamic effects in vitro on a RG2 rat glioma cell line. Glioma cells, seeded at the bottom of 96-well plates and incubated with ALA (10 μg/mL) for 6 h, were exposed to the sinusoidal US pulses with a resonance frequency of 1 MHz, 1000 μs duration, 0.4 duty-cycle, and average acoustic power varying from 2 W to 6 W. Ultrasound waves were generated by a flat circular piezoelectric transducer with a diameter of 25 mm. Cell viability was determined by the MTT assay. The structural cellular changes were visualised with a fluorescence microscope. Signs of cytotoxicity such as decrease in cell viability, chromatin condensation and apoptosis were found. The ALA-mediated SDT evokes cytotoxic effects of low intensity US on RG2 rat glioma cells in vitro. At an ultrasound exposure of 2 W and 4 W, the cell survival exposed group was similar to the reference, indicating no sonosensitisation. At an ultrasound exposure of 6 W, the cytotoxic effect after 24 h was significant, reducing the cell viability to 37%. This cell line is indicated for further preclinical assessment of SDT in the in vivo conditions, Fig. 4.5.3. This work was done in collaboration with the Mossakowski Medical Research Centre, Polish Academy of Sciences, Warsaw.

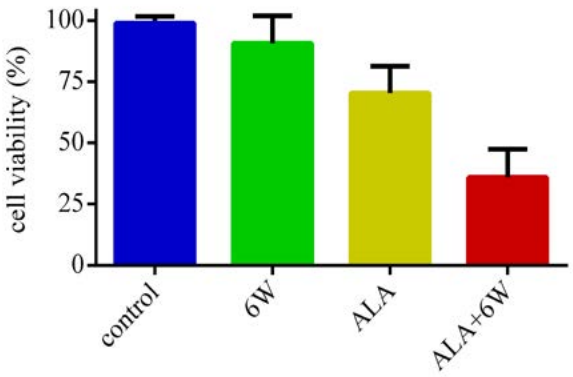


Fig. 4.5.3. Cytotoxic effect of combined ultrasound and 5-aminolevulinic acid (ALA) on RG2 rat glioma cells

Towards enhancement of osteoporosis diagnosis

The lack of adequate means for early detection of bone deterioration is the most critical issue in the problem of diagnosing and monitoring osteoporosis therapy in general and in minimisation of side effects of pharmaceutical treatment on skeletal system. "Bone sonometry" is an accepted technique for diagnosis of osteoporosis. It is based on sound transmission through the examined bone, which enables the determination of the frequency-dependent attenuation coefficient correlating well with bone density. However, the applicability of transmission techniques for in vivo measurements is limited to peripheral bones only, while the most frequent and dangerous osteoporotic fractures of bone occur deep in the body. We have used the scattered waves to the study cancellous bone including bones located deep in the body, inaccessible so far for ultrasonic testing. The existence of the cortical shell, however, can substantially reduce the accuracy of the measurements. For reliable assessments of trabecular bone quality it is necessary to take cortical bone properties into account and to correct the impact of this layer on the ultrasonic echoes. The method proposed estimates simultaneously the thickness of the cortical bone layer and acoustic wave velocity by fitting the temporal spectrum of the simulated reflected wave to the spectrum of the reflected wave measured experimentally, Fig. 4.5.4.

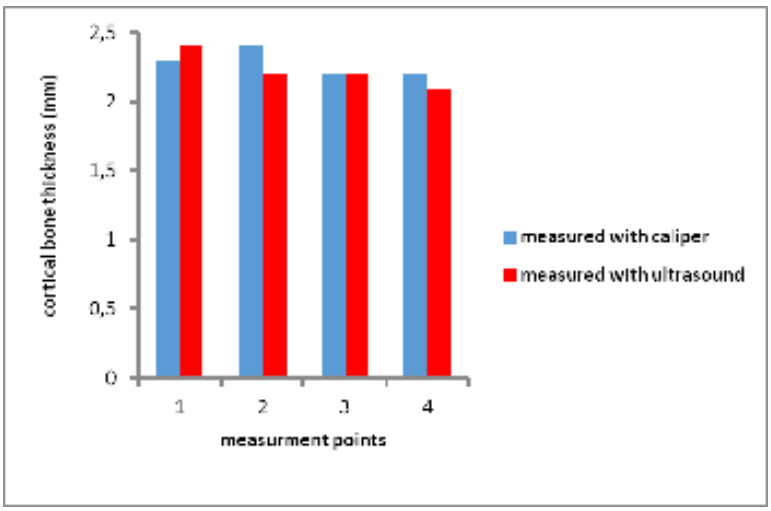


Fig. 4.5.4. Thickness of cortical bone determined with caliper (reference) and US

The method of measurement of cortical bone physical properties can assist diagnosis of bone disease because the thickness of cortical bone has an important diagnostic value. Development of bone deterioration monitoring method will provide a substantial benefit to society by diagnosing patients at risk of increased bone fragility. It will enable intervention to prevent further bone loss and debilitating fracture. This, in turn, will contribute to the reduction of osteoporotic fractures and increase chances of survival of patients.

Endothelial dysfunction – normalisation of the flow mediated radial dilation to the integrated shear rate

The clots forming inside a blood vessel on the ruptured atherosclerotic plaques play the central role in the pathogenesis of the cardiovascular system diseases. The development process of atherosclerosis is preceded by endothelial dysfunction (DS) of blood vessels and the development of a local inflammatory process. It is believed that the endothelium plays a fundamental role in the process of vascular homeostasis - numerous vasoactive substances are released from endothelial cells, including prostacyclin, endothelin, endothelial cell growth factors, interleukins, plasminogen, plasminogen inhibitors and NO. The latter is, perhaps, the main mediator of vasodilation. The extension of the artery due to an increased blood flow (flow mediated dilation- FMD) is a measure of endothelial function. It is believed that endothelial function, enhanced by the FMD correlates well with release of NO. Reduced NO bioavailability becomes the synonymous of endothelial dysfunction. During an FMD test, vasodilation occurs after an acute increase in blood flow, typically induced via circulatory arrest in the arm (ischemia) for 5 minutes. Specifically, this hyperemia increases laminar shear forces parallel to the long axis of the vessel. Percentage change in FMD (% FMD) is determined from a comparison of the reactively dilated artery diameter with a diameter before occlusion.

We developed a new original method of testing a reactive response of radial artery to ischemia using a 20 MHz ultrasound pulsed Doppler flowmeter (PDF) with a resolution of about 0.02 mm. The PDF prototype allows to register the profiles of flow in small vessels (1-3mm) and to determine on that basis the shear rate. The percentage change in FMD diameter is normalised by the integrated shear rate on the vessel wall. The integrated shear value is calculated between the release of the cuff up to the moment in which the radial artery dilation reaches its maximum, Fig. 4.5.5. Research is carried out in cooperation with the Department of Cardiology and Internal Medicine, Military Medical Institute in Warsaw and the Cardiology Department at the Mazowiecki Hospital in Siedlce on the cohort of healthy volunteers and in patients with stable coronary artery disease and in patients with a history of acute coronary syndrome.

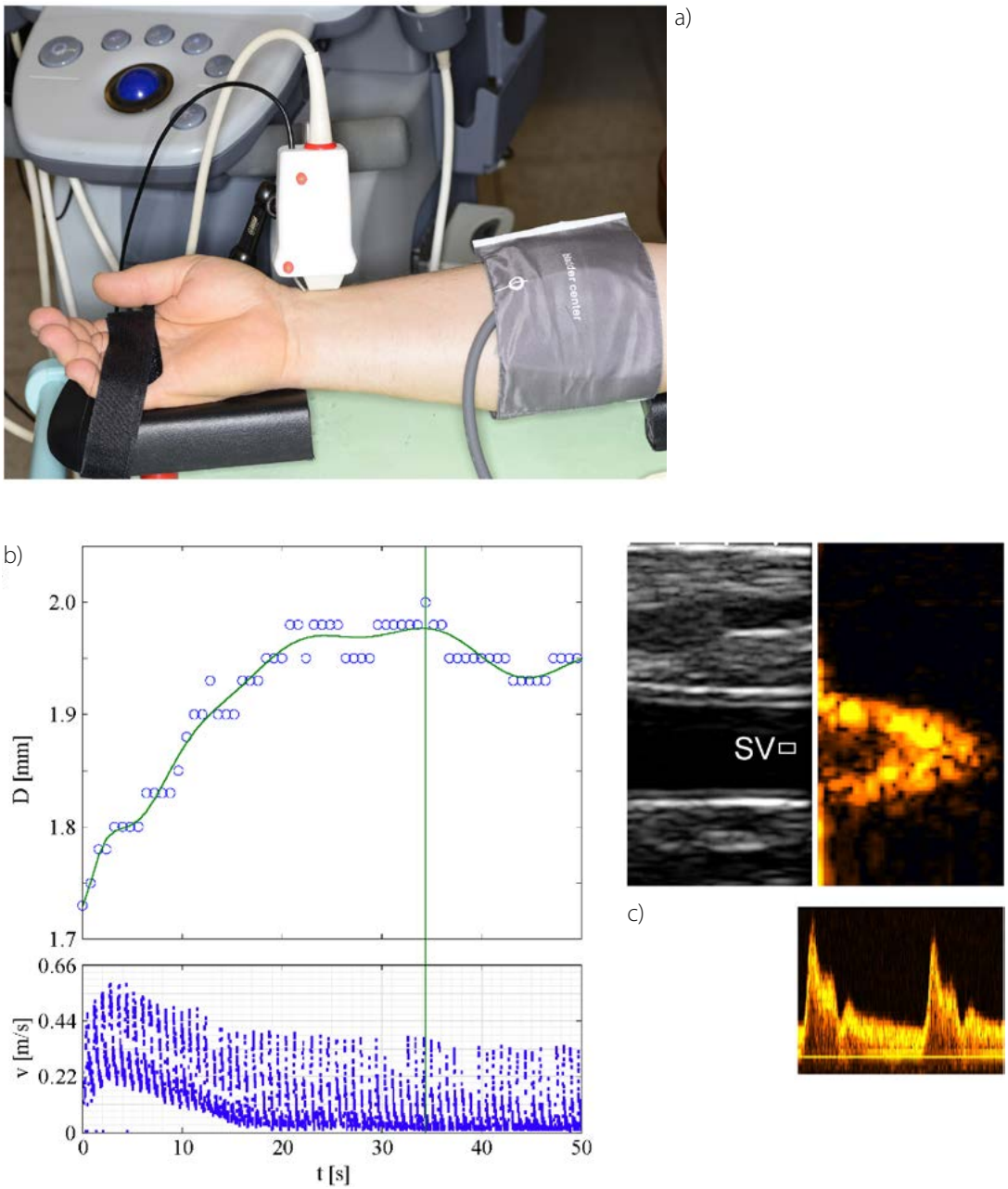


Fig. 4.5.5. The FMD measurement experimental set-up: a) positioning of the ultrasonic probe (20 MHz linear array + 20 MHz pulse Doppler) for measuring the FMD and shear rate in the radial artery, b) B-image, flow profile and middle stream blood flow velocity spectrum in radial artery, c) dilatation and velocity/shear rate recordings after the releasing of the pressure cuff occluding the flow in the arm

4.6. DEPARTMENT OF THEORY OF CONTINUOUS MEDIA

Heat pulse propagation in dielectric crystals

A new phonon gas model is developed to describe propagation of heat pulse in the dielectric crystals. The phonon pulse is considered as a mixture of longitudinal and transverse branches of the phonon gas. One-directional flow is discussed based on the hyperbolic equations of gas hydrodynamics and the equivalent coupled differential equations for the energy densities of longitudinal and transverse phonon branches. With this model, the dispersion relation governing the propagation of complex waves has been studied. It is concluded that the interactions between the longitudinal and transverse branches significantly influence the dependence of the complex wave-number on the angular frequency of plane harmonic waves. With the superposition of the plane harmonic waves, real pulse-like solution is constructed for the phonon hydrodynamics. The features of the energy-pulse profiles determined with this model agree well with the main features of the energy or temperature profiles observed in the heat-pulse experiments. The results yield a new insight in the physics of transient ballistic–diffusive heat conduction with the effects of phonon scattering and provide a tool for studying similar transient ballistic–diffusive heat conduction effects in nanoelectronics and modern optoelectronics.

Optical methods in nano-technology – nanophotonics and plasmonics of metamaterials

The research was directed towards the description of interactions of optical vector vortex beams with planar layered and periodic nanostructures. The beam fields under consideration were mainly Laguerre-Gaussian (LG) beams with complex arguments, known also as elegant LG beams. It was theoretically proved that the beams of this type are normal modes of planar multilayers and because of that their interactions with nanostructures should appear especially efficient in many photonic applications (see Fig. 4.6.1).

These interactions were described by using the cross-polarisation coupling between the orthogonal field components and the spin-orbit conversion between the spin and orbital components of the total angular momentum of the beam. The theoretical derivations showed that new optical vortices of different order ought to be excited in the polarisation field component orthogonal to that of the incident beam. Preliminary numerical simulations were performed for paraxial beams, that is, of a wide cross-section with respect to a field wavelength. They confirmed the theoretical predictions.

However, the detailed inspection of the nanostructure behaviour requires the scale dimension of the beam cross-sections of the order of few wavelengths or less. Therefore, an exact bidirectional extension of the above-mentioned theory of paraxial beams was also given, together with derivation of their separation into the paraxial and nonparaxial field ingredients. Complete description of these narrow elegant beams in cases of linear, circular and polar polarisations was presented, including their vortex and anti-vortex field compositions. The obtained results are of fundamental values and innovative significance, especially in optical communication, metamaterial engineering, nanovisualisation, nanotrapping and self-organisation, as well as in many other branches of applied physics, nanophotonics, nanoelectronics and nanotechnology.

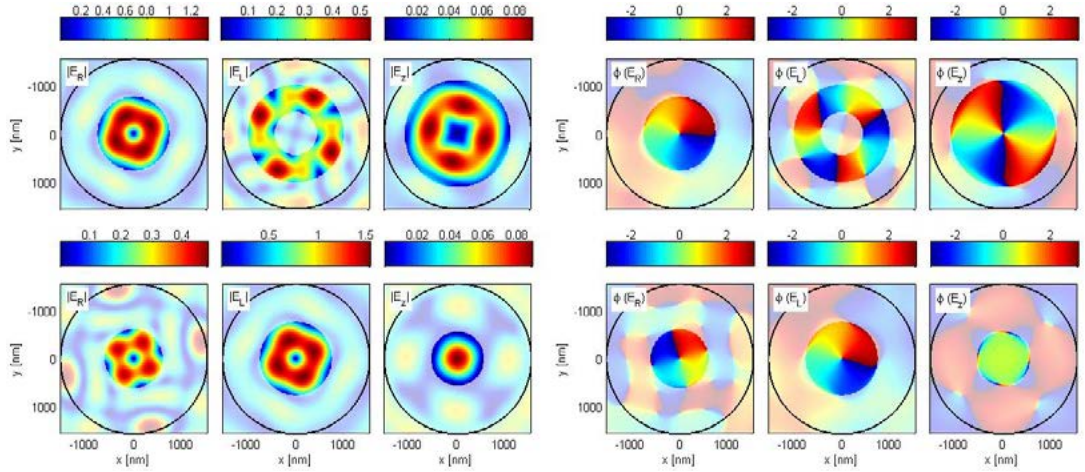


Fig. 4.6.1. Magnitude (on the left) and phase (on the right) of the transmitted field components of the circular-right (R), circular-left (L) and longitudinal (z) polarisation. The field is evaluated in the beam focal plane for normal incidence of the paraxial elegant LG^1_0 beam of R (first row) and L (second row) polarisation. The focal plane coincides with the horizontal plane of the periodic Fresnel zone plate array. Excitation of vortices in the orthogonal to the incident field polarisation is clearly visible

Ultrasonic sensors to study physical properties of liquids

Contemporary civilisation is characterised by a high consumption of energy derived more than 80% from fossil sources (e.g., crude oil, coal). The combustion of these natural raw materials leads to serious environmental problems such as pollution and global warming. In order to overcome these risks, alternative renewable energy sources are searched for. One possibility is the use of biofuels.

Serious drawback of biofuels is the possibility of the occurrence of high-pressure phase transitions. Since in modern injection systems (common rail) for diesel engines the values of pressure above 2000 atm are required, the occurrence of high-phase transitions would result in engine damage. The existence of these high-pressure phase transitions in biofuels has not yet been investigated.

The aim of our work is to validate the high-pressure phase transitions occurrence, and to determine the physicochemical properties of biofuels at high pressures and at various temperatures. Performing these researches at high pressure by using conventional methods is extremely difficult.

To overcome the disadvantages of classical methods, we apply the original ultrasonic methods. These methods (e.g., the measurement of liquid viscosity under high pressure using the Love and Bleustein-Gulyaev (BG) surface acoustic waves) have been developed theoretically and experimentally at IPPT PAN.

The high-pressure method of food preservation and processing is a modern process that has many advantages, e.g., maintenance of the color, taste and aroma, and increase in the product shelf life. Food, subjected to the high-pressure processing, is treated by the high pressure at various temperatures. Knowledge of the physicochemical parameters of processed food products in a wide range of pressures is essential in the design and modelling of high-pressure methods of food processing.

Determination of the physicochemical parameters (by conventional methods) of the investigated foods in the range of high pressures is extremely difficult. The solution to this problem is the use of ultrasonic methods that can determine these parameters in a relatively simple way. Thus, the aim of our research is the modelling, using innovative ultrasonic methods, of changes in physicochemical parameters of food products subjected to high pressure (up to 700 MPa) at various temperatures (Fig. 4.6.2).

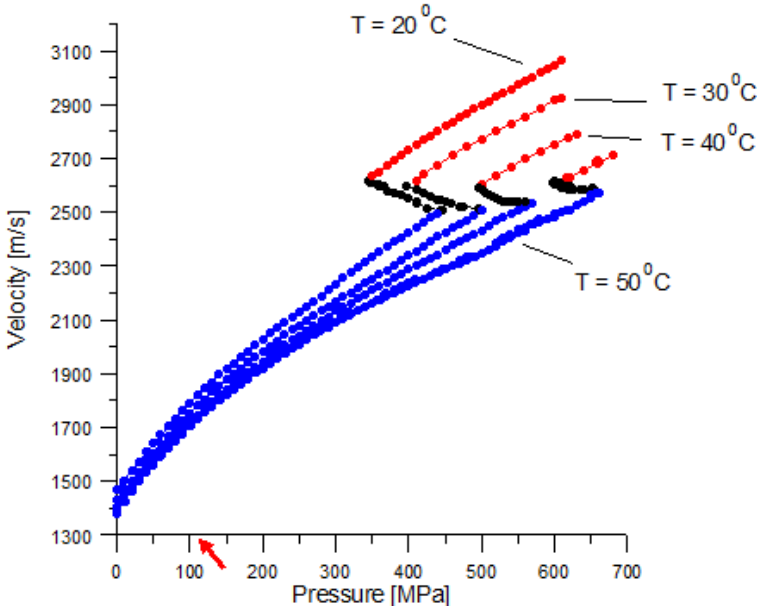


Fig. 4.6.2. Plots of sound velocity in olive oil as a function of pressure along various isotherms (T = 20, 30, 40, and 50 °C). Low-pressure phase of olive oil is marked by blue points. Black points indicate phase transition region. High-pressure phase of olive oil is denoted by red dots. Red arrow indicates the pressure value such as on the bottom of the Mariana Trench

These ultrasonic methods can also find applications in other fields of science, e.g., geophysics and astrophysics: study of the interior of stars and planets of the Solar System and their moons e.g., Europa, Titan, and Ganymede. It is on these moons that the presence of big amounts of liquid water was reported.

Nanofiber scaffolds by electrospinning for tissue engineering

Nowadays, taking into account the evolving challenges of the modern world, our activity is aimed more at the applied research, mostly in the area of bio-medical applications of polymeric materials. One of the important scientific topics referred to is the fast growing area of tissue engineering. Generally speaking, tissue engineering is a relatively new, interdisciplinary branch of science and technology, which combines biology, biotechnology, chemistry, and materials science, aiming to repair or replace portions of or even whole tissues (bone, cartilage, blood vessels, skin, etc.).

Our activity is focused on the tissue engineering related to the biodegradable polymers used as scaffolds for cells/tissues. The aim is the optimisation of the structure and the process of formation of scaffolds for regeneration of various tissues. Our method for scaffold production is electrospinning allowing formation of submicron and nanofibers, mimicking the natural structure of extracellular matrix (ECM). The investigated polymers are biocompatible and biodegradable with time of biodegradation being dependent on a particular application. Synthetic polymers and biopolymers such as collagen, gelatin and chitosan are used.

We are interested in investigations of the effect of electrospinning conditions on morphology/structure of the resulting fibers and nonwovens, having in perspective a more practical aim – the optimisation of materials for tissue engineering applications. Determination of "formation conditions – structure - properties" general relationship for a particular system enables further optimisation of electrospinning

of particular polymeric materials from the perspective of cellular response. We apply this type of analysis to various biodegradable polymers suitable for different tissue types with specific requirements.

We perform electrospinning using different, than commonly used, types of solvents trying to develop the method which is as environment-friendly as possible. This point is important not only for an operator but also for cells being cultivated on scaffolds. So far, we have optimised the process of electrospinning of PCL/gelatin and PCL/collagen nanofibers based on the use of non-toxic, alternative solvents – acetic acid and formic acid. Apart from being less hazardous for the operator, another benefit of the application of these acids is a reduction of manufacturing costs.

Next point is related to investigations of drug delivery systems made of nano- and submicron fibers. When it comes to the most applicable part of our activity, we undertake efforts toward formation of some medical products from biodegradable polymers such as wound healing materials, tendon and ligament prostheses as well as expandable biodegradable external support device mitigating causative factors for early and late graft failure. Our investigations also deal with formation of slowly biodegradable polyurethane fibers. Some efforts in this matter were made in order to improve the control of the morphology of fiber mats. By the use of liquid collectors, we succeeded in obtaining fibers mats in the forms of 2D films or 3D sponge-like structures. The applicative potential of these new tissue engineering polyurethanes was tested during the in vitro studies. Another project in our laboratory is focused on electrospun blends of chitosan and its surface modification by naturally occurring polysaccharides.

In the cooperation with the Nicolaus Copernicus University Collegium Medicum in Bydgoszcz, a scaffold for regeneration of bladder and urinary tract was optimised, which is now subjected to preclinical studies in rats. In addition, together with the Laboratory of Semipermeable Membranes and Bioreactors of the PAS Institute of Biocybernetics and Biomedical Engineering we developed a hybrid material for cartilage regeneration (patent application filed).

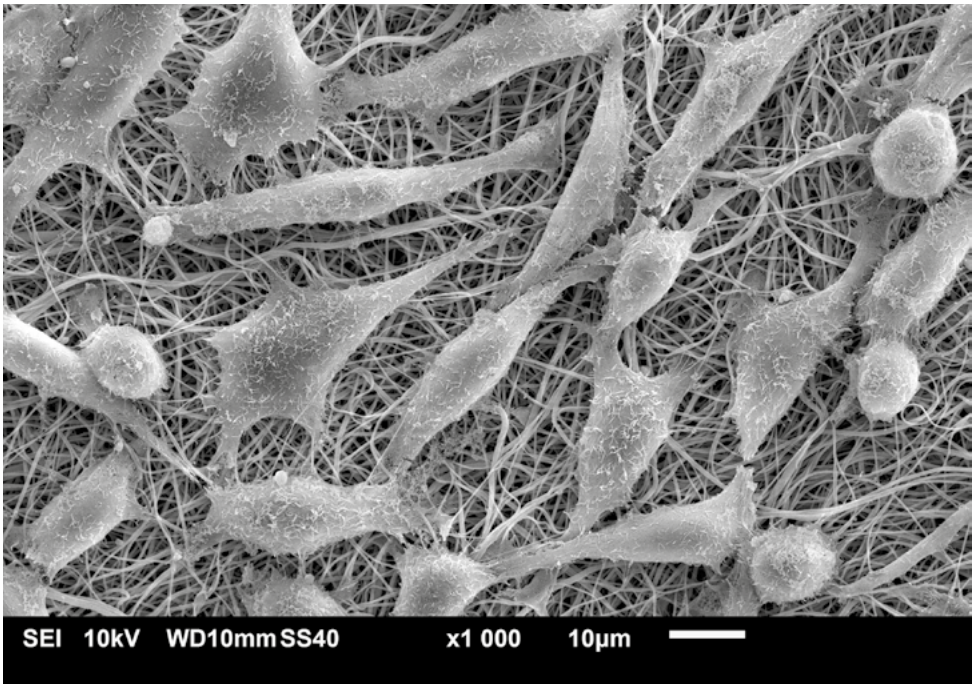


Fig. 4.6.3. Scanning electron microscopy image of mouse fibroblasts cultured on electrospun nanofibrous scaffold material made of polycaprolactone with gelatin

4.7. DEPARTMENT OF STRENGTH OF MATERIALS

The durability of cement-based composites in aggressive environments

The durability of cement-based composites in aggressive environments is studied. The objective is to develop experimental methods for quantitative characterisation of microstructure and to identify its influence on physical/chemical properties of composites. Microscopic methods involving digital image analysis of thin and polished sections are applied to evaluation of porosity, grain size distribution, and identification of reactive phases. Selected soft computing methods, including machine learning and decision trees, are used to generate the rules to predict mechanical properties and long term durability, particularly when by-product components such as calcareous fly ash are used. A close relation between the pore size distribution and the chloride ion diffusion in cement-based composites was found.

The long term performance of cement-based materials in shielding structures in nuclear power plants is investigated within the research consortium "Atomshield", led by IPPT PAN. The objective of this project is to gain an insight into materials aging phenomena and to develop both the criteria for material evaluation and the new material solutions with enhanced radiation shielding capacity. The results are published on the following web page: http://atomshield.ippt.pan.pl. The proposed criteria for the long term service of biological shields are based on the microstructural features of materials, particularly the bound water content and the pore size distribution as well as the water and gas transport properties. The risk of internal damage due to expansive chemical reaction is evaluated and prevented using the developed experimental test method of alkali-silica gel identification (Fig. 4.7.1).

