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NANOTECHNOLOGIES IN THE CZECH REPUBLIC 2005

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CONTENTS

1. INTRODUCTION

Government of the Czech Republic has passed, in its Resolution No. 1006 of 17 August 2005, the draft of the research and development programme "Nanotechnologies for the Society". The programme goal is **"the speedy achievement of a notable progress in research development and practical utilisation of nanotechnologies and nanomaterials for the benefit of the society in the Czech Republic by co-ordinated and concentrated efforts in the academic sector, research organisations and companies, especially SME"**. The perspective and fast developing discipline of nanotechnologies thus have, for the first time, an independent research programme.

Research of nanotechnologies, especially the basic research, started to develop in Czechoslovakia in the second half of 1980s, when Antonín Fojtík[1], then the worker in the Institute of Physical and Electrical Chemistry of the Czech Academy of Sciences (CAS), published a series of original studies on the research of "semiconductor colloids" and quantum effects in extremely small particles. We present the image proving the influence of the CdS particle sizes on their fluorescent spectrum, which makes a part of his article "World of the (non)negligible sizes" published in the journal Vesmír (Universe)[2] – **Fig. No. 1.** A. Fojtík published results of his work done together with Jiří Jirkovský, now the worker in the J. Heyrovský Institute of Physical Chemistry of the Academy of Sciences of the Czech Republic, in the late 1980s. The term nanotechnology was not used in our country then.

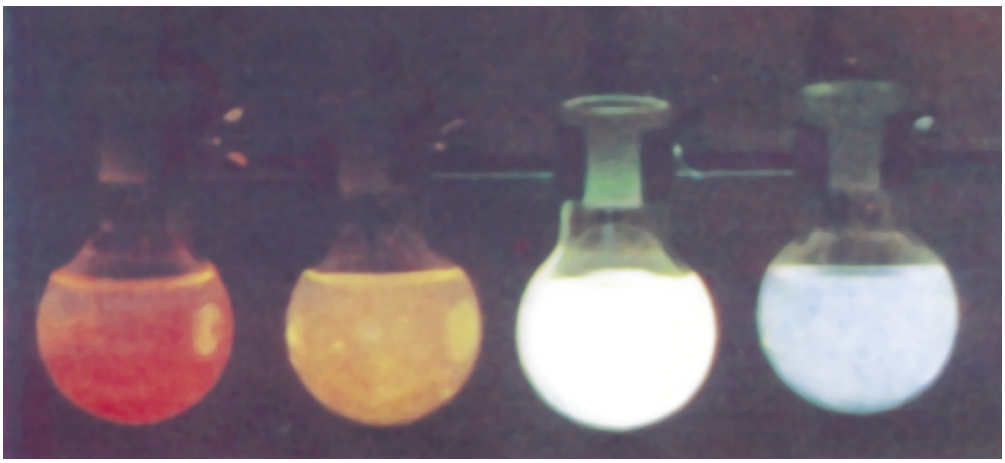

Fig. No. 1 *– The fluorescent spectrum shifts, when the particle sizes of cadmium sulfide get smaller. The quantic particle sizes get smaller from 5nm to 1nm (from left to right). The fluorescent spectrum was excited by light with the wave length of 366nm. (Used with the author's permission.)*

Miloš Matyáš was probably the first, who wrote about now popular fullerenes in 1992[3], as well as Pavel Lukáč, who wrote about nanocrystalline materials in 1993[4].

The first grants supporting the research of nanotechnologies were also assigned by the Grant Agency of the Czech Republic in 1993[5]:

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1 Dr. Ing. Anton Fojtík, CSc. (*1948), now a scientific worker in ČVUT-FJFI in Praha. http://kfe.fjfi.cvut.cz/k412/home/Fojtik/cz/docs/List_of_Publication.pdf

2 Antonín Fojtík: "World of (non)negligible sizes", Vesmír, 65, 1986, pp. 690-692.

3 Miloš Matyáš: "Fullerens and fullerites", Progress in mathematics, physics and astronomy, 37, 1992, p. 288

4 Pavel Lukáč: "Nanocrystals", Progress in mathematics, physics and astronomy, 38, 1993, p.14

5 "Review of completed projects within the first round of the grant tender – Projects resolved in 1993-1995", GAČR, Praha, 1998

- 101/93/0733 “Non contact non destructive measuring and the topography of surfaces with the nanometric resolution ability”, the grantee - Doc. RNDr. Pavel Tománek, CSc., VUT-FEI Brno
- 202/93/1173 “Magnetic-elastic properties of amorphous and nanocrystalline materials”, the grantee - Ing. Luděk Kraus, CSc., Institute of Physics of the Academy of Sciences of the Czech Republic
- 202/93/0391 “Structure and properties of metallic and oxidic magnetic materials prepared with non traditional technologies”, the grantee - Ing. Jan Šubrt, CSc., Institute of Inorganic Chemistry of the Academy of Sciences of the Czech Republic.

The term “nanotechnology” was used, probably for the first time, in 1995, when it appeared in the title of the international workshop “Nanotechnology – Nanometrology”, organised at VUT –FS in Brno[6]. Presentations dealt with measuring, structure inspection and machining in the scale of nanometres.

The first research and development review of nanotechnologies in the Czech Republic was prepared by Jarmila Walachová in ÚRE of the Academy of Sciences of the Czech Republic in 1997[7] in the solution of the international project within the programme PHARE. She covered 18 universities, 39 institutes of the Academy of Sciences of the Czech Republic and 3 private subjects in her extensive analysis, which was structured according to individual partial fields. The evaluation covered not only workplaces involved in the research and development of nanotechnologies, but also the workplaces, which had conditions for the conduct of such research. The review was supplemented with a list of 177 publications by different Czech authors.

In December 2000, Tasilo Prnka, from Tastech Slavičín, prepared for the Czech Society for New Materials and Technologies (ČSNMT) a brief review of the research and development in nanotechnologies that was included in an unpublished report[8]. The report showed a progressive increase in the resolved grant projects after 1993 (there had been 15 projects since 2001). There were activities by 8 institutes of the Academy of Sciences of the Czech Republic, 7 university faculties and 3 private subjects characterised.

There was a report by the EU Nanoforum published in June 2003 that briefly characterised subjects involved in the research of nanotechnologies in EU candidate countries[9]. There were described activities conducted in 6 institutes of the Academy of Sciences of the Czech Republic, at 6 universities and by 8 private companies. There was also the information about the founding of the “Nanoscience and Nanotechnology” section within ČSNMT in 2002 and about the first conference on the topic of nanotechnologies “NANO 02” organised in Brno. However, the information included in this report has had a small importance in general.

Another report by the thematic EU network Nanoforum was issued in August 2004. This one reacted to the accession of 10 new countries into EU on 1 May 2004. The part of the report related to the Czech Republic was extended with the information on TC activities of the

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6 Proceedings “Nanotechnology – Nanometrology”, a series of presentations, organisers VUT-FS Brno and TU Wien, 26 April 1995, 98 pages.

7 J. Walachová: “The State of the Art of Nanotechnology in the Czech Republic”, in “Nanotechnology – A dedicated tool for the future”, published by I. Mojzes, B Kovacs, MIL-ORG Ltd – NETI, Budapest, 1997, pp. 45-66

8 T. Prnka: “Situation in research of nanotechnologies and nanomaterials”, ČSNMT, 2000, 12 pages.

9 “Nanotechnology in the Candidate Countries – Who’s Who and Research Priorities”, published by I. Malsch, Chapter 5 “Czech Republic”, 6/2003, pp. 45-64, www.nanoforum.org

Academy of Sciences of the Czech Republic and with the characteristics of other two universities (UTB Zlín and VŠB Ostrava)[10].

Just another Nanoforum report was published in October 2004. It focussed on the mapping of the situation in bioanalytical and biodiagnostic techniques in individual European countries[11]. The author of the report noticed just the only subject involved in bionanotechnologies in the Czech Republic – Institute of Physical Biology at the University of South Bohemia in České Budějovice.

The next report by the thematic Nanoforum Network, mapping the nanotechnology infrastructure and networks in the EU member countries, was issued in July 2005[12]. There were 4 institutes of the Academy of Sciences of the Czech Republic, 5 university workplaces and the Czech Metrology Institute assessed. Two solver networks (MOVPE and Czech Nano-Team) were described. In addition to the activity descriptions, their instrument equipment is described there as well.

Because of not complete and sometimes also misleading information about the development in research and about the application of nanotechnologies in the Czech Republic presented within EU and because of the management needs of research in this area in the Czech Republic, Czech Society for New Materials and Technologies (ČSNMT) had decided to prepare a more detailed report on the current situation in the research and application of nanotechnologies in the Czech Republic. That report was prepared within the project LA 249 in the programme of the Ministry of Education, Youth and Sport "International Co-operation in Research and Development – INGO" that has been a part of the National Research Programme I.

10 "Nanotechnology in the Candidate Countries – Who's Who and Research Priorities", published by I. Malsch, Chapter 5 "Czech Republic", 8/2004, pp. 66-85, www.nanoforum.org

11 "Nanotechnology in the EU – Bioanalytical and Biodiagnostic Techniques" by Ch. Ruch, published by M. Morrison, 10/2004, info on the Czech Republic on pp. 30-31, www.nanoforum.org

12 "European Nanotechnology Infrastructure and Networks", 7/2005, published by M. Morrison, Annex 1, www.nanoforum.org

2. USED DEFINITIONS AND THE NOMENCLATURE

Nanosciences and nanotechnologies mean, in their concept, new approaches to the understanding and utilisation of properties of the mass that critically depend on sizes, which are at the level of nanometres.

Nanoscience is the study of phenomena and manipulation of materials at atomic, molecular and macromolecuar scales, where properties significantly differ from those at larger scale.

Nanotechnologies are the design, characterisation, production and application of structures, devices and systems controlling shape and size at nanometre scale.

The presented definitions were formulated within the preparation of the British study "Nanoscience and Nanotechnologies: Opportunities and Uncertainties" in 2004.[13]

It is important to define this interdisciplinary area of science and technology in order to make it different from classic disciplines of science and technology. That is the reason why the words with the prefix of "nano", like, for example, nanomaterials, nanomedicine, nanobiotechnology, nanoanalytics, nanoelectronics, and a number of others, but also nanochemistry and nanophysics, are often used, even if that can be sometimes misleading. On the other hand, many authors, institutions and companies do not use, in their fields of work done within the nanometre sizes, the prefix nano and that makes the identification of their activities more difficult and may even lead to not precise results of conducted research.

The following nomenclature has been used to characterise the fields – **Table I.** The mentioned nomenclature was used in the Austrian NANO Catalogue[14]. However, it has been supplemented with the field 8.

Table I Nanotechnology – Nomenclature

1. **Nanomaterials**
   a) Nanopowder materials, nanoparticles
   b) Composite materials containing nanoparticles
   c) Materials with carbon nanotubes, or fullerenes
   d) Thin layers
   e) Nanostructure metals and alloys, nanoceramics
   f) Polymer nanocomposites, polymer nanomaterials
2. **Nanotechnologies for information, storage and transmission, micro and nanoelectronics**
   a) Nanoelectronics, materials and equipment
   b) Optoelectronics (photonics)
   c) Optical materials and equipment
   d) Magnetic materials and equipment, spintronics
   e) Organic photonics
   f) MEMS, NEMS

[13] "Nanoscience and Nanotechnologies: Opportunities and Uncertainties", Royal Society and Royal Academy of Engineering, 29 July 2004, www.nanotec.org.uk

[14] Austrian NANO Catalogue, www.bit.ac.at/nanotechnology

3. **Nanobiotechnology, nanomedicine**
   a) Drug encapsulation
   b) Targeted drug delivery
   c) Tissue engineering
   d) Biocompatible materials and layers
   e) Molecular analysis, DNA analysis
   f) Biological-inorganic interfaces and hybrids
   g) Diagnostics, molecular recognition
4. **Nanotechnologies for the application in sensors**
   a) Sensors using nanomaterials
   b) Biomolecular sensors
5. **Nanotechnologies for the (electrical) chemical processing technologies**
   a) Filtration
   b) Catalysis and electrodes with nanostructure surfaces
   c) Chemical synthesis, supramolecular chemistry
6. **Long-term research for wider applications**
   a) Self-assembly
   b) Quantum physics, quantum phenomena in nanosizes
   c) Nano and mesoscopic systems,
   d) Chemical materials - nanochemistry
   e) Ultra-precise engineering
7. **Instruments, equipment, and research and technology applications**
   a) Analytical instruments, applications, techniques, and exploration
   b) Production of powders (of nanoparticles) and their processing
   c) Equipment and applications for the creation of layers and coatings
   d) Equipment and applications for the creation of objects (patterning, ECAP, creation of fibres, etc.)
   e) Ultra-precise machining, nanometrology
8. **Health, environmental and social aspects of nanotechnologies**
   a) Toxicity of nanoparticles
   b) Environmental aspects
   c) Social and ethic aspects
   d) Standardisation
   e) Patents
   f) Prognoses, foresight
   g) Nanotechnologies made popular
   h) Trading of nanoproducts

3. METHODOLOGY OF THE IMPLEMENTED SURVEY

There were several ways used for the gain of trustworthy information for this report:

- There was a questionnaire survey organised, in which respondents answered only two requests: a) To send brief activity characteristics and b) To send a brief list of their instruments and equipment used in the research of nanotechnologies. There were 19 institutes of the Academy of Sciences of the Czech Republic (12 institutes replied), 30 university faculties (14 faculties replied), 11 private research workplaces (4 workplaces replied), and 54 companies (24 of them replied) contacted,
- Further information was gained from the Internet pages of research workplaces and enterprises,
- There were annexes to the Government Resolution related to the programme "Nanotechnologies for the Society" used. They include lists of solved projects,
- There were data used from earlier prepared analyses of the development in nanotechnologies in the Czech Republic[7-12],
- Information included in NANO 02, 03, 04, and 05 conference proceedings were taken into consideration,
- The Central Registers of R&D projects and Research intentions and the databases of the Grant Agency of the Czech Republic and the Grant Agency of the Academy of Sciences of the Czech Republic, programmes EUREKA, COST, EU 5th FP, and EU 6th FP were surveyed,
- There were data used from the list of members of the Section "Nanoscience and Nanotechnologies" by the Czech Society for New Materials and Technologies[15],
- The list of publications by workers of the Academy of Sciences of the Czech Republic (ASEP) and the list of actual topics and experts in workplaces of the Academy of Sciences of the Czech Republic[16] were also used.