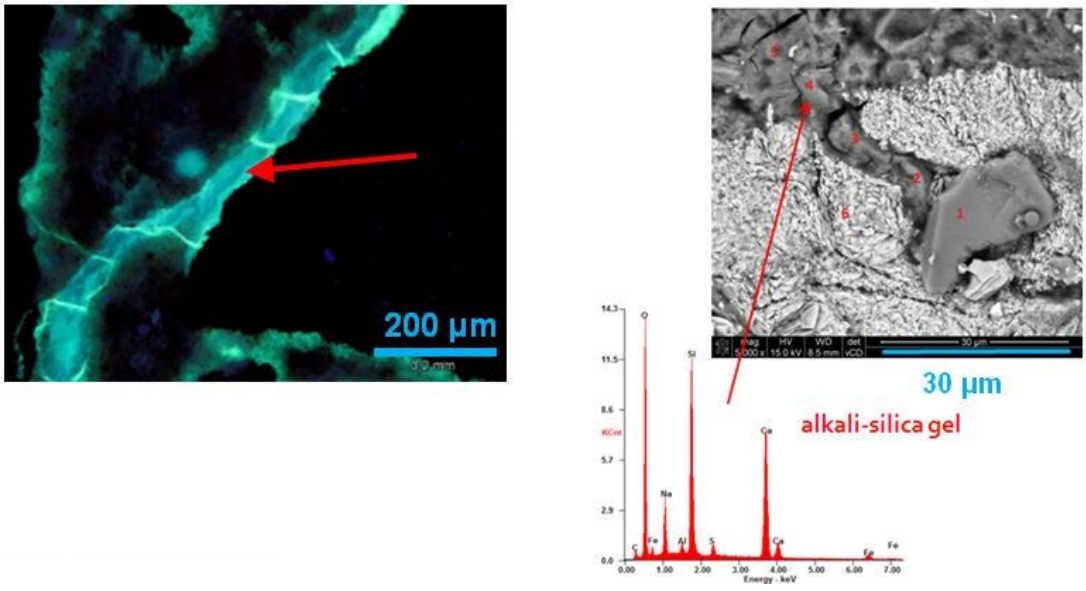


Fig. 4.7.1. Alkali-silica gel observed on thin section in transmitted UV light and in SEM-EDX

Assessments of damage development during fatigue-creep interactions – identification of damage mechanisms

Originality of the approach for damage assessment steams from the fact that both the mechanical investigations for strength parameter determinations and the non-destructive testing for acoustic or magnetic parameters can be carried out parallelly. Such realisation of the testing programmes gives an opportunity to find mutual correlation between both types of parameters for a range of deformation processes taken into account. Moreover, observations on the microscopic level of the tested materials may be conducted for various degrees of damage. This gives additional opportunity of the damage analysis, namely, assessment of mutual correlation between macro and microparameters. Full-field optical techniques such as ESPI and DIC have been implemented for damage development analysis.

The creep and fatigue results are used to verify the fundamental rupture criteria, and, moreover, due to a better understanding of the phenomena observed experimentally , they may be applied to formulate new and more effective criteria capable to capture macro and micro effects. The experimental data obtained during the tests provide a comprehensive source of knowledge that stimulates a theoretical analysis in the field of constitutive modelling of material behaviour under multiaxial stress states after different types of prestraining.

Super-hard thin layers

Super-hard thin layers are widely used in the industry because they increase the reliability and durability of machine parts and tools working in extremely difficult conditions. The most promising new super-hard materials are transition metal borides, and, among them, tungsten borides are one of the most interesting. Therefore tungsten diboride (WB2) and tungsten boride (WB) have been examined as candidates for the superhard layers. The WB2 layers produced by the pulsed laser deposition on Si (100) substrates exhibited excellent hardness of about 50 GPa, but their roughness was high. The WB layers have been deposited by RF magnetron sputtering on Si (100) and 304 stainless steel substrates. The WB layers with a thickness of about 1 μm are dense, uniform and smooth. The X-ray diffraction spectra of WB layers are dominated by (101) reflection and indicate a fine grained structure with a grain size of about 40 nm. These results have been confirmed by transmission electron microscope (Fig. 4.7.2). The WB layers have excellent hardness reaching 70 GPa and reduced Young's modulus above 400 GPa.

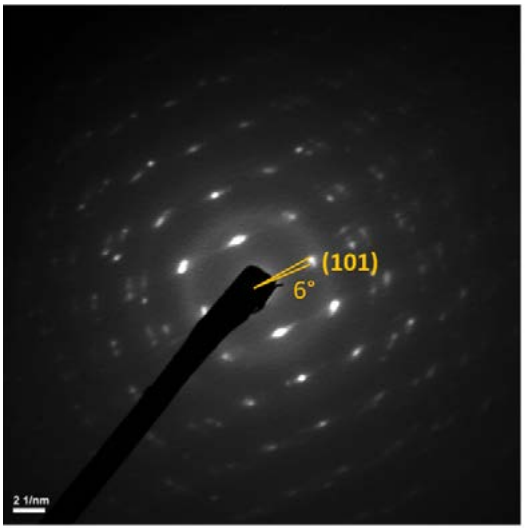


Fig. 4.7.2. Electron diffraction pattern of WB laye

Carbon nanotubes

Carbon nanotubes (CNTs) are among the most promising materials in nanotechnology. A double- pulse Nd:YAG laser, working at a wavelength of 355 or 1064 nm, was used for carbon nanotube production. The synthesised carbon nanotubes (CNTs) were investigated using the SEM/STEM microscopy and Raman spectroscopy. The results show that the useful range of UV laser radiation fluence is narrower and the properties of synthesised CNTs depend much more on the laser fluence than in the case of infrared laser radiation.

Ultrasonic testing of materials subjected to mechanical loads

Material changes in the course of fatigue are evaluated by monitoring velocity and amplitude of ultrasonic waves propagating in the sample material. Ultrasonic pulses are generated and detected by special, small probehead equipped with piezoelectric transducers and operating in transmission mode. Probeheads are fixed to the sample surface and the time of flight between transmitting and receiving probes depends on both the wave velocity changes due to material mechanical properties decrease and the sample elongation due to tensile load. The mode of ultrasonic wave depends on sample dimensions. In samples of rectangular cross-section of 6 x 6 mm times of flight of longitudinal and surface waves are measured. In samples made of thin, 1.5 mm thick plates parameters of Lamb waves are evaluated.

In order to correlate the changes of ultrasonic parameters with the mechanical data such as mechanical hysteresis loop and ratcheting, the ultrasonic and mechanical readings have to be precisely synchronised. To obtain multiple readings during one load cycle ultrasonic devices have to be able to store the full RF signals in a very short time. Therefore, a special electronic equipment has to be used in the measurements.

In the tests performed on flat samples made of metal sheet, damage of material can occur in any location along the sample width. To detect the places of early stages of material degradation optical methods are used. To correlate optical readings with ultrasonic data, times of flight and amplitudes of Lamb waves in such samples are measured along three separated lines spaced by 5 mm as shown in Fig. 4.7.3. Such configuration of ultrasonic probes allows to detect if material damage occurs at the sample edge or in its middle.

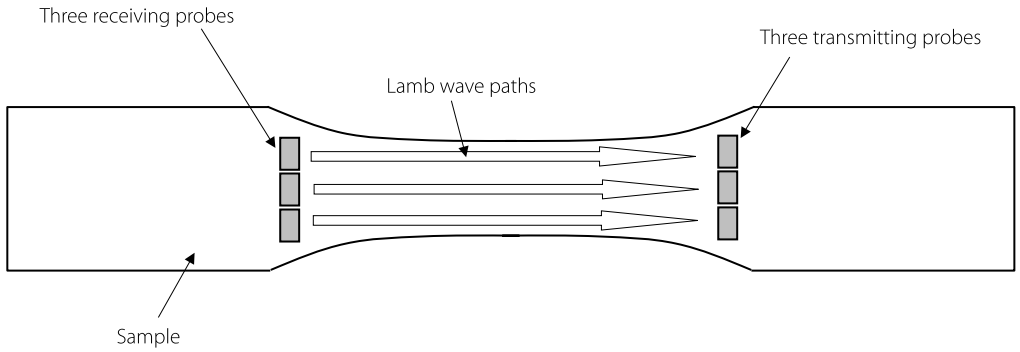


Fig. 4.7.3. Sample with six miniature ultrasonic probe-heads fixed to its surface

Investigation of thermomechanical properties and acoustic emission in shape memory polyurethane and composite

This research covers the unknown effects of thermomechanical couplings in shape memory polymer (SMP) during its loading in various conditions. A comprehensive study, embracing the experimental and theoretical approaches, is carried out in Poland, Japan and Romania. SMP specimens with various values of glass transition temperature Tg responsible for different polymer properties were characterised according to their structural, physical and thermo-mechanical properties. The structure investigation was conducted using dynamic mechanical analysis, ultrasonic testing, electron microscopy and acoustic emission techniques. The SMP specimens (sheets, foils and foams) were subjected to loading within a wide range of strain rates at various temperatures. Tension, cyclic tension as well as thermo-mechanical cyclic load-unload tests were carried out in various conditions, at the temperature below and above Tg. Shape fixity and shape recovery parameters, crucial for SMP applicability, were estimated. Thermoelastic effect was studied and the SMP yield point was identified based on temperature changes obtained using a fast and sensitive infrared camera (Fig. 4.7.4). Strain localisation phenomenon was investigated and found to occur when the SMP elastic deformation range ended. At higher strain rates, the localisation ran more dynamically leading to specimen rupture, while at lower strain rates the effects vanished at higher strains. A constitutive model considering mechanical parameters and related temperature changes was proposed and verified by experimental results.

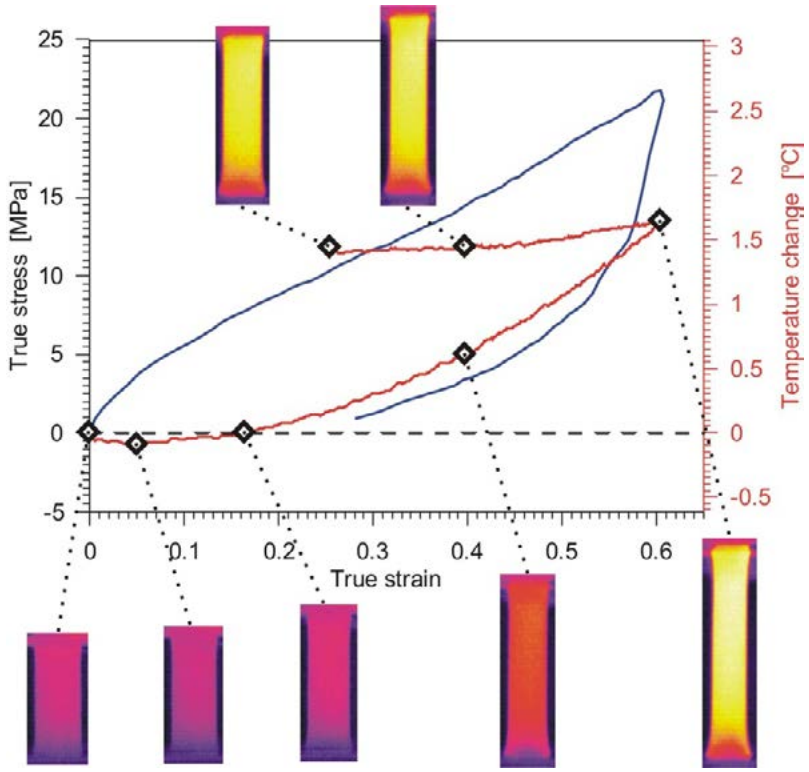


Fig. 4.7.4. Stress and temperature change vs. strain during the SMP (Tg=25°C) loading-unloading cycle at strain rate 2 x 10^0 s^{-1}. In addition, thermal images and sizes of the sample surface corresponding to different strain values are presented

4.8. JOINT LABORATORY OF MULTIFUNCTIONAL MATERIALS

The Biomaterials Group is a research group focused on the investigation and development of advanced materials for medical application. The main aim of the Biomaterials Group is to develop and initiate new technological solutions for biomaterials, implants, tissue engineering products and drug delivery systems for the purpose of treatment of human diseases as well as for improving human health.

The Group's research is concentrated primarily on finding solutions for the cartilage and bone tissue repair and regeneration.

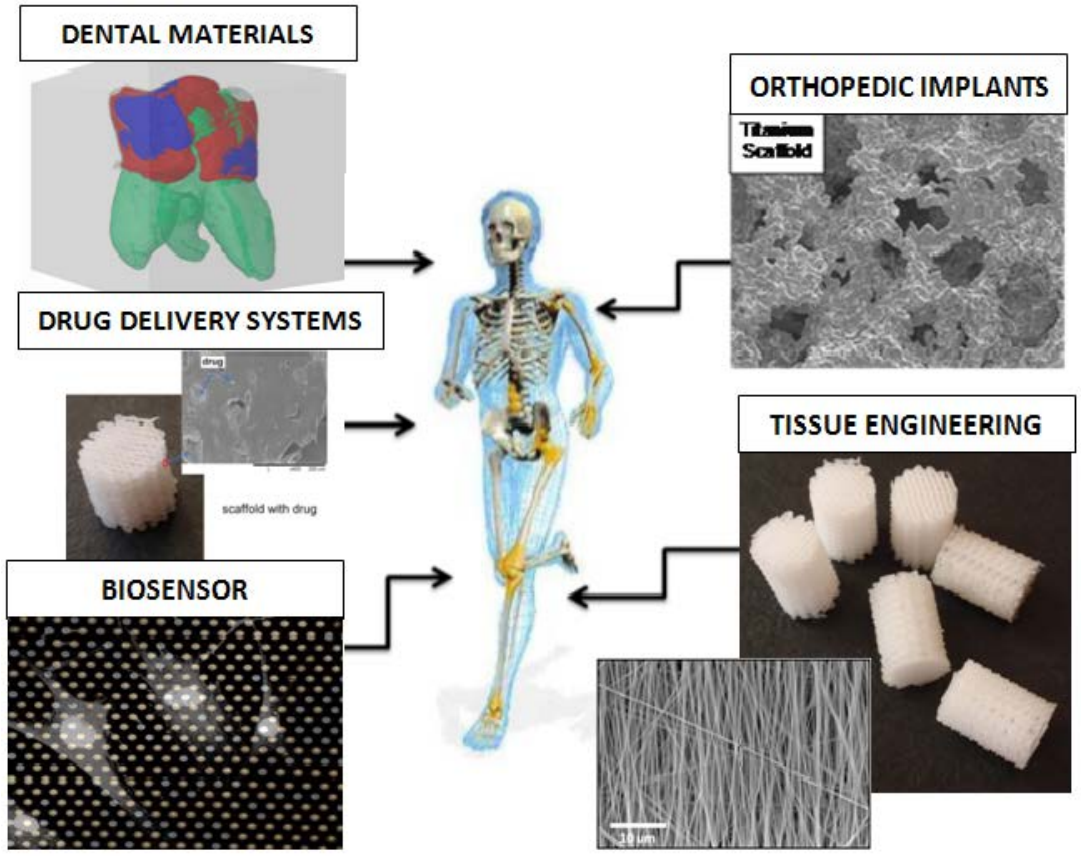


Fig. 4.8.1. Scheme of research interests of the Biomaterials Group

The Group's main areas of strength and interest are the following research topics:

a) Biomaterials and advanced scaffolds for the repair of articular cartilage and bone defects including advances in micro and nanotechnology to design and process biomaterials (e.g., polymeric and metallic porous structures, biodegradable synthetic polymers as well as polymer-ceramic composites, nanofibers) that can guide, accelerate, and/or act as a template for tissue regeneration and/or formation;

b) Biomaterials for artificial joints including the development of new materials for implants (artificialcartilage hydrogels and nanotitanium, magnesium alloys), ceramic coatings (CaP and TiO2), and study on the performance of orthopedic total joint replacement (e.g., hip, knee, elbow, and shoulder implants) through fundamental materials studies including materials testing and implant retrieval analysis;

c) Biomaterials for dental restoration including optimisation of the composite microstructure for restorative materials in stomatology with the aim to improve mechanical properties and reduce the contraction during the polymerisation by reinforcement of the composites with nanoparticles;

d) Drug delivery systems including the development of nanostructure polymeric systems for drug delivery;

e) Modelling (e.g., using finite element methods) for biomaterials and implant-tissue systems including the computation of stress concentration in non-homogenous materials and biological systems, and scaffold design and optimisation.

Fig. 4.8.2. Biomaterials Group, Materials Design Division, Faculty of Materials Science and Engineering, Warsaw University of Technology (WIM PW)

SCIENTIFIC BOARD:

IPPT PAN:

Prof. Tomasz A. Kowalewski

Prof. Jerzy Litniewski

Assoc. Prof. Paweł Ł. Sajkiewicz

WIM PW:

Prof. Krzysztof J. Kurzydłowski

Assoc. Prof. Wojciech Święszkowski

5. SCIENTIFIC CENTRES

Centre of Excellence and Innovation of Composite Materials

The centre is a horizontal component of the IPPT PAN organogram consisting of four research divisions: Advanced Composite Materials, Laser Technological Applications, Mechanics of Inelastic Materials, and Computational Methods in Nonlinear Mechanics. Its primary focus is on metal-ceramic bulk composites, functionally graded materials and thin coatings, driven by the needs of transport, energy, electronics and medical sectors. In 2014-2015 the centre conducted integrated research comprising processing, characterisation and modelling of the bulk composites (e.g., Cr(Re)/Al_2O_3, NiAl(Re)/Al_2O_3, Al/Al_2O_3) obtained from powder metallurgy and metal infiltration, as well as ceramic coatings (e.g., ReB_2, WB_4) produced by pulse laser deposition. The scientific results have been published in top international journals, some of them ranked with 50 points - the highest score in the classification of the Polish Ministry of Science and Higher Education. Among several composites developed by the Centre the ones doped with rhenium are mature enough for applications and was tested with promising results as valve seats in combustion engines. The centre has built cooperative links with Polish and foreign research centres (including four Fraunhofer institutes) and with Polish industry including KGHM Metraco S.A., FPM S.A., and the Polish Motor Chamber. In addition, the Industrial Advisory Group and the website (http://pzmk.ippt.pan.pl/CDIMK) were created.

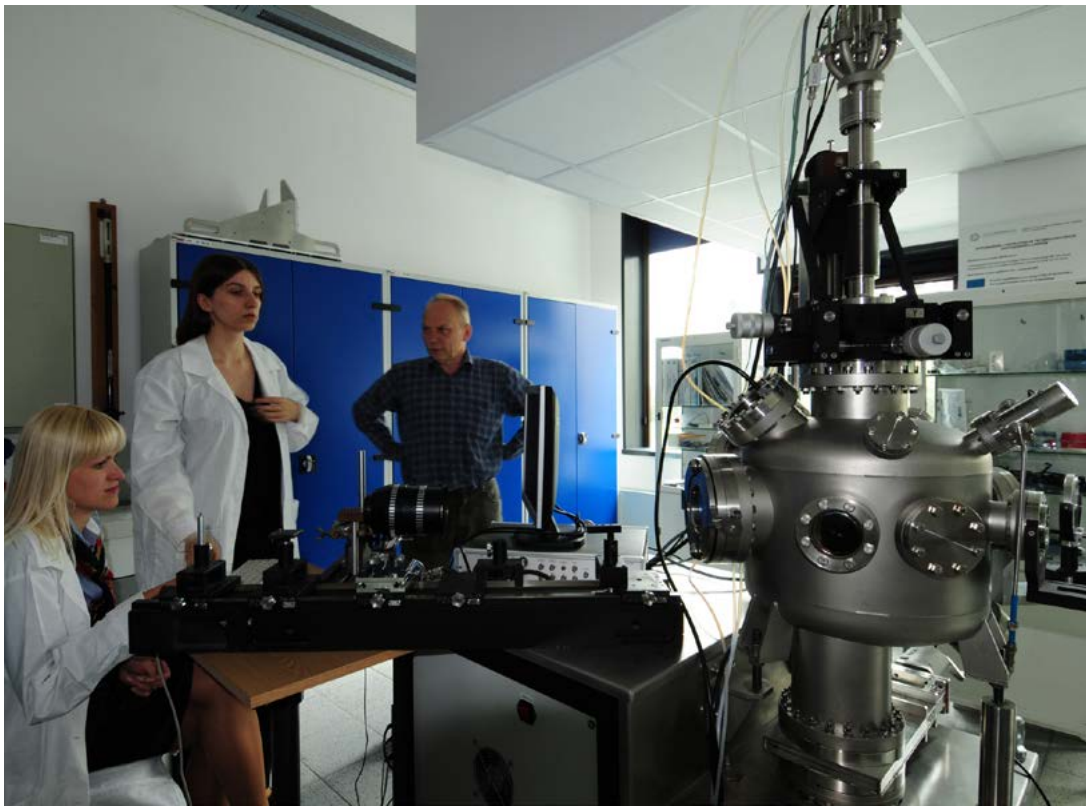


Fig. 5.1. Laboratory of Technological Laser Application Division

Biomedical Research Centre

The Biomedical Research Centre is a subdivision of IPPT PAN consisting of the Laboratory of Modelling in Biology and Medicine (PI: Prof. Tomasz Lipniacki), the Polymer Physics Laboratory (PI: Assoc. Prof. Paweł Sajkiewicz), and the Scanning Acoustic Microscopy Laboratory (PI: Prof. Jerzy Litniewski). The centre is a nationally unique, interdisciplinary collaboration with the mission to conduct research that utilises mathematics, physics and chemistry to understand biological processes and advanced medical techniques and materials. As such, it brings together researchers from the areas of expertise ranging from molecular and systems biology, bioengineering and physics to computer science and mathematics. The main research areas involve: 1) modelling of biological signaling pathways and regulatory networks involved in immune response and cell fate decisions, 2) microfluidics, 3) application of biopolymers and electrospinning to tissue engineering, wound healing, and drug delivery, 4) application of optical tweezers for biomolecule manipulation, and 5) application of ultrasounds to medical diagnostics, especially detection of dermal malignancies and non-invasive measurements of bone density.

The centre has state-of-the-art facilities and equipment, which include Molecular Biology Unit (RT and digital PCR), Tissue Culture Facility, Microscopy Unit (white-laser confocal microscope, TIRF, AFM, optical tweezers), Microfluidics Unit, Electrospinning Unit, X-ray diffractometer, several laboratories designed for ultrasound microscopy as well as significant laboratory workspace.

The centre offers opportunities for graduate studies (master and doctoral) and postdoctoral training. Six Ph.D. projects have been completed in the centre so far.

In the years 2012-2015 the centre's teams have collectively published more than 60 research articles and filed two patent applications. The members of the centre have successfully applied for and received approximately 20 research grants from such organisations as the National Science Centre, the European Molecular Biology Organisation, Marie Skłodowska-Curie actions, Wiener Wissenschafts-, Forschungs- und Technologiefonds, the Foundation for Polish Science, and the National Centre for Research and Development.

Centre for Intelligent Technologies

The research of the Centre for Intelligent Technologies for Energetics is focuses on problems of safety engineering and, in particular, those related to the development of structural health monitoring (SHM) systems for monitoring and prediction of life cycle of infrastructure, designing new systems for passive and adaptive structural protection against dynamic loads, and modelling and manufacturing advanced structural components by means of additive methods.

One of the centre's achievements is the opening of the Laboratory of Safety Engineering for Energy Generation in Jabłonna, which was created as a part of the Research Centre for Energy Conversion and Renewable Resources of the Institute of Fluid-Flow Machinery, Polish Academy of Sciences. The combination of the complementary infrastructures enables to conduct complex research aimed at increasing the safety of energy and transportation systems. The laboratory provides the resources enabling professional design and manufacturing of advanced electronic devices, including the application of thin layers of materials on 3D surfaces with the aerosol jet printing technology, and the research on manufacturing of metal parts by means of direct laser sintering.

Fig. 5.1. 2. Laboratory of Safety Engineering for Energy Generation in Jabłonna

Laboratory Services Centre

The Laboratory Services Centre, founded in 2012, is an interdisciplinary technological centre dedicated to supporting the research projects within the framework of broadly understood mechanics, including strength of materials, mechanics of materials, mechanics and physics of fluids, automation, intelligent technologies and ultrasound.

The laboratory is equipped with modern machinery, including precision CNC machine tools, wire-cut electrical discharge machines, microfabrication and 3D prototyping tools, specialised electronic equipment and CAD/CAM/CAE/EDA software used by high-class specialists.

The Laboratory Services Centre provides an environment for both research and industry in the area of cooperation with the R&D departments. Its main activity between 2014 and 2015 was to design and implement the innovative devices and scientific research stands consisting of unique mechanical and electronic elements, and adapted to individual needs. It also produced short series of precise, difficult to be made elements from different kinds of materials such as plastics, ultra-high strength steel, composites of nickel, molybdenum, titanium and aluminum alloys. As a result, two devices were created: "an anti-buckling fixture for large deformation tension–compression cyclic loading of thin metal sheets" in cooperation with the IPPT Department of Strength of Materials for R&D Arcelor Mittal East Chicago and "the viscosity of thin films measurement device" for the IPPT Department of Mechanics of Materials.

Recently, the laboratory has begun to work on a prototype of a unique nanotensile tester intended for research departments dealing with materials engineering, mechanics and nanotechnology.

6. NATIONAL CONTACT POINT FOR RESEARCH PROGRAMMES OF THE EU

National Contact Point in POLAND

We support the innovators of tomorrow !

The Institute's extensive experience in international cooperation has resulted in establishing the Polish National Contact Point for Research Programmes of the EU (NCP in Poland) at IPPT PAN. This is the National Contact Point for the Horizon 2020, EURATOM Fission, Innovative Medicines Initiative 2 and the coordinator of the EURAXESS network in Poland. Our organisation coordinates the Network of National Contact Points, which comprises the NCP in Poland and 11 Regional Contact Points located in Poland's biggest academic centres. The NCP in Poland is a part of the European Network of National Contact Points for Horizon 2020.