The situation existing in 2005 was preferably considered and only in some cases the information from the last three or four years was taken into account. The following uniform arrangement was utilised, when individual workplaces were described:

- Workplace's name
- Address, (I.D. No. – IČO)
- URL
- Brief workplace characteristics
- Research and development focus
- Solved projects in the area of nanotechnologies
- Experts/Field

There is no information published in this publication on experimental facilities necessary for the research of nanotechnologies, or about the production equipment. However, extensive information was gained also from this area. It looked, however, that the vast majority of the

15 http://csnmt.fme.vutbr.cz/nano
16 www.cas.cz

used equipment is often also utilised for experimental activities in other fields. Some special and unique equipment necessary for the research of nanotechnologies is mentioned in the text.

In order to make the review of research workplaces and manufacturing enterprises better arranged, the individual activities were assigned codes, according to the nomenclature in **Table I**.

Data presented in this study were sent for authorisation to all mentioned subjects. In the case of the subjects that adjusted or confirmed the sent data, there is the note **"Authorised"** added.

4. PROGRAMME ORGANISATION OF THE RESEARCH AND DEVELOPMENT IN NANOTECHNOLOGIES IN THE CZECH REPUBLIC

The area of research and development (R&D) is funded from both public and private sources in the Czech Republic. R&D was assigned 1.27 % GDP in 2004 and that included 0.54 % of public funds. The means given to the research of nanotechnologies could not be precisely determined because this area has not been statistically monitored and there are the above--mentioned problems with the identification of projects.

Basic research is funded basically only with public funds. Applied research, especially its part – the industrial research, can be funded from both sources. There are EU rules applied in the support of industrial research and programmes are approved by the Office for the Protection of Competition.

The area of public support of research and development is currently managed by the Act No. 130/2002 Coll. on the support of research and development with public funds. The Act has been valid since 1 July 2002. It determines in detail the basic terms, the subject and the ways of support, the support conditions, the ownership of tangible assets acquired for research and development, the tenders in research and development, the provision of information about research and development, and the bodies managing research and development. The Act has been put into practice by the 3 following governmental directives:

- Government Directive No. 267/2002 Coll. on information system related to research and development,
- Government Directive No. 461/2002 Coll. on purpose-oriented support of research and development with public funds and on public tenders in research and development,
- Government Directive No. 462/2002 Coll. on institutional support of research and development with public funds and on the assessment of research goals.

The finances for R&D from public funds are provided in the 2 following ways:

- Institutional support, i.e. the provision of the so-called institutional funds for the research intentions, for specific research done at universities, or for international co-operation of the Czech Republic in research and development,
- Target-oriented support, i.e. the provision of the so-called target-oriented funds for the research or development project, where the project means the determined research or development activity. There are programme projects, undertaken within research programmes, differentiated from grant projects resolved within tenders by grant agencies (Grant Agency of the Czech Republic, Grant Agency of the Academy of Sciences of the Czech Republic).

Definitions of the individual terms are described in the **Block 1**.

BLOCK 1

Basic definitions and terms, according to the Act No. 130/2002 Coll. on the support of research and development, are as follows:

Research means systematic creative work differentiating learning, including gaining of human knowledge, culture and society, with applications allowing for the confirmation, supplementing, or refuting of the gained knowledge done as

1. **Basic research** that means experimental or theoretical works implemented with the goal of gaining knowledge about basics or fundamentals of observed phenomena, the explanation of their causes and possible impacts of the utilised knowledge, or
2. **Applied research** that means experimental or theoretical works implemented with the goal to gain new knowledge required for the future utilisation in practice. This part of applied research, the results of which are utilised thanks to the development in new products, technologies and services determined for business activities in accordance with the special legal regulation (e.g. Commercial Code), is called the **industrial research**.

Development means the systematic creative utilisation of research findings, or other topics, for the production of new or improved materials, products or equipment, or for the introduction of new or improved technologies, systems and services, including the acquiring and verification of prototypes, trial or demonstration facilities.

Research intention means the determination of the research subject of activities by a legal person or organisation unit, its goals, strategy, costs, and envisaged results tried for within the basic or applied research, with the exception of the industrial research, its conceptual development in the period of 5 to 7 years.

Specific research at universities is that part of research implemented at universities, which is directly related to education of students participate in it.

International co-operation of the Czech Republic in research and development means the co-operation implemented on the basis of international agreements, by which the Czech Republic is bound.

Programme project – the receiving party expresses in which way and under which conditions it would contribute to the fulfilment of the programme goals formulated by the provider.

Grant project – the receiving party establishes the basic research goals and ways by itself.

4.1. CURRENT SUPPORT OF R&D IN NANOTECHNOLOGIES WITH PUBLIC FUNDS

Research and development in the area of nanotechnologies is mostly funded with public funds (from the budgetary chapters of the Academy of Sciences of the Czech Republic, Grant Agency of the Czech Republic, Ministry of Education, Youth and Sports, and partly the Ministry of Industry and Trade), which must be applied for within public tenders. A part of the basic research in the area of nanotechnologies is funded in the institutional way through research intentions.

The current situation in the area of research and development of nanotechnologies in the Czech Republic is well characterised by the following example:

- Funds for the research of nanotechnologies could be gained within tenders announced by the following providers of funds for research and development: Grant Agency of the Czech Republic (GA CR), Grant Agency of the Academy of Sciences of the Czech Republic (GA CAS), Ministry of Education, Youth and Sports (MEYS), Ministry of Industry and Trade (MIT), Ministry of Health (MH), and Ministry of Defence (MD). There is the bottom-up system used in all cases. Project proposals are expected from individual solvers.
- GA CR, GA CAS, MEYS, MA, and MD have not announced any programme, in the assignment of which nanotechnologies would be mentioned as the topical priority. Projects

focussed on nanotechnologies can be presented within public tenders in generally focussed programmes (e.g. in the case of MEYS, they are the programmes NRP I "Research Centres" and "Basic Research Centres").

- MIT announced, for the first time, nanotechnologies and nanomaterials as the priority in 2002 within the programmes CONSORTIUM and PROGRESS. However, that was within 17 different priorities in total. MIT did something similar also in 2003, 2004, and 2005 with the framework of programmes TANDEM and IMPULS.
- The government approved the **National Research Programme I (NRP I)** for the period 2004–2009 in April 2003. The word "nano" occurs in NRP I in neither title of Topical Programmes and in neither title of Partial Programmes. Nanotechnologies are mentioned only in two points of the Topical Programme 3 (TP3) "Competitiveness in the Sustainable Development", organised by MIT within the Programme POKROK (PROGRESS), among 90 other key research directions. They are the following key directions: TP3-DP4 (New Materials), the priority 7 "Electronic and Photonic Materials and Structures", point a) semiconductors, waveguides, micro electromechanical and nanoelectromechanical systems and TP3-DP5 (Emerging Technologies), the priority 1 "Nanotechnologies and nanomaterials" (phenomena in nanosizes, nanobiotechnology). The programme POKROK has not been announced in 2005 again.
- The government approved of the **National Research Programme II (NRP II)** for the period 2006–2011 in March 2005. There are projects within 49 topical areas expected to be resolved within the framework of 4 topical programmes. The topic "nanotechnology" occurs in the following topical areas:
  Provider - MIT, the topical programme 1 "Permanent Prosperity"
  T1-3-5 "New semiconductor sensors and nanoparts"
  T1-3-7 "New applications in nanodiagnostics"
  T1-5-3 "Nanomaterials and processes"
  Provider – MEYS, the topical programme "Healthy and High Quality Life"
  T2-2-3 "Nanomaterials in biology and medicine"
  Generally characterised goals have been established for the individual topical programmes. Participation of not public funds is required.
  A public tender should be announced at the end of 2005.
- Research intentions focussed on nanotechnologies are funded with institutional funds of MEYS and MH.
- With the exception of participation in projects solved within the EU 6th Framework Research and Development Programme, projects containing international co-operation focussed on nanotechnologies can get support also from funds of MEYS – within the Partial NRP I Programme "Programmes of International Co-operation in Research" (COST, EUREKA, EUPRO, CONTACT, and INGO), and from funds of GA CR in programmes ESF EUROCORES.

4.2. THE PROGRAMME "NANOTECHNOLOGIES FOR THE SOCIETY"

As it has been already said in the introduction, the government of the Czech Republic approved of the research programme "Nanotechnologies for the Society" on August 17th, 2005. The state will partly participate in its funding. The participation will vary and the private sector will participate as well. The programme should be announced in December 2005 for the period

of 7 years, i.e. 2006–2012. The solution duration of individual projects will be 5 years at the maximum. First projects within this programme should commence after 1 July 2006. The announcement will be repeated in 2006 and 2007 and further projects should commence on 1 January 2007, on 1 January 2008 respectively.

4.2.1. Programme goals

1) Creation of new materials and applications for them, the creation of optimised applications, and the achievement of target-modified usable mechanical, electrical and other material properties based on the unique characteristics of nanoparticles, nanofibres, composite, and nanostructured materials.

   Efficient transfer of knowledge extending the spectrum of technologies used in the industry, which are based on practical use of nanoparticles, nanofibres, nanocoatings, nanostructures, and nanocomposites in the manufacture of materials in the Czech Republic. In the case of free nanoparticles and nanofibres, to assess their possible negative impacts on the environment and humans.

2) Utilisation of nanostructures and nanocomplexes, including hybrid materials manageable by an external magnetic field, for new forms of drugs, diagnostics, specific agents and carriers ensuring the target-oriented transport of these substances, or the transfer of gene information, their activation and biodegradation in organisms.

   Proposition of new biosensors and diagnostic systems allowing for a sensitive detection of molecular objects and the support of the introduction of modern nanotechnology materials and applications into the medical practice in the Czech Republic.

3) Design of new instruments, tools and equipment for the creation and high resolution characterisation of nanostructures and the preparation of new applications for the handling and interconnecting the nanoobjects with micro and macro surroundings, especially with micro electronics.

   In the case of technologically interesting bulk and gradient materials, the creation of new characterising processes allowing for the concurrent high lateral resolution characterisation of the topography and the chemical composition of their surfaces and the preparation of applications for the optimising of usable mechanical, electrical and other properties of these materials.

4) Proposition, preparation, characterisation, and modelling of new nanostructures suitable for detectors, photonic crystals and lasers, and new semiconductor spintronic materials for the development of a new generation of nanoparts for the recording and transfer of information.

   Design of new applications for the preparation of nanostructures and nanomaterials with the target-oriented management of object sizes, or their self-organisation, especially the preparation, characterisation and optimising of new nanocarbonaceous and nanodiamond materials for the bio-applications and nanoelectronics.

4.2.2. Programme structure

1) Sub programme “Nanoparticles, nanofibres and nanocomposite materials”
2) Sub programme “Nanobiology and nanomedicine”
3) Sub programme “Nano-macro interface”
4) Sub programme “New phenomena and materials for nanoelectronics”

4.2.3 Priorities in individual sub programmes:

1) Sub programme "Nanoparticles, nanofibres and nanocomposite materials"

➢ **Nanoparticles of metals and metallic oxides.** The research will focus on the preparation technologies related to nanoparticles of metals (e.g. Au, Ag, etc.) and their oxides, nitrides, and other substances (e.g. MgO, TiO_2, etc.), technologies for their compacting, stability, usable nanoparticle properties, research of their application and the research of their impact on the environment and humans.

➢ **Nanoparticles and nanolayers on the basis of ceramic materials.** The preparation and characterisation of nanograins, ultra-thin layers and super-matrices on the basis of nanocrystalline ceramics of unique properties. Specifically, this can relate to the study and research of new nanocomposites made of magnetic oxides, size effects of layered cuprates, and ferroelectric or ferromagnetic materials. These nanomaterials can become themselves the research or industrial production targets in the area of mechanical engineering, electrical engineering, or electronics.

➢ **Nanofibres based on carbon, special inorganic materials, and polymers.** Research will focus on the materials with purpose-oriented modification of their mechanical, electrical, magnetic, and optical properties. These nanomaterials can become themselves the research or industrial production targets with the aim to obtain products of a high usable value. They should also result in the practical utilisation in new technologies, e.g. in the conversion and accumulation of energies.

➢ **Nanocoatings, nanostructures and nanocomposite materials.** The research of nanocoatings and functional nanostructures in thin layers will be target-oriented on the improvement of usable properties of materials important for the practical use, e.g. the development of self-cleaning and antibacterial layers and products usable for the protection of the environment, especially for the removal of hazardous materials from water or air. The research of nanocomposites will focus on the finding of a suitable bond between metallic and ceramic or polymer matrices and the strengthening of the nanostructural (usually ceramic) composite phase determined for extreme mechanical and chemical duties. The utilisation areas should be the miniaturised systems and their integration in a new generation of products at the level of micro and nanosizes.

2) Sub programme "Nanobiology and nanomedicine"

➢ **The targeted drug delivery of biologically active substances and nanosystems for diagnostics, therapy, or radiotherapy, e.g. with the aid of polymers or "molecular vessels".** Research of drug forms, contrast substances and diagnostics based on biodegradable (especially polymer) systems allowing for the bonds of drugs, or possibly diagnostics and other biologically active molecules as the units ensuring the organ or cell-specific delivery of a complete system within a living organism and its specific activation in the required place of effect. In an ideal case, this system should function as a diagnostic medium and, at the same time, also as a specific therapeutic agent. The fundamental is the delivery of chemotherapeutics and radio-therapeutics determined especially for the treatment of tumorous diseases.

➢ **Magnetic nanoparticles for medical purposes.** The stress will be put on hybrid materials consisting of magnetic cores and biocompatible macromolecular coatings, where their transport, distribution, and behaviour can be managed by an external magnetic field. These

nanoparticle systems should serve *in vivo* in diagnostics and therapy as the drug target delivery, chemotherapeutic and radio-therapeutic substances, or in the role of contrast substances for the magnetic resonance imagining and the local destruction of cancerous tumours by the magnetic hyperthermy.

- ➢ **Bio-functionalisation of surfaces.** This relates to the understanding of fundamental processes influencing the interaction of molecular objects on metallic and semiconductor surfaces, the understanding of their creation, or self-assembly. The stress will be put on nanobiotechnologies allowing for the creation of a defined interface between biological and non biological environments that will allow for the achievement of a specific biological activity, e.g. the creation, regeneration or reconstruction of cells and tissues (the bioengineering) and for the creation of biocompatible surfaces of medical preparations, tools and instruments, or adjustment of surfaces specifically reacting to the presence of selected molecules (the detection system of biosensors). This should not be only for the medical use.
- ➢ **Biosensors and diagnostic systems.** Research of diagnostic systems and chips based on the surface modification of nanofibres, matrices and sensitive detectors of antibodies specifically against different molecules. The interaction even of a small amount of molecules with antibodies and the connected highly sensitive conductivity changes, or other properties, should be utilised for their specific detection.
- ➢ **Polymer nanocomplexes for the transport of gene information and the gene therapy.** The preparation, study of properties, and the research of DNA complexes allowing for the *in vivo* effective destination-focussed delivery a gene information to the beforehand selected kinds of cells, or used as the systems ensuring the efficient transfection of more kinds of cells and their use for the therapy.
- ➢ **Supramolecular creation of nanostructures.** It is fundamental for the biomedical use to create artificial nanostructures by a managed setup of purpose-prepared molecular construction units. This is, together with the maximal utilisation of self-assembly of covalent and non covalent bonds, one of the goals of the supramolecular chemistry.

3) Sub programme "Nano-macro interface"

- ➢ **Development of tools, instruments, equipment, and applications for the creation and characterisation of high resolution nanostructures** that will focus on the characterisation of materials from the topographic, electric, optical, and magnetic properties points of view, their passivation, thermal resistance and the resistance against intensive beams and mechanical effects. These nanotechnology tools will allow for a direct control of individual technological steps.
- ➢ **Development of applications for the handling and connection of nanoobjects with micro and macro environments,** especially with microelectronics that should allow for the measuring of electric and operational parameters of individual electronic elements and nanostructures. There will be applications of manipulation the atoms, molecules and clusters researched with lithographic applications for the contacting of nanostructures and nanoparts and their in-building in complex circuits and electronic equipment.
- ➢ **Development of metrological applications and the characterisation of surfaces of technically interesting macroscopic materials with the nm resolution** with the use of scanning probe microscopes, optics, and diffractive electron and photoelectron applicati-

ons. There will be metrological processes created for the determination of nanoobject sizes and, at the same time, of their chemical composition, topography and electron properties. These applications will be utilised also for the grants of attests and for guaranteeing the properties of new products, in which their state of surface plays the decisive role.

➢ **Study of bulk materials, properties of which are fundamentally influenced by their microstructure or nanostructure, especially by the nanometric grain boudaries.** An important group of such materials is made of nanostructured bulk and gradient dielectric and metallic materials, the research of which will focus especially on the nanotechnology of preparation of nanostructured ceramics or ultra-fine-grained metals and inter-metallic alloys (e.g. the application of extreme local plastic deformations or the influencing of grain boundaries) with the goal to gain materials, which will be outstandingly strong and plastic and having excellent electric and magnetic properties.

4) Sub programme "New phenomena and materials for nanoelectronics"

➢ **Nanophotonics and especially new kinds of lasers.** The stress will be put on the study of quantum properties of electrons and their effect on the emission, spread and absorption of photons in the two, one and zero-dimensional structures, their theoretical modelling and simulation of general nanophotonic systems. The fundamental will become the preparation and characterisation of nanostructures or nanosize polymers suitable for detectors, photonic crystals, emission diodes, and especially lasers.

➢ **Semiconductor spintronics** focussed on the preparation, characterisation and utilisation of spintronic materials and structures combining the magnetic and non magnetic semiconductors. The stress will be put on the design of nanoparts that will not use for the recording and transfer of information the electrons' charge, but their spin. They will create in this way an important part of nanoelectronics.

➢ **Nanostructures on the basis of carbon and the nanodiamond layers.** The objective of the research of unique electrical, optical and magnetic properties of the carbonaceous nanostructures containing the atom of carbon in sp, sp^2, and sp^3 states will be the exploration of new possibilities of carbonaceous nanomaterials and also of new physical phenomena, which are exclusively bound with nano-carbon and which are perspective in nanoelectronics and bio-applications. An important research task will be to manage the deposition of nanodiamond layers on substrates of the size larger than 10 cm^2 and the modification of their surface, which should allow for the achievement of in practice usable unique electric and surface properties.

➢ **Nanotechnologies and nanophenomena on the atomic and molecular levels.** An important part should focus on the development and implementation of preparation applications for nanostructures and nanomaterials with the targeted management of object sizes, or their self-organisation related to lithographic, epitaxial, steam and sputtering, sol-gel, laser managed or other applications and techniques, but also on the preparation and utilisation of metallic nanostructures in the area of plasmonics focussed on the research of the spreading of elmg. signal along to nanostructures. The fundamental role will be played by the creation of nanoelectronic items and parts (e.g. the single-electron transistor) and their application in the research of quantum phenomena with the perspective utilisation in nanoelectronics or molecular electronics.

5. RESEARCH AND DEVELOPMENT IN NANOTECHNOLOGIES IN THE CZECH REPUBLIC

A number of workplaces within the academic sector (institutes of the Academy of Sciences of the Czech Republic and workplaces at universities) and also in the private sector conduct research activities at various levels and with different capacities in the area of nanoscience and nanotechnologies. The activities of each workplace within individual organisations carry codes, according to **Table I**. When assessed, the kinds of research and development were not taken into account (the basic research, the applied research, and development). There were individual institutes assessed in the case of the Academy of Sciences of the Czech Republic and faculties in the case of universities.

5.1. ACADEMY OF SCIENCES OF THE CZECH REPUBLIC

The Academy of Sciences of the Czech Republic (hereinafter called "CAS" only) is a national research institution consisting of a number of scientific workplaces active in science fields ranging from animate and inanimate nature to humanities and social science. The main and irreplaceable task is the solution of long-term and important research projects, especially in the field of the basic research. At the same time, the Academy of Sciences of the Czech Republic fulfils related functions: To help in the implementation of results of its own exploratory work in practice, to develop researchers' training, to participate in university education, and to make science and its results popular in the society.

CAS has got its own budgetary chapter and its activities are thus mostly funded by the state. The main activity subject is the basic research. There are more than 6 800 workers employed in CAS (researchers with university qualifications make a majority). This results in 18–20% of the research base in the Czech Republic.

At the moment, there are 57 scientific workplaces in CAS. They have the status of basic scientific-organisational units with the legal juridical subjectivity. The survey showed that at least 17 workplaces are involved in the research of nanotechnologies. The workplaces involved in the research of nanotechnologies are presented in the alphabetical order.

5.1.1. Institute of Biophysics of the Academy of Sciences of the Czech Republic (BFÚ CAS)

Královopolská 135, 612 65 Brno, I.D. (IČO) 68081707

www.ibp.cz

Brief workplace description

The activities in the Institute focus on the research of physical and chemical properties, structure and interactions of bio-macromolecules, the research of biophysical properties of living systems at the molecular, cell and organism levels, including the influences of external environmental factors, and the theoretical research in these areas. BFÚ CAS has been divided into 16 laboratories. The research of the character of bio-nanotechnologies is done mainly in the Laboratory of the Biophysical Chemistry and Molecular Oncology (the leader is E. Paleček), in the Laboratory of Bio-macromolecular Physics and Their Parts (V. Vetterl), and in the Laboratory of Cytokinetics (A. Kozubík).

Research and development focus

The research in BFÚ CAS is focussed mostly on the issues of the ***research intention AV0Z50040507 "Biophysics of the dynamic structures and functions of biological systems" in the period 2005–2010. The solver is RNDr. Jana Šlotová, CSc.***

The research is focussed on relations between the primary DNA structure and its conformation properties, while the evolution of genomes, the DNA interaction with proteins (histones, HMG proteins, oncological proteins) and efficient anti-tumour substances containing metals, the interaction of DNA and proteins in interim stages in relation to electrochemical sensors for genomics and proteomics, the architecture of the cell core, the arrangement and modification of the chromatin, the structure and function of nucleoproteins and telomere complexes, dynamics of genomes and genomic territories, relations between the gene expression, cell differentiation, oncological transformation and ontogenetic development, influence of endo and exogenic mediators modifying proliferation, differentiation and the apoptis in cell populations, computer simulations of the dynamic structure and the interactions of DNA/RNA with proteins and biological active substances are taken into consideration. The application will occur in medicine, agrobiology, ecotoxicology, and in biotechnology.

The above-description implies that the Institute focuses its activities on the area of molecular biology, biotechnology, genomics, and proteomics and other bioscience. A number of the above-mentioned issues belong, according to the definitions in Part 2, to the field of nanoscience, bio-nanotechnology, and nanomedicine.

Projects solved in the area of nanotechnologies

The following projects[17] have been selected from the review of the programme projects solved currently in BFÚ CAS:

Grant Agency of CAS project IAA4004402 "Electrochemical detectors of the DNA hybridisation and its applications in the DNA diagnostics" (2004–2007), the solver – RNDr. Miroslav Fojta, CSc.

GA CAS project IBS5004107 "Application of biophysical methods in the biotechnological and clinical practice" (2001–2005), the solver – Prof. RNDr. Vladimír Vetterl, DrSc. The preparation of solid electrodes and their modification: Metallic, graphitic/carbonaceous and semiconductor materials, mercury film electrodes, amalgam alloys, chemically, with nanoparticles and biopolymers modified electrodes.

GA CAS project IAA4004404 "Interaction of biopolymers with ligands and the detection of their conformation changes at phase interfaces with the aid of electrochemical and optical methods" (2004–2006), the solver – Prof. RNDr. Vladimír Vetterl, DrSc.

GA CAS project IAB4004305 "Chemically modified solid electrodes in the electrochemical analysis of nucleic acids and their parts" (2003), the solver – Mgr. Stanislav Hasoň

MEYS project – FRVŠ 2005 – F4a 2541/2005 "Application of electrochemical and optical methods in the design of chemical sensors and biosensors" (2005), the solver – Prof. RNDr. Vladimír Vetterl, DrSc.

GA CAS project IBS5004355 "Abilities of electrochemical methods in genomics, basics in the development of DNA biosensors" (2003–2005), the solver – Prof. RNDr. Emil Paleček, DrSc.

[17] www.vlada.cz/1250/rvv/cep/ceplist.sqw

GA CR project 203/04/1325 “New approaches to the development of electrochemical sensors of damaged DNA” (2004–2006), the solver – RNDr. Miroslav Fojta, CSc.

GA CR project 204/03/0566 “Utilisation of electrochemistry in the analysis of proteins and in the detection of DNA hybridisation” (2003–2005), the solver – Prof. RNDr. Emil Paleček, DrSc.

Project MA 1A8241 “New diagnostic possibilities in leukaemia with the use of DNA micro chip technology” (2004–2006), the solver – Doc. RNDr. Stanislav Kozubek, DrSc.

Experts/Field

Prof. RNDr. Vladimír Vetterl, DrSc. – Biopolymer physics, the interaction of biomolecules with surfaces, bio-electrochemistry, nanobiotechnology

Prof. RNDr. Emil Paleček, DrSc. – Chemical reactivity of nucleic acids, the interaction of DNA with proteins, electrochemical sensors of damaged DNA

Doc. RNDr. Jiří Šponer, DrSc. – Structure, dynamics and the molecular interaction of RNA and DNA

Doc. RNDr. Stanislav Kozubek, DrSc. – Molecular cytology and cytometry, the radiation biology, the biology of tumours, Institute Director

Doc. RNDr. Alois Kozubík, CSc. – Cytokinetics, the cell oncology

Doc. RNDr. Miroslav Fojta, CSc. – Tumour suppressors and molecular mechanisms in their activity, electrochemical sensors

Mgr. Stanislav Hasoň, PhD. – Biopolymer physics, the interaction of biomolecules with surfaces, bio-electrochemistry

Authorised

Codes: 3e, 3f, 3g, 4b

5.1.2 Institut of Physics of the Academy of Sciences of the Czech Republic (FZÚ CAS)

Na Slovance 2, 182 21 Praha 8, I.D. (IČO) 68378271

www.fzu.cz

Brief workplace description

The current research programme of the Institute covers the physics of elementary particles, the physics of condensed systems, the physics of plasma, and optics. It has been focussed mainly on the following research areas: Mathematical physics, quantum thermodynamics, the structure of elementary particles, plasma diagnostics, particle detectors, properties of substances with different kinds and levels of arrangement, surfaces and interfaces of solid substances, quantum-size phenomena, quantic liquids, superconductivity, phase junctions, classical and modern technologies in the preparation of crystals and thin layers, non linear and quantum optics, special optical equipment.

The review of FZÚ CAS activities is also available in the Czechoslovak Journal for Physics, 4/2005[18].

[18] Czechoslovak Journal for Physics, 55, No. 4, 2005, pages 289–404 (in Czech)

The research is organised in 5 following sections:

- Section of elementary particle physics (the leading researcher J. Chýla)
- Section of condensed substances (M. Glogarová)
- Section of solid substances physics (A. Šimůnek)
- Section of optics (J. Řídký)
- Section of high performance systems (K. Jungwirth – Institute Director)

The sections have been divided into 24 research departments further divided into laboratories or groups. A large number of solving teams are involved in the area of nanoscience (nanophysics) and nanotechnologies. The Institute is the co-ordinating workplace of the network "MOSFET" and the initiator and co-ordinator of the virtual centre for the physics of nanostructures "Czech Nano-Team" (see Part 7.3.). The Institute was the initiator of the new programme of the Academy of Sciences of the Czech Republic "Nanotechnologies for the Society".

Research and development focus

The research in FZÚ CAS has been focussed mostly on the issues of the following research intentions in the period 2005–2010:

- AV0Z10100502 "Phenomena in the physics of elementary particles exceeding the standard model"
- AV0Z10100520 "Specific phenomena in condensed systems with a lowered space dimension and disturbed symmetry"
- AV0Z10100521 "Physical properties and preparation of nanostructures, surfaces and thin layers"
- AV0Z10100522 "Wave and particle spreading of light, optical materials and technologies"
- AV0Z10100523 "Intensive resources of radiation and the radiation interaction with the matter"

Solved tasks and programme projects in the area of nanotechnologies

The following representative research intentions and programme projects related to nanotechnologies have been selected in the databases of CEP and CEZ:

The research intention AV0Z10100520 "Specific phenomena in condensed systems with the lowered space dimension and disturbed symmetry" (2005–2010), the solver – prom. fyz. Milada Glogarová, CSc.

The subject of activities is the study of dynamic and co-operation phenomena in condensed substances with significantly disturbed symmetry caused by the lowered dimension, faults and irregularities in the space arrangement (thin layers, supermatrices, grain boundaries, domains, and phases, impurities, clusters, nanocomposites, liquid crystals). There is the influence of electron correlations, impurities, and non homogeneities on the formation of the electron structure of materials with complicated crystalline structures studied.

The dynamics of the dielectric response of materials with significant dielectric properties are studied as well as the mechanical and structural properties of grain boundaries in selected metallic semi-crystals and the phase transformations in the intermetallic alloys with the shape

memory (the high temperature alloys, magnetic alloys, etc.) in the polycrystalline state. The structure of nanocrystalline metallic materials, including the presence of micro tensions and remaining deformations, changes in the matrix parameter and in the structures at the grain boundaries, which differ in these materials from the structure in classic polycrystals, is researched. There are systems with pronounced magnetic and co-operation properties prepared and tested.

The theoretical part of the intention has got as its objective the complex microscopic description of electron and atomic properties of the systems with a non trivial structure, the disturbed symmetry, a lowered dimension, or existing in extreme conditions both in the state of the thermodynamic balance and outside. On one hand, researchers will start with the fundamental theory of electron and atomic processes described with the qualitative microscopic models of specific aspects of solid substances, but on the other hand, they will try for *the application of the basic theory in the area of material research* that requires realistic calculations for concrete systems.