OUR MISSION is to provide support to Polish organisations in applying for funding from the Horizon 2020 Programme. We assist Polish leaders of research and innovation: individual researchers, research organisations, entrepreneurs and any other stakeholders interested in this type of funding.

OUR STAFF includes experts with unique knowledge and long practical experience in the area of R&D projects funded by the European authorities.

WE OFFER free of charge assistance in preparing project proposals, trainings, workshops, consultations, advisory and mentoring support, as well as – at an international level – partner search services, organisation of conferences, brokerage events and networking sessions.

Activities of the NCP in Poland during 2014 and 2015

The activities of the NCP in Poland are strictly connected with the contract between the Polish Ministry of Science and Higher Education and IPPT PAN. This includes improvement of the ecosystem of support for potential beneficiaries of the Horizon 2020 Programme as well as promotion of Polish organisations' participation in the EU programmes calls. Our organisation puts a great emphasis on identification of parties with the potential of applying for funding, on support in the process of submission of proposals, on improvement of the position of Polish organisations in the Horizon 2020-funded projects, and on participation of Polish enterprises in the programme and promotion of Polish achievements.

During the first two years of the Horizon 2020 Programme the NCP in Poland conducted 130 mentoring activities in the most thematic areas of H2020. Together with the Network of NCP, we managed to reach every scientific organisation with A and A+ category (the highest grades) in Poland. Our services have been evaluated at 4.7 (on a five-point scale).

EXPERT ACTIVITIES at the European level:

Input into the new Work Programme for 2016-2017; the staff of the NCP in Poland participated actively in most delegations to the Programme Committees of Horizon 2020;

Cooperation with the Permanent Representation of the Republic of Poland (PRRP) to the European Union in Brussels, the European Commission (EC), the European Parliament and the PolSCA office; The NCP in Poland together with the above mentioned partners organised a meeting of the Polish Energy Sector in Brussels;

Strengthening of Poland's position in the European NCP networks, especially through active participation in the network's activities such as brokerage events, info days, etc.;

Cooperation with the EC, PRRP, National Centre for Research and Development in order to reach a synergy between Horizon 2020 and Structural Funds, the advocacy on the introduction of the Seal of Excellence into the national programmes;

A communication campaign in the field of financial and administrative issues, as well as issuing the guide on legal and financial issues in the Horizon 2020 Programme.

COOPERATION WITH PARTNERS in Poland:

Ministry of Science and Higher Education – with regard to the Grants for Grants (Granty na Granty) initiative, change of the remuneration rules in Horizon 2020 as well as regulation concerning Bonus on the Horizon (Premia na Horyzoncie);

Polish Council for Research Project Coordinators – in the area of identification of barriers for the implementation of Horizon 2020 in Poland, as well as in providing input to the seminaries organised by the Council;

Cooperation with the Conference of Rectors of Academic Schools in Poland, the Main Council of Research Institutes and the Polish Academy of Sciences to create a common administrative framework and a system for motivating research teams to participate in the Horizon 2020 Programme;

Cooperation with universities in the area of education and training for research managers and administrators;

Cooperation with the Enterprise Europe Network and the Polish Agency for Enterprise Development concerning innovative enterprises;

The introduction of a system of cooperation with the consultancy companies involved in cooperation with Polish applicants;

Cooperation with the Committee for Evaluation of Scientific Research Institutions in the area of a regulation for parametric evaluation of academic institutions, especially for the purpose of increasing the impact of participation in the European Framework Programmes.

PROMOTION, COMMUNICATION AND TRAINING:

The national portal for Horizon 2020 (www.kpk.gov.pl) as well as the Polish EURAXESS portal (www.euraxess.pl) were launched in the period of 2014-2015, the websites have been visited 638 244 and 316 110 times, respectively;

Launching of an English-language Horizon2020 national portal which will be used for promoting Polish research potential and for attracting partners for international projects;

A country-wide communication campaign, which involved 50 info-days, and 11 regional conferences on Horizon 2020;

Extensive support for the potential beneficiaries of Horizon 2020, including mentoring, consultations, workshops, and brokerage events;

Research and analysis of statistical data concerning Polish participation in Horizon 2020, based on data provided by the EC via e-Corda database;

Strengthening of activities supporting the Horizon 2020-related communication activities – promotional materials, newsletters, campaigns in social media and traditional media, and promotion of Polish success stories.

National Contact Point for Research Programmes of the EU

Zygmunt Krasiński, Ph.D. – Director

Sebastian Serwiak, M.Sc. – Deputy Director

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7. PUBLICATIONS 2014-2015

The Institute's mission has always been to conduct a high-quality research in the areas of interest of the international science and industry. IPPT PAN is engaged in extensive cooperation with renowned research centres in Poland and abroad, which is reflected by many joint projects and publications in prestigious journals as well as exchange of researchers. In recent years, the activities of the Institute have been mainly focused on the areas intensively pursued by leading research centres in the world, including interdisciplinary research. In particular, this applies to such areas as new intelligent materials and technologies, nanomaterials and nanofluids, multifunctional materials, bioinformatics, and ultrasound diagnostics in medicine. The combination of advanced experimental studies carried out on high-quality equipment with mathematical methods and extensive knowledge of computer science enables performing advanced computer simulations for the analysis of very complex systems and processes.

These research activities are reflected in several publications of our research staff. In 2014 and 2015 the researchers from IPPT PAN published 220 articles in leading international journals indexed in Journal Citation Reports. The diagram below illustrates the publication activity of the Institute during the last three years. Every year an increasing number of high quality publications is written by our scientists , especially those in journals listed in Table A as defined by the Polish Minister of Science (the list includes journals assigned the impact factor in the Thomson Reuters reports). It should also be stressed out that a significant part of these publications appeared in the most prestigious journals from Q1 and Q2 quartile scores set according to Thomson Reuters classification.

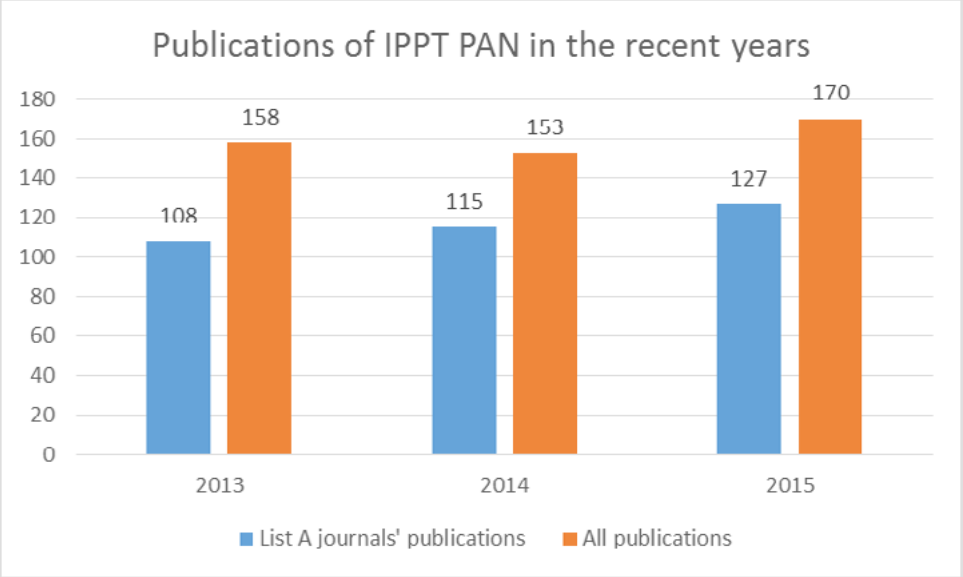


Fig. 7.1. Publications of IPPT PAN in the recent years

8. PROJECTS 2014-2015

A) Research projects

Modern research projects undertaken at the Institute provide an excellent basis for successful applying for grants, including both those in the area of fundamental research as well as those more application--oriented. Purpose-oriented research projects, high efficiency and openness to new ideas are always the most important foundations for defining the activities and projects carried out at IPPT PAN. This active policy resulted in winning by the Institute employees many prestigious grants sponsored among others by the National Science Centre, the National Centre for Research and Development, the Polish Science Foundation and the Polish Ministry of Science. In addition, the Institute has been involved in realisation of projects sponsored by foreign institutions, including the European Commission within the 7th Framework Programme. In 2014 and 2015, the Institute was conducting over 110 projects. This fact emphasises the quality and modern approach of the research pursued at the Institute.

Table 8.1. List of research projects

Principal investigator at IPPT PAN	Topic of the project	Start date	End date	Subsidized by
Dyniewicz Bartłomiej	Scholarship for outstanding young scientists	2011-11-04	2014-10-31	Ministry of Science and Higher Education, Republic of Poland
Korczyk Piotr	Scholarship for outstanding young scientists	2012-11-30	2015-10-31	Ministry of Science and Higher Education, Republic of Poland
Komorowski Michał	Estimation of kinetic parameters of the NF-kB signalling pathway	2013-09-01	2015-09-01	Ministry of Science and Higher Education, Republic of Poland
Komorowski Michał	Scholarship for outstanding young scientists	2013-11-20	2016-10-31	Ministry of Science and Higher Education, Republic of Poland
Faraj Rami	Innovative systems for safe airdrop DROPs	2015-08-31	2019-08-30	Ministry of Science and Higher Education, Republic of Poland
Kuciński Jacek	The establishment of the target company synergy biomedicine and technology	2013-10-01	2014-09-30	National Centre for Research and Development

Nowicki Andrzej	Medical ultrasound instruments - new methods of testing and visualization of tissue structure of human organs	2008-12-01	2015-10-31	National Centre for Research and Development
Basista Michał	Ceramic-metal composites and nanocomposites for aerospace and automotive industries	2008-10-01	2014-03-31	National Centre for Research and Development
Holnicki-Szulc Jan	PKAERO - Innovative material technologies for aero-industry	2008-07-01	2015-11-30	National Centre for Research and Development
Kowalczyk Piotr	Advanced numerical methods of analysis, optimisation and reliability assessment for industrial metal forming processes	2009-10-01	2015-04-30	National Information Processing Institute
Kowalewski Tomasz A.	Biocentrum Ochota - infrastructure for the development of strategic directions of biology and medicine	2009-10-01	2015-03-31	National Centre for Research and Development
Sajkiewicz Paweł	CePT - Centre for preclinical research and technology	2009-07-01	2014-06-30	National Centre for Research and Development
Lewandowska-Gruszka Bogusława	The Digital Repository of Scientific Institutes (DRSI)	2010-03-02	2014-06-30	National Centre for Research and Development
Nowak Łukasz	Bionic Sonar	2013-01-01	2014-12-31	Foundation for Polish Science
Pisarski Dominik	Real-time distributed adaptation of structures subjected to travelling loads	2014-06-01	2015-12-31	Foundation for Polish Science
Siemaszko Andrzej	IT platform database for the effective use of research results	2014-05-01	2015-03-31	National Centre for Research and Development
Nowak Łukasz	Commercialisation of Innovative, Passive Underwater Voice Communication System	2014-12-01	2015-11-30	Foundation for Polish Science

Jarząbek Dariusz	The technique and the device for measurement of viscoelastic properties of thin films at the nanoscale	2015-01-01	2015-11-30	Foundation for Polish Science
Kowalewski Zbigniew	Turbine drive - advanced manufacturing techniques	2013-12-01	2018-11-30	National Centre for Research and Development / Przemysł: PZL Świdnik
Basista Michał	Novel graphene reinforced metal matrix composites for power and electronics industry	2013-01-01	2015-12-31	National Centre for Research and Development
Kowalczyk Tomasz	Innovative urine draining prothesis for patients with urinary bladder cancer treated with minimum invasive urinary bladder oncological surgeries	2014-11-01	2017-10-31	National Centre for Research and Development
Szolc Tomasz	Innovative technology for copper ore preparation for flotation with application of high-energy comminution techniques	2015-01-01	2017-12-31	National Centre for Research and Development / KGHM
Glinicki Michał A.	Alkaline reactivity of domestic mineral aggregates	2016-01-01	2018-12-31	National Centre for Research and Development / GDDKiA
Lewandowski Marcin	The introduction of the original Polish implantable rotary pump cardiac support, remote monitoring system and remotely supervised rehabilitation of patients with heart support	2015-11-01	2018-10-31	National Centre for Research and Development
Lewandowski Marcin	Development of economic ultrasound platform	2010-07-01	2014-03-31	National Centre for Research and Development
Dyniewicz Bartłomiej	Protection of buildings using adaptive damping of a vibration caused by rail vehicles using smart materials	2011-08-15	2014-08-14	National Centre for Research and Development
Pawłowski Piotr	Innovative high performance valves for adaptive pneumatic impact absorbers	2012-12-19	2015-12-31	National Centre for Research and Development
Nowak Łukasz	New methods and technologies for acoustic medicsl diagnostics	2015-01-01	2017-12-31	National Centre for Research and Development

Jarząbek Dariusz	The design of compact nanotensile tester	2016-01-01	2018-12-31	National Centre for Research and Development
Kołbuk Dorota	Development of bioactive, hybrid material for ACL ligament regeneration	2016-04-01	2019-03-31	National Centre for Research and Development
Lewandowski Marcin	The measurement of blood flow and detection of micro embolic material for the pulsatile heart assist prosthesis ReligaHeart EXT	2012-12-01	2015-11-30	National Centre for Research and Development
Kukla Dominik	Develop a methodology to evaluate the fatigue strength of aluminide layer on the nickel superalloys using selected non-destructive techniques	2014-01-01	2015-10-31	National Centre for Research and Development
Glinicki Michał A.	Durability and efficiency of concrete shields against ionizing radiation in nuclear power structures	2014-01-01	2016-10-31	National Centre for Research and Development
Doliński Krzysztof	Dynamic management of transmission capacity of power networks, using innovative measurement techniques	2014-06-01	2016-05-31	National Centre for Research and Development
Holnicki-Szulc Jan	New measuring device and evaluation of dynamic responses for eksploatable railway bridges	2015-03-01	2018-02-28	National Centre for Research and Development
Kukla Dominik	Development of non-destructive methods for characterization of layers of carburized gear wheels	2015-09-01	2017-11-30	National Centre for Research and Development
Widłaszewski Jacek	Mechanically assisted laser forming of thin-walled profiles	2015-09-01	2018-08-31	National Centre for Research and Development
Doliński Krzysztof	Innovative materials solutions for Transport, Energy and Biomedical sectors by strengthening integration and enhancing research dynamics of KMM-VIN	2012-02-01	2015-01-31	European Commission
Komorowski Michał	Innate immune signaling: optimal experimental protocols for microfluidic devices	2013-01-01	2016-12-31	EMBO - European Molecular Biology Organization

Lipniacki Tomasz	The multi-scale dynamics of signal transduction: dissecting the MAPK pathway	2015-05-01	2018-04-30	WWTF - Vienna Science and Technology Fund
Dłużewski Paweł	Residual stresses and coupled fields in semiconductors: Consitutive equations and computer modelling	2011-04-15	2014-04-14	National Science Centre
Tasinkevych Yuriy	Integrated double sided array transducer for ultrasound beamforming applications	2011-04-18	2014-04-17	National Science Centre
Trawiński Zbigniew	Pattern and design of the ultrasound model of the left ventricle to the analysis of speckle changes for wxhographic imaging of physiological and pathological conditions	2011-04-18	2014-04-17	National Science Centre
Sławianowski Jan	Nonlinearity, geometry and quantum processes in complex material structures	2011-05-11	2014-05-10	National Science Centre
Gutkowski Witold	Diagnostics of joints in engineering structures	2011-05-25	2015-05-24	National Science Centre
Kucharski Stanisław	Study of the method of identification of mechanical properties of metals using nano- and micro- indentation test with account for anisotropy	2011-06-02	2015-06-01	National Science Centre
Rutecka Agnieszka	Assessment criteria for degradation degree of metal matrix composites under exploitation loading conditions, based on relations between parameters obtained in destructive and non-destructive tests	2011-06-02	2015-06-01	National Science Centre
Stupkiewicz Stanisław	Multiscale modelling of contact interactions: elastohydrodynamic coupling at the microscale	2011-12-14	2014-12-13	National Science Centre
Nowak Łukasz	Adaptive Composite Noise Absorbers	2011-12-12	2014-02-11	National Science Centre
Kiełczyński Piotr	Elastic parameters profiles identification in graded materials using ultrasonic Love waves	2011-12-16	2015-02-15	National Science Centre

Święszkowski Wojciech	A mathematical model of aliphatic polyesters degradation as an efficient tool for preclinical evaluation of biodegradable tissue engineering implants	2012-04-30	2015-12-29	National Science Centre
Litniewski Jerzy	Parametric sonographic imaging - application of synthetic aperture technique to imaging attenuation of ultrasound in tissue structures	2011-12-07	2014-12-06	National Science Centre
Ekiel-Jeżewska Maria	Microhydrodynamics of soft matter	2011-12-12	2014-12-11	National Science Centre
Kujawska Tamara	Controlling of depth of local necrosis induced in rat liver in vivo by nonlinear focused ultrasonic beam with electronically controlled focus	2011-12-07	2015-06-06	National Science Centre
Pieczyska Elżbieta	Investigation of thermomechanical properties and acoustic emission in shape memory polyurethane and composite	2011-12-20	2015-03-19	National Science Centre
Lipniacki Tomasz	Inter- and intracellular signalling in innate immune response: experimental and mathematical analysis	2012-08-06	2016-02-05	National Science Centre
Kowalewski Tomasz	Dynamics of micro and nano objects suspended in fluids	2012-08-07	2016-08-06	National Science Centre
Pręgowska Agnieszka	Semi-active control of vibration of the drive systems of mechines and vehicles using the actuators with the magneto-rheological fluid	2012-08-21	2014-08-20	National Science Centre
Lengiewicz Jakub	Micromechanics of Programmable Matter	2012-08-28	2017-08-27	National Science Centre
Gambin Barbara	Modelling and measurements the temperature increase in soft tissue phantom and tissue samples in vitro by analysis of backscattered ultrasound field	2012-08-30	2016-08-29	National Science Centre
Mościcki Tomasz	Superhard coatings deposited by pulsed laser deposition method	2013-01-31	2016-01-30	National Science Centre

Holnicki-Szulc Jan	Foundations of „Adaptive Impact Absorption (AIA)" and Feasibility Study of its Application to Damage Reduction in Transport Collisions	2013-02-14	2017-02-13	National Science Centre
Wajnryb Eligiusz	The influence of Brownian motion and inferfaces on dynamics of suspensions	2013-02-19	2016-10-18	National Science Centre
Nosewicz Szymon	Numerical modeling of composite powder metallurgy using discrete element method	2013-02-26	2016-12-25	National Science Centre
Borkowski Adam	Modeling cooperation of agents by multivalued logics and parallel processing	2013-03-19	2016-03-18	National Science Centre
Michajłow Maciej	The dynamic analysis of intelligent, electrmechanical drive systems of machines and vehicles	2013-06-21	2015-06-20	National Science Centre
Jarząbek Dariusz	The measurement of the adhesion force between ceramic particles and metal in ceramic particles reinforced-metal matrix composites	2013-06-26	2015-06-25	National Science Centre
Maj Michał	Experimental analysis of thermomechanical couplings in micro-scale during plastic deformation of polycrystals	2013-06-27	2016-06-26	National Science Centre
Moćko Wojciech	Influence of microstructural evolution induced by fatigue loadings on the viscoplastic response of selected materials under wide range of strain rates and temperatures	2013-06-27	2016-06-26	National Science Centre
Orłowska Anita	Analysis of mechanical properities and manufacdturing process of the pre-stressed FRP composites	2013-08-28	2017-08-27	National Science Centre
Sajkiewicz Paweł	Electrospinning of bicomponent nanofibers - synthetic polymer/biopolymer using alternative, protein non-denaturing, noncytotxic solvents	2014-04-20	2017-02-19	National Science Centre
Radziejewska Joanna	Development of a new testing method of dynamic hardness and selected mechanical properties of homogenous material and thin films under conditions of high stress rate	2014-04-20	2017-02-19	National Science Centre

Kowalczyk-Gajewska Katarzyna	Multiscale modelling of heterogeneous materials: description of microstructure evolution and scale effects	2014-04-20	2017-02-19	National Science Centre
Kołbuk Dorota	Influence of one- and two-componet polymer substrate crystallinity degree on cells response during in-vitro study	2014-03-13	2016-12-12	National Science Centre
Levintant-Zayonts Neonila	Investigation of the properties and creation of thin layers with use of ion implantation technique on NiTi Shape Memory Alloy possessing micro- and nanocrystalline structures	2014-03-13	2017-03-12	National Science Centre
Kochańczyk Marek	Formation of spatial heterogeneities on the plasma membrane and their impact on cell signaling	2014-05-05	2016-05-04	National Science Centre
Kocieniewski Paweł	Regulation of the RAF/MEK/ERK cascade involving RAF isoforms	2014-07-17	2016-07-16	National Science Centre
Dyniewicz Bartłomiej	Semi-active damping of vibrations by using sandwich structures with a smart core	2014-07-17	2017-07-16	National Science Centre
Rojek Jerzy	Multiscale numerical modelling of sintering processes	2014-08-07	2017-08-06	National Science Centre
Nosewicz Szymon	Numerical modeling of the powder metallurgy processes using the discrete element method	2014-10-01	2015-09-30	National Science Centre
Jaruszewicz-Błońska Joanna	Stochastic phenotype switching in growing and dividing bacteria	2015-01-23	2017-01-22	National Science Centre
Gradys Arkadiusz	Studies on confinement effects in quasi one-dimensional geometry on phase transitions using electrospun "core-shell" fibers	2015-01-22	2017-01-21	National Science Centre
Lipniacki Tomasz	Mechanism controlling cell fate decision in response to stress. Experimental and theoretical analysis	2015-01-22	2018-01-21	National Science Centre

Petryk Henryk	Gradient-enhanced constitutive model of crystal plasticity of metals accounting for size effects and microstructure evolution	2015-01-22	2018-01-21	National Science Centre
Szymański Zygmunt	Synthesis of Carbon Nanostructures by Pulsed Laser Vaporization	2015-01-29	2018-01-28	National Science Centre
Nowicki Andrzej	Assesment of neoplastic lesions using parametric discrimination of the statistical properties of ultrasound scattering in breast tissue	2015-01-23	2018-01-22	National Science Centre
Pieczyska Elżbieta	Investigation of thermomechanical properties of Gum Metal - a new titanium alloy with high elasto-plastic properties, unknown deformation mechanisms and great potential for practical application	2015-02-11	2018-02-10	National Science Centre
Korczyk Piotr	The study of hydrodynamic interactions of droplets in complex microfluidic structures. The analysis of algorithms encoded in the architecture of microchannels enabling dosing of the reactants with arbitrary precision	2015-05-07	2018-05-06	National Science Centre
Lipniacki Tomasz	Innate immune response to RSV infection, role of non-structural proteins. Experiments and modeling of signal transduction and among cells communication	2015-06-08	2018-06-07	National Science Centre
Ekiel-Jeżewska Maria	Microhydrodynamics of soft matter	2015-07-13	2018-07-12	National Science Centre
Jankowski Łukasz	Development and efficiency assessment of new algorithms for identification and modeling of structural damping at the local level and for optimum design and semiactive control of dissipative structures	2015-08-05	2018-08-04	National Science Centre
Urbanek Olga	Biomimetic surface modification of bicomponent nanofibers with chondroitin sulfate and its effect on properties of scaffold and cellular response	2015-07-14	2017-07-13	National Science Centre
Kowalewski Zbigniew	Elaboration of fundaments for a new, interdyscyplinary method of damage development monitoring of materials on the basis of structural defects invastigation.	2015-07-24	2018-07-23	National Science Centre
Basista Michał	Influence of Thermal Residual Stresses on Fracture Behaviour and selected Mechanical Properties of Metal-Ceramic Composites: Experiments and Modelling	2015-08-03	2018-08-02	National Science Centre

Secomski Wojciech	Ultrasonic streaming aided thrombolysis	2015-08-05	2018-08-04	National Science Centre
Dulnik Judyta	The effect of crosslinking conditions on structure and properties of bicomponent PCL/gelatin nanofibres from alternative solvents	2016-02-15	2019-02-14	National Science Centre
Frąś Leszek	Dynamic properties of magnetorheological materials: experiment - modelling - identification - verification	2016-02-15	2018-02-14	National Science Centre
Pawłowska Sylwia	Hydrogel nanofilaments for biomedical application	2016-02-22	2018-02-21	National Science Centre
Lewandowski Maciej	New model of contact of higher-order solids and its numerical implementation	2016-02-15	2019-02-14	National Science Centre
Stupkiewicz Stanisław	Finite-strain phase-field model of evolution of martensitic microstructures in shape memory alloys	2016-02-15	2019-02-14	National Science Centre
Bajer Czesław	Modelling and control of structural vibrations with the use of smart materials	2016-02-10	2019-02-09	National Science Centre
Komorowski Michał	Phosphorylation dynamics of STAT1, STAT3 and STAT5 proteins in breast cancer cell lines - systematic experimental and theoretical analysis	2016-03-15	2019-03-14	National Science Centre
Szmidt Tomasz	Stability and non-linear dynamics of an electromagnetically damped pipe conveying fluid	2016-03-17	2019-03-16	National Science Centre
Kowalewski Tomasz A.	Elucidating the mechanism of lubrication for sliding droplets: hydrodynamics, surfactants forces, and role of surfactans and polymers	2012-08-01	2014-07-30	European Commission
Holnicki-Szulc Jan	The concept development of micro-explosive shock-absorbers for comunicative satelites	2014-07-03	2015-08-17	European Space Agency

Rojek Jerzy	NUMSIM - Advanced numerical simulation techniques for solving complex engineering problems	2010-11-01	2014-10-30	European Commission
Holnicki-Szulc Jan	SMART-NEST - Smart technologies for transport safety - innovation cluster nesting impact on cell signaling	2012-01-01	2015-12-31	European Commission
Komorowski Michał	Innate immune signalling: optimal microfluidics protocols, prediction and control	2013-09-01	2017-09-01	European Commission
Kowalewski Tomasz A.	CEZAMAT - Centre of research on advanced materials and technologies	2008-08-01	2015-12-31	National Centre for Research and Development
Ekiel-Jeżewska Maria	Flowing matter - MPNS COST Action MP1305	2014-05-06	2018-05-05	European Commission

B) Other Projects

The National Contact Point for Research Programmes of the EU is actively involved in projects financed by the European Commission under the 7th Framework Programme and Horizon 2020. The NCP in Poland is an active partner of the European NCP network projects, especially through organisation of brokerage events, participating in partner search services and providing expertise in the area of R&I policy. The NCP in Poland has a wide experience in realisation/coordination of the International Cooperation (INCO) projects focused on Eastern European, Black Sea and Central Asian countries, and USA as well as the projects in the area of education and training for research managers and administrators financed by the Norwegian Grants and EEA Grants.