The gained knowledge should make a base for further development of materials with the required properties, or possibly functional materials utilising characteristic changes of its properties caused by influences of external conditions.

The research intention AV0Z 10100521 "Physical properties and preparation of nanostructures, surfaces, and thin layers", the solver – RNDr. Antonín Šimůnek, CSc. (2005–2010)

The research intention focuses its main activity on the exploratory research of new forms of solid substances, the properties or behaviour of which are decisively determined either by their surface or by their nanometry or stratification or possibly aperiodic structure. The world trends in the research of such materials are significantly influenced not only by the already existing successful or at least hopeful practical applications, but also by the scope of the newly found physical phenomena. The workplace finds itself in a very suitable position for the research of these "modern" materials because of the past long-term successful experimental and theoretical study of semiconductors and magnetic materials. The solution of the research task present the purposeful interconnection of advanced technologies used in the preparation of the researched materials, unique methods for their experimental study within the extensive field of external conditions and the theoretical processing of resulting knowledge with the aid of microphysical theoretical models and *ab-initio* calculations. The subject of the research activity is focussed on the 3 following topical directions I, II, and III:

I.

The study of surfaces and of the growth of thin layers and nanostructures, especially silicon and diamond, but also of scintillation materials, the determination of their microstructure with the nanometric resolution and the study of the influence of a microstructure on the transport and optical properties.

- The research of thin layers of Si is focussed on the growth of micro(nano)-crystalline Si, especially at the low temperatures of the deposition, the creation of predictive model and its utilisation for the verification of possible creation of non traditional kinds of photovoltaic cells, but also the possibility to utilise these materials for nanolithography. Si nanostructures, prepared in the form of thin layers made of nanoparticles obtained by the photochemical etching or by the implantation of Si ions, e.g. into Infrasil, are studied with the objective

to verify the existence of an optical benefit and the consequent possibility of preparation of the Si laser for the silicon nanophotonics.

- Important subjects of studies are also the semiconductor surfaces and their reconstruction at the atomic level and the diffusion of adsorbed atoms. There is the STM microscopy used and the observed topographic shapes are characterised by the local density of electron states in a real space, which decisively determines the future application in nanotechnologies. STS spectroscopy allows for the chemical identification of observed objects, which will be interpreted with model and *ab-initio* calculations within the DFT formalism.
- Diamond is prepared in the form of homoepitaxial and heteroepitaxial layers. There are the structural, electron, and spectroscopic properties studied at the atomic level as well as the introduced optical and electric characterisation of layers, the spectroscopy of defects and impurities in the diamond layers, including the macroscopic characterisation of samples. There are electronic parts (e.g. detectors) prepared on the basis of diamond layers and the bioactive surfaces for the DNA biochips, and also biosensors in future.
- Selected scintillation materials are used for the studies of transfer processes and energy capture, material stability under the conditions of a scintillation conversion and the influence of material defects. There are methods of the spectroscopy differentiated in time and EPR utilised, mostly on monocrystals of complex fluorides and oxides with a wide banned band, including the modelling of dynamics of excited states of luminescent centres.

II.

Semiconductor structures on the basis of $A^{III}B^{V}$ compounds, especially the research of nanostructures and systems with lowered dimension and diluted ferromagnetic semiconductors.

The research covers:

- Optimising of the structure growth with required parameters prepared by the MBE technologies, or MOVPE,
- Experimental study of electric, optical and magnetic properties of samples prepared from these structures. In the case of nanostructures and low-dimension systems, this relates mostly to the luminescent spectroscopy and the electron transport, the magnetic transport and the cyclotron resonance respectively. In the case of ferromagnetic semiconductors, the transport measuring is accompanied with magnetic-optical experiments and with the study of magnetisation and magnetic susceptibility,
- The comprehensive quantitative theoretical description of the observed phenomena within the quantum electrodynamics. In the case of ferromagnetic semiconductors, there is the implemented methodology developed on the basis of a model of the magnetic interaction existing between the local impurity spins mediated by movable carriers in the valence band of semiconductors,
- The research of the non magnetic nanostructures is oriented on the future potential application in optoelectronics. The diluted ferromagnetic semiconductors will find their utilisation in the so-called spin electronics (spintronics). The implemented methodology will allow for the quantitative modelling of spintronic functions connected with the phenomena, like the giant magnetic resistance, by the power induced change in the magnetisation, Kerr and Faraday rotation, etc. The preliminary researches show that these phenomena can be in the semiconductors of this kind much stronger than in classical metallic ferromagnetic materials.

III.

Crystalline structure, magnetic and transport properties of selected materials

Research is focussed on:

- The stratified, nanosegregated and special complex oxides and inter-metallic compounds showing a strong response to changes of external thermodynamic conditions, which are researched within the combined extreme conditions, i.e. under very low and very high temperatures, high external pressure, and strong magnetic fields.
- Superconductive vortexes will be studied experimentally and theoretically in nanostructured superconductors. There will be ab-initio and model calculations related to the electron structure of the system with a strong electron correlation done.
- Development of calculation methods related to the electron states using the first principles based on the theory of the functional spin density, especially the methods suitable for the systems with strong correlation, where the current approaches have not shown the satisfactory conformity of the theory and experiments. In parallel with the electron structure, there is also the real material structure theoretically explored by diffractive and spectroscopic methods. There are methods developed for the description of X-ray absorption spectra (XANES) for the purpose of the structural analysis of clusters (the cluster size, the influence of the shape and the surface of the cluster).
- Draw of general conclusions in relation to the unconnected modulation functions for the cases, which show single-dimensional modulations to two or three-dimensional modulations. It shows that the high symmetry of certain substances leads consequently to the occurrence of several modulation vectors.
- The implementation of a general multiphase description for the analyses of material structures consisting of more phases.

The research activity related to the mentioned materials done at the atomic level will allow, together with theoretical models and calculations, not only for the analysis and interpretation of experimental data, but also for the prediction of physical properties of the studied systems. The introduction of full operations of the Czech Measuring Station at the synchrotron Elettra in Trieste opens new chances for the physics of solid substances.

Research intention AV0Z10100522 "Wave and particle spreading of light, optical materials and technologies", the solver – prom. fyz. Jan Řídký, CSc., 2005–2010

The objective is to study properties of classical and quantum aspects of the light spreading, the optical materials, stratified structures, and optical systems and technologies. In the case of the classical optics, the work focuses mainly on the interferometers, holography, coherent and statistical behaviour of light beams, and the fractal optics. In the area of quantum optics, there are different kinds of sources of quantum correlated photon pairs constructed. In quantum informatics, the work focuses on the measuring of the overlap, the fidelity, and the purity of quantum states. In the case of optical materials, the research relates to selected multiple doped oxide crystals with high polarisation and nanostructured optical materials, especially to the anomalous behaviour of optical properties close to the phase junctions. The optical technologies will be covered in the study of physical bases of non traditional optical and opto-plasma technologies suitable for the preparation of new kinds of functional optical thin-layered systems and nanostructures. In the X-ray optics, the work will focus on the crystalline optics for the synchrotron radiation.

In connection with the nanotechnology:

There are physical properties of thin layers prepared with the aid of differently modified low temperature plasma technologies studied. They are mainly thin layers, multilayer systems, and nanostructures determined for the research and application in optics and optoelectronics.

There is also the research of basic micromechanical parameters of optical functional thin layered systems, nanocomposites, interfaces and nanostructured surfaces organised. The experimental research focuses mainly on structures prepared on the basis of different forms of doped carbon, or the perovskite oxides, including the study of diffusion processes and the adsorption on defined surfaces.

The research focuses mainly on the following forms of optical materials: Crystals, textures, ceramics, thin layers and their systems, interfaces, sub surface layers and surface structures, nanocomposites, and nanoparticles and nanoporous systems.

The creation of nanocrystalline, nanocomposite and gradient layers in new and perspective materials in the reactive environment. The study and optimising of the depositing process with the objective to create stoichiometric and crystalline layers under low depository temperatures on large area pads (at the level of 3 x 3 cm^2) and the thickness non homogeneity lower than 10 %. The attention focuses mainly on the following materials: C, Ti, Zr, Zn, Al, Fe, BN, Cr, Si, etc.

MEYS project LC 510: "Centre for nanotechnologies and materials used in nanoelectronics" (2005–2009), the solver – RNDr. Jan Kočka, DrSc. Co-operation: UK-MFF (doc. RNDr. Jan Valenta, PhD), ÚFCHJH CAS (Prof. RNDr. Ladislav Kavan, CSc.)

One of the biggest problems in further development in electronics is the fact that the smaller sizes, necessary for the increased integration, lead to the increase number of parts. The length of conductive connections in integrated circuits per square cm thus hugely increases together with the heat freed by the resistance warming up.

This problem, however, has some solutions. They determine 3 directions in the necessary basic research done within the Centre for Nanotechnologies and Materials Used in Nanoelectronics:

I To utilise light photons instead of the transport of electric charge, i.e. to manage the photonic processing of information, if possible on silicon,

II To utilise both for the transfer and for the saving of information electron spin instead of its charge. This could lead not only to lower freed heat, but also to the revolutionary changes in memories and to other benefits provided by these so-called spintronics.

III To utilise new materials instead of nowadays dominant crystalline silicon, e.g. diamond (which allows for much higher temperatures) or nanostructures of unique properties – e.g. the carbon nanotubes, or possibly only individual molecules or supramolecular complexes.

An important progress has been achieved in the understanding of "nanophenomena" in biology. It is fundamental, for the practical utilisation, to use for the processing in computing "bio" signals. It is why the "bio-functionality" of nanoelectronic materials and the ability to integrate different kinds of biosensors, which open the possibility to use them in medicine and biology, are such important research directions for "nanoelectronics".

List of projects related to nanotechnologies solved in FZÚ CAS:

GA CAS projects

IAA1010113 “Complex dielectric response of high permittivity materials with nanoscopic arrangement” (2002–2005), the solver – RNDr. Stanislav Kamba, CSc.

IAA1010408 “Magnetotransport in semiconductor nanosupermatrices” (2004–2006), the solver – Ing. Ludvík Smrčka, DrSc.

KJB1010417 “Nanocrystalline structures in thin optical waveguides prepared by the method of pulse laser depositing and magnetron sputtering” (2004–2006), the solver – Ing. Ján Lančok, CSc.

IAA1010213 “Mechanism of radiation recombination in sub nanometric InAs/GaAs laser structures” (2003–2005), the solver – Doc. Ing. Eduard Hulicius, CSc.

IAA1010404 “Effect of external fields on small size electron structures” (2004–2008), the solver – Ing. Jozef Krištofik, CSc.

IAA100480501 “Solvable nanosystem models” (2005–2007), the solver – Doc. RNDr. Petr Šeba, DrSc.

IAA1010203 “Electron correlations and solid substance properties” (2002–2005), the solver – RNDr. Václav Drchal, CSc.

IAA1010316 “Microcrystalline and nanocrystalline semiconductors for photonics: Electron phenomena at the level of nanometres and femtoseconds” (2003–2007), the solver - Prof. RNDr. Ivan Pelant, DrSc.

IAA1010413 “Nanoscience and nanotechnology with probe microscopes: From a phenomenon at the atomic level to material properties” (2004–2008), the solver – Ing. Vladimír Cháb, CSc.

1QS100100553 “New hybrid-magnetic-nanocomposite materials for selected applications in medicine, for the imagining magnetic resonance and hyperthermy” (2005–2008), the solver – Doc. Ing. Emil Pollert, DrSc.

GA CR projects

202/05/0575 “Theoretical research of semiconductor spintronics” (2005–2007), the solver – RNDr. Tomáš Jungwirth, CSc.

202/03/0413 “Quantum dots with long-wave emission” (2003–2005), the solver – Ing. Jiří Oswald, CSc.

202/04/0994 “Crystallography, the electron and magnetic structure of surfaces of nanolayers GaAs prepared by low temperature molecular epitaxy” (2004–2006), the solver – Prof. RNDr. Igor Bartoš, DrSc.

202/05/2233 “Thin layers of nanodiamond: Technology, the structural and electronic properties and bio-sensors” (2005–2007), the solver – RNDr. Milan Vaněček, CSc.

202/02/D069 “Quantum size semiconductor structures prepared by the MOVPE technology” (2002–2005), the solver – Ing. Alice Hospodková, PhD, the guarantor Doc. Ing. Eduard Hulicius, CSc.

202/04/0993 “Dielectric response of the system with high permittivity and nanoscopic non homogeneities” (2004–2006), the solver – RNDr. Jan Petzelt, DrSc.

202/05/0242 “In space differentiated ballistic electron emission spectroscopy on simple InAs/GaAs quantum dots” (2005–2007), the solver – RNDr. Jiří Pangrác

202/04/1519 “Low temperature molecular beam epitaxy of the ferromagnetic (Ga, Mn) As”, (2004–2006), the solver – Ing. Vít Novák, CSc.

202/05/0365 “Quantum properties of electrons in two-dimensional periodic systems and strong magnetic fields” (2005–2007), the solver – Ing. Pavel Středa, DrSc.

202/04/2016 “Study of deformational processes in modern metallic materials by the *in situ* methods” (2004–2006), the solver – RNDr. Juliana Gemperlová, CSc.

202/05/0218 “Cryogenic helium classical and quantum turbulence” (2005–2007), the solver – Doc. RNDr. Ladislav Skrbek, DrSc.

202/04/1440 “Magnetic and spectroscopic properties of clusters of transitive metals” (2004–2006), the solver – RNDr. Ondřej Šipr, CSc.

202/04/1055 “Charge renormalisation for strongly correlated and non arranged electrons” (2004–2006), the solver – RNDr. Václav Janiš, DrSc.

202/04/0585 “Not balanced time dynamics of strong correlations in the itinerant electron systems” (2004–2006), the solver – RNDr. Anděla Kalvová, CSc.

202/04/0583 “*Ab initio* theory for magnetic semiconductors” (2004–2006), the solver – RNDr. František Máca, CSc.

203/03/0924 “Effects of the arrangement and the nature of the chemical bond in manganite on the basis of bismuth” (2003–2005), the solver – Ing. Jiří Hejtmánek, CSc.

202/05/2111 “Structure and magnetic properties of amorphous and nanocrystalline alloys on the Fe(Ni)MoCuB basis” (2005–2007), the solver – Ing. Miroslav Maryško, CSc.

202/03/0789 “New silicon nanomaterials for optoelectronics” (2003–2005), the solver – Prof. RNDr. Ivan Pelant, DrSc.

205/03/1468 “The creation of fullerenes in minerals by the pyrolysis of bitumen precursors”, (2003–2005), the solver – Ing. Věra Hamplová, CSc.

MEYS – Support of new young workers:

1K05019 “Hybrid nanocomposite magnetism for the diagnostics and therapy in medicine” (2005–2006), the solver – Doc. Ing. Emil Pollert, DrSc., the key person – Pavel Veverka, PhD.

1K05020 “*Ab initio* study of electric and mechanical properties of nanosystems” (2005–2007), the solver – Ing. Vladimír Cháb, CSc., the key person – Ing. Pavel Jelínek, PhD.

Projects within the international co-operation, and others

EU projects:

2004-005567 “Synthesis of the orbital magnetism of plastic nanoparts” (2004–2008), the solver – RNDr. Zdeněk Frait, DrSc.

CT-04-512224 “Research of diamond interfaces for general electronics” (2004–2008), the solver – RNDr. Milan Vaněček, CSc.

IST-01-39112 “Nanostructural photonic sensors” (2003–2006), the solver – Ing. Miroslav Jelínek, DrSc.

EAPCLG981519 “Nanocrystalline diamond layers for the biomedical optical applications” (2005–2006), the solver – Ing. Miroslav Jelínek, DrSc.

NATO projects:

SfP 977980 “New nanostructured glass, anisotropic glass, and textured glass-ceramic materials” (2002–2005), the solver – Ing. Ivan Gregora, CSc.

MEYS - Kontakt

ME 655 “Dynamics of adsorbed atoms and the creation of nanostructures” (2003–2005), the solver – Doc. RNDr. Zdeněk Chvoj, DrSc.

Selected experts/Field

Prof. RNDr. Igor Bartoš, DrSc. – Theory of surfaces and interfaces,

RNDr. Miroslav Cukr, CSc. – MBE technology,

RNDr. Václav Drchal, CSc. – Theory of magnetic semiconductors,

RNDr. Antonín Fejfar, CSc. – Probe microscopy, nanocrystalline materials, thin layers of semiconductors for solar cells,

Ing. František Fendrych, PhD – Depositing of nanogranular magnetic layers, magnetoresistance, spin dependent tunnelling of electrons,

Doc. Ing. Eduard Hulicius, CSc. – Quantum-size semiconductor structures, epitaxial semiconductor technologies, especially MOVPE,

Ing. Alice Hospodková, PhD – MOVPE technology for nanostructures, quantum wells and dots,

Ing. Vladimír Cháb, CSc. – Semiconductor surfaces at the atomic level, characterisation and calculations,

RNDr. Tomáš Jungwirth, CSc. – Spintronics, nanoelectronics, the theory of the Hall phenomenon,

Ing. Miroslav Jelínek, DrSc. – Thin layers, laser deposits, laser applications,

RNDr. Jan Kočka, DrSc. – Multifunctional materials in the area of non crystalline semiconductors with the stress put on the nanotechnology, silicon nanoelectronics,

RNDr. Miroslav Kotrla, CSc. – Theory of surface growth processes, the methodology for numerical simulations,

RNDr. Karel Král, CSc. – Quantum theory for solid substances, quantum transport in nanostructures, quantum calculations,

Ing. Luděk Kraus, CSc. – Nanomagnetic materials,

RNDr. Jiří J. Mareš, CSc. – Transport properties of low dimensional semiconductor nanostructures,

Ing. Jiří Oswald, CSc. – Luminescence of low dimensional semiconductor nanostructures,

Prof. RNDr. Ivan Pelant, DrSc. – Optical properties of nanocrystalline semiconductors, especially of silicon,

RNDr. Jan Petzelt. DrSc. – Dielectrics, ferroelectrics, the infrared and Raman spectroscopy,

Doc. Ing. Emil Pollert, DrSc. – Nanomagnetic materials for the use in medicine,

Ing. Ludvík Smrčka, DrSc. – Spintronics, the theory of low dimensional structures,

Ing. Pavel Středa, DrSc. – Theory of low dimensional structures and of the Hall phenomenon,

RNDr. Antonín Šimůnek, CSc. – Electron states in the volume and on the surfaces of solid substances and nanostructures,

RNDr. Milan Vaněček, CSc. – Preparation and characterisation of diamond and nanodiamond layers,

RNDr. Zdeněk Výborný, CSc. – Lithography and nanolithography.

Authorised

Codes: 1b, 1d, 1e, 2a, 2c, 2d, 4b, 6b, 6c, 7a, 7c, 7d, 8g

5.1.3. Institut of Microbiology of the Academy of Sciences of the Czech Republic (MBÚ CAS)

Vídeňská 1083, 142 20 Praha 4, I.D. (IČO) 61388971

www.biomed.cas.cz

Brief workplace description

Subject of activities by MBÚ CAS is the scientific research in the fields of physiology, biochemistry and genetics of microorganisms, molecular biology and molecular microbiology, the study of microbe products and their creation, and the research of biodegradation activities and symbiotic relations of biological models, including the development of new biotechnological processes. The research activity takes place in the 5 following sectors:

- Biogenesis and biotechnology of natural substances (the leading researcher is M. Flieger)
- Cell and molecular microbiology (J. Nešvera)
- Ecology (F. Nerud)
- Immunology and gnotology (M. Bilej)
- Autotrophic microorganisms (V. Zachleder)

The sectors are divided into 23 laboratories. Research work in the area of nanotechnologies is done mainly in the Laboratory of Humoral Immunity (B. Říhová), Laboratory of Genetics, Physiology and Bioengineering of Fungi (M. Flieger), Laboratory of Molecular Genetics of Bacteria (J. Nešvera), and in the Laboratory of Protein Architecture (K. Bezouška).

Research and development focus

Research will focus mainly on the issues of the research intention AV0Z50200510 "Microorganisms in research and biotechnologies" in the period 2005–2010, the solver – Prof. RNDr. Blanka Říhová DrSc.

The work will focus on genomics, proteomics, bioinformatics, physiology, stress factors, differentiation, morphology, phylogenesis, ecology of microorganisms, including their biodegradation activities, and on the mechanisms of their long-term adaptations to unfavourable conditions. There will be also biotransformations, recombination and transgenic microbe technologies studied. Breeding and molecular-genetic methods will help in the preparation of recombinated microorganisms and their products will be gained in pilot plant conditions. In the case of algae and bacteria, there will be molecular mechanisms in photosynthetic processes and phototrophic and heterotrophic reproductions studied. Molecular aspects of bacterial

pathogenicity, both inborn and gained immunity reactions of conventional and germ free animals and their regulations under physiologically and pathologically changed conditions will be analysed. The attention will be turned to the study of possible influencing of autoimmune reactions and tumorous diseases, the preparation of vaccines, the antitumour drugs, and immunotherapeutics.

Some works belong to the area of nanotechnologies, especially to nanobiotechnologies and nanomedicine:

- Preparation of organic-metallic nanocomposites based on soluble exopolysaccharides, Al, Fe, Cu, and Cd (M. Flieger)
- Targeted drug delivery – the antitumour medications covalently bound with a polymer carrier (B. Říhová)
- Development of electrochemical biosensors for the detection of herbicides (J. Masojídek)
- Genetic modification of restricting-modifying enzymes of the Type I for their utilisation in nanobiotechnologies – the molecular motor, a part of biosensors (M. Weiserová)

Projects solved in the area of nanotechnologies

Co-operation in the solution of the project of the Academy of Sciences of the Czech Republic IAA4050201 "New generation of polymer medication carriers for targeted therapy" (2002–2006), the solver – Doc. Ing. Karel Ulbrich, DrSc., ÚMCH CAS, the co-solver from MBÚ CAS: Prof. RNDr. Blanka Říhová, DrSc.

CAS project IBS5020101 "Macromolecular chemotherapeutics" (2001–2005), the solver – Prof. RNDr. Blanka Říhová, DrSc.

Co-operation in the solution of the GA CR project GA204/05/2255 "Polymer conjugates of medications directed by specified oligopeptides" (2005-2007), the solver – Doc. Ing. Karel Ulbrich DrSc., ÚMCH CAS, the co-solver – Prof. RNDr. Blanka Říhová, DrSc.

Co-operation in the solution of the MEYS project 1M0505 "Centre of targeted therapeutics" (2005–2009), the solver – Doc. MUDr. Vladimír Viklický CSc., ÚJV Řež, the co-solver – Prof. RNDr. Blanka Říhová, DrSc.

GA CR project GA204/03/1011 "Disconnection of DNA, restrictive and DNA translocation functions of the restrictivelly-modificational enzyme EcoR124I – the potential molecular motor" (2003–2005), the solver – RNDr. Marie Weiserová CSc.

Experts/Fields

Prof. RNDr. Blanka Říhová, DrSc. – Immune system and genetic regulation of the production of antibodies, tumorous diseases, Institute Director

RNDr. Marie Weiserová, CSc. – Bionanotechnology, molecular motors

Doc. RNDr. Karel Bezouška, CSc. – Molecular biology

RNDr. Miroslav Flieger, CSc. – Genetics and the physiology of microorganisms and analytical chemistry

Authorised

Codes: 1f, 3a, 3b, 3e, 4b

5.1.4. Technology Centre of the Academy of Sciences of the Czech Republic (TC CAS)

Rozvojová 135, 165 02 Praha 6

www.tc.cz

Brief workplace description

Technological Centre is a national information centre for European research that prepares analytical and feasibility studies in the area of research, development and innovation. It is involved in the international transfer of technologies. The Centre is an association of legal persons represented by five institutes of the Academy of Sciences of the Czech Republic - the Institute of Physics, Institute of Microbiology, Institute of Chemical Process Fundamentals, Institute of Plasma Physics, Institute of Molecular Genetics, and the company Technology Management, s.r.o.

Main activities by the Technology Centre:

- National Information Centre for the European Research - NICER (information and consulting related to EU framework programmes, the monitoring of the participation of the Czech Republic in programmes involving international research co-operation, the co-ordination and methodical management of the national information network NINET)
- Transfer of technologies (the direct co-operation with industrial companies and entrepreneurs in innovation of products and technological processes, the international transfer of technologies, and the commercial utilisation of results of research and development)
- Strategic studies and projects (the studies for the research and innovation policy, priorities in research and development, foresight, and the strategy for the knowledge economy)
- Regional development (regional innovation strategies, projects for structural funds focussed on innovation)

Activities in the field of nanotechnologies

- NICER: The information activity, consulting, monitoring and international co-operation as the subject of work for the national contact related to 3rd priority in NMP (Nanotechnologies and nanoscience, intelligent multifunctional materials, manufacturing technologies, and equipment), 6th Framework Programme by EU – the national contact – Doc. RNDr. Jitka Kubátová, CSc.
- Partner in the project of 5th Framework Programme IPS 199 950015 "Micro and Nano Technologies and Markets – MINATECH" (2000–2003): The participation in the preparation of a study on the current situation and development in nanotechnologies and their market applications in the areas of information technologies, healthcare, automotive industry, and instrument technology, a study on possibilities and needs of small and medium-size enterprises related to the commercial utilisation of nanotechnologies and the support of these companies when they wish to get involved in projects of 5th framework Programme. The solver on behalf of the Technology Centre – Doc. RNDr. Jitka Kubátová, CSc.
- Partner in the project of 6th Framework Programme NMP4-CT-2003-505726 "Technological road maps till 2014 in nanoscience and nanotechnologies in materials, health and medical systems, energy – NANOROADMAP" (2004–2005): The participation in the preparation of three technological maps ("roadmaps") providing prognoses of the commercial utilisa-

tion of nanotechnologies in the areas of materials, health & medicine and energy in the next 10 years. The technological maps are determined for research organisations, small and medium-size enterprises, big industry, and the creators of strategies for research and applications of nanotechnologies. It will serve also to the European Commission in the preparation of the 7th Framework Programme. The solver on behalf of the Technology Centre – Doc. RNDr. Jitka Kubátová, CSc.

Experts/Field

Doc. RNDr. Jitka Kubátová, CSc. – Information activities, consulting, co-ordination activities, the popularisation and international co-operation in the area of nanotechnologies

Ing. Rudolf Fryček – Research, co-ordination activities, the popularisation and international co-operation in the area of nanotechnologies

Authorised

Codes: 8f, 8g

5.1.5. Institute of Inorganic Chemistry of the Academy of Sciences of the Czech Republic (ÚACH CAS)

250 68 Řež u Prahy, I.D. (IČO) 61388980

www.iic.cas.cz

Brief workplace description

The Institute is involved in the basic research in inorganic chemistry, in the junction fields of the inorganic chemistry with the physics of a solid phase and the ecology, and in the basic research done in bio-inorganic chemistry. The research activities are done in 3 departments and 2 joint laboratories:

- Department of the chemistry of solid substances and intercalation compounds (the leading researcher – J. Šubrt)
- Department of syntheses (Z. Černý)
- Department of kinetics (K. Lang)
- Joint laboratory of low temperatures (together with FZÚ CAS and MFF UK)
- Laboratory of inorganic materials (together with VŠCHT Praha, L. Němec)

Research and development focus

Research is focussed on the issues within the research intention AV0Z40320502 "Design, synthesis and characterisation of clusters, composites, complexes, and other compounds based on inorganic substances; mechanisms and kinetics and their interactions" in the period 2005–2010, the solver – Ing. Jana Bludská, CSc. (Institute Director).

The research intention relates to the design and preparation of composites and crystalline materials of defined particle sizes, borane clusters, special glass, organic-metallic and intercalating compounds with targeted properties for the use in optoelectronics, magnetic optics, photocatalysis, medicine, and ecology. The characterisation includes the static and kinetic

approaches with the aim to define the structure, reactivity and also other properties of prepared compounds. Non covalent interaction of metallic complexes will be used for the molecular differentiation. The description of the interactions of the crystalline and gas phases with solutions and melts will provide for know–how related to new technologies.

Research activities in the area of nanotechnologies take place mainly in the Department of the chemistry of solid substances and intercalating compounds. The following activities are organised:

- Synthesis of nanocomposites based on nanoparticles of metallic oxides in SiO_2 matrix by the sol-gel method. Characterisation of the structure, magnetic and optical properties of these materials,
- Synthesis of nanoparticles in binary and multipart metallic oxides by the method of homogenous condensing in water solutions. The prepared materials are tested as photocatalysts and catalysts for the detoxication (the degradation into non toxic products) of combat poisons,
- Synthesis, characterisation and application of "sandwich" pigments with the barrier anticorrosive effect based on mica covered with nanoparticles of metallic oxides,
- Characterisation of nanostructures prepared by chemical reactions initiated by laser,
- Research of porphyria nanostructures, preparation and their chemical and photo-physical properties,
- Synthesis and characterisation of gold and other precious metallic nanoparticles modified on the surface by the isotope ^{10}B in the active carbon shell for the use in the neutron treatment of tumorous diseases.

As from April 2005, the Institute has had just the only high resolution transmission electron microscope (HR-TEM) in the Czech Republic, from the JEOL company.

Projects solved in the area of nanotechnologies

MIT project 1H-PK2/56 "Nanodispersion oxides and hydroxides Ti, Fe, Al, Zn, and Zr for the destruction of chemical combat compounds" (2005–2009), the solver – RNDr. Bakardjieva Snejana, PhD.