Table 8.2. List of NCP projects

Project Leader	Topic of the project	Start date	End date	Subsidized by
Anna Dziubczyńska-Pytko	JPI's: a process of mutual learning: TOwards a COmmon adoption of frameWORK	2011-12-01	2014-03-31	European Commission, 7th Framework Programme
Zbigniew Turek	Virtual Integrated Partnering (VIP) for SME service, technology and information providers in the European maritime sector	2011-06-01	2014-05-31	European Commission, 7th Framework Programme

Jarosław Piekarski	Improving the services of the NMP NCP Network through Trans-national Activities 2	2012-02-01	2014-07-31	European Commission, 7th Framework Programme
Piotr Świerczyński	Continuation Of the cooperation of Space NCPs as a Means to Optimise Services	2012-05-01	2014-11-30	European Commission, 7th Framework Programme
Małgorzata Krótki	Trans-national co-operation among National Contact Points for Socio-economic Sciences and the Humanities (SSH NCPs)	2013-02-01	2014-11-30	European Commission, 7th Framework Programme
Andrzej Galik	Trans-national cooperation among ICT NCPs	2011-10-01	2014-12-31	European Commission, 7th Framework Programme
Katarzyna Walczyk-Matuszyk	International Network Supporting Research and Knowledge Transfer as a Platform of Cooperation Between Polish and Norwegian Universities	2014-04-01	2015-05-31	Norwegian Grants and EEA Grants
Zbigniew Turek	European Transport Network Alliance	2013-01-01	2015-06-30	European Commission, 7th Framework Programme
Zygmunt Krasiński	Bilateral Coordination for the Enhancement and Development of S&T Partnerships between the European Union and the United States of America	2012-11-01	2015-10-31	European Commission, 7th Framework Programme
Zygmunt Krasiński	Education towards research and innovation development	2014-04-01	2016-03-31	Norwegian Grants and EEA Grants
Zygmunt Krasiński	STI International Cooperation Network for Eastern Partnership Countries	2013-09-01	2016-08-31	European Commission, 7th Framework Programme
Barbara Trammer	STI International Cooperation Network for Central Asian Countries	2013-09-11	2016-09-10	European Commission, 7th Framework Programme
Jarosław Piekarski	Improving the services of the NMP NCP Network through Transnational Activities	2015-01-01	2016-12-31	European Commission, Horizon 2020

Małgorzata Krótki	Network of Science with and for Society National Contact Points	2014-11-01	2017-10-31	European Commission, Horizon 2020
Piotr Świerczyński	Cooperation Of Space NCPs as a Means to Optimise Services under Horizon 2020	2015-01-01	2017-12-31	European Commission, Horizon 2020
Sebastian Serwiak, Zygmunt Krasiński	National Contact Points for quality standards and horizontal issues	2014-12-10	2017-11-09	European Commission, Horizon 2020
Anna Wiśniewska	Trans-national cooperation among Marie Skłodowska-Curie National Contact Points	2015-02-01	2018-01-31	European Commission, Horizon 2020
Zygmunt Krasiński	Enhanced bi-regional STI cooperation between the EU and the Black Sea Region	2015-02-01	2018-01-31	European Commission, Horizon 2020
Piotr Świerczyński	Security Research NCP Network 3	2015-05-01	2018-04-30	European Commission, Horizon 2020
Anna Wiśniewska	Making European research careers more attractive by developing new services and enhancing the current services of the EURAXESS network.	2015-09-01	2018-08-31	European Commission, Horizon 2020
Ewa Szkiłądź	Improving and professionalizing the Health, Demographic Change and Wellbeing NCP service across Europe	2014-12-01	2018-11-30	European Commission, Horizon 2020
Wiesław Studnecki	Research Infrastructures Consortium for Horizon 2020	2014-12-01	2018-11-30	European Commission, Horizon 2020
Katarzyna Sobótka-Demianowska, Maria Śmietanka	Connecting Energy National Contact Points in a pro-active network under Societal Challenge 3‚Secure, clean and efficient energy' in Horizon 2020	2014-12-01	2018-11-30	European Commission, Horizon 2020
Andrzej Galik	Trans-national cooperation among ICT NCPs	2015-01-01	2018-12-31	European Commission, Horizon 2020

Małgorzata Krótki	Transnational network of National Contact Points (NCPs) of Societal Challenge 6,Europe in a changing world - inclusive, innovative and reflective Societies' (SC6)	2015-02-01	2019-01-31	European Commission, Horizon 2020
Maria Antosiewicz, Magdalena Głogowska	National Contact points for Climate action, Raw materials, Environment and Resource Efficiency	2015-02-01	2019-01-31	European Commission, Horizon 2020
Bożena Podlaska	Cooperation between NCPs for Horizon 2020 Societal Challenge 2 on "Food security, Sustainable Agriculture, Marine and Maritime Research and the Bioeconomy" and the Key Enabling Technology (KET) "Biotechnology" improving professionalism NCP service across Europe	2015-03-01	2019-02-28	European Commission, Horizon 2020
Ewa Szkiłądź, Aneta Maszewska	Connecting EURATOM National Contact Points in a pro-active network under EURATOM Programme in H2020	2015-09-01	2019-08-31	European Commission, Horizon 2020
Katarzyna Walczyk-Matuszyk	Transnational Network for cooperation of WIDESPREAD NCPs	2015-01-01	2019-12-31	European Commission, Horizon 2020

Fig. 8.1. International Networking Day on Factories of the Future and H2020 FoF Brokerage Event, May 19, 2015 (the Conference is co-organised by the National Centre for Research and Development and the National Contact Point for Research Programmes of the EU)

9. DETAILS OF SELECTED PROJECTS

Project "Protection of buildings using adaptive damping of a vibration caused by rail vehicles using smart materials", 2011-2014.

Coordinator: Bartłomiej Dyniewicz, Ph. D.

A significant increase in rail transportation speed confronts us with new problems in the field of structural dynamics and, primarily, adverse track vibrations transmitted to surrounding infrastructures. Classical solutions based on passive damping of vibration are insufficient. The aim of this project was to develop rheological properties of a smart damping material, which would allow us to reduce amplitudes of vibration to a greater extent than the existing solutions do. A semi-active control of track damping elements was considered. The main goal of the project was to develop a proper numerical model of a moving inertial load. General finite elements describing the travelling mass point were described. They were used in a simplified dynamic model of a rail vehicle, consistent with the experimental tests from the literature. According to the computer simulations, the adverse forms of vibration transferred to the ground were defined and a control strategy was developed. Within the project, the prototype test stand based on magnetorheological dampers simulating smart material was designed and assembled. It was used to verify the results of computer simulation and control strategy of damping material. In the case of high vehicle speed range the effectiveness of the developed solution reached 40% vs. the passive one. In experimental verification at lower speeds a 15% improvement was demonstrated.

This work was supported by the National Centre for Research and Development (NCBiR) LIDER/26/40/L-2/10/NCBiR/2011.

Project "Hydrodynamics of complex fluids", 2011-2014.

Coordinator: Prof. Maria L. Ekiel-Jeżewska

The goal of the project was to analyse motion of micro and nano particles in fluids, and create theoretical background for understanding biological, medical or industrial complex flows.

We investigated numerically hydrodynamic interactions between many particles settling under gravity. We discovered that due to elastic constraints, the horizontal distance between sedimenting microparticles connected by springs can increase significantly. Such an effective hydrodynamic repulsion is not observed for rigid particles. For systems consisting of many microparticles settling under gravity in a fluid, we found periodic solutions and showed how they influence the system lifetime, decay and shape deformation. Periodic oscillations of very close sedimenting particles were also detected experimentally.

We studied the dynamics of flexible particles subjected to ambient flows. We found that in Poiseuille's flow between two rigid walls, flexible fibers accumulate at different distances from the wall, depending on their flexibility and length. In the unbounded shear flow, we detected and analysed formation and topology of compact or entangled shapes of flexible fibers.

We contributed to the new concept of theoretical hydrodynamic radius model for the dense suspensions of spherical particles with complex internal structures, taking into account direct interactions while averaging over particle configurations.

This work was supported by the National Science Centre, 2011/01/B/ST3/05691.

Project "Multiscale modelling of contact interactions: elastohydrodynamic coupling at the microscale", 2011-2014.

Coordinator: Prof. Stanisław Stupkiewicz

In elastohydrodynamic lubrication (EHL), the contacting bodies are fully separated by a fluid lubricant, and the contact load is carried by the hydrodynamic pressure which is sufficiently high to induce elastic deformation of contacting bodies. In the so-called soft-EHL regime, the pressure is relatively low, but the elastic deflections are significant because one or both contacting bodies are highly compliant. Currently, there is a growing interest in the soft-EHL regime because of its numerous applications in engineering (classical ones being seals, wipers, etc.) and in an emerging area of biotribological systems (synovial joints, contact lens lubrication, and many others).

The aim of this project was to develop multiscale models for thin-film soft-EHL problems, i.e., for contact conditions in which the elastohydrodynamic coupling is essential both at the macroscale and at the multiple lower scales of surface roughness. A micromechanical scheme was developed that accounts for the deformation of surface asperities and apparent evolution of surface roughness due to local fluctuations of hydrodynamic pressure. In turn, the fluctuations of pressure result from the fluctuations of film thickness at the scale of surface asperities. An important part of the project was also to develop and implement efficient computational algorithms for the soft-EHL problems, and, more generally, for rough contact problems.

This work was supported by the National Science Centre, 2011/01/B/ST8/07434.

Project "Investigation of thermomechanical properties and acoustic emission in shape memory polyurethane and composite", 2011-2015.

Coordinator: Assoc. Prof. Elżbieta Pieczyska

This research covers the unknown effects of thermomechanical couplings in shape memory polymer (SMP) during its loading in various conditions. A comprehensive study, embracing the experimental and theoretical approaches, was performed in Poland, Japan and Romania. SMP specimens with various values of glass transition temperature Tg responsible for different polymer properties were characterised

according to their structural, physical and thermo-mechanical properties. The structure investigation was conducted using dynamic mechanical analysis, and ultrasonic and acoustic tests. The SMP specimens were subjected to deformations within a wide range of strain rates at various temperatures. Tension, cyclic tension as well as thermo-mechanical cyclic load-unload tests below and above Tg were carried out. Shape fixity and shape recovery properties, crucial for SMP applicability, were estimated. Thermoelastic effect was studied and the SMP yield point was identified based on temperature changes obtained using a fast and sensitive infrared camera. The strain localisation phenomenon was investigated and found to initiate when the SMP elastic deformation range ended. At higher strain rates, the localisation ran more dynamically leading to specimen rupture, while at lower strain rates it vanished at higher strains. A constitutive model considering mechanical parameters and temperature changes during the deformation was proposed and verified by experimental results. The investigated SMP properties were published in scientific journals, presented at international conferences as well as at the Scientific Picnic at the National Stadium. The SMP simulations were a topic of a master's thesis defended at the Warsaw University of Technology in 2014.

NARODOWE CENTRUM NAUKI

This work was supported by the National Science Centre, 2011/01/M/ST8/07754.

Project "NUMPRESS – integrated computer system for analysis and optimisation of industrial sheet metal forming processes", 2009-2015.

Coordinator: Assoc. Prof. Piotr Kowalczyk

The objective of this project was to develop the computer software for analysis and optimisation of sheet metal forming processes, involving the recent advances in numerical methods related to this subject. The system named NUMPRESS is primarily dedicated to small and middle enterprises dealing with sheet metal forming as well as to the researchers interested in modelling such processes. The program consists of (i) an analytical module for the analysis of forming processes with the finite element method, (ii) an optimisation module controlling execution of the analytical module and performing optimisation with respect to selected process parameters in both deterministic and robust manner, (iii) a reliability analysis module controlling execution of the analytical module to assess how random distribution of design parameters affects the results, and (iv) a graphical user interface enabling communication between modules and easy definition of design parameters and optimisation criteria. The analytical module consists of two independent programs up to the user's choice: a faster and less accurate program for implicit quasi-static analysis of rigid-viscoplastic shells and a program for explicit dynamical analysis of elastic-plastic and elastic-viscoplastic shells (both interfaced to a commercial graphical pre- and post-processor GiD.

The program is ready to download from the web site http://numpress.ippt.pan.pl and free to use at no license fees.

INNOVATIVE ECONOMY
NATIONAL COHESION STRATEGY

IPPT PAN

EUROPEAN UNION
EUROPEAN REGIONAL DEVELOPMENT FUND

Project partially funded by the European Regional Development Fund, within the framework of the Innovative Economy Programme, contract no. POIG.01.03.01-14-209/09.

Project "Medical ultrasound instruments – new methods of testing and visualisation of tissue structure of human organs", 2008-2015.

Coordinator: Prof. Andrzej Nowicki

The goal of this project was to develop new methods and techniques of ultrasonic imaging to increase the availability and effectiveness of medical diagnosis.

The project was based on two approaches: scientific and technical. The scientific approach was focused on new ultrasound imaging methods and, in particular, on the parametric imaging of attenuation and backscatter, as well as the synthetic aperture focusing technique (SAFT). The technical approach involved the development of a new research ultrasound system capable of implementing those advanced imaging methods.

The developed platform provides a fully programmable ultrasound acquisition subsystem with extremely powerful real-time processing capabilities, thanks to the applied graphical processing units (GPUs). An advanced software framework enables the implementation of complex signal processing algorithms. The platform has not only provided an opportunity to implement the newly developed methods, but also served as the basis for building the entire medical diagnosis device family.

The project also contributed to the flourishing of international cooperation and has attracted new research and industry partners. The technical group of the project have created a spin-off company and led to the commercialisation of the developed research platform – selling a device to the Hong Kong University.

The results of the project, including the created electronic laboratory, and the technical team and collaboration, will be maintained and developed for the next 5 years.

INNOVATIVE ECONOMY
NATIONAL COHESION STRATEGY
IPPT PAN
EUROPEAN UNION
EUROPEAN REGIONAL DEVELOPMENT FUND

Project POIG.01.03.01-14-012/08-00 was co-financed by the European Regional Development Fund under the Innovative Economy Operational Programme.

Project "SMART-NEST - Smart technologies for transport safety - innovation cluster nesting impact on cell signaling", 2013-2017.

Coordinator: Prof. Jan Holnicki-Szulc

The IPPT PAN research team has coordinated this European research project (Maria Curie mobility type of activities) with three academic and three SME industrial partners: IPPT PAN (PL), Ecole Centrale de Lyon (F), Saarland University (D), Adaptronica (PL), Cedrat Technologies (F), I-Deal Technologies (D).

The strong interdisciplinarity of the research and training programme was implied by the need for integration and implementation of knowledge and technologies scattered among various disciplines.

The project was based on studies on system identification and model updating, and then proceeded to the identification of dynamic loads, which is a prerequisite for optimum strategies for semi-active structural adaptation to unknown loads. In parallel, the relevant smart sensors/actuators, driving electronics and self-diagnosis techniques were pursued. Finally, the respective hardware and model demonstrators were developed.

The completed project:

In terms of the end product, investigated a new class of semi-actively controlled smart structures, which are impact- or vibration-resistant, and capable of preserving integrity in critical conditions under unpredictable loads and of post-accident self-diagnosis;

In terms of the methodology, aimed at investigating new, semi-active strategies for optimum structural adaptation, which required exploring techniques for system identification, model updating and load identification.

The research leading to these results received funding from the People Programme (Marie Curie actions) of the European Union`s 7th Framework Programme FP7/2007-2013/ under REA grant agreement no 284995.

Project "The influence of Brownian motion and interfaces on dynamics of suspensions", 2013-2016.

Coordinator: Prof. Eligiusz Wajnryb

TThe project was focused on evaluating, in various systems, the mobility and transport coefficients of suspended particles, close to interfaces or undergoing the Brownian motion, which have been currently extensively investigated experimentally in the leading international physical, chemical and biological laboratories.

One of the most interesting project's result is the calculation of the short-time intrinsic viscosity of a suspension of rigid rods in shear flow between two parallel solid walls, as a function of the distance between the walls. The rods were modeled as chains of beads. The mobility coefficients were evaluated by solving the Stokes equations by the multipole expansion, corrected for lubrication, and implemented in the hydromultipole numerical codes. It turns out that the walls can significantly reduce or increase the value of the intrinsic viscosity in comparison with the unbounded fluid, depending on the specific geometry of the system. This is a very important theoretical finding, and also of a great significance for applications.

Another interesting process is formation of a quasi-two-dimensional layer of Brownian particles above a horizontal planar solid wall. In this project, probability distribution of particles and their diffusion coefficients

were determined theoretically and numerically, in a reasonable agreement with the known experimental results.

This work was supported by the National Science Centre, 2012/05/B/ST8/03010.

Project "Influence of one- and two-component polymer substrate crystallinity degree on cells response during in-vitro study", 2014-2016.

Coordinator: Dorota Kołbuk, Ph. D.

TThis research project concerns the fundamental matter of polymer chains arrangement (crystallinity) influence on cells morphology and growth effectiveness. The commonly used methods of forming three-dimensional cell substrate for tissue regeneration do not take into account crystallinity optimisation.

The aim of the proposed research is to investigate crystallinity effect on the cellular response under in-vitro studies.

In this research, we demonstrated that it was possible to develop films with varying crystallinity by solvent type, diversification of polymer chain lengths and natural protein addition. It has been shown that differentiation of the degree of crystallinity results in a change in the surface properties (surface tension) and mechanical properties (Young's modulus). Differences in mouse and human cells behavior of films with varying degrees of crystallinity were noted.

It is anticipated that the proposed and implemented research will expand the scientific knowledge about the crystallinity effect on the cell substrate functionality and contribute to the more complete literature description of the efficient degree of crystallinity control of the substrates formed by different methods and development of more effective commercial cells substrate for tissue regeneration in the future.

This work was supported by the National Science Centre, 2013/09/D/ST8/04009.

Project "Modern Material Technologies in Aerospace Industry –PKAERO", 2008-2015.

Coordinator: Prof. Jan Holnicki-Szulc

The main challenge that encouraged the IPPT PAN research team to participate in this project was to develop new technologies (based on smart materials) applicable in aerospace engineering and,

especially, in safety engineering for the Polish general aviation sector (production of small aircrafts, which is the only remaining national production area able to absorb innovations born in Polish labs with a century-long intellectual tradition).

Two main technological areas cover safety engineering issues in general aviation: structural health monitoring (SHM) and stabilisation of structural response to dynamic excitations, including impacts and forced vibrations.

The most promising outcomes of the project generated by the IPPT PAN team, with a perspective for further commercialisation, are the following:

- adaptive landing gears with piezo-valve based pneumatic/hydraulic shock-absorbers,
- adaptive airbags based on a special release valve for a rotorcraft emergency landing system,
- adaptive inerter-based shock-absorbers for absorption of impact loads,
- prestress accumulation–Release (PAR) system for damping of impact-born vibrations,
- new technique for manufacturing of prestressed composite structural elements with monitored self-stress state,
- local isolation of forced vibrations (e.g., in pilot location) via inducing pre-designed prestressing (states of self-equilibrated stresses).

Project POIG.01.03.01-14-015/08-00 was co-financed by the European Regional Development Fund under the Innovative Economy Operational Programme.

Project "clotALERT – The system for blood flow measurement and microemboli detection for the pulsatile heart assist prosthesis Religa Heart EXT", 2012-2015.

Coordinator: Marcin Lewandowski, Ph. D.

The Religa Heart EXT is a pulsatile extracorporeal ventricular assist device (VAD) developed by the Foundation of Cardiac Surgery Development and its partners as a part of the Polish Artificial Heart programme. The system is actively used for short to mid-term support of patients as a "bridge" to transplantation or as a replacement therapy for failing hearts.

One of the main risks and side-effects connected with the VAD are microembolism and clot formation, which can lead to a stroke. The main goal of the clotALERT project was to develop a new method and instrumentation for an ultrasonic monitoring of the blood flowing through the artificial heart chamber.

The IPPT's expertise and know-how of the ultrasound Doppler system have enabled the development of a new system for Religa Heart EXT, which greatly extendes its real-time monitoring functions. The developed pulsed-wave Doppler device, equipped with a special clamped-on cannula probe, provides an estimate of the total blood flow volume, as well as a statistical detection of flowing microemboli. The prototype system was tested in-vitro and in-vivo animal studies on VAD chambers of various sizes.

An automated continuous monitoring of blood flow parameters will grant a new medical insight into long-term heart support therapy and improve its outcome.

The promising results of the project have encouraged the partners to continue the research and prepare the system for future implementation as a commercial product.

This work was supported by the National Centre for Research and Development (NCBiR) PBS1/A3/11/2012.

Project "Novel graphene reinforced metal matrix composites for power and electronics industry", 2011-2015.

Coordinator: Assoc. Prof. Michał Basista

The goal of the cooperative project "Novel graphene reinforced metal matrix composites for power and electronics industry" (GRAMCOM) is to develop graphene reinforced metal matrix composites with enhanced physical and service properties. The target applications are electric contacts and heat dissipation elements in power and electronics industry. GRAMCOM deals with two groups of materials: copper and silver matrix composites reinforced with different forms of graphene.

The project methodology can be seen as a chain of interrelated activities of material processing, characterisation, modelling and demonstration. The processing includes, among other things, material consolidation by spark plasma sintering or hot pressing. Characterisation of the manufactured composites includes description of nano/microstructure, measurement of physical and mechanical properties and resistance to service conditions. Modelling by molecular dynamics is carried out at the material design phase with the purpose of supporting the experimental tasks in reaching the expected values of the overall material properties.

The project consortium consists of the Institute of Electronic Materials Technology (project leader), the Institute of Metallurgy and Materials Science, the Warsaw University of Technology, the Foundry Research Institute, IPPT PAN, and two industrial partners (SIEMENS and TAURON S.A.). The main goal of the IPPT PAN team (Division of Advanced Composite Materials) is the processing of Cu-graphene composites by sintering under pressure (HP).

This work was supported by the National Centre for Research and Development (NCBiR), GRAF-TECH/NCBR/10/29/2013.

10. YOUNG SCIENTISTS ACHIEVEMENTS IN 2014-2015

Winners of the LIDER (NCBiR) contest:

Łukasz Nowak, Ph.D.

The winning project is titled "New methods and technologies for acoustic medical diagnostics". The aim of the project is to develop a new generation of methods and technologies for acoustic medical diagnostics, as well as to construct prototypes and prepare a new generation of stethoscopes for commercial implementation by implementing the developed solutions.

Dariusz Jarząbek, Ph.D.

The winning project is titled "Design and construction of nanotensile tester". The aim of this project is to develop a nanotensile testing device for characterizing extremely small nanostructures. This device will allow for in-situ micro and nanotensile testing of different types of materials. The device can be used in many different fields of science such as materials science or biology for, among other things, the investigation of so- called 'size effects'.

Dorota Kołbuk, Ph.D.

The title of this winning project is "Development of bioactive, hybrid graft for regeneration of ACL ligaments". The project involves the development of a biodegradable cell substrate for the regeneration of the anterior cruciate ligament (ACL). Using the knowledge of materials science, mechanics, biology and medicine, a hybrid graft that simulates the architecture and structure of natural allograft-bone-ligament-bone will be developed. In the longer term, this innovative graft will allow for the reconstruction of the ligament and bone to/on which the ligament is fixed.

Winners of the IMPULS (FNP) contest:

Dariusz Jarząbek, Ph. D.

The winning project is titled "Measurement technique and the device for determination of viscoelastic properties of materials at the nanoscale". The aim of the project is to develop the measurement technique and a device for determination of viscoelastic properties of thin polymer films. Furthermore, the commercialisation potential of the project results will be evaluated.

Łukasz Nowak, Ph.D.

The winning project is titled "Commercialisation of an innovative, passive underwater acoustic communication system". The project continues the research performed within the framework of the "Bionic Sonar" project, conducted at IPPT PAN by the same author.

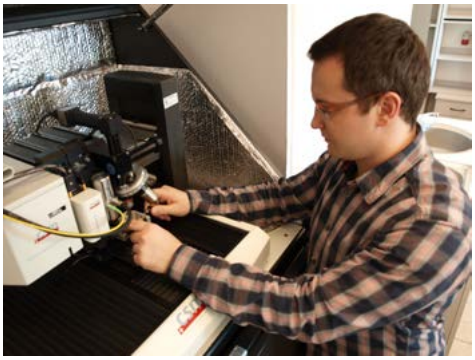


Fig. 10.1. Dariusz Jarząbek, Ph.D., testing of nanomechanical properties of materials

Fig. 10.2. Łukasz Nowak, Ph.D., testing with dolphins

Winner of the START (FNP) contest:

Marek Kochańczyk, M.Sc.

This programme is intended for young researchers, at the outset of their career, who have already achieved some success in their field. The stipends serve as recognition of the young scholars' scientific achievements and as an incentive for further growth by enabling them to devote themselves fully to their research.

Winners of the TOP 500 Innovators-Science, Management, Commercialisation (MNiSW):

Dorota Kołbuk, Ph.D., Paweł Nakielski, Ph.D. and Agnieszka Pręgowska, Ph.D.

This programme focuses on innovation, execution and leadership, entrepreneurship, intellectual property, and technology transfer.