MIT project FD-K3/062 "Creation of multifunction nanostructures of titania ionex nanoplates with a polymer nanolayer as the photostable electroactive anticorrosive pigments" (2003–2005), the solver – RNDr. Zdeněk Kváča

MIT project FI-IM2/107 "Creation of exfoliates of the nanomolecular annexed phases of mixed metallic salts and titanium as selective anticorrosive pigments for the ecological paint systems" (2005–2007), the solver – RNDr. Zdeněk Kváča

The Institute participates in the solution of the MEYS project 1M0577 "Research Centre for the nanosurface engineering – NANOPIN" (2005–2009), the grantee ATG, s.r.o, Praha (F. Peterka). The co-solver on behalf of ÚACH CAS is Ing. Jan Šubrt, CSc. There are works on the preparation and optimising method for the preparation of anatase (TiO_2) nanoparticles by homogeneous condensing in water solutions of $TiOSO_4$ done within the research. The consequent calcination, under controlled temperature, will change the ratio of anatase and rutile for the purpose of gaining a product with the highest possible photoactivity.

The Institute participates in the solution of the MEYS project within the programme "Basic research centres" LC523 "Perspective inorganic materials" (2005–2009), the solver – Prof. Ing. Miloslav Frumar, DrSc. from the University in Pardubice. The co-worker, on behalf of ÚACH CAS, is Ing. Jan Šubrt, CSc.

Experts/Field

Ing. Jan Šubrt, CSc. – powdered inorganic oxide materials, application of the photocatalytically active TiO_2, pigments, and electron microscopy.

RNDr. Zdeněk Kváča – Nanoplates of titania ionexes and redox and ferroelectric properties of titania nanostructures

Mgr. Václav Štengl, PhD. – Synthesis, characterisation and application of metallic oxides' nanoparticles prepared by condensing processes in water solutions.

RNDr. Daniel Nižňanský, PhD. – Synthesis of nanocomposites based on metallic oxides' nanoparticles in the SiO_2 matrix by the sol-gel method, characterisation of the structure, magnetic and optical properties of these materials.

Mgr. Tomáš Baše – Nanoparticles of metals, preparation, characterisation and application.

RNDr. Bakardjieva Snejana, PhD. – Electron microscopy

Mgr. Mariana Klementová – Electron microscopy

Authorised

Codes: 1a, 1b, 1e, 7a, 7b

5.1.6. Institute of Experimental Medicine of the Academy of Sciences of the Czech Republic (ÚEM CAS)

Vídeňská 1083, 142 40 Praha 4, I.D. (IČO) 68378041

http://uemweb.biomed.cas.cz

Brief workplace description

ÚEM CAS is involved in selected biomedical problems and is focussed on applications in clinical medicine. It organises mainly the basic neuroscientific research within the cell biology, researches genotoxic and embryotoxic effects of xenobiotics, mechanisms in the occurrence of inborn defects, occurrence and process of toxic reactions at the cell and tissue levels, the histochemistry and pharmacology of eyes, biochemistry of enzymes as the markers of metabolic processes, and effects of pharmaceuticals on the immune reactions during infectious diseases. The Institute has been, since 2000, a part of the EU Excellence Centre called MEDIPRA. The research activities take place in 13 departments. The Institute participates in works done in 8 joint laboratories and institutes with other workplaces. The research having the character of nanomedicine and nanobiotechnology takes place in the Department of neuroscience (the leading researcher E. Syková), Department of tissue cultures and stem cells (P. Jendelová), Department of neurobiology (A. Chvátal), and the Department of tissue engineering (E. Amler).

Research and development focus

In the period 2005–2010, the research in ÚEM CAS will focus mainly on the issues in the research intention AV0Z50390512 "Molecular, cell and system mechanisms of serious diseases of the human organism, their diagnostics, therapy and pharmaceutical therapy", the solver – Prof. MUDr. Eva Syková, DrSc.

The aim is the research in the area of biomedicine and looking for the possibilities of practical utilisation of gained results in the following fields: Molecular and cell biology, molecular embryology, and pharmacology, neurophysiology, neurochemistry, neuropathology, neuropharmacology, immunopharmacology, gene-toxicology, and teratology. The research is focussed on the study of the cell function mechanisms, sub cellular structures, receptors and mediators, interactions of cells, activities of cell tissues and organs, and pathological changes caused in living organisms by effects of harmful substances in both inner and outer environments. The objective is the finding of diagnostic way and therapy of diseases and to develop them for the practical utilisation. The application areas include healthcare (the therapeutic processes in neurosurgery, traumatology, especially the spinal cord injuries, immunology, ophtalmology, plastic surgery, otolaryngology), the pharmaceutical industry (drugs and diagnostic sets), and hygiene and epidemiology (the assessment of risks by chemical substances for the human population).

In the areas of nanoscience and nanotechnology, there are works organised, which are focussed on:

- Marking of cells with superparamagnetic nanoparticles and their *in vivo* monitoring with the aid of nuclear magnetic resonance (NMR).
- *In vivo* testing of materials based on nanofibres as the reconstruction scaffold for tissues, especially for the central nerve system and the connective tissue (the cartilage).

Projects solved in the area of nanotechnologies

The Institute co-operates in the solution of the GA CR project 304/03/1189 "Utilisation of superparamagnetic nanoparticles for the MR imagining of implanted cells" (2003–2005), the solver – Ing. Milan Hájek DrSc., the grantee – the Institute of Clinical and Experimental Medicine in Praha 4. The co-operation with ÚEM CAS – Prof. MUDr. Eva Syková, DrSc. and RNDr. Pavla Jendelová, PhD.

The Institute is a co-founder of the Research Centre: "Centre for the Cell Therapy and Tissue Replacements", MEYS 1M0021620803 (2005–2009), the leading solver – Prof. MUDr. Eva Syková, DrSc., the grantee – Charles University, 2nd Faculty of Medicine.

The Institute is a partner in three foreign projects within the European Union

DiMI/512146 "Diagnostic Molecular Imaging: A Network of Excellence for Identification of New Molecular Imaging Markers for Diagnostic Purposes", the project co-ordinator – Prof. Andreas Jacobs, University of Cologne, Germany. The leading solver in ÚEM CAS – Prof. MUDr. Eva Syková, DrSc.

ANGIOTARGETING/504743 "Targeting-Tumour-Vascular/Matrix Interactions", the co-ordinator – Prof. Rolf Bjerkvig, University of Bergen, Norway. The leading solver in ÚEM CAS – Prof. MUDr. Eva Syková, DrSc.

RESCUE/518233 “From stem cell technology to functional restoration after spinal cord injury”, STREP, the co-ordinator – Dr. Alain Privat, Institute of Neuroscience, Montpellier, France. The leading solver in ÚEM CAS – Prof. MUDr. Eva Syková, DrSc.

Experts/Field

Prof. MUDr. Eva Syková, DrSc. – Stem cells, nanoparticles, artificial biomaterials, neuroscience, Institute Director

RNDr. Pavla Jendelová, PhD. – Stem cells, nanoparticles, artificial biomaterials, neuroscience

Doc. RNDr. Alexandr Chvátal, DrSc. – Stem cells, neuroscience

RNDr. Evžen Amler, CSc. – Stem cells, connecting tissue

Authorised

Codes: 3b, 3c, 3f, 3g

5.1.7. Jaroslav Heyrovský Istitute of Physical Chemistry of the Academy of Sciences of the Czech Republic (ÚFCH JH CAS)

Dolejškova 3, 182 23 Praha 8, I.D. (IČO) 61388955

www.jh-inst.cas.cz

Brief workplace description

The Institute develops the exploratory activities in physical chemistry and chemical physics focussed on relations in between the structure and reactivity of substances. It focuses especially on theoretical and experimental research of chemical and physical-chemical phenomena at atomic and molecular levels (the structure and dynamics of substances, reaction mechanisms) in gas, liquid and solid phases and at their interfaces, especially in systems, which are important for the chemical catalysis and sorption, electrochemical and biological processes (including the preparation and characterisation of new catalytic, sorption, electrode, and other special materials).

Research activities take place in the 6 following departments:

- Department of theoretical chemistry (the leading researcher J. Pitner)
- Department of chemical physics (S. Civiš)
- Department of biophysical chemistry (V. Mareček)
- Department of catalysis I (Z. Sobalík)
- Department of catalysis II (J. Čejka)
- Department of electrochemistry (Z. Samec)

The research of nanotechnologies takes place in the Department of chemical physics (the involved workers are P. Čársky, Z. Bastl, and Z. Knor), Department of catalysis I (Z. Sobalík, J. Dědeček, L. Brabec, and B. Wichterlová), Department of catalysis II (J. Čejka), and in the Department of electrochemistry (Z. Samec, L. Kavan, and J. Jirkovský).

Research and development focus

The research in ÚFCH JH CAS will focus, in the period 2005–2010, mainly on the issues within the research intention AV0Z40400503 "Structure, reactivity and dynamics in molecular and biomolecular systems: Theory, experiments and applications", the solver – Prof. RNDr. Petr Čársky, DrSc.

The objective of the research intention is the identification and clarification of relations existing in between the structure and interactions in molecular and biomolecular systems and their chemical or electrochemical reactivity and physical dynamics. The new thing about this task is based on the experimental approach at the atomic or molecular levels, which is possible thanks to the fast development of spectroscopic and microscopic high definition methods and techniques of the material synthesis at the nanolevel. The subjects of the research are as follows:

- Development and utilisation of quantum chemistry methods in chemical physics, catalysis, and electrochemistry,
- Kinetics and dynamics in chemical processes in the gas phase and on surfaces,
- Structure and properties of molecules and their aggregates,
- Structure, functionality and dynamics of biomembranes,
- Synthesis and structural chemistry of nanoscopic materials,
- Mechanism of catalytic and electrocatalytic processes,
- Sorption and transport phenomena,
- Structure and (photo)electrochemical reactivity of molecules and biomolecules in liquid phases and interphases.

Projects solved in the area of nanotechnologies

Domestic projects

The project of the Academy of Sciences of the Czech Republic No. 1ET400400413 "Development of the programme environment for the mathematical simulations and predicting in catalysis and electrocatalysis" (2004–2008), the solver – Ing. Zdeněk Sobalík, CSc.
The research develops, inter alia, processes of the mathematical simulation and predicting of the reactivity of metallic and oxide nanostructures in solid matrices for (electro)catalytic processes. The project objective is also to gain general processes – the software for the modelling of nanostructured catalysts and processes for the development of catalysts' structures for the important NOx transformation to nitrogen processes, the selective oxidation of hydrocarbons, and the electrocatalytic processes in fuel cells.

GA CAS project No. IAA4040411 "Oxides in transition metals on mesoporous molecular screens for the metathesis of linear olefines" (2004–2007), the solver – Prof. Ing. Jiří Čejka, DrSc.
The project is focussed on the synthesis of new kinds of heterogenous catalysts for the metathesis of olefines based on the oxides of transition metals with the carrier of the mesoporous molecular screen kind. The project envisages the synthesis of mesoporous molecular screens with the precisely defined sizes of pores in the area of 3–10 nm on the basis of alumina, silica, silica-alumina, and their modifications by oxides of Mo and Re. The combination of experimental techniques (XRD, ESCA, MAS NMR, FTIR, and Raman) will be used for the study of the interaction of the relevant oxide with the carrier and for the characterisation of

changes, which will take place during the preparation of catalysts, during their activation, and after the reaction and regeneration.

The GA CAS project No. IAA4040306 “Transfer of the charge in organised supramolecular sets of fullerenes” (2003–2006), the solver – Prof. RNDr. Ladislav Kavan, CSc.
The substance of the proposal is the electrochemical research of the reaction in the transfer of a charge of fullerenes C_{60}, C_{70}, and endohedral fullerenes in the form of organised films on a pad, or in the form of supramolecular complex of fullerene inside a carbonaceous nanotube (“fullerene peapods”). Own preparation and characterisation of the mentioned materials (Vis-NIR, Raman, SEM, XRD, SPM, and ESCA) from commercially accessible fullerenes and nanotubes make also a part of the project.

GA CR project No. 203/03/0824 “Template prepared mesoscopic TiO_2 for electrodes and photocatalysts” (2003–2005), the solver – Prof. RNDr. Ladislav Kavan, CSc.
The base of this proposal is made by the systematic structure, electrochemical, photochemical and photoelectrochemical study of mesoscopic materials based on TiO_2, prepared with the aid of the template synthesis. The targeted application of the advanced synthesis and characterisation of materials should lead to a consistent picture of highly organised mesoscopic TiO_2, from its utilisation point of view as the electrode material and photocatalyst. The project objective is the understanding of the photochemical, electrochemical and photoelectrochemical properties in relation to the mesoscopic structure of the TiO_2 surface.

GA CAS project No. IAA4040407 “Electrocatalysis on metal nanoparticles deposited on a liquid membrane” (2004–2007), the solver – Prof. RNDr. Zdeněk Samec, DrSc.
There will be new methods for the preparation of metallic nanoparticles developed and the research of their electrocatalytic properties for the potential utilisation in fuel cells will be organised within this project. The preparation methods will be based on the electrochemical reduction of metallic ions on a liquid membrane on a porous carrier.

GA CR project No. 203/05/0846 “Growth of nanofiltration layers of colloidal solutions. The effect of electrochemical properties of colloidal solutions on the kinetics in the layer growth and morphology” (2005–2007), the solver – RNDr. Libor Brabec, CSc.
Nanofiltration layers have found its utilisation as membrane separators, reactors, or sensors. The research of these materials’ properties relates also to the study of particles of original colloidal solutions. There must be factors influencing the aggregation of colloidal particles and the consequent layer growth known for the management of the resulting morphology and layer textures, their permeability, compactness and separation function. The main project objectives are as follows: (i) To clarify the relation of the activation energy for the layers’ growth with the zeta-potential of colloidal particles, and (ii) To find out, how the zeta-potential depends on properties of the liquid phase (pH, ion strength, and composition).

GA CR project No. 203/05/2309 “Nanostructured inorganic materials based on molecular screens for sensor applications” (2005–2007), the solver – Mgr. Jiří Dědeček, CSc.
The project focuses on the preparation of materials for the application in optical sensors of gases active under increased/high temperatures and under aggressive conditions during the managed combustion and industrial processes. These fully inorganic materials are designed on the basis of zeolites and related molecular screens with ions of transition metals localised in the grid and outside grid positions with the local arrangement at the atomic level.

The co-operation in the solution of the MEYS project 1M4531433201 “Research centre for nanosurface engineering” (2005–2009), the grantee – ATG, a.s., the solver – RNDr. František Peterka, PhD., the co-operation on behalf of ÚFCHJH CAS – RNDr. Jaromír Jirkovský, CSc. (see 6.2.1).