Winner of the DIAMOND GRANT (MNiSW) contest:

Rami Faraj

The title of this winning project is "Innovative systems for safe airdrop DROPs". The goal of the project is to analyse the operation and assess the feasibility of three inventions reported for patent protection by IPPT PAN in the Polish Patent Office. Within the project, the preparation and tests of demonstrators of analysed systems are planned. These systems will be used for safe transport and cargo discharge from the air using the innovative systems dissipating energy of impact.

11. CERTIFIED QUALITY MANAGEMENT SYSTEMS

In 2014, two certified quality management systems were implemented in the Laboratory of Professional Electronics, IPPT PAN:

ISO-9001:2009 – Design and development, manufacture, service and training in the area of electronic systems and software;

ISO-13485:2012 – Design and development, manufacture and service of medical devices, and training for users of medical ultrasonic devices.

The obtained certification validates our professionalism and enables us to design, develop and introduce new medical devices to clinical practice. We are proud of being involved in the development and implementation of two medical systems: a transcranial Doppler system digiTDS and a high-frequency ultrasound scanner uScan2. We work closely with industrial partners and provide them with expertise, R&D and electronic design services.

Our laboratory develops advanced electronic systems and digital signal processing algorithms for demanding medical and industrial applications. Our specialisation is in the area of ultrasound methods and instrumentation, including medical diagnostics,as well as industrial non-destructive testing of materials and structures.

Together with the other divisions of IPPT PAN, we provide a unique blend of R&D services and commercial system development – bridging the gap between research and the market. Our motto is to ensure the highest level of science and industrial-grade technical solutions for real -world applications.

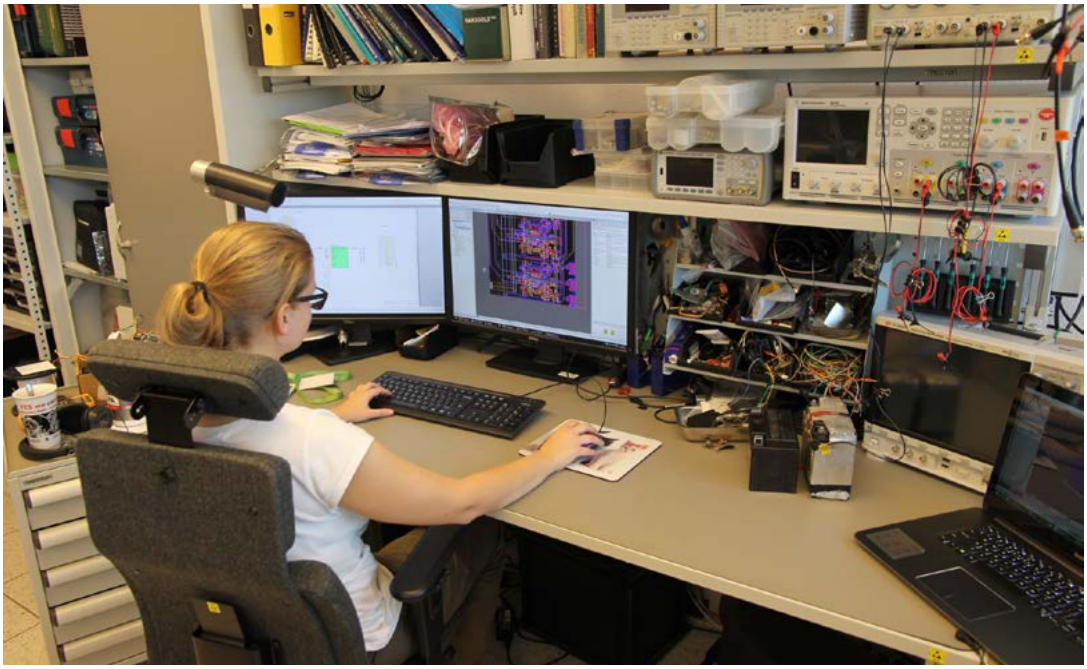


Fig. 11.1. The Laboratory of Professional Electronics, IPPT PAN

12. INTERNATIONAL SCIENTIFIC CO-OPERATION

The Institute has an extensive experience in international co-operation particularly in the area of international research projects.

Table 12.1. Selected projects under the agreements on scientific cooperation

Country	Institution	Topic	Manager at IPPT PAN	Duration
BELARUS	Belarusian State University	Analysis of ultrasonic signals in imaging of tissue and of tissue phantoms.	Assoc. Prof. Barbara Gambin	since 2011
BULGARIA	Institute of Biophysics and Biomedical Engineering, Bulgarian Academy o Science, Sofia	Nonlinear Dynamics of Molecular and Supramolecular Structures	Assoc. Prof. Vasyl Kovalchuk	2015 - 2017
FRANCE	Université Lyon 1, CNRS Institut Camille Jordan	Applications of reaction-diffusion equations in cell signalling	Assoc. Prof. Bogdan Kaźmierczak	2014 - 2015
FRANCE GERMANY	CEDRAT Technologies SA , École Centrale de Lyon , Saarland University, I-Deal Technologies GmbH	Smart Technologies for Transport Safety - Innovation Cluster Nesting (Smart-Nest), FP7-PEOPLE-2011-IAPP	Prof. Jan Holnicki-Szulc	2012 - 2015
HONG-KONG	Department of Electrical and Electronic Engineering, The University of Hong Kong	Ultrasound methods and instrumentation of blood flow estimation and visualization	Marcin Lewandowski, Ph.D.	since 2014
HUNGARY	Budapest University of Technology and Economics	Robust and reliability based approach in topology optimisation	Piotr Tauzowski, Ph.D.	2014 - 2016
LITHUANIA	Vilnius Gediminas Technical University, Department of Strength of Materials	Discrete element modelling of materials and particulate flows	Assoc. Prof. Jerzy Rojek	2014 - 2016
ROMANIA	National Institute for Laser, Plasma and Radiation Physics	Pulsed laser deposition and synthesis of carbon-containing nanostructures	Prof. Zygmunt Szymański	2012 - 2015
RUSSIA	Institute for Problems in Mechanics of the Russian Academy of Sciences, Moscow	Mathematical models of surface-modified solids and their experimental identification	Assoc. Prof. Stanisław Kucharski	2014 - 2016
RUSSIA	Dorodnitsyn Computing Centre of the Russian Academy of Sciences	Affine deformable bodies and their applications in quantum and celestial mechanics	Assoc. Prof. Vasyl Kovalchuk	2014 - 2016
SLOVAKIA	Institute of Materials and Machine Mechanics, Slovak Academy of Science, Bratislava	Investigation of novel concrete compositions with application of X-ray microtomography	Assoc. Prof. Zbigniew Ranachowski	2013 - 2015

TAIWAN (ROC)	Department of Mathematics, National Chung Cheng University	Wave propagation in cell signaling	Assoc. Prof. Bogdan Kaźmierczak	2014 – 2015
UKRAINE	Pidstryhach Institute for Applied Problems of Mechanics and Mathematics of the National Academy of Sciences of Ukraine	Creation of thin modified layers on functional materials by high-energy treatment methods	Neonila Levintant-Zayonts, Ph.D.	2015 - 2017
UKRAINE	Pidstryhach Institute for Applied Problems of Mechanics and Mathematics of the National Academy of Sciences of Ukraine	Investigations of oriented polymers by light depolarization	Arkadiusz Gradys, Ph.D.	2015 - 2017

Fig. 12.1. Workshop on "Adaptive Impact Absorption", 15-16 October 2015, IPPT PAN, Warsaw

Gathered participants from several countries including France (École Centrale de Lyon), Germany (Saarland University) and UK (The University of Liverpool)

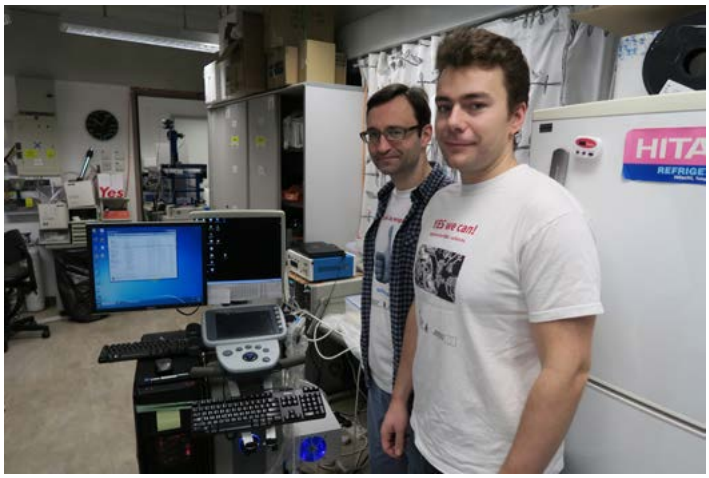


Fig. 12.2. A research visit at Hong-Kong University (Department of Electrical and Electronic Engineering) - we are working on new ultrasound methods and algorithms for blood flow estimation and visualization - from left to right: M. Lewandowski, Ph.D. and M. Walczak

Table. 12.2. Other international co-operation (without contract)

Country	Members	Topic	Manager	Duration
AUSTRALIA	Prof. David A. Beattie, University of South Australia	Formation of droplets and surface-droplet interactions	Piotr Korczyk, Ph.D.	since 2012
BELGIUM	Cathedral of St. Aubain in Namur	Remote optical shape measurements and monitoring of H. Loder's large-size curvilinear painting "Adoration of the Magi".	Marek Skłodowski, Ph.D., Piotr Pawłowski, Ph.D.	2013 - 2015
CANADA	Department of Electrical and Computer Engineering, The University of Waterloo	Novel ultrasound methods and instrumentation for medical applications	Marcin Lewandowski, Ph.D.	since 2015
CHINA	Assoc. Prof. Yonghui An, Dalian University of Technology	Structural health monitoring techniques and modifications of the damage locating vectors method	Bartłomiej Błachowski, Ph.D.	since 2014
CHINA	Prof. Jilin Hou, Dalian University of Technology, Dalian	Substructuring and local analysis in structural health monitoring	Assoc. Prof. Łukasz Jankowski	since 2008
CHINA	Prof. Qingxia Zhang, Dalian Nationalities University, Dalian	Load identification techniques for structural health monitoring	Assoc. Prof. Łukasz Jankowski	since 2007
FRANCE	Prof. Chaouqi Misbah, Dr. Alexander Farutin, Laboratoire de Spectrométrie Physique, Université Joseph Fourier and CNRS, Grenoble	Dynamics of vesicles and flexible fibers in Poiseuille flow	Prof. Maria Ekiel-Jeżewska, Agnieszka Słowicka, Ph.D., Prof. Eligiusz Wajnryb	2014 - 2015
FRANCE, USA	Prof. Antoine Sellier, Laboratoire d'Hydrodynamique (LadHyX) École Polytechnique, Palaiseau, France, Prof. François Feuillebois, Laboratoire d'Informatique pour la Mécanique et les Sciencesde l'Ingénieur, (LIMSI) and CNRS, Orsay, France, Prof. Jerzy Bławzdziewicz, Texas Tech University, Lubbock, USA	High-frequency viscosity of a dilute suspension of elongated particles in a linear shear flow between two walls	Prof. Maria Ekiel-Jeżewska, Prof. Eligiusz Wajnryb	2014 - 2015
FRANCE	Freddy Geyer, Ph.D., Thales Alenia Space	Safety in space engineering	Prof. Jan Holnicki-Szulc, Piotr Pawłowski, Ph.D., Cezary Graczykowski, Ph.D.	since 2014
FRANCE	French-German Research Institute of Saint-Louis - ISL	Selected problems of numerical modeling in terminal ballistics	Piotr Pawłowski, Ph.D.	2014 - 2016
FRANCE	Université de Montpellier	Mechanics of discontinuous media, applications in biophysics	Assoc. Prof. Eligiusz Postek	since 2013

GERMANY	Fraunhofer Institute for Manufacturing Technology and Advanced Materials IFAM, Dresden	Effect of grain size on thermal residual stresses and damage in sintered chromium-alumina composites	Assoc. Prof. Michal Basista	Feb.-July 2014
GERMANY	Fraunhofer-Institut für Kommunikation, Informationsverarbeitung und Ergonomie FKIE, Kognitive Mobile Systeme, Wachtberg	6DSLAM (6D Simultaneous localization and mapping)	Janusz Będkowski, Ph.D.	October-December 2015
GERMANY	Julius-Maximilians-University Würzburg, Am Hubland D-97074 Würzburg, Germany	Pattern recognition for security application	Janusz Będkowski, Ph.D.	May 2015
GERMANY	Prof. B. Ubbo Felderhof, RWTH, Aachen	Hydrodynamic interactions between a sphere and a number of small particles	Prof. Maria Ekiel-Jeżewska	2014 - 2015
GERMANY, USA	Prof. Jan K. G. Dhont, Prof. Peter Lang, Institute of Complex Systems, Soft Matter Division, Research Centre, Juelich, Germany and Prof. Jerzy Bławzdziewicz, Texas Tech University, Lubbock, USA	Near-wall dynamics of concentrated hard-sphere suspensions: comparison of evanescent wave DLS experiments, virial approximation and simulations	Prof. Eligiusz Wajnryb	2014 - 2015
GREECE	Assoc. Prof. Nikolaos Pnevmatikos, Technological Educational Institute of Athens	Structural health monitoring of bolted connections	Bartłomiej Błachowski, Ph.D.	since 2014
GREECE	Prof. Ph. Komninou, Prof. T. Karakostas, Prof. G. Dimitrakopulos, Prof. J. Kioseoglou, A. Lotsari, Ph.D, School of Physics, Faculty of Sciences at Aristotle University of Thessaloniki	Modelling of coupled fields in III-nitride hetero-structures, piezoelectric properties of semipolar and nonpolar III-nitride semiconducting heterostructures	Prof. P. Dłużewski, G. Jurczak, Ph.D., T. Young, Ph.D.	since 2005
IRAN	Polymer Engineering Group, Department of Chemical Engineering, University of Technology, Isfahan	Polymer/ceramic bio-nanocomposites formed by electrospinning	Assoc. Prof. Paweł Sajkiewicz	2015
ISRAEL, USA	Prof. Haim Diamant, Prof. Yael Roichman, Dr. Adar Sonn-Segev, Tel Aviv University, Tel Aviv, Israel Prof. Jerzy Bławzdziewicz, Texas Tech University, Lubbock	Structure and dynamics of a layer of sedimented particles	Prof. Maria Ekiel-Jeżewska, Prof. Eligiusz Wajnryb	2014 - 2015
ISRAEL	Technion - Israel Institute of Technology, Haifa	Electrospinning of nanofibers, phase transitions in polymeric nanofibers	Assoc. Prof. Paweł Sajkiewicz	2014 - 2015
ITALY	Massimiliano Lanzi, Ph.D., Department of Industrial Chemistry, "Toso Montanari", Alma Mater Studiorum, University of Bologna	Electrospinning of conductive polymers	Filippo Pierini, Ph.D.	since 2015
ITALY	Istituto di Chimica e Tecnologia dei Polimeri CNR, Pozzuoli/Napoli	Kinetics of polymer crystallization	Assoc. Prof. Paweł Sajkiewicz	2014 - 2015
ITALY	Università Politecnica delle Marche, Ancona (Sezione di Biochimica, Biologia e Fisica) Ancona	Determination of thermal residual stresses in metal-ceramic bulk composites by neutron diffraction	Assoc. Prof. Michal Basista	since 2014

ITALY	Prof. Tommaso Ruggeri Department of Mathematics and Alma Mater Research Center on Applied Mathematics, University of Bologna	Hyperbolic systems of partial differential equations and wave propagation	Prof. Wiesław Larecki	since 2014
ITALY	University of Trento	Modelling of elasto-plastic coupling in granular materials	Prof. Stanisław Stupkiewicz	since 2013
JAPAN	University of Hiroshima	Analysis of nonlinear multifolding structures. Design and optimisation of scissor-type mobile bridges.	Piotr Pawłowski, Ph.D. Cezary Graczykowski, Ph.D. Prof. Jan Holnicki-Szulc	2004 - 2016
LITHUANIA	Vilnius Gediminas Technical University	Modelling of granular materials using the discrete element method	Assoc. Prof. Jerzy Rojek	since 2011
NETHERLANDS	Volkert van Steijn, Ph.D., Delft University of Technology	Droplet formation in the microfluidic T-junction	Piotr Korczyk, Ph.D.	since 2011
ROMANIA	Mariana Cristea	Dynamic mechanical analysis (DMA) of polyurethane shape memory polymers (SMP)	Assoc. Prof. Elżbieta Pieczyska, Maria Staszczak, Karol Golasiński	since 2013
ROMANIA	Technical University of Cluj-Napoca	Experimental and numerical investigation of sheet metal forming	Assoc. Prof. Jerzy Rojek	since 2015
SLOVAKIA	Institute of Materials Research of Slovak Academy of Science, Kosice	Micro-CT examination of composite microstructure	Assoc. Prof. Michal Basista	since 2015
SLOVAKIA	Institute of Measurement Science of the Slovak Academy of Sciences, Bratislava	Microstructure and thermal residual stress effect on fracture properties of metal matrix composites	Assoc. Prof. Michal Basista	since 2015
SLOVENIA	University of Ljubljana	Automation of computational modelling of materials and contact interfaces	Prof. Stanisław Stupkiewicz	since 1998
SPAIN	International Center for Numerical Methods in Engineering (CIMNE), Barcelona	Modelling of rock cutting using the discrete element method	Assoc. Prof. Jerzy Rojek	since 2005
SPAIN	Miguel Hernandez University, Alicante, IDIBAPS Barcelona	Transmission of information between cortical neurons	Prof. Janusz Szczepański, Prof. Eligiusz Wajnryb	2004 - 2015
SPAIN	Prof. Maria Victoria Sanchez-Vives, August Pi i Sunyer Biomed Res Inst IDIBAPS, Syst Neuroscience, Barcelona 08036, Spain	Neuronal signals analysis (cortical networks) with the application of Information Theory	Prof. Janusz Szczepański	since 2001

SWITZERLAND	Eidgenössische Materialprüfungs- und Forschungsanstalt (EMPA), Sankt Gallen	Bicomponent scaffolds for tissue engineering	Assoc. Prof. Paweł Sajkiewicz, Dorota Kołbuk, Ph.D.	2014
TURKEY	Bilkent University	Modelling of elastohydrodynamic lubrication in soft contacts	Prof. Stanisław Stupkiewicz	since 2014
USA	Materials Science and Engineering Dept., Clemson University, Clemson, S.C.	Hot pressing of ceramic and ceramic/metal composite membranes	Assoc. Prof. Michal Basista	since 2015
USA	Prof. Juan Caicedo, University of South Carolina	Human-structure interaction	Bartłomiej Błachowski, Ph.D.	since 2015
USA	Prof. Billie F. Spencer, Jr. University of Illinois at Urbana - Champaign	Structural health monitoring of truss structures	Bartłomiej Błachowski, Ph.D.	since 2014
USA	Prof. Howard A. Stone, Dr. Steve Kuei, Princeton University, Princeton	Dynamics and topology of a flexible chain: knots in steady shear flow	Prof. Maria Ekiel-Jeżewska, Agnieszka Słowicka, Ph.D., Prof. Eligiusz Wajnryb	2014 - 2015
USA	Purdue University	Durability of cement based composites in aggressive environment - application of experimental and soft computing methods	Prof. Michał A. Glinicki	since 2014
USA	Prof. Alexander Yarin, University of Illinois at Chicago Mechanical and Industrial Engineering Department	Electrospinning of nanofibres, biomedical applications	Prof. Tomasz A. Kowalewski	permanent cooperation since 2003, short visits 2004
USA	Prof. Joseph T. C. Liu, School of Engineering, Brown University, Providence, RI 02912	Nanofluids	Prof. Tomasz A. Kowalewski	6 months visit at IPPT in 2015
USA	University of New Mexico, Albuquerque	Development of new formulation of the discrete element method	Assoc. Prof. Jerzy Rojek	since 2015
USA	Prof. Krzysztof Kuczera, Prof. Gouri S. Jas, Dr. Eric C. Rentchler, Carey K. Johnson, C. Russel Middaugh, University of Kansas, Lawrence and Dr. J. R. Hermansen, School of Medicine, Central University of the Caribbean, Bayamon	Reorientation Motion and Preferential Interactions of a Peptide in Denaturants and Osmolyte	Agnieszka Słowicka, Ph.D.	2015
USA	Binghamton University	Modelling of contact of boron-nitride nanotubes	Prof. Stanisław Stupkiewicz	2013-2014
USA	Prof. Ehud Kaplan, The Icahn School of Medicine at Mount Sinai, NY, USA	Signals processing analysis (LGN) with application of Information Theory	Prof. Janusz Szczepański, Agnieszka Pręgowska, Ph.D.	since 2014

Fig. 12.3.
Prof. M. A. Glinicki and his graduate students attending the course on engineering durability at Purdue University, USA

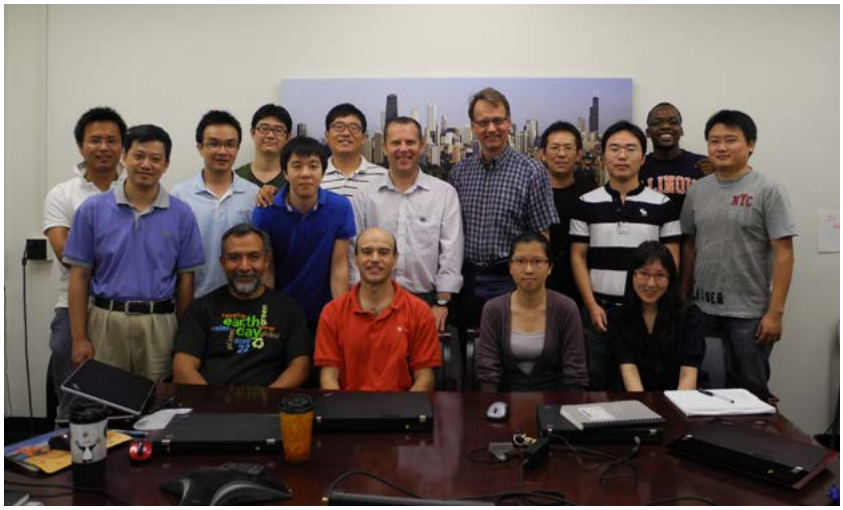


Fig. 12.4.
Sensor Group headed by Prof. Billie F. Spencer, Jr. at the University of Illinois at Urbana-Champaign. In the middle of the group – Prof. B. F. Spencer and B. Błachowski, Ph.D. (IPPT PAN); collaboration concerns the development of new strategies for Structural Health Monitoring

Fig. 12.5.
An exhibition booth at the IEEE International Ultrasonics 2014 conference in Chicago, USA (M. Lewandowski Ph.D. and his team). We presented a Versatile Ultrasound Research Platform developed at IPPT PAN

13. EUROPEAN VIRTUAL INSTITUTE ON KNOWLEDGE-BASED MULTIFUNCTIONAL MATERIALS (KMM-VIN AISBL)

KMM-VIN AISBL, founded in 2007, is a non-profit international association based in Brussels, fostering integrated basic and applied research, and educational and innovation activities in the field of advanced structural and functional materials. The main activities and services are dedicated to transport, energy and health sectors. The KMM-VIN research activities are conducted within four Working Groups: 1. Materials for Transport, 2. Materials for Energy, 3. Biomaterials and 4. Modelling. KMM-VIN AISBL consists of 70 members including academic and industrial organisations from 15 EU Member States with expertise in materials processing, characterisation, testing and modelling. KMM-VIN has emerged from the FP6 Network of Excellence project KMM-NoE ('Knowledge-based Multicomponent Materials for Durable and Safe Performance', 2004-2009) coordinated by IPPT PAN, which was devoted to the study, understanding, design and development of new advanced materials (ceramic, metallic, metal-ceramic, intermetallic, polymer, etc.). Besides joint research activities, KMM-VIN runs mobility programme for young researchers, organises specialised courses and workshops targeted at industry, manages own database on KMM-VIN materials, members' expertise and research infrastructure. The KMM-VIN dissemination activities include creation and administration of the association's website with public and members' areas, IT tools for the EU projects coordinated by KMM-VIN, and preparation and publishing of semiannual KMM-VIN newsletters.

Fig. 13.1. Participants of 4th KMM-VIN Industrial Workshop on "Advanced Materials Modeling for Industrial Practice", January 30, 2015, Graz, Austria

14. CONFERENCES ORGANISED AND CO-ORGANISED BY IPPT PAN IN 2014-2015

- Experiments in Fluid Mechanics Symposium – EFM 2015, October 26-27, 2015, Warsaw,
- Workshop on Adaptive Impact Absorption - AIA'15, October 15-16, 2015, Warsaw,
- 11th International Symposium on Brittle Matrix Composites, September 28-30, 2015, Warsaw,
- 3rd Polish Congress of Mechanics & 21st Computer Methods in Mechanics - PCM-CMM 2015, September 8-11, 2015, Gdańsk,
- EMBO Young Scientists Forum, July 2-3, 2015, Warsaw,
- "Composites and Ceramic Materials – Technology, Application and Testing", 14th International Conference, June 1-3, 2015, Białowieża,
- XXI Seminar "Nondestructive Testing of Materials", March 18-20, 2015, Zakopane,
- EMBO Workshop on Computational Biology, February, 20-22, 2015, Goniądz,
- 4th Industrial Workshop on "Advanced Materials Modelling for Industrial Practice", January 30, 2015, Graz,
- 39th Solid Mechanics Conference - SolMech 2014, September 1-5, 2014, Zakopane,
- 4th National Conference on Nano- and Micromechanics, July 8-10, 2014, Wrocław,
- 8th Workshop on Dynamic Behaviour of Materials and its Applications in Industrial Processes, June 25-27, 2014, Warsaw,
- XXI Fluid Mechanics Conference - KKMP2014, June 15-18, 2014, Cracow.

Fig. 14.1. Long lasting cooperation in organizing the cutting-edge international conferences on Brittle Matrix Composites (BMC) (Prof. Jan Olek of Purdue University accompanied by the co-chairmen of BMC-11 Symposium and Prof. T. Burczyński, the director of IPPT PAN) – September 28-30, 2015, Staszic Palace, Warsaw

ABOUT THE 39th SOLID MECHANICS CONFERENCE

A long tradition to organise the Solid Mechanics Conferences (SolMech) at different locations in Poland aims to include all areas and research centres in Poland focused on mechanics of materials and structures including interactive fields. The Polish Solid Mechanics Conferences have been organised by the Institute of Fundamental Technological Research of Polish Academy of Sciences since 1953, when the first conference was held in Karpacz located in the south of Poland. At the beginning, the conferences have had mainly national character and concentrated mostly on problems of elasticity, plasticity and structural mechanics. Later on, they became international with considerable participation of scientists from foreign countries, and with a much wider scope covering most important and actual aspects of solid mechanics.

The Conferences have maintained high scientific standard and serve as a forum for the exchange of ideas and research information. Their official language is English.

The 39th Solid Mechanics Conference (SolMech 2014) took place on September 1-5, 2014 in Zakopane near Cracow, Poland.

The aim of this conference was to bring together researchers from different countries and to provide an opportunity for the presentation and discussion of scientific results from a wide field of solid mechanics.

The invited lecturers included the outstanding researchers: Prof. Holm Altenbach, Germany (Mechanics of Nanostructures), Prof. Josef Eberhardsteiner, Austria (Mechanical Behavior of Wood - a Bridge from Microstructure to Structural Applications by Means of Computational Methods), Prof. Narinder Gupta, India, (Some Aspects of Large Deformations of Structures under Dynamic Loading), Prof. David Hayhurst, UK (High-temperature Continuum Damage Mechanics. Simulation of Materials and Components from Processing and Manufacture to Component Performance), Prof. Shaker Meguid, Canada (Multiscale Modelling of Multifunctional Nanocomposites for Aerospace Applications), Prof. Ryszard Pęcherski, Poland (Plastic Flow and Failure of Solids. Modelling Across Scales), Prof. Krzysztof Wiśniewski, Poland (Recent Improvements in Mixed/Enhanced Shell Elements with Drilling Rotation), Prof. Ramon Zaera Polo, Spain (Deformation of Dynamically Phase Transforming Metals in Adiabatic Conditions: Thermal Effects and Instabilities).

The following sessions were organised during SolMech 2014:

- Micromechanics, Interfaces and Multi-Scale Modelling,
- Fracture, Damage and Fatigue of Materials,
- Continuum Mechanics, Elasticity and Plasticity,
- Experimental Mechanics,
- Mechanics of Composites and Porous Media,
- Geomechanics,
- Smart Materials and Structures,
- Structural Mechanics, Optimisation and Reliability Analysis,
- Shells and Plates,
- Computational Aspects of Solid Mechanics,
- Dynamics of Solids and Structures.

Scientific Committee

Badur J.
Basista M.
Borkowski A.
Burczyński T.
Dłużewski P.
Gutkowski W.
Holnicki-Szulc J.
Kleiber M.
Kosiński W.
Kotulski Z.
Kowalczyk P.
Kowalewski Z.
Kubik J.
Łodygowski T.
Mróz Z.
Nowicki A.
Perzyna P.
Petryk P.
Pęcherski R.
Pieczyska E.
Pietraszkiewicz W.
Pietrzyk M.
Rojek J.
Skoczeń B.
Stupkiewicz S.
Szefer G.
Tejchman J.
Tylikowski A.
Wiśniewski K.

Fig. 14.2. (left) Opening speech by Prof. T. Burczyński – Director of IPPT PAN

Fig. 14.3. (right) Opening speech by Prof. Z. Kowalewski – Chairman of SolMech 2014

Fig. 14.4. Participants of the 39th Solid Mechanics Conference, September 1-5, 2014, Zakopane, Poland

More details on SolMech 2014 are available on the conference website: http://solmech2014.ippt.pan.pl

15. PROMOTIONS AND IMPROVEMENT OF SCIENTIFIC QUALIFICATIONS

Professor titles awarded by the President of the Republic of Poland

1. Maria Ekiel-Jeżewska, (Professor since February 19, 2014)

Fig. 15.1. Prof. Maria Ekiel-Jeżewska nomination during the official celebration in Belweder

Photo from the President`s Office (Ł. Kamiński)

On April 10, 2014, at the ceremony in Belweder Palace, the professor's nomination was granted to Mrs Maria Ekiel-Jeżewska by Mr Bronisław Komorowski, the President of Poland.

2. Janusz Szczepański, (Professor since July 28, 2014)

Fig. 15.2. The ceremony of nomination of Prof. Janusz Szczepański in Belweder

Photo from the President`s Office (W. Olkuśnik)

On July 28, 2014, at the ceremony in Belweder Palace, the professor's nomination was granted to Mr Janusz Szczepanski by Mr Bronisław Komorowski, the President of Poland.

3. Jerzy Litniewski, (Professor since February 27, 2015)

Fig. 15.3. Prof. Jerzy Litniewski nomination during the official celebration in Belweder

Photo from the President`s Office (W. Olkuśnik)

On February 17, 2015, at the ceremony in Belweder Palace, the professor's nomination was granted to Mr Jerzy Litniewski by Mr Bronisław Komorowski, the President of Poland.

Habilitations

Table 15.1. Habilitations awarded by IPPT PAN - year 2014

First name	Last name	Date	Work title	Discipline
Yuriy	Tasinkevych	2014-01-30	Electrostatic methods in analysis of acoustic beam-forming structures	Electronics
Łukasz	Jankowski	2014-03-06	Dynamic load identification for structural health monitoring	Mechanics
Beata	Misztal-Faraj	2014-05-29	Modelowanie kinetyki krystalizacji polimorficznej i płytkowej w polimerach	Materials Engineering
Eligiusz Witold	Postek	2014-09-25	Modelowanie numeryczne problemów sprzężonych wraz z paralelizacją	Mechanics
Andrzej	Pawlak	2014-09-25	Zbadanie zjawiska kawitacji występującego w polimerach częściowo krystalicznych poddawanych odkształceniu w stanie stałym	Materials Engineering

Table 15.2. Habilitations awarded by IPPT PAN - year 2015

First name	Last name	Date	Work title	Discipline
Wasyl	Kowalczuk	2015-06-25	Modele afiniczne w opisie dyskretnych i ciągłych ośrodków z mikrostrukturą w mechanice analitycznej	Mechanics
Ewa	Turska	2015-10-29	Zbieżność i stabilność algorytmów numerycznych w sformułowaniach wielopolowych mechaniki	Mechanics

Table 15.3. Habilitations of IPPT PAN researches awarded by other institutions - year 2015

First name	Last name	Date	Work title	Discipline
Zbigniew	Wołejsza	2015-05-12	The study of adaptive landing gear for light general aviation aircraft	Machines construction and Exploitation

Fig. 15.4. The Ceremonial Promotion of Doctors and Postdoctoral Degrees at IPPT PAN, June 19, 2015

Ph.D. Degrees

Table 15.4. Ph.D. Degrees awarded by IPPT PAN – year 2014

First name	Last name	Date	Title of Ph.D. thesis	Bestowed title range	Supervisor
Jacek Mateusz	Bajkowski	2014-10-30	Vibrations of sandwich beams controlled by smart materials	Mechanics	Prof. Czesław Bajer, Bartłomiej Dyniewicz, Ph.D. (auxiliary supervisor)
Łukasz	Nowak	2014-11-27	Adaptive feedback control system for reduction of vibroacoustic emission	Electronics	Assoc. Prof. Mirosław Meissner, Tomasz Zieliński, Ph.D. (auxiliary supervisor)

Table 15.5. Ph.D. Degrees of IPPT PAN researches awarded by other institutions – year 2014 (supervisor from IPPT PAN)

First name	Last name	Date	Title of Ph.D. thesis	Bestowed title range	Supervisor
Paweł	Nakielski	2014-02-03	Systemy uwalniania leków oparte na nanowłóknach	Biocybernetics and Biomedical Engineering	Prof. Tomasz A. Kowalewski, Tomasz Kowalczyk, Ph.D. (auxiliary supervisor)
Joanna	Jaruszewicz-Błońska	2014-10-07	The influence of noise characteristics on the relative stability of attractors in bistable biochemical systems	Biocybernetics and Biomedical Engineering	Prof. Tomasz Lipniacki

Table 15.6. Ph.D. Degrees awarded by IPPT PAN – year 2015

First name	Last name	Date	Title of Ph.D. thesis	Bestowed title range	Supervisor
Karol	Przystalski	2015-02-26	Detekcja i klasyfikacja barwnikowych zmian skóry na zdjęciach wielowarstwowych	Informatics	Prof. Maciej Ogorzałek
Grzegorz	Knor	2015-03-26	Identyfikacja, modelowanie i sterowanie polami temperatury w konstrukcjach betonowych	Mechanics	Prof. Jan Holnicki-Szulc

First name	Last name	Date	Title of Ph.D. thesis	Bestowed title range	Supervisor
Marcin	Nowak	2015-03-26	Analiza deformacji i zniszczenia struktur komórkowych w zastosowaniu do symulacji procesu infiltracji pianki korundowej ciekłym metalem	Mechanics	Assoc. Prof. Zdzisław Nowak
Katarzyna	Makowska	2015-03-26	Metodyka oceny stanu uszkodzenia materiałów poddawanych laboratoryjnie symulowanym obciążeniom eksploatacyjnym	Materials Engineering	Prof. Zbigniew Kowalewski
Stanisław J.	Kotorowicz	2015-09-24	Kryptograficzne algorytmy strumieniowe oparte na specjalnych grafach algebraicznych	Mechanics	Prof. Vasyl Ustymenko
Grzegorz	Suwała	2015-10-29	Nieparametryczna metoda identyfikacji zmian masy i sztywności konstrukcji	Mechanics	Assoc. Prof. Łukasz Jankowski
Grzegorz	Oryńczak	2015-10-29	System agentowy dla wspomagania bezpiecznych usług czasu rzeczywistego	Informatics	Prof. Zbigniew Kotulski
Bartosz	Paprocki	2015-12-04	Analiza wydajności transmisji danych w komórkach i sieciach neuronowych metodami Teorii Informacji	Informatics	Prof. Janusz Szczepański

Fig. 15.5. Karol Przystalski, Ph.D., received the Diploma from Prof. H. Petryk, Chairman of the Scientific Council of IPPT PAN

Fig. 15.6. Participants of the Ceremonial Promotion of Doctors and Postdoctoral Degrees at IPPT PAN, June 19, 2015

Fig. 15.7. Opening speech by Prof. Elżbieta Frąckowiak, Vice-President of PAN, during the Ceremonial Promotion of Doctors and Postdoctoral Degrees at IPPT PAN, June 19, 2015

Fig. 15. 8. Occasional lecture of Prof. Andrzej K. Wróblewski, during the Ceremonial Promotion of Doctors and Postdoctoral Degrees at IPPT PAN, June 19, 2015

16. THE DOCTORAL STUDY

The Doctoral Study programme at IPPT PAN was established in 1968 as one of the first among the scientific institutes of the Polish Academy of Sciences. Since that moment until the present the IPPT Doctoral Study plays an important role as a third level education utilizing the potential of highly qualified academic staff. We invite graduates with a strong motivation for scientific work, determined to commit (dedicate) a few years to realise their ambitious research plans.

Currently, the doctoral program of the IPPT Doctoral Study is offered in four disciplines: mechanics, electronics, materials engineering and computer science. However, due to a very common interdisciplinary character of the carried out research, the investigations conducted by our Ph.D. students involve a knowledge in which a topic or a problem crosses the borders of one discipline and comprises several fields of study. Therefore, the results are usually obtained within two or three of such fields. Moreover, in accordance with the proper long-term bi-lateral agreements, the IPPT Doctoral Study performs its activity in cooperation with the doctoral studies of other Polish scientific institutions, i.e., with the Institute of Biocybernetics and Biomedical Engineering of the Polish Academy of Sciences in the field of biomedical engineering as well as with four departments of Polish state universities in the field of computer science.

We offer modern research equipment and cooperation with renowned research institutions both in Poland and abroad. In addition, we offer internships abroad and participation in the European projects conducted by IPPT PAN for outstanding doctoral candidates. Our Ph.D. students receive attractive fellowships and may attend free of charge language courses at different levels. A doctoral programme at IPPT PAN is largely based on the student's personal research project, which is complemented with courses and clearly specified knowledge requirements. The education process is led by our own scientists, and the lectures given during the successive terms are chosen by the Ph.D. students from among more than 30 courses included in the didactic offer of the IPPT Doctoral Study programme. Studies must be completed in four years and the Ph.D. degree is awarded on the submission of a thesis subject to its passing a public defense. Since 1955, 670 graduates were promoted at IPPT PAN including 456 Institute employees and Ph.D. students as well as 214 external scientists.

In 2014-2015, the IPPT Doctoral Study had a total number of 38 Ph.D. students, 25 of whom completed their study in a framework of our scientific activity with a regular scholarship support of IPPT PAN. The remaining 13 students carried out their studies via distance learning using our own highly skilled supervisors and the advanced laboratory equipment. In 2014-2015, 10 scientists achieved the doctoral degree at IPPT PAN, including 4 Ph.D. students of the IPPT Doctoral Study. Their dissertations are devoted to scientific problems in the field of computer science, material engineering and mechanics combined with the essential contribution of electronics. Nowadays, this multidisciplinary field is commonly called "mechatronics"".

Head of the Doctoral Study:
Assoc. Prof. Tomasz Szolc

Secretary: Monika Węglowska
Phone: + 48 22 826 98 41, +48 22 826 12 81 ext. 219

Fig. 16.1. The PhD students of IPPT PAN together with the Head of the Doctoral Study

LIST OF STUDENTS (as of December 31, 2015)

1st year of the Study

1. Golasiński Karol
2. Marijnissen Michał
3. Trombley Chris
4. Wasilewski Maciej
5. Wiśniewski Piotr
6. Faraj Rami
7. Gawlicki Michał
8. Jurczak Kamila
9. Madan Nikhil
10. Wójtowicz Hubert

2nd year of the Study

1. Lewandowski Maciej
2. Majewski Michał
3. Wichrowski Michał
4. Nienałtowski Karol
5. Bartkowski Konrad
6. Chrzanowska Justyna
7. Żegleń Filip
8. Gruntowski Andrzej
9. Gruntowski Tomasz
10. Nowakowski Kamil
11. Łazarska Małgorzata
12. Tomaszewska Ewa
13. Witkowski Dawid
14. Czerwiński Tomasz

3rd year of the Study

1. Frydrych Karol
2. Nowicka Dominika
3. Pawłowska Sylwia
4. Chatterjee Paramita
5. Jakubowska Justyna
6. Wawrzyk Krzysztof
7. Staszczak Maria
8. Markiewicz Joanna

4th year of the Study

1. Białecki Sławomir
2. Bukowicki Marek
3. Byra Michał
4. Gruca Marta
5. Jarzębski Paweł

17. CONSORTIUMS

The selected consortiums which include the Institute in the years 2014-2015:

European Technology Platform for Advanced Engineering Materials and Technologies (EuMaT)

European Technology Platform for Advanced Engineering Materials and Technologies has been launched in order to assure optimal involvement of industry and other important stakeholders in the process of establishing R&D priorities in the area of advanced engineering materials and technologies. EuMaT should improve coherence in the existing and forthcoming EU projects, in the field of materials R&D.

EuMaT covers all elements of the life cycle of an industrial product, should it be a component, a system or a final product:

- Design, development & qualification of advanced material,
- Advanced production, processing and manufacturing,
- Material and component testing,
- Material selection and optimisation,
- Advanced modelling on all scales,
- Databases and supporting analytical tools,
- Life cycle considerations, including impacts, decommissioning, reliability, hazards, risks and recyclability.

The main goal of EuMaT is to contribute to the best relation and dialogue between industry, R&D actors and institutions aiming at improving the coordination and synergies at national and European level in the field of materials R&D.

EuMaT includes members from:

- Industry (large, medium and small, embracing the whole production and supply chain, including component, equipment and sub-system suppliers, service providers and user industries, those involved in technology transfer, and industry associations),
- Public authorities (regulators and policy makers, funding agencies, in particular, notified and licensing bodies),
- Scientific and technical community (apart from education and research also those involved in innovation and interested in the issue of European Innovation Area),
- Associations and consortia from other EU projects,
- Financial community (private banks including the EIB, the European Investment Fund (EIF), venture capital, etc., in particular, those supporting SME's),
- Civil society, including users and consumers (involving also the future customers, e.g., through associations).

Ochota Biocentre Consortium

Ochota Biocentre is a scientific consortium established on January 1, 2008 by six institutes located at Ochota Campus in Warsaw. The Ochota Biocentre members are:

- Institute of Biochemistry and Biophysics (IBB PAN),
- Institute of Fundamental and Technological Research (IPPT PAN),
- International Institute of Molecular and Cell Biology (IIMCB),

- Nencki Institute of Experimental Biology (IBD PAN),
- Mossakowski Medical Research Center (IMDiK PAN),
- Nałęcz Institute of Biocybernetics and Biomedical Engineering (IBIB PAN).

With over 1000 scientists publishing over 350 scientific papers annually, the Ochota Biocentre is one of the largest research centres in Poland. The main goal of Ochota Biocentre is to consolidate the research potential of its participants who are capable of carrying out extensive research activities in disciplines such as biology, medicine and bioengineering.

All Ochota Biocentre institutes are involved in implementation of two large projects financed by structural funds: Ochota Biocentre - IT infrastructure for the development of strategic directions in biology and medicine and CePT.

The Centre for Preclinical Research and Technology (CePT)

The CePT consortium was established by: the Medical University of Warsaw (WUM), being the coordinator, the University of Warsaw (UW),the Warsaw University of Technology (PW) and seven institutes of the Polish Academy of Sciences: the Nencki Institute of Experimental Biology (IBD PAN), the Institute of Biochemistry and Biophysics (IBB PAN),the Mossakowski Medical Research Centre (IMDiK PAN), the International Institute of Molecular and Cell Biology (MIBMiK), IPPT PAN, the Institute of High Pressure Physics (IWC PAN), and the Nałęcz Institute of Biocybernetics and Biomedical Engineering (IBIB PAN).

The main goal and the chief asset of the CePT consortium is to bring together the potential of outstanding scientists and the opportunities provided by infrastructure of well-equipped state-of- the-art core-facility research laboratories: physical and chemical laboratories (UW), biomolecular and biotechnological facilities (UW, PAN, WUM), biomedical engineering and biomaterial technology laboratories (PW, PAN), units conducting preclinical research on animal models of diseases associated with the progress of civilisation (PAN, WUM), as well as specialised base for clinical research provided by the Medical University of Warsaw.

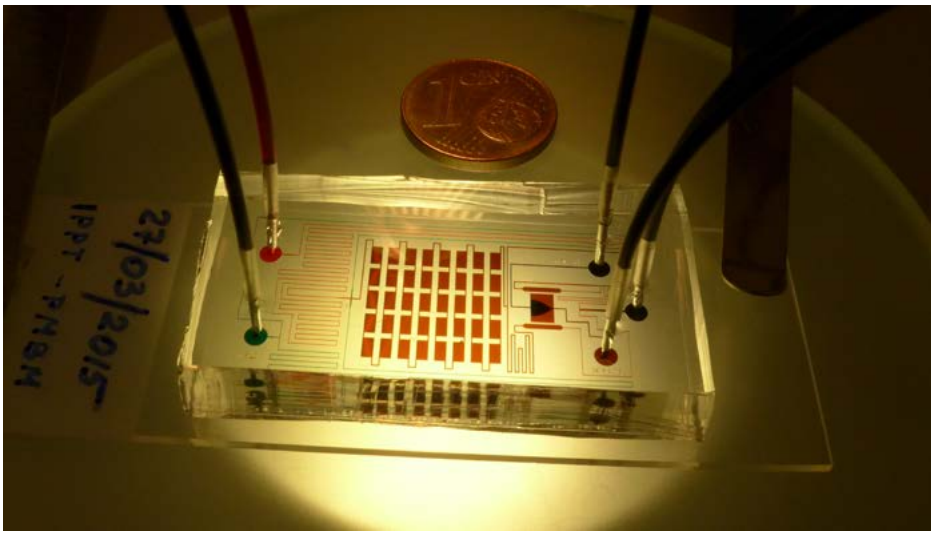


Fig. 17.1. A microfluidic device (made of PDMS by soft photolitography) for cell cultures. Inlets are connected to programmable syringe pumps which allow for precise control of the dose and duration of stimulation with, e.g., cytokines

The Centre of Advanced Technology "AERONET – Aviation Valley"

The Centre of Advanced Technology "AERONET – Aviation Valley" is a consortium including academic units conducting world-class research and other subjects beneficial to scientific research and developmental work, innovations and implementations within the scope of widely interpreted aviation technology. Undertaking interdisciplinary activities the Centre will serve to work out, implement and commercialise new aviation technologies in accordance with the Polish scientific and innovative policy.

Thanks to the use of intellectual and research potential of specific creative circles in building and improving the results of activities within the scope of aviation, the Centre will lead to broadening and strengthening the cooperation between universities and industry (research, implementations, etc.) as well as international cooperation.

The Centre of Advanced Technologies "AERONET – Aviation Valley" became active in the following scientific fields pertaining to aviation and its related areas:

- Design and testing of aviation structures and propulsions,
- Aviation teleinformatics and avionics systems,
- Modern materials and surface engineering processes,
- Modern production techniques in the aerospace industry,
- Aerodynamics.

Fig. 17.1. Laboratory of Safety Engineering, IPPT PAN

Piezo Institute

The Piezo Institute is a European organisation dedicated to research and application development in piezoelectric materials and devices. Emerging from EC-funded projects such as MIND and POLECER, the founding members represent the best academic and industrial expertise in this fast-growing sector. The Piezo Institute is the European hub of expertise and resources in piezo technologies, offering research, resources, education and training. Its expertise includes ferroelectricity, electrostriction and pyroelectricity in materials including ceramics, single crystals, polymers and composites.

The Piezo Institute founding members are: MEGGITT - Ferroperm Piezoceramics, Centro Ricerche Fiat, the National Physical Laboratory, University of Tours - LUSSI, Université François Rabelais - CNRS, Laboratoire de Céramique, École Polytechnique Fédérale de Lausanne - EPFL, the Jozef Stefan Institute, Cranfield University, the Institute of Solid State Physics- University of Latvia.

The Piezo Institute companies and sponsor members are: ELTEK S.p.A., Instituto de Ciencia de Materiales de Madrid, Italian Institute of Technology, IBULE PHOTONICS, IPPT PAN, the Institute of Science and Technology of Ceramic Materials, Nanoforce Technology, SINTEF, the Wrocław University of Technology, Yzatec.

The Centre for Advanced Materials and Technologies (CEZAMAT)

The main goal of CEZAMAT is to provide the platform which can integrate research society and enable development of interdisciplinary research on modern materials and technologies. The research infrastructure and integrated research programmes will allow to conduct research and development work at the highest level and to promote and implement new technologies as well. The centre is dedicated to Polish and international scientific communities and companies which use innovative technologies and products.

Another important goal of CEZAMAT is transferring advanced technologies and commercializing developed ideas. The centre's objective is to improve cooperation between Mazovian, national research centres and business. CEZAMAT also will support/help in development activities in the region.

The consortium members are: the Warsaw University of Technology (coordinator), the Institute of Physical Chemistry of the Polish Academy of Sciences, the Institute of Physics of the Polish Academy of Sciences, IPPT PAN, the Institute of Electronic Materials Technology, the Institute of Electron Technology, Institute of High Pressure of the Polish Academy of Sciences, the University of Warsaw, and the Military University of Technology.

18. PRESTIGIOUS AWARDS IN 2014-2015

Jan Szmelter Medals

Fig. 18.1. Jan Szmelter Medal

On May 7, 2014, during the XIII Conference on Science and Technology in Computer Engineering Technology in Licheń, Prof. Michał Kleiber and Prof. Tadeusz Burczyński were honoured with prestigious awards – Jan Szmelter Medals.

Fig. 18.2. The award ceremony during the XIII Conference on Science and Technology in Computer Engineering Technology in Licheń; from right to left: Gen., Brig., Prof. Zygmunt Mierczyk, Rector - Commander of Military University of Technology, Prof. Marian Dacko, Prof. Michał Kleiber, Prof. Tadeusz Burczyński, and Prof. Tadeusz Niezgoda

Prof. Michał Kleiber was awarded the medal for his overall activity in the field of computer methods in engineering.

Prof. Tadeusz Burczyński was awarded the medal for development of modern computational methods based on artificial intelligence and genetic algorithms.

Medal for merits in the scientific cooperation and support of the development of academic staff

In May, 2014, the Scientific Council of Faculty of Metals Engineering and Industrial Computer Science of AGH University of Science and Technology in Kraków awarded Prof. Tadeusz Burczyński with the medal for merits in the scientific cooperation and support of the development of academic staff.

The Visegrad Group Academies Awards

In October, 2014, Agata Roszkiewicz-Walczuk, Ph.D., was awarded the Visegrad Group Academies Award for young scientists for achievements in the field of applied mathematics.

The Visegrad Group Academies consists of: the Czech Academy of Sciences, the Polish Academy of Sciences, the Slovak Academy of Sciences and the Hungarian Academy of Sciences. On October 14, 2014, at a ceremony held at the Czech Academy of Sciences in Prague, the Presidents of the academies handed out diplomas to the winners. The winners presented their research topics, their most important achievements and prospects for further development.

The Maksymilian Tytus Huber Scientific Award

On December 2, 2014, Assoc. Prof. Łukasz Jankowski, was granted the Scientific Award of the Fourth Division of Engineering Sciences,Polish Academy of Sciences. The award was presented for a series of eleven publications collectively entitled "Dynamic load identification for structural health monitoring" consisting of a monograph and the selected ten journal papers.