The co-operation in the solution of the MEYS project LC510 “Centre for nanotechnologies and materials for nanoelectronics” (2005–2009), the grantee – FZÚ CAS, the solver – RNDr. Jan Kočka, DrSc., the co-solver on behalf of ÚFCHJH CAS – Prof. RNDr. Ladislav Kavan, CSc.

European projects solved within the 6th Framework Programme:

Project FP6-2004-ENERGY-3 SUSDEV-1.2.7 “Advanced Separation and Storage of Carbon Dioxide: Design, Synthesis and Application of Novel Nanoporous Sorbents”, (2005–2008), the solver – Prof. Ing. Jiří Čejka, DrSc.

Project SES6-CT-2003-502783 “Molecular orientation, low band gap materials and new hybrid device concepts for the improvement of plastic solar cells”, (2004–2006), the solver – Prof. RNDr. Ladislav Kavan, CSc.

Project NMP3-CT-2005-516982 “Nanocrystalline Heterosupramolecular Materials for Optoelectronic Applications”, (2005–2008), the solver – Prof. RNDr. Ladislav Kavan, CSc.

Project NMP3-CT-2004-505906 “Nanostructures for energy and chemical production”, (2004–2007), the solver – Prof. RNDr. Zdeněk Samec, DrSc.

Project NMP3-CT-2005-011730 IDECAT “Integrated Design of Catalytic Nanomaterials for a Sustainable Production”, (2005–2010), the solver – Ing. Blanka Wichterlová, DrSc.

Project within the 6th FP EU NENA – “Nanostructures for Energy and Chemicals Production”, the solver – Prof. RNDr. Petr Čársky, DrSc.

Experts/Field

Prof. RNDr. Petr Čársky, DrSc. – Development of quantum-chemical methods, Institute Director

Prof. RNDr. Ladislav Kavan, DrSc. – Carbonaceous and oxide nanostructures, electrochemistry, spectroelectrochemistry

Prof. RNDr. Zdeněk Samec, DrSc. – Electrocatalysis

RNDr. Jaromír Jirkovský, CSc. – Photocatalysis, nanosurfaces of TiO_2, the application in the area of self-cleaning surfaces

Doc. Ing. Jiří Čejka, CSc. – Heterogeneous catalysis, synthesis of microporous and mesoporous molecular screens, zeolites and molecular screens

Ing. Zdeněk Sobalík, CSc. – Development of catalysts’ structures for research processes of NO_x transformations to nitrogen, the selective oxidation of hydrocarbons

RNDr. Zdeněk Bastl, CSc. – Study of nanostructured materials by the methods of electron spectroscopy

Authorised

Codes: 1a, 1c, 5a, 5b, 6b, 6c, 6d, 7a

5.1.8. Institute of Physics of Materials of the Academy of Sciences of the Czech Republic (ÚFM CAS)

Žižkova 22, 606 62 Brno, I.D. (IČO) 68081723

www.ipm.cz

Brief workplace description

The activities in the Institute focus on interdisciplinary area of material science. The most important are the activities within the basic research of metallic materials. The Institute focuses on the physical fundamentals of processes taking place in metallic materials during the creep, fatigue and the creep interaction with the fatigue, and in other kinds of mechanical duties. The Institute focuses also on the research of structures and selected physical properties of materials. The objective in both research areas is the clarification of relations between the behaviour and the properties of materials and their structural characteristics. The research activities take place in two departments divided into groups:

- Department of mechanical properties (the leading researcher L. Kunz)
  - Group for the creep in metallic materials (K. Milička)
  - Group of advanced high temperature materials (V. Sklenička)
  - Group of the high-cycle fatigue (P. Lukáš)
  - Group of the low-cycle fatigue (J. Polák)
  - Group for the brittle fracture (I. Dlouhý)
- Department of structure (M. Svoboda)
  - Group for the diffusion and thermodynamics (J. Čermák)
  - Group of the structure phases (M. Svoboda)
  - Group for the electric and magnetic properties (O. Schneeweiss)

The research activities relating with nanotechnologies are done by the Group of advanced high temperature materials (V. Sklenička), in the Group of the high-cycle fatigue (L. Kunz), in the Group of the phase structures (J. Buršík), and in the Group for the electric and magnetic properties (O. Schneeweiss, Y. Jirásková).

Research and development focus

The research in ÚFM CAS will mainly focus on the issues established in the research intention AV0Z20410507 "Physical properties of advanced materials in relation with their microstructures and the preparation way" in the period 2005–2010, the solver is the Director of ÚFM CAS – Doc. RNDr. Petr Lukáš, CSc.

The physical properties of the following advanced materials are experimentally and theoretically studied in relation to their microstructures and preparation ways: Ultra-fine grain, microcrystalline, nanocrystalline, and amorphous materials, intermetallics, monocrystals of superalloys, advanced steels, advanced Mg, Fe, and Ni alloys, shape memory alloys, composites, nanocomposites, metallic laminates, lead free solders, magnetic semiconductors, semi-metallic magnets, magnetic multilayers, and silicides of transition metals. The objective is to clarify, describe and quantify mechanisms in processes and in the development of microstructure taking place in advanced materials during creep, fatigue, and fracturing. Diffusion, thermodynamics, phase structures, electric, and magnetic characteristics will be studied within the relevant scope of temperatures. This all should contribute to the worldwide treasure

of knowledge about advanced materials (mechanisms in processes, databases of experimental data and properties) and consequently for the optimising of their preparations.

Projects solved in the area of nanotechnologies and nanomaterials

GA CAS project IAA2041301 "Creep processes in ultra-soft metals and alloys prepared by the ECAP technique" (2003–2007), the solver – Prof. Ing. Václav Sklenička, DrSc.

GA CR project 202/04/0221 "Structure, electric and magnetic properties of nanocrystalline materials made of carbon and 3d transition metals" (2004–2006), the solver – Ing. Oldřich Schneeweiss, DrSc.

GA CR project 202/05/2111 "Structure and magnetic properties of amorphous and nanocrystalline alloys based on Fe(Ni)MoCuB" (2005–2007), the solver – Ing. Yvonna Jirásková, CSc.

Co-operation in the solution of the GA CR project 202/05/0607 "Preparation of carbonaceous micro and nanostructures by plasma technologies" the solver – Mgr. Lenka Zajíčková, PhD., Masaryk University in Brno. The co-operation on behalf of ÚFM CAS – RNDr. Jiří Buršík, CSc. Project description – see MU-PřF.

The Institute co-operates in the MEYS project 1M0512 "Centre for the research of powdered nanomaterials" (2005-2009), the solver – Prof. RNDr. Miroslav Mašláň, CSc., the grantee - Palacky University in Olomouc. The co-operation on behalf of ÚFM CAS – Ing. Oldřich Schneeweiss, DrSc. and Ing. Bořivoj Million, DrSc.

The MEYS project 1P05ME804 – National Research Programme, International Co-operation Programmes "Fatigue properties of ultra-fine-grain alloys of copper and magnesium" 2005–2008, the solver – Prof. RNDr. Ludvík Kunz, CSc.

Experts/Field

Prof. Ing. Václav Sklenička, DrSc. – Ultra-fine-grain materials prepared by the extreme plastic deformation (ECAP), nanocomposite materials and layers, mechanical properties and the microstructure of nanomaterials

Ing. Oldřich Schneeweiss, DrSc. – Nanocrystalline materials made of metals, oxides, and interstitial compounds, nanocomposites, structures, phase compositions, electric and magnetic properties

Ing. Yvonna Jirásková, CSc. – Nanocrystalline materials prepared by the managed crystallisation of amorphous alloys, structures, phase compositions, electric and magnetic properties

RNDr. Jiří Buršík, CSc. – Electron microscopy of nanostructures prepared by plasma technologies

Authorised

Codes: 1a, 1b, 1c, 2d, 7a

5.1.9. Institute of Plasma Physics of the Academy of Sciences of the Czech Republic (ÚFP CAS)

Za Slovankou 3, 182 21 Praha 8, I.D. (IČO) 61389021

www.ipp.cas.cz

Brief workplace description

The Institute organises research and development of managed thermonuclear fusion, the utilisation of electric discharges, plasma generators, and the interaction of plasma with other states of matter, waste liquidation in plasma streams, plasma spraying processes, and solutions of other plasma related problems. The research takes place in the 5 following departments:

- Department of tokamak (the leading researcher F. Žáček)
- Department of impulse plasma systems (K. Koláček)
- Department of thermal plasma (M. Hrabovský)
- Department of materials engineering (P. Chráska)
- Department of laser plasma (K. Jungwirth)

The research focussed on nanotechnology takes place within limited scope in the Department of materials engineering.

Research and development focus

The research will focus on the issues within the research intention AV0Z20430508 "Physical and chemical processes in plasma, and their applications" in the period 2005–2010, the solver – Prof. Ing. Dr. Pavel Chráska, DrSc.

Plasma becomes more and more important in the 21st century. It is involved in many areas of our life. Commencing with the nuclear fusion, plasma technologies and plasma chemistry to laser plasma and the utilisation of discharges in plasma. To improve controls of these plasma applications, we must better understand many basic physical and chemical processes. This is the reason why there will be different kinds of plasma generated and new methods for their study will be developed. The objective is to describe the behaviour of hot plasma in tokamaks, the dense or not balanced plasma in discharges, thermal plasma and its interaction with other states. Experimental measuring will be confronted with theoretical calculations and numerical modelling. The results should have their direct impact on a number of fields – starting with the participation in the ITER project, the ecological cleaning methods, and generation of soft X-rays radiation, plasma technologies and plasma liquidation of wastes to the development of new materials for the extreme conditions of use.

The subjects within the area of research of nanotechnologies are currently the following works:

- Creation of amorphous and nanocrystalline coatings and self-carrying parts of ceramic materials with the aid of plasma spraying by the water stabilised plasma burner (WSP), during which fast solidification occurs as well as the creation of not balanced structures.
- Production of nanocrystalline ceramic parts with the aid of managed crystallisation during suitable thermal processing from the original amorphous parts containing multicomponent ceramic material with the eutectic point.

- Production of general plasma sprays (coatings), the basic building unit of which is a thin circular disk – the so-called splat that is usually made of in parallel arranged column grains going across the splat's thickness. The cut through the column grains in the splat is typically within the order of tens of nanometres.

Projects solved in the area of nanotechnologies

The Institute resolves within the international co-operation the project "Amorphous and nanocrystalline ceramic spray applications" (2003–2006), the solvers – Ing. Tomáš Chráska, PhD., Prof. Ing. Dr. Pavel Chráska, DrSc., the co-operation: Industrial Materials Institute, NRC, Canada.

The project objective is to produce amorphous and nanocrystalline ceramic spray applications with the aid of the heat spraying technology. The amorphous and nanocrystalline structures of spray coatings could be achieved by the suitable application of the initial materials and by changes in the spraying conditions and parameters. Spray coatings are done with different kinds of plasma burners. The parameters of the heat spraying are modified in such a way that nanocrystalline structures occur during the coating, or the amorphous structure is created first and it is then transformed with controlled crystallisation to the nanostructure.

The main expected results of the programme are as follows:

- Thick spray coats with the amorphous and nanocrystalline structure achieved by the heat spraying technology,
- Set of parameters controlling the crystallisation of amorphous spray coatings for the achievement of the nanocrystalline structure.

Experts/Field

Ing. Tomáš Chráska, PhD. – Transmission electron microscopy, plasma sprayed layers (especially of the nanocrystalline ceramics), semiconductor nanostructures

Prof. Ing. Dr. Pavel Chráska, DrSc. – Structural and phase transformations, Institute Director

Ing. Pavel Rohan, PhD. – Thermal properties of materials, phase transformations

Authorised

Codes: 1a, 1d

5.1.10. Institute of Chemical Process Fundamentals of the Academy of Sciences of the Czech Republic (ÚCHP CAS)

Rozvojová 135, 165 02 Praha 6, I.D. (IČO) 67985858

www.icpf.cas.cz

Brief workplace description

The Institute is involved in the research area of the theory of chemical processes, especially in the scientific fields of chemical engineering, physical chemistry, and the engineering of the environment. Research activities are done in 5 departments and 4 laboratories.

The research focussed on nanotechnologies is organised in the Thermodynamic Laboratory of Eduard Hála (I. Wichterle, I. Nezbeda, M. Lísal), in the Department of catalysis and reaction engineering (M. Zdražil, O. Šolcová, V. Hejtmánek), in the Department of new processes in chemistry and biotechnology (J. Čermák, G. Kuncová), in the Laboratory of the chemistry and physics of aerosols (J. Smolík), and in the Laboratory of laser chemistry (J. Pola).

Research and development focus

The research will focus on the issues within the research intention AV0Z40720504 "Research of multiphase reaction systems for the design of processes in the area of synthesis and preparation of new materials, energy and protection of the environment" in the period 2005–2010, the solver – Prof. Ing. Jiří Hanika, DrSc., Institute Director.

The research objective is the identification of sets' characteristics at the molecular level and their integration with phenomenology knowledge related to the system behaviour in connection with process conditions. The main research directions are as follows: The study of balanced behaviour of multiphase sets with chemical reactions; the thermo and hydrodynamics of multiphase systems under extreme conditions; fundamentals of extraction, sorption, and membrane separation processes and the processes using supercritical liquids; the dynamics in transport processes in the chemical, electrochemical, combustion, and biotechnological reactors; the clarification of mechanisms in catalysed reactions and of destruction reactions of toxic organic substances; the preparation of new materials by reactions induced by microwave and laser radiation. The results will allow for the quantitative description of behaviours of reacting multiphase sets with the aid of mathematical models usable for the optimal design of processing facilities observing requirements on the maximal environmental friendliness.

The research in the area of nanotechnologies focus especially on nanoporous materials, nanocatalysis and synthesis of nanoparticles, e.g. with aerosol processes.

Projects solved in the area of nanotechnologies

GA CR project 203/05/0725 "Molecular simulation of chemically reacting liquids in nanoporous materials" (2005–2007), the solver – Doc. Ing. M. Lísal, DrSc.

GA CAS project 1ET400720409 "Application of advanced simulation methods in studies of the structure, physical–chemical properties, and of the preparation of composite materials and nanomaterials" (2004–2008), the solver – Prof. RNDr. I. Nezbeda, DrSc.

GA CR project 104/04/0963 "Nanostructured materials – the texture from the physical adsorption" (2004–2006), the solver – Ing. O. Šolcová, CSc.

NATO project CLG980587 "Fe and γ-Fe_2O_3 polymer nanocomposites with the excellent thermal stability created by laser" (2004–2006), the solver – RNDr. J. Pola, CSc.

Co-operation in the project within the 5th FP EU MATINOES – "Novel organic-inorganic materials in opto-electronic systems for the monitoring and control of bio-processes" (2002–2005), the solver – Ing. Gabriela Kuncová, CSc. The development of enzyme-based bio-optoelectronic sensors.