Fig. 18.3. Assoc. Prof. Łukasz Jankowski received the award from Prof. Michał Kleiber, President of the Polish Academy of Sciences at a ceremony at the PAN (photo: M. Mlekicki)

The Scientific Awards of the Fourth Division of Engineering Sciences, Polish Academy of Sciences, are annual individual awards for an outstanding research publication (or a series of such publications) in engineering sciences. The awards are granted to researchers, who – in the year of publication – did not held the scientific title of professor and were under the age of 45.

19. PUBLISHING OFFICE

Scientific journals presently published by IPPT PAN:

Archives of Acoustics is an English-language peer-reviewed journal, quarterly publishing original research papers from all areas of acoustics as well as abstracts from selected acoustical conferences. Full access to the current journal issues is provided.

http://acoustics.ippt.pan.pl

Indexed and abstracted (from vol. 32(1) 2007) in Science Citation Index Expanded (SciSearch) and Journal Citation Reports and many other bases.

Impact Factor 2014: 0.565
Editor-in-chief: Prof. Andrzej Nowicki

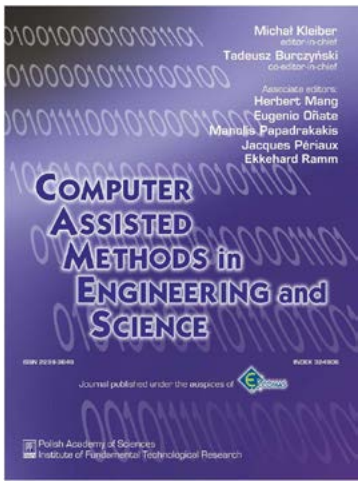
Archives of Mechanics is a refereed international journal founded in 1949. It is edited and published by IPPT PAN.

The journal provides a forum for original research on mechanics of solids, fluids and discrete systems, including the development of mathematical methods for solving mechanical problems.

http://am.ippt.pan.pl/

Archives of Mechanics is abstracted/indexed in: Science Citation Index Expanded (SciSearch, Thomson ISI, Philadelphia), ISI Alerting Services, Current Contents/Engineering, Computing and Technology, Materials Science Citation Index, EBSCO Academic Search Complete, Applied Mechanics Reviews, Current Mathematical Publications, Mathematical Reviews, MathSci, Zentralblatt fur Mathematik, UnCover, Inspec.

Impact Factor 2014: 0.654, 5 Year 0.798
Editor-in-chief: Prof. Henryk Petryk



Computer Assisted Methods in Engineering and Sciences (CAMES) – former title (up to 2011) Computer Assisted Mechanics and Engineering Sciences – is a refereed international journal, published quarterly, providing a scientific exchange forum and an authoritative source of information in the field of broadly understood computational engineering and applied sciences.

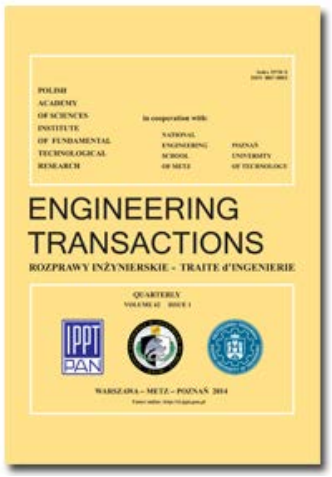
http://cames.ippt.pan.pl/

The objective of the journal is to support researchers and practitioners by offering them a means facilitating access to newest research results reported by leading experts in the field, publication of own contributions and dissemination of information relevant to the scope of the journal.

CAMES is published under the auspices of European Community on Computational Methods in Applied Sciences (ECCOMAS). The journal is also publishing book reviews and information on activities of the ECCOMAS.

CAMES is abstracted/indexed in: Applied Mechanics Reviews, Current Mathematical Publications, Inspec, Mathematical Reviews, MathSci, Zentralblatt für Mathematik.

Editor-in-chief: Prof. Michał Kleiber, Co-editor-in-chief: Prof. Tadeusz Burczyński



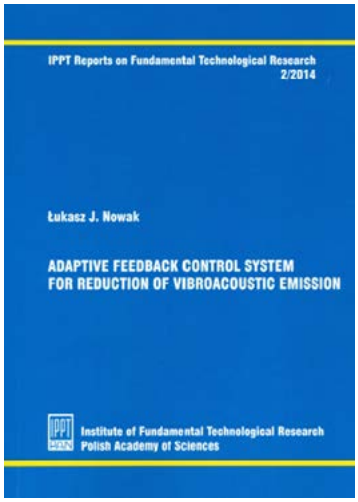
Engineering Transactions – formerly Rozprawy Inżynierskie – is a refereed international journal founded in 1952 at IPPT PAN.

Since 2011 the journal has been published by IPPT PAN in cooperation with the National Engineering School of Metz (Ecole Nationale d'Ingénieurs de Metz – ENIM), and since 2014 in cooperation with Poznań University of Technology.

http://et.ippt.pan.pl/

Engineering Transactions is abstracted/indexed in: Applied Mechanics Reviews, Current Mathematical Publications, Inspec, Mathematical Reviews, MathSci, Scopus, Zentralblatt für Mathematik.

Editor-in-chief: Assoc. Prof. Katarzyna Kowalczyk-Gajewska (IPPT PAN), co-editor-in-chief: Prof. Alexis Rusinek (ENIM), co-editor-in-chief: Prof. Tomasz Łodygowski (Poznań University of Technology).



IPPT Reports on Fundamental Technological Research
The journal "IPPT Reports on Fundamental Technological Research" (IPPT Reports on FTR) is the international open-access publishing medium for high quality research focused on fundamental aspects of applied science and engineering. (Former title: „Prace IPPT. IFTR Reports").

http://reports. ippt.pan.pl

The scope of the journal includes – among others – theoretical, experimental and computational research in mechanics and materials science, acoustics and electronics, fluid and molecular physics, photonics and plasmonics, physics of nanostructures, crystals and polymers, ultrasonic medical diagnostics, interdisciplinary physics in biology and medicine, informatics and applied mathematics, as well as development of advanced numerical methods within a broad range of science and engineering.

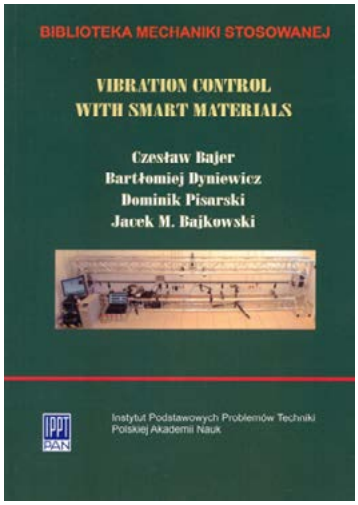
Editor-in-chief: Prof. Wojciech Nasalski
Total circulation of journals: Year 2014 – 3750, Year 2015 – 3770
Total circulation of books: Year 2014 – 680, Year 2015 - 740

In addition to journals the Editorial Office of IPPT PAN publishes (in Polish and in English) five book series:

- Library of Applied Mechanics (Biblioteka Mechaniki Stosowanej)

Editor: Prof. Zenon Mróz

Last published:



1. Czesław Bajer, Bartłomiej Dyniewicz, Dominik Pisarski, Jacek M. Bajkowski – ***Vibration Control with Smart Materials***

Elimination of vibration is an important task in the period of rapid technological development. Although the theoretical basis on the vibration mitigation was created many years ago, practical solutions are not sufficiently implemented. The vibration theory and the control theory are the basis of considerations.

The book is addressed to Ph.D. students, researchers, and engineers. It covers the fields of control of structures in civil engineering and machinery engineering. In the book, the reader will find and learn about the theoretical background of structural vibrations, optimal semi-active control strategies and examples of numerical simulations of real-life engineering structures. Nonclassical materials will deliver data that could be used in further research.

2. Janina Ostrowska-Maciejewska, Katarzyna Kowalczyk-Gajewska – ***Rachunek tensorowy w mechanice ośrodków ciągłych*** (Tensor calculus in continuum mechanics). In Polish.

• Library of Acoustics and Ultrasounds (Biblioteka Akustyki i Ultradźwięków)

Editor: Prof. Andrzej Nowicki

Last published: Andrzej Nowicki - ***Ultradźwięki w medycynie - wprowadzenie do współczesnej ultrasonografii*** (Ultrasounds in medicine - introduction to modern ultrasonography). In Polish.

• Trends in Mechanics of Materials (Trendy w Mechanice Materiałów)

Editor: Prof. Zenon Mróz

Last published: Wojciech Nasalski – ***Optical beams at dielectric interfaces - fundamentals***

• Technological Mechanics (Mechanika Techniczna)

Editor: Prof. Witold Gutkowski

Last published: Romuald Będziński (Editor) - ***Biomechanika*** (Biomechanics). In Polish.

• Library of Scientists' Reflection (Biblioteka Refleksji Naukowej)

Last published:

Michał Kleiber – ***Mądra Polska*** (Wise Poland). In Polish.

Kazimierz Sobczyk – ***O meandrach życia i stochastyce – optymistycznie. Opowieść autobiograficzna*** (The turns of life and stochastics - optimistic autobiography). In Polish.

20. THE WITOLD NOWACKI LIBRARY

Commission on Developing Library Collections:
Prof. Ryszard Pęcherski – Chairman
Prof. Paweł Dłużewski
Prof. Jerzy Litniewski
Assoc. Prof. Jerzy Rojek
Assoc. Prof. Katarzyna Kowalczyk-Gajewska

Head: Bogusława Lewandowska-Gruszka, Ph.D.

The IPPT PAN Library is one of the oldest and largest libraries at the Polish Academy of Sciences and is also nationally recognised. The Library mission is providing access to knowledge resources for research work. The IPPT PAN Library, to achieve this mission, participates in running some projects in cooperation with other research libraries:

- Consortium of the Scientific Libraries of the Polish Academy of Sciences for developing a union bibliographic database and catalogue of the libraries within the project's network of members,
- Virtual Library of Science (coordinated by the University of Warsaw),
- Consortium for Digital Repository of Scientific Institutes (based on the EU-funded project completed in 2014),
- Consortium of Open Science Resources of Scientific Institutes, established in 2015, for increasing the number of digital collections from the open- access publications of 25 research libraries of the Polish Academy of Sciences.

The IPPT PAN Library activity is mainly focused on:

- Providing a reference service to the Library's users based on the electronic catalogue of its own collections, Polish and world libraries' catalogues and other resources of bibliographic information,
- Making print and electronic resources available within the Library's reading room and over the Internet through the Polish libraries resource-sharing consortiums and networks,
- Developing and protecting the Library's own print and electronic collections of books and journals, including purchases of classification and cataloging using a metadata standards, as well as digital preservation of the selected collections,
- Exchanging publications between IPPT PAN and more than 60 scientific institutions both in Poland and abroad.

The Library provides to all visitors computers with research access to electronic catalogues, e-books and e-periodicals databases and other licensed resources. In 2014, the Library electronic resources were very readily used (see Fig. 20.1).

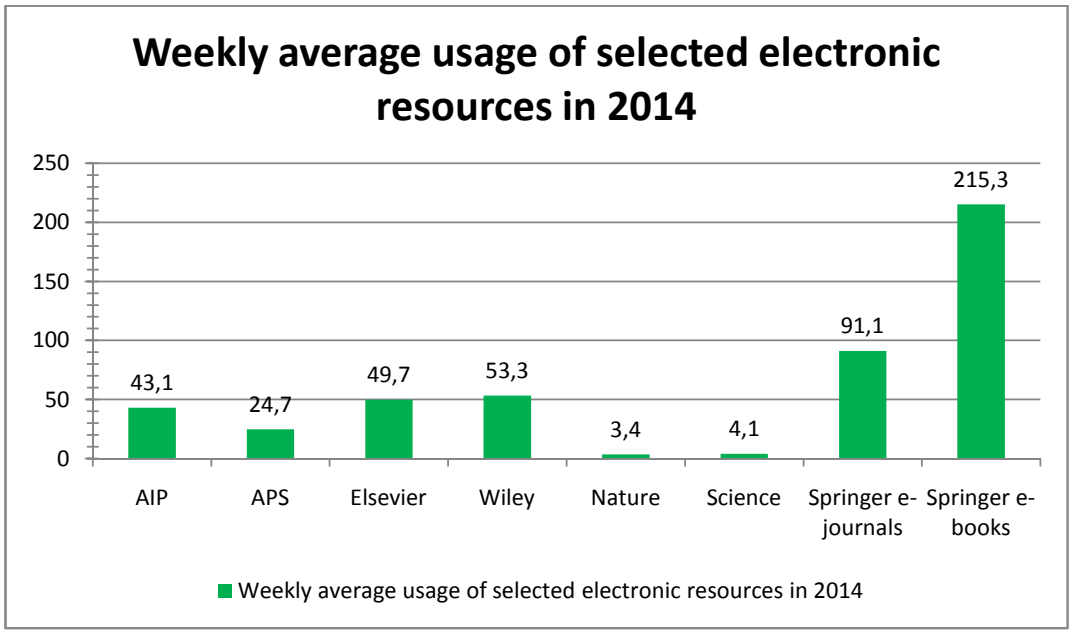


Fig. 20.1. Weekly average usage of the IPPT PAN Library selected electronic resources in 2014. Scientific articles reached online per week: AIP journals - 43.1, APS journals - 24.7, Elsevier journals – 49.7, Wiley journals - 53.3, title "Nature" - 3.4, title "Science" - 4.1, Springer books - 215.3, Springer journals - 91.1

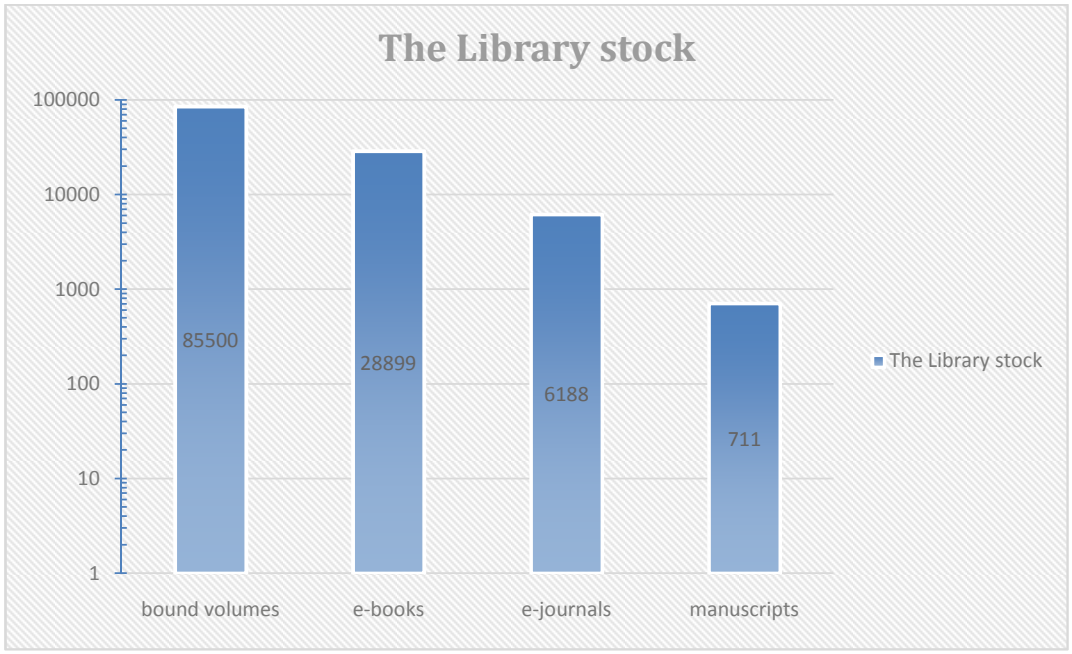


Fig. 20.2. The Library stock as of October, 2015: over 85500 bound volumes, 28899 electronic books, 6188 current electronic periodicals, 711 manuscripts

21. LIST OF PUBLICATIONS 2014-2015

Publications scored by MNiSW - Ministry of Science and Higher Education

LIST A, 2014

1. Stupkiewicz S., Piccolroaz A., Bigoni D., Elastoplastic coupling to model cold ceramic powder compaction, JOURNAL OF THE EUROPEAN CERAMIC SOCIETY, ISSN: 0955-2219, DOI: 10.1016/j.jeurceramsoc.2013.11.017, Vol.34, pp.2839-2848, 2014 (50 MNiSW points)
2. Fischer F.D., Svoboda J., Petryk H., Thermodynamic extremal principles for irreversible processes in materials science, ACTA MATERIALIA, ISSN: 1359-6454, DOI: 10.1016/j.actamat.2013.11.050, Vol.67, No.153, pp.1-20, 2014 (45 MNiSW points)
3. Marszałek A., Burczyński T., Modeling and forecasting financial time series with ordered fuzzy candlesticks, INFORMATION SCIENCES, ISSN: 0020-0255, DOI: 10.1016/j.ins.2014.03.026, Vol.273, pp.144-155, 2014 (45 MNiSW points)
4. Widłaszewski J., The effects of design parameters on the laser-induced in-plane deformation of two-bridge actuators, International Journal of Machine Tools and Manufacture, ISSN: 0890-6955, DOI: 10.1016/j.ijmachtools.2014.03.001, Vol.80-81, pp.30-38, 2014 (45 MNiSW points)
5. Wojnar P., Zielinski M., Janik E., Zaleszczyk W., Wojciechowski T., Wojnar R., Szymura M., Kłopotowski Ł., Baczewski L.T., Pietruchik A., Wiater M., Kret S., Karczewski G., Wojtowicz T., Kossut J., Strain-induced energy gap variation in ZnTe/ZnMgTe core/shell nanowires, APPLIED PHYSICS LETTERS, ISSN: 0003-6951, DOI: 10.1063/1.4873355, Vol.104, pp.163111-1-5, 2014 (40 MNiSW points)
6. Będkowski J., Majek K., Musialik P., Adamek A., Andrzejewski D., Czekaj D., Towards terrestrial 3D data registration improved by parallel programming and evaluated with geodetic precision, Automation in Construction, ISSN: 0926-5805, DOI: 10.1016/j.autcon.2014.07.013, Vol.47, pp.78-91, 2014 (40 MNiSW points)
7. Jetka T., Charzynska A., Gambin A., Stumpf M.P.H., Komorowski M., StochDecomp—Matlab package for noise decomposition in stochastic biochemical systems, BIOINFORMATICS, ISSN: 1367-4803, DOI: 10.1093/bioinformatics/btt631, Vol.30, No.1, pp.137-138, 2014 (40 MNiSW points)
8. Kursa M., Kowalczyk-Gajewska K., Petryk H., Multi-objective optimisation of thermo-mechanical properties of metal-ceramic composites, COMPOSITES PART B-ENGINEERING, ISSN: 1359-8368, DOI: 10.1016/j.compositesb.2014.01.009, Vol.60, pp.586-596, 2014 (40 MNiSW points)
9. Węglewski W., Basista M., Manescu A., Chmielewski M., Pietrzak K., Schubert Th., Effect of grain size on thermal residual stresses and damage in sintered chromium–alumina composites: Measurement and modeling, COMPOSITES PART B-ENGINEERING, ISSN: 1359-8368, DOI: 10.1016/j.compositesb.2014.06.027, Vol.67, pp.119-124, 2014 (40 MNiSW points)
10. Dyniewicz B., Efficient numerical approach to unbounded systems subjected to a moving load, COMPUTATIONAL MECHANICS, ISSN: 0178-7675, DOI: 10.1007/s00466-014-0987-3, Vol.54, No.2, pp.321-329, 2014 (40 MNiSW points)
11. Stupkiewicz S., Denzer R., Piccolroaz A., Bigoni D., Implicit yield function formulation for granular and rock-like materials, COMPUTATIONAL MECHANICS, ISSN: 0178-7675, DOI: 10.1007/s00466-014-1047-8, Vol.54, pp.1163-1173, 2014 (40 MNiSW points)
12. Zalewski R., Szmidt T., Application of Special Granular Structures for semi-active damping of lateral beam vibrations, ENGINEERING STRUCTURES, ISSN: 0141-0296, DOI: 10.1016/j.engstruct.2014.01.035, Vol.65, pp.13-20, 2014 (40 MNiSW points)
13. Korelc J., Stupkiewicz S., Closed-form matrix exponential and its application in finite-strain plasticity, INTERNATIONAL JOURNAL FOR NUMERICAL METHODS IN ENGINEERING, ISSN: 0029-5981, DOI: 10.1002/nme.4653, Vol.98, pp.960-987, 2014 (40 MNiSW points)
14. Żuk P.J., Wajnryb E., Mizerski K.A., Szymczak P., Rotne–Prager–Yamakawa approximation for different-sized particles in application to macromolecular bead models, JOURNAL OF FLUID MECHANICS, ISSN: 0022-1120, DOI: 10.1017/jfm.2013.668, Vol.741, pp.R5-1-13, 2014 (40 MNiSW points)
15. Dyniewicz B., Pręgowska A., Bajer C.I., Adaptive control of a rotating system, MECHANICAL SYSTEMS AND SIGNAL PROCESSING, ISSN: 0888-3270, DOI: 10.1016/j.ymssp.2013.09.006, Vol.43, pp.90-102, 2014 (40 MNiSW points)
16. Szolc T., Konowrocki R., Michajłow M., Pręgowska A., An investigation of the dynamic electromechanical coupling effects in machine drive systems driven by asynchronous motors, MECHANICAL SYSTEMS AND SIGNAL PROCESSING, ISSN: 0888-3270, DOI: 10.1016/j.ymssp.2014.04.004, Vol.49, pp.118-134, 2014 (40 MNiSW points)
17. Chen G.Y., Codemard C.A., Lewis R.J., Jankowski Ł., Chan J.S., Gorman P.M, Zervas M.N., Enhanced responsivity with skew

ray excitation of reflection- and transmission-type refractometric sensors, OPTICS LETTERS, ISSN: 0146-9592, DOI: 10.1364/OL.39.003822, Vol.39, No.13, pp.3822-3825, 2014 (40 MNiSW points)

18. Kujawska T., Secomski W., Kruglenko E., Krawczyk K., Nowicki A., Determination of Tissue Thermal Conductivity by Measuring and Modeling Temperature Rise Induced in Tissue by Pulsed Focused Ultrasound, PLOS ONE, ISSN: 1932-6203, DOI: 10.1371/journal.pone.0094929, Vol.9, No.4, pp.e94929-1-8, 2014 (40 MNiSW points)
19. Bertolusso R., Tian B., Zhao Y., Vergara L., Sabree A., Iwanaszko M., Lipniacki T., Brasier A.R., Kimmel M., Dynamic cross talk model of the epithelial innate immune response to double-stranded RNA stimulation: Coordinated dynamics emerging from cell-level noise, PLOS ONE, ISSN: 1932-6203, DOI: 10.1371/journal.pone.0093396, Vol.9, No.4, pp.e93396-1-21, 2014 (40 MNiSW points)
20. Pokrywczyńska M., Jundziłł A., Adamowicz J., Kowalczyk T., Warda K., Rasmus M., Buchholz Ł., Krzyżanowska S., Nakielski P., Chmielewski T., Bodnar M., Marszałek A., Dębski R., Frontczak-Baniewicz M., Mikułowski G., Nowacki M., Kowalewski T.A., Drewa T., Is the Poly (L- Lactide- Co– Caprolactone) Nanofibrous Membrane Suitable for Urinary Bladder Regeneration?, PLOS ONE, ISSN: 1932-6203, DOI: 10.1371/journal.pone.0105295, Vol.9, No.8, pp.105295-1-12, 2014 (40 MNiSW points)
21. Kloskowski T., Jundziłł A., Kowalczyk T., Nowacki M., Bodnar M., Marszałek A., Pokrywczyńska M., Frontczak-Baniewicz M., Kowalewski T.A., Chłosta P., Drewa T., Ureter Regeneration–The Proper Scaffold Has to Be Defined, PLOS ONE, ISSN: 1932-6203, DOI: 10.1371/journal.pone.0106023, Vol.9, No.8, pp.106023-1-13, 2014 (40 MNiSW points)
22. Alster O., Bielak-Zmijewska A., Mosieniak G., Moreno-Villanueva M., Dudka-Ruszkowska W., Wojtala A., Kusio-Kobiałka M., Korwek Z., Burkle A., Piwocka K., Siwicki J.K., Sikora E., The Role of Nibrin in Doxorubicin-Induced Apoptosis and Cell Senescence in Nijmegen Breakage Syndrome Patients Lymphocytes, PLOS ONE, ISSN: 1932-6203, DOI: 10.1371/journal.pone.0104964, Vol.9, No.8, pp.e104964-1-13, 2014 (40 MNiSW points)
23. Cheng F.H.C., Aguda B.D., Tsai J-C., Kochańczyk M., Lin J.M.J., Chen G.C.W., Lai H-C., Nephew K.P., Hwang T-W., Chan M.W.Y., A Mathematical Model of Bimodal Epigenetic Control of miR-193a in Ovarian Cancer Stem Cells, PLOS ONE, ISSN: 1932-6203, DOI: 10.1371/journal.pone.0116050, Vol.9, No.12, pp.e116050-1-17, 2014 (40 MNiSW points)
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LIST OF MONOGRAPHS AND BOOKS ENTIRELY WRITTEN BY IPPT'S RESEARCHERS

Table 21.1. Monographs and books entirely written by IPPT's researchers - year 2014

No.	Authors	Title	Publisher	Year, Volume, Pages	Language
1	Szlagowska-Spychalska J., Kukla D., Dragan K.	Metoda prądów wirowych do oceny konstrukcji lotniczych z uwzględnieniem metod modelowania sygnałów elektromagnetycznych	Oficyna Wydawnicza Politechniki Warszawskiej	2014, 1 - 127	Polish

Table 21.2. Monographs and books entirely written by IPPT's researchers - year 2015

No.	Authors	Title	Publisher	Year, Volume, Pages	Language
1	Bajer C.I., Dyniewicz B., Pisarski D., Bajkowski J.M.	Vibration control with smart materials	IPPT PAN	2015, 1 - 240	English
2	Będkowski J.	Qualitative Spatio-Temporal Representation and Reasoning for Robotic Applications	Computer Science, Academic Publishing House EXIT	2015, 1 - 206	English
3	Glinicki M.A.	Długotrwała funkcjonalność betonu w konstrukcjach osłonowych elektrowni jądrowych	IPPT PAN	2015, 1 - 64	Polish
4	Kleer J., Kleiber M.	Zagrożenia globalne barierami rozwoju	Polska Akademia Nauk Komitet Prognoz "Polska 2000 Plus"	2015, 1 - 153	Polish

5	Kleer J., Kleiber M.	Global threats as barriers to development	Polish Academy of Sciences "Poland 2000 Plus Foresight Committee	2015, 1 - 143	English
6	Kleiber M.	Mądra Polska	IPPT PAN	2015, 1 - 584	Polish
7	Nakielski P.	Systemy uwalniania leków oparte na nanowłóknach, rozprawa doktorska	IPPT Reports on Fundamental Technological Research	2015, 1, 1 - 216	Polish
8	Ziółkowski A.	Pseudoelasticity of Shape Memory Alloys - Theory and Experimental Studies	Butterworth-Heinemann, Elsevier	2015, 1 - 270	English

LIST OF MONOGRAPHS AND BOOKS CONTAINING CHAPTERS WRITTEN BY IPPT'S RESEARCHERS

Table 21.3. Monographs and books containing chapters written by IPPT's researchers - year 2014

No.	Authors	Title Chapter title	Publisher	Year, Volume, Pages	Language
1	Będkowski J., Pełka M., Musialik P., Masłowski A.	Mobile Service Robotics Chapter: Multi robot simulator for robot operator training in tiramisu project	World Scientific	2014, 575 - 580	English
2	Brandt A.M., Jóźwiak-Niedźwiedzka D., Nowowiejski G., Denis P.	Dni betonu, Tradycja i Nowoczesność Chapter: Wyniki badania betonu osłonowego z kruszywem magnetytowym	SPC Stowarzyszenie Producentów Cementu	2014, 839 - 850	Polish
3	Chikahiro Y., Ario I., Nakazawa M., Ono S., Holnicki-Szulc J., Pawłowski P., Graczykowski C.	Mobile and Rapidly Assembled Structures IV Chapter: An Experimental Study On The Design Method Of A Real-sized Mobile Bridge For A Moving Vehicle	N. De Temmerman,Vrije, C.A. Brebbia, WITPress	2014, 93 - 106	English
4	Dolińska I., Kowalewski T., Lewandowska-Gruszka B.	Repozytorium Cyfrowe Instytutów Naukowych Chapter: Instytut Podstawowych Problemów Techniki PAN	Muzeum i Instytut Zoologii PAN	2014, 87 - 92	Polish
5	Ekiel-Jeżewska M.L.	Advances in Science, Technology, Higher Education and Society in the Conceptual Age: STHESCA Chapter: The system of learning and teaching organised by the Polish Commission of the National Education (1773-94)	AHFE Conference in US	2014, 31 - 40	English
6	Ekiel-Jeżewska M.L.	Human Factors of a Global Society; A system of systems perspective Chapter: Experimenting with Teaching Contexts	CRC Press Taylor & Francis Group, 6000 Broken Sound Parkway NW, Suite 300, Boca Raton, FL 33487-2742	2014, 79, 895 - 905	English
7	Gambin B., Doubrovina O.	Complex Analysis and Potential Theory With Applications Chapter: Wavelet analysis for temperature increase detection from acoustic backscattered signal	Cambridge Scientific Publishers	2014, 63 - 76	English

8	Graczykowski C., Knor G., Kołakowski P., Mikułowski G., Orłowska A., Pawłowski P., Skłodowski M., Świercz A., Wiszowaty R., Zieliński T.	Monitorowanie obciążeń i stanu technicznego konstrukcji mostowych Chapter: Wybrane zagadnienia monitorowania	IPPT Reports on Fundamental Technological Research	2014, 189 - 236	Polish
9	Holnicki-Szulc J., Kokot M., Kołakowski P.	Monitorowanie obciążeń i stanu technicznego konstrukcji mostowych Chapter: System identyfikacji spękań w konstrukcjach betonowy	IPPT Reports on Fundamental Technological Research	2014, 160 - 188	Polish
10	Jankowski Ł., Holnicki-Szulc J., Świercz A., Mróz M., Kołakowski P.	Monitorowanie obciążeń i stanu technicznego konstrukcji mostowych Chapter: Numeryczne metody identyfikacji parametrów konstrukcji	IPPT Reports on Fundamental Technological Research	2014, 109 - 159	Polish
11	Kaźmierczak K., Sobieraj W.	Mechanika w Lotnictwie Chapter: Uproszczony sposób tworzenia wirtualnego modelu dynamiki lotu bezpilotowego statku powietrznego	Polskie Towarzystwo Mechaniki Teoretycznej i Stosowane	2014, 189 - 198	Polish
12	Kielanowski P., Martens A.	Fizycy wspominają Chapter: Rozmowa z Andrzejem Trautmanem – Moje pierwsze 50 lat na Hożej	red. Andrzej Michał Kobos, Polska Akademia Umiejętności, Kraków	2014, 489 - 523	Polish
13	Konowrocki R., Bogacz R., Kukulski J., Walczak S.	Selected Dynamical Problems in Mechanical Systems Chapter: Experimental and Numerical Investigation of Oscillations in a Brake System	Oficyna Wydawnicza Politechniki Warszawskiej	2014, 75 - 84	English
14	Kowalczyk-Gajewska K.	Encyclopedia of Thermal Stresses Chapter: Thermoplasticity of Polycrystals	R. Hetnarski, Springer, Netherlands	2014, 11, 6064 - 6079	English
15	Kowalewski T.A.	Nanomechanics Selected problems Chapter: Nanofluids and Nanofibres	Wydawnictwo Politechniki Krakowskiej, Muc A., Chwał M., Garstecki A., Szefer G. (Eds.)	2014, 31 - 50	English
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17	Kowalska D., Jóźwiak-Niedźwiedzka D., Chalimoniuk M., Dąbrowski M.	Dni betonu, Tradycja i Nowoczesność Chapter: Zastosowanie metody tomografii komputerowej CT do oceny napowietrzenia betonu	SPC Stowarzyszenie Producentów Cementu	2014, 907 - 918	Polish
18	Kołakowski P., Mróz A., Orłowska A., Pawłowski P., Sala D., Sekuła K., Świercz A., Wiącek D., Wójcicki P.	Monitorowanie obciążeń i stanu technicznego konstrukcji mostowych Chapter: System monitorowania stalowego mostu kolejowego	IPPT Reports on Fundamental Technological Research	2014, 85 - 108	Polish
19	Kołakowski P., Pawłowski P., Sala D., Sekuła K., Świercz A., Wiącek D., Wójcicki P.	Monitorowanie obciążeń i stanu technicznego konstrukcji mostowych Chapter: Dynamiczna waga kolejowa	IPPT Reports on Fundamental Technological Research	2014, 55 - 84	Polish

20	Nowicki A.	50 lat Komitetu Akustyki Polskiej Akademii Nauk 1964-2014. Osiągnięcia i wydarzenia Chapter: Polska szkoła ultrasonografii Zakładu Ultradźwięków IPPT PAN	Polska Akademia Nauk, Polskie Towarzystwo Akustyczne, Warszawa	2014, 203 - 213	Polish
21	Pęcherski R.B., Nalepka K., Frąś T., Nowak M.	Constitutive Relations under Impact Loadings. Experiments, Theoretical and Numerical Aspects Chapter: Inelastic Flow and Failure of Metallic Solids. Material Effort: Study Across Scales	Springer, CISM, Udine, T. Łodygowski, A. Rusinek (Eds.)	2014, 552, 245 - 285	English
22	Postek E.	GRAFEN – IPPT PAN COMPUTER OF BIOCENTRUM OCHOTA GRID Chapter: Parameter Sensitivity of a Tensegrity Model of a Tissue	IPPT Reports on Fundamental Technological Research (eds. Postek E., Kowalewski T.A.)	2014, 3, 81 - 92	English
23	Postek E.	GRAFEN – IPPT PAN COMPUTER OF BIOCENTRUM OCHOTA GRID Chapter: Generic Models of Linear and Non-linear Visco-elastic Surface Deformation above a Fault	IPPT Reports on Fundamental Technological Research (eds. Postek E., Kowalewski T.A.)	2014, 92 - 101	English
24	Postek E.	GRAFEN – IPPT PAN COMPUTER OF BIOCENTRUM OCHOTA GRID Chapter: Reliability Analysis of Reinforced Concrete Structures	IPPT Reports on Fundamental Technological Research (eds. Postek E., Kowalewski T.A.)	2014, 105 - 127	English
25	Postek E.	GRAFEN – IPPT PAN COMPUTER OF BIOCENTRUM OCHOTA GRID Chapter: Development of a Concept of an Agent-stress Model of a Tissue	IPPT Reports on Fundamental Technological Research (eds. Postek E., Kowalewski T.A.)	2014, 127 - 134	English
26	Pręgowska A., Szolc T., Pochanke A., Konowrocki R.	Recent Advances in Automation, Robotics and Measuring Techniques Chapter: Modeling and dynamic analysis of the precise electromechanical systems driven by the stepping motors	Springer International Publishing, Series: Advances in Intelligent Systems and Computing	2014, Series Volume 267, Part.I, 205 - 215	English
27	Sekuła K., Pawłowski P., Sala D., Kołakowski P., Świercz A., Wiącek D.	Monitorowanie obciążeń i stanu technicznego konstrukcji mostowych Chapter: Dynamiczna waga drogowa	IPPT Reports on Fundamental Technological Research	2014, 21 - 54	Polish
28	Skłodowski M., Pawłowski P.	Monitorowanie obciążeń i stanu technicznego konstrukcji mostowych Chapter:System monitorowania konstrukcji stadionu	Institute of Fundamental Technological Research Polish Academy of Sciences	2014, 197 - 207	Polish
29	Skłodowski M., Pawłowski P., Górecka K.	Computer Vision and Graphics, ICCVG 2014 Chapter: Geometrical Models of Old Curvilinear Paintings	Springer Verlag	2014, LNCS, 578 - 585	English
30	Wojnar R., Bielski W.	Complex analysis and potential theory with applications Chapter: Flow in the canal with plants on the bottom	editors: T. Aliev Azerogly, A. Golberg, S.V. Rogosin, Cambridge Scientific Publishers	2014, 167 - 183	English

31	Zieliński T.	GRAFEN – IPPT PAN COMPUTER OF BIOCENTRUM OCHOTA GRID Chapter: Microstructure-based modelling of sound absorption in rigid porous media	IPPT Reports on Fundamental Technological Research (eds. Postek E., Kowalewski T.A.)	2014, 106 - 111	English

Table 21.4. Monographs and books containing chapters written by IPPT's researchers - year 2015

No.	Authors	Title Chapter title	Publisher	Year, Volume, Pages	Language
1	Banak R., Zowczak W., Mościcki T.	Monografie, Studia, Rozprawy Chapter: Symulacja numeryczna kształtu jeziorka spawalniczego w trakcie procesu spawania laserowego stali 304	Politechnika Świętokrzyska, Kielce	2015, 193 - 203	Polish
2	Behnood A., Olek J., Glinicki M.A.	Proc. Int. Symp. Brittle Matrix Composites, BMC-11, Warsaw, September 28-30, 2015 Chapter: Predicting compressive strength of recycled concrete aggregate using M5' model	A.M.Brandt, J.Olek, M.A.Glinicki, C.K.Y.Leung, J.Lis, eds., Institute of Fundamental Technological Research	2015, 1, 381 - 391	English
3	Bielski W., Kowalczyk P., Wojnar R.	The Conference Proceedings of the Numerical Heat Transfer 2015 - Eurotherm Seminar No. 109 Chapter: Two-temperature heat transfer in metal films	Institute of Thermal Technology, Silesian University of Technology, Gliwice, Poland and Institute of Heat Engineering, Warsaw University of Technology, Warsaw, Poland, Editors: Andrzej J. Nowak, Jerzy Banaszek, and Bozidar Sarler	2015, 57 - 67	English
4	Burczyński T., Poteralski A., Szczepanik M.	Advances in Evolutionary and Deterministic Methods for Design, Optimisation and Control in Engineering and Sciences Chapter: Immune and swarm optimisation of structures	Springer International Publishing Switzerland, D.Greiner et al. (eds.), Computational Methods in Applied Sciences 36	2015, 295 - 308	English
5	Dąbrowski M., Gibas K., Glinicki M.A.	Proc. Int. Symp. Brittle Matrix Composites, BMC-11, Warsaw, September 28-30, 2015 Chapter: Influence of blended cement with HCFA on microstructure and chloride ions transport of concrete resistant to surface scaling	A.M.Brandt, J.Olek, M.A.Glinicki, C.K.Y.Leung, J.Lis, eds., Institute of Fundamental Technological Research	2015, 1, 111 - 120	English
6	Glinicki M.A., Jaskulski R., Pichór W., Dąbrowski M., Sobczak M.	Proc. Int. Symp. Brittle Matrix Composites, BMC-11, Warsaw, September 28-30, 2015 Chapter: Investigation of thermal properties of shielding concrete	A.M.Brandt, J.Olek, M.A.Glinicki, C.K.Y.Leung, J.Lis, eds., Institute of Fundamental Technological Research	2015, 1, 371 - 380	English
7	Jóźwiak-Niedźwiedzka D., Glinicki M.A., Gibas K., Jaskulski R., Denis P., Garbacik A.	Proc. Int. Symp. Brittle Matrix Composites, BMC-11, Warsaw, September 28-30, 2015 Chapter: Alkali-silica expansion of heavy aggregates used for nuclear shielding concrete	A.M.Brandt, J.Olek, M.A.Glinicki, C.K.Y.Leung, J.Lis, eds., Institute of Fundamental Technological Research	2015, 1, 353 - 360	English
8	Jurczak G., Maździarz M., Dłużewski P.	Nanomechanics Chapter: Atomistic-continuum modelling of coupled fields and defects in semiconductor crystals	Wydawnictwa Politechniki Krakowskiej	2015, 77 - 98	English
9	Kovalchuk V.	Geometry, Integrability, Mechanics and Quantization Chapter: On new ideas of nonlinearity in quantum mechanics	Ivailo M. Mladenov, Mariana Hadzhilazova and Vasyl Kovalchuk (Editors), Avangard Prima, Sofia	2015, 267 - 279	English

10	Kowalczyk P.	Biomechanika i Inżynieria Rehabilitacyjna Chapter: Badania modelowe z wykorzystaniem MES w biomechanice	Akademicka Oficyna Wydawnicza EXIT	2015, 363 - 378	Polish
11	Kowalewski Z.L.	Methods for Creep Rupture Analysis – Previous Attempts and New Challenges Chapter: From Creep Damage Mechanics to Homogenization Methods	Springer, Eds: Altenbach H., Matsuda T., Okumura D.	2015, 163 - 198	English
12	Kowalewski Z.L., Szymczak T., Maciejewski J.	Experimental and Numerical Investigations of the Effects Associated to Complex Loading Combinations Chapter: Inelastic Behavior of Materials and Structures Under Monotonic and Cyclic Loading	Springer, Eds: Altenbach H., Brunig M.	2015, 117 - 142	English
13	Martens A.	Geometry, Integrability, Mechanics and Quantization Chapter: Affine models of internal degrees of freedom and their quantization	Ivailo M. Mladenov, Mariana Hadzhilazova and Vasyl Kovalchuk (Editors), Avangard Prima, Sofia	2015, 306 - 317	English
14	Meissner M.	Progress of Acoustics Chapter: Numerical Analysis of Sound Decay Process in Acoustically Coupled Spaces	Polskie Towarzystwo Akustyczne	2015, 497 - 508	English
15	Paczelt I., Baksa A., Mróz Z.	Mathematical Modeling and Optimisation of Complex Structures, Computational Methods in Applied Sciences Chapter: Contact Optimisation Problems for Stationary and Sliding Conditions	Springer	2015, 40, 281 - 312	English
16	Ranachowski Z., Jóźwiak-Niedźwiedzka D., Ranachowski P., Dąbrowski M., Kudela S. Jr., Dvorak T.	Proc. Int. Symp. Brittle Matrix Composites, BMC-11, Warsaw, September 28-30, 2015 Chapter: Analysis of pore distribution and connectivity in concrete using X-ray microtomography	A.M.Brandt, J.Olek, M.A.Glinicki, C.K.Y.Leung, J.Lis, eds., Institute of Fundamental Technological Research	2015, 1, 203 - 212	English
19	Rylko N., Wojnar R.	Geometry, Integrability, Mechanics and Quantization Chapter: Resurgence edge effects in composites: fortuity and geometry	Ivailo M. Mladenov, Mariana Hadzhilazova and Vasyl Kovalchuk (Editors), Avangard Prima, Sofia	2015, 342 - 349	English
17	Skoczeń B., Ustrzycka A.	From Creep Damage Mechanics to Homogenization Methods Chapter: Radiation Damage Evolution in Ductile Materials	Springer International Publishing	2015, Vol. 64 of the series Advance Structured Materials, 391 - 406	English
18	Skłodowski M.	System Wartościowania Dziedzictwa: Stan badań i problemy Chapter: Przykłady Analizy Wielokryterialnej w Ocenie Wartości i Ochronie Dziedzictwa Kultury	Politechnika Lubelska. Polski Komitet Narodowy ICOMOS	2015, 209 - 240	Polish

19	Szolc T., Falkowski K.	Mechanisms and Machine Science Chapter: Dynamic analysis of the high-speed flexible rotors supported on the electrodynamic passive magnetic bearings	Springer International Publishing	2015, 21, 1489 - 1500	English
20	Sławianowski J. J.	Geometry, Integrability, Mechanics and Quantization Chapter: The two apparently different but hiddenly related Euler achievements: rigid body and ideal fluid. Our unifying going between: affinely-rigid body and affine invariance in physics	Ivailo M. Mladenov, Mariana Hadzhilazova and Vasyl Kovalchuk (Editors), Avangard Prima, Sofia	2015, 31 - 67	English
21	Sławianowski J. J., Gołubowska B.	Geometry, Integrability, Mechanics and Quantization Chapter: Bertrand systems on spaces of constant sectional curvature. The action-angle analysis. Classical, quasi-classical and quantum problems	Ivailo M. Mladenov, Mariana Hadzhilazova and Vasyl Kovalchuk (Editors), Avangard Prima, Sofia	2015, 106 - 134	English
22	Sławianowski J. J., Kovalchuk V.	Selected Topics in Applications of Quantum Mechanics Chapter: Classical or Quantum? What is Reality?	prof. Mohammad Reza Pahlavani (Ed.), InTech, Rijeka	2015, 3 - 35	English
23	Sławianowski J. J., Kovalchuk V.	Geometry, Integrability, Mechanics and Quantization Chapter: Quantized version of the theory of affine body	Ivailo M. Mladenov, Mariana Hadzhilazova and Vasyl Kovalchuk (Editors), Avangard Prima, Sofia	2015, 68 - 88	English
24	Sławianowski J. J., Martens A.	Geometry, Integrability, Mechanics and Quantization Chapter: Affinely-rigid body and oscillatory two-dimensional models	Ivailo M. Mladenov, Mariana Hadzhilazova and Vasyl Kovalchuk (Editors), Avangard Prima, Sofia	2015, 89 - 105	English
25	Sławianowski J. J., Rożko E.E.	Geometry, Integrability, Mechanics and Quantization Chapter: Classical and quantization problems in degenerate affine motion	Ivailo M. Mladenov, Mariana Hadzhilazova and Vasyl Kovalchuk (Editors), Avangard Prima, Sofia	2015, 135 - 159	English
26	Taczała M., Buczkowski R., Kleiber M.	Współczesna Mechanika Konstrukcji w Projektowaniu Inżynierskim Chapter: Stateczność płyt o cechach materiałów gradientowych na podłożu sprężystym	Polska Akademia nauk, Komitet Inżynierii Lądowej i Wodnej	2015, 375 - 388	Polish
27	Trzęsowski A.	Geometry, Integrability, Mechanics and Quantization Chapter: On the material geometry of continuously defective corrugated graphene	Ivailo M. Mladenov, Mariana Hadzhilazova and Vasyl Kovalchuk (Editors), Avangard Prima, Sofia	2015, 367 - 410	English
28	Wójcik J., Gambin B.	Dynamical Systems. Mathematical and Numerical Approaches Chapter: Numerical analysis of reflection and transmission phenomena of nonlinear ultrasound wave	Wydawnictwo Politechniki Łódzkiej, Awrejcewicz, M. Kaźmierczak, J. Mrozowski, P. Olejnik (Eds), Łódź	2015, 603 - 614	English
29	Wojnar R.	Geometry, Integrability, Mechanics and Quantization Chapter: Bohmian picture of the wave function and the gauge invariance	Ivailo M. Mladenov, Mariana Hadzhilazova and Vasyl Kovalchuk (Editors), Avangard Prima, Sofia	2015, 411 - 424	English

EDITORS OF MONOGRAPHS AND BOOKS PUBLISHED BY IPPT

Table 21.5. Editors of monographs and books published by IPPT – year 2014

No.	Editors	Title	Publisher	Year, Volume, Pages	Language
1	Kowalewski Z.L., Ranachowski Z., Widłaszewski J.	39th Solid Mechanics Conference SolMech 2014, Book of Abstracts	IPPT PAN	2014, 1, 1 - 336	English
2	Postek E., Kowalewski T.A.	Grafen – IPPT PAN computer of Biocentrum Ochota grid	IPPT Reports on Fundamental Technological Research	2014, 3, 1 - 164	English

Table 21.6. Editors of monographs and books published by IPPT – year 2015

No.	Editors	Title	Publisher	Year, Volume, Pages	Language
1	Brandt A.M., Olek J., Glinicki M.A., Leung C.K.Y., Lis J.	Brittle Matrix Composites 11	IPPT PAN	2015, 1 - 500	English
2	Kovalchuk V.	Geometry, Integrability, Mechanics and Quantization	Ivailo M. Mladenov, Mariana Hadzhilazova and Vasyl Kovalchuk (Editors), Avangard Prima, Sofia	2015, 1 - 461	English

Fig. 21.1. The Witold Nowacki Library of IPPT PAN

22. ADMINISTRATION UNITS (AS OF DECEMBER 31, 2015)

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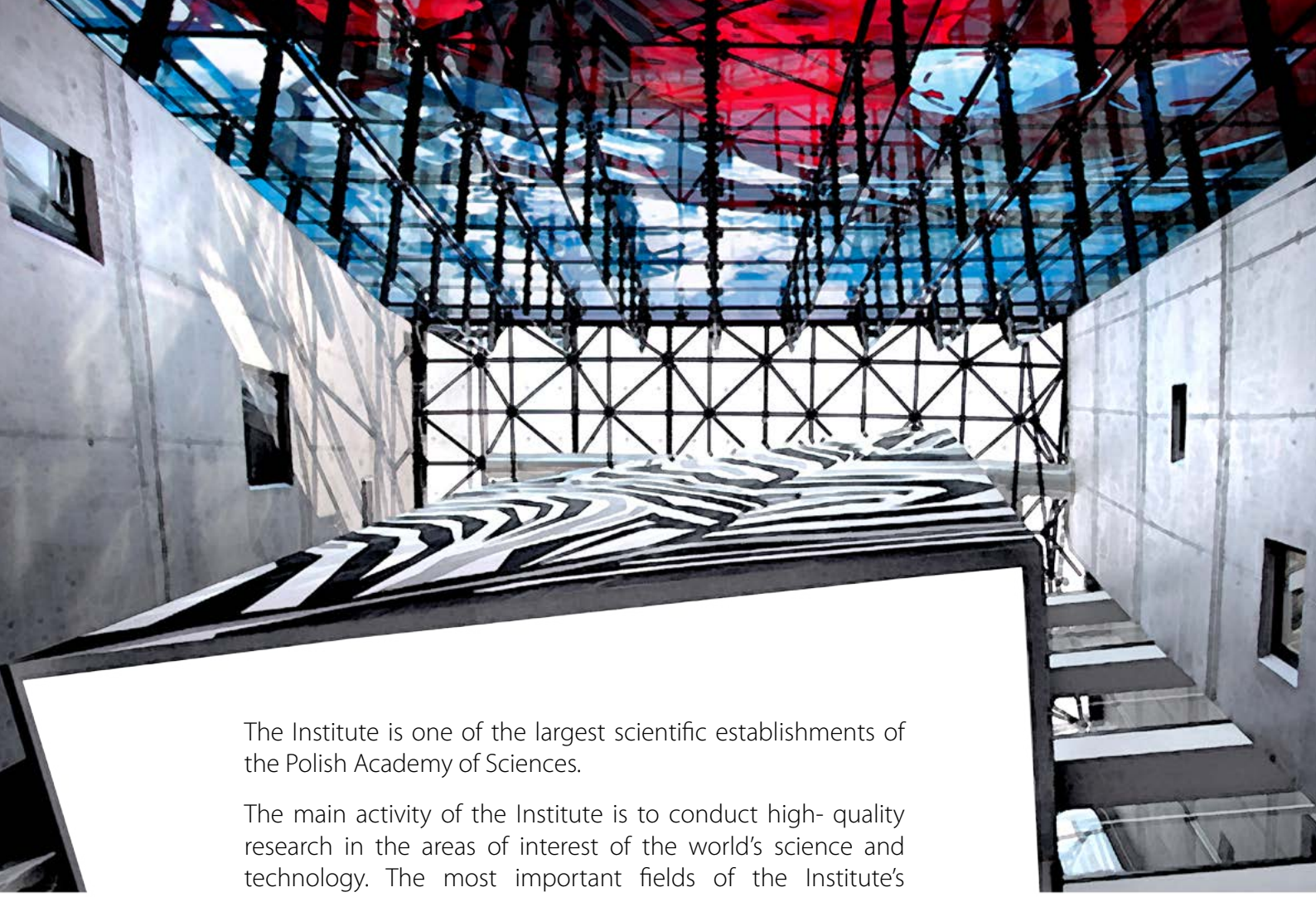

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