Experts/Field

Prof. RNDr. Ivo Nezbeda, DrSc. – Molecular physics of liquids, intermolecular interaction

Doc. Ing. Martin Lísal, DrSc. – Applied statistical thermodynamics, the computer simulation, molecular and multicomponent modelling

RNDr. Josef Pola, DrSc. – Laser chemistry

Ing. Olga Šolcová, CSc. – Texture of solid porous substances, the transport of matter in solid substances

Authorised

Codes: 1f, 2b, 4b, 5b, 5c, 6d

5.1.11. Institute of Nuclear Physics of the Academy of Sciences of the Czech Republic (ÚJF CAS)

250 68 Řež, I.D. (IČO) 61389005

www.ujf.cas.cz

Brief workplace description

The Institute activities focus mainly on nuclear physics in the area of low and medium energy, including both theoretical and experimental activities. The Institute deals with the studies of the nuclear spectroscopy of the beta and gamma radiation, nuclear reactions, including collisions of heavy ions and hypernuclear physics. Its activity has been focussed also on some of the related fields, e.g. the study of the solid phase with the aid of neutron dispersion, the mathematical physics and the theoretical sub nuclear physics. The research activities have been divided among 7 departments. The research of nanotechnologies takes place in the Department of neutron physics in the Laboratory of nuclear analytical methods (the leading researcher is V. Hnatowicz) and in the Department of theoretical physics (P. Exner).

Research and development focus

The research will focus on the issues within the research intention AV0Z10480505 "Nuclear physics and related fields in the basic, applied and interdisciplinary research" in the period 2005–2010, the solver – Ing. Jan Dobeš, CSc., Institute Director.

There is the experimental study running of the strongly inter-reactive mass in collisions of heavy ions, remote nuclei from the stability line, nuclear reactions for the astrophysics, and the weight of a neutrino from the electron spectroscopy. They expect the utilisation of nuclear analytical methods and neutron diffraction in the research of condensed substances and materials and in the animate science. There will be also research and development of radio-pharmaceuticals organised. The work objective is the extension of knowledge about the strongly inter-reacting systems and applications and the implementation of nuclear methods in other scientific and technological fields.

Department of neutron physics, the Laboratory of nuclear analytical methods gets involved in the area of micro and nanoscience in the following fields:

- Preparation and characterising of thin layers of hybrid materials based on carbonaceous allotrops and transition metals, e.g. C_{60}-Ni (hybrid materials of the C_{60}-Ni kind show inte-

resting structural properties, often in the form of spontaneously organising systems in sub microscopic area),
- Preparation of LIPSS structures (the co-operation with FZÚ CAS),
- Utilisation of nuclear analytical methods (PIXE – proton induced X-ray emission, PTT – particle transmission technique).

The Department of theoretical physics. Prof. RNDr. Pavel Exner, DrSc. is currently involved in mathematical models of nanosystems.

Projects solved in the area of nanotechnologies

GA CAS project IAA100480501 "Solvable nanosystem models" (2005–2007) – Prof. RNDr. Pavel Exner, DrSc.
The importance of microscopic structures, in which the coherent properties of quantic particles can be studied in relation to the geometry and topology of such systems, constantly grows, together with better experimental methods and the introduction of new materials like carbonaceous nanotubes. The project objective is the detailed analysis of some of these models, in which interesting physical phenomena can be expected, with the aid of efficient mathematical methods. The soled issues include the spectral and dispersion properties of quantic layers and "fine" quantic wires induced by curvature, their behaviour to defects, including the localisation resulting from random shapes, the possibility to describe the system of branching nanotubes with the aid of the relevant graph, the transport through the material interfaces of different spin-orbital interaction, including the possible utilisation as the source of polarised electrons, the finding of a spectrum of the electron inter-reacting with the boundary of a waveguard and with the chain of point defects, etc.

CAS project IBS1048301 "Preparation of new radio-pharmaceuticals based on monoclonal and recombinant antibodies and peptides marked α and β radionuclides" (2003–2006), the solver – Ing. Rostislav Mach, DrSc.

Experts/Field

Doc. Ing. Vladimír Hnatowicz, DrSc. – Experimental nuclear physics, nuclear analytical methods

RNDr. J. Vacík, CSc. – Study of the metallic oxides systems and of the system metal-fullerene, spontaneous self-organisation, etc.

Ing. Rostislav Mach, DrSc. – Radiopharmaceuticals

Prof. RNDr. Pavel Exner, DrSc. – Not stable systems, quantum mechanics of surfaces, resonance phenomena, etc.

RNDr. Vratislav Peřina, CSc. – Growth, modification and structure of thin layers and multilayers used in microelectronics and optics, optoelectronics, etc.

RNDr. Anna Macková, PhD. – Growth, modification and structure of thin layers and multilayers used in microelectronics and optics, optoelectronics, etc.

RNDr. Vladimír Havránek, CSc. – PIXE analysis of aerosols, thin solid layers, biological materials, etc.

Codes: 1c, 1d, 6b, 7a

5.1.12. Institute of Macromolecular Chemistry of the Academy of Sciences of the Czech Republic (ÚMCH CAS)

Heyrovského nám. 2, 162 06 Praha 6, I.D. (IČO) 61389013

www.imc.cas.cz

Brief workplace description

The task of ÚMCH CAS is the basic, target-oriented, and applied research in chemistry and physics of synthetic macromolecules. This research includes the four main following areas: Molecular and supramolecular polymer systems, biologically active macromolecular systems, functional polymers, and polymer materials.

The research takes place in 11 departments, some of which have been divided into working groups. Workers focussing on nanotechnologies have been put into brackets accompanying the highlighted names of departments.

- Department of managed polymerisations (leading researcher P. Vlček)
- **Department of polymer networks and mechanical properties** (L. Matějka, K. Dušek, M. Raab, M. Špírková)
- **Department of polymer materials** (I. Fortelný, M. Šlouf, I. Kelnar, S. Nešpůrek, J. Pfleger)
- Department of hydrogels for the medical and technological practice (J. Michálek)
- **Department of biomedical polymers** (K. Ulbrich)
- **Department of bioanalogical and special polymers** (F. Rypáček, D. Horák)
- **Department of polymer membranes** (E. Brynda)
- Department of chemistry of solid substances (L. Tichý)
- **Department of supramolecular polymer structures** (P. Štěpánek, Č. Koňák, V. Cimrová)
- **Department of structural analysis** (J. Dybal, J. Pleštil)
- Department of analytical chemistry (P. Holler)

The Institute co-ordinates the activities of the Consortium for the research of nanostructured and network polymer materials (see Part 7.3.3.) and within the 6th Framework EU Research Programme organises activities of the Marie Curie Training Centre (MCTS) "Organised polymer nanostructures for applications in biology and technologies".

Research and development focus

Research will focus on the issues within the research intention AV0Z40500505 "Progressive macromolecular materials and supramolecular systems: The synthesis and the study of properties, phenomena, and possibilities in the use for special applications and modern technologies" in the period 2005–2010, the solver – Doc. Ing. Karel Ulbrich, DrSc.

The research is focussed on the managed synthesis of polymer substances and supramolecular systems of synthetic macromolecules and hybrid systems of synthetic and biological macromolecules leading to products with a unified and defined structure and specific usable properties and on the development of new theories explaining physical and chemical behaviour of the studied systems. The attention is focussed on the study of arranged systems created by mutual interactions of synthetic or synthetic and natural macromolecules and the low-molecular substances. The study takes place at the atomic, molecular and supramolecular levels. From

the potential applications point of view, the attention will be paid to the development of new intelligent materials reacting to surrounding environmental stimulation, to materials for bioengineering and biomimetics with the stress put on the tissue engineering, bioconjugates for the drug transport and gene therapy, materials applicable in membranes for separation processes and fuel cells, materials and systems for sensors, photonics and microelectronics. The research of technical polymers will focus on the development of hybrid organic-inorganic nanocomposites and polymer nanostructured materials, on the improvement of usable properties of polymer mixtures and on the development of recyclable and biodegradable materials and the materials created from renewable natural resources.

The Institute organises relatively extensive research focussed on nanobiotechnologies, nanomedicine, organic nanoelectronics, nanomaterials (polymer nanocomposites and nanostructures), and on the development in nanoscience and experimental methods applicable in macromolecular nanotechnologies.

Projects solved in the area of nanotechnologies

GA CAS project 1ET400500402 "Computer modelling of chemical structures for the development of macromolecular systems with new biological, mechanical, and electronic properties" (2004–2008), the solver – RNDr. Jiří Dybal, CSc.
The mathematical modelling of structures of macromolecular systems is successfully used to predict properties and behaviour of substances, the preparation of which is difficult and requires long-term planning, but also for the analysis of gained substances. The extended possibilities of modelling will be used for the effective development and designs of biologically active macromolecules in the area of destination-targeted transport of drugs, gene therapy and tissue replacements, biomimetic polymers able to perform mechanical work, nanostructurally organised hybrid polymer networks and molecular optoelectronic components.

GA CAS project IAA4050201 "New generation of polymer drug carriers for the targeted therapy" (2002–2006), the solver – Doc. Ing. Karel Ulbrich, DrSc. The project belongs to the area of nanomedicine.

GA CAS project IAA4050313 "Conductive polymer nanofilms" (2003–2007), the solver – RNDr. Jan Prokeš, CSc. The project deals with the preparation of conductive nanofilms (40–500 nm) directly during the polymerisation.

GA CAS project IAA4050409 "Polymers for photonics" (2004–2008), the solver – RNDr. Věra Cimrová, CSc.
There are new conjugated polymers and polymers with luminescent, photoconductive, photochromic, and mesogenic units prepared and studied. The utilisation of polymer mixtures and arranged nanostructures of active elements will allow for the modification of photophysical and electric properties of thin films.

GA CAS project IAA100500501 "Nanoparticles sensitive to environmental changes" (2005–2008), the solver – Doc. RNDr. Čestmír Koňák, DrSc.
Project GA of the Academy of Science of the Czech Republic IAA400500506 "New multicomponent automatically organised nanocomposite materials" (2005–2009), the solver – Ing. Milena Špírková, CSc.

GA CAS project IAA400500507 "Nanobiotechnologies for the preparation of the interface between biological environment and artificial objects" (2005–2007), the solver – RNDr. Eduard Brynda, CSc.

The progressive adsorption of proteins, polypeptides, charged polysaccharides and natural or synthetic polyelectrolytic solutions on firm pads managed by influences of physical interactions between macromolecules is utilised for the creation of organised molecular sets creating functional interfaces between artificial surfaces and biological liquids or cells. At the same time, there are mechanisms showing during the contact of solid surfaces with blood plasma and the blood and adhesion and cell growth on supporting structures studied. There will be sets developed (i) consisting mainly of albumin and polysaccharides preventing the settling down of substances from the blood plasma, adhesion of plates and blood coagulation, (ii) sets containing antibodies immobilised on surfaces of optical (SPR) immunosensors and magnetic particles allowing for the detection or separation of specific substances from the blood plasma or blood, and (iii) sets containing components of the inter-cell matter and modified fibrinous networks supporting or regulating the cell adhesion, proliferation and differentiation.

GA CR project 106/03/0679 "Development of polyamide nanocomposites with increased persistence prepared by mixing in the melting" (2003–2005), the solver – Ing. Ivan Kelnar, CSc.

GA CR project 203/03/0600 "Association behaviour, structure and properties of block copolymers" (2003–2005), the solver – Ing. Josef Pleštil, CSc.
The project focuses mainly on the preparation and structural characterisation of the systems containing hydrophilic-hydrophobic block copolymers in water environments (micelles, mixed micelles, multilayer nanoparticles, complex lyotropic structures containing arranged physical gels and stabilised forms of these structures).

GA CR project 203/05/2252 "Polymer nanocomposite systems of a hierarchy structure" (2005–2007), the solver – RNDr. Libor Matějka, CSc.

GA CR project 203/05/2256 "Magnetic hydrophilic polymer microparticles reacting to outside stimuli for the medicine and bioengineering" (2005–2007), the solver – Ing. Daniel Horák, CSc.
There will be suitable magnetic liquids with the regulated coverage of surfaces with different stabilising layers, influencing the hydrophilic/hydrophobic properties, synthesised. The monodispersion polymer micro and nanoparticles, encapsulating the magnetic colloid and reacting, at the same time, to outside stimuli, e.g. the temperature or pH, will be consequently synthesised in the (mini)emulsion and dispersion copolymerisation of hydrophilic monomers with the thermally and/or pH sensitive comonomer.

GA CR project 204/05/2255 "Polymer conjugates of drugs oriented by specific oligopeptides" (2005–2007), the solver – Doc. Ing. Karel Ulbrich, DrSc. The project belongs to the area of nanomedicine.

GA CR project EUROCORES GESON/03/E001 "Self-organised nanostructures of the amphiphilic block copolymers" (2003–2006), the solver – RNDr. Petr Štěpánek, CSc.

Co-operation in the solution of the MIT project FT-TA2/018 "Advanced beam technologies for the creation and processing of layers for the manufacturing practice in electronics" (2005–2008), the grantee ELCERAM, a.s., Hradec Králové, the solver – Ing. Karel Strobl, the co-solver on behalf of ÚMCH CAS – Prof. RNDr. Stanislav Nešpůrek, DrSc.

Participation in the MEYS project 1M0505 "Centre for the targeted therapeutics" (2005–2009), the solver – Doc. MUDr. Vladimír Viklický, CSc., Institute of Nuclear Research, a.s., Řež. The co-solver in ÚMCH CAS – Doc. Ing. Karel Ulbrich, DrSc. The project belongs to the area of nanomedicine.

Participation in the solution of the MEYS project 1M0538 “Centre for the cell therapy and tissue replacements” (2005–2009), the solver – Prof. MUDr. Eva Syková, DrSc., Charles University. The co-solver on behalf of ÚMCH – RNDr. František Rypáček, CSc. The project belongs to the area of nanomedicine.

Participation in research works within the excellence network of the 6th FP NANOFUN-POLY “Nanostructured and Multi-Functional Polymer-Based Materials and Nanocomposites” (2004–2008), the solver – Prof. Ing. Dr. Karel Dušek.

Co-operation in the project of the 6th FP EU EXPERTISSUES – “Novel Therapeutic Strategies for Tissue Engineering of Bone and Cartilage Using Second Generation Biomimetic Scaffolds” (2004–2009), the solver – RNDr. František Rypáček, CSc.

Experts/Field

Doc. Ing. Karel Ulbrich, DrSc. – Nanomedicine (molecular systems for the targeted transport of drugs and genes), Institute Director

RNDr. František Rypáček, CSc. – Nanomedicine (materials for the tissue engineering)

RNDr. Eduard Brynda, CSc. – Nanobiotechnology and nanomedicine (organised sets of biological and synthetic macromolecules for the tissue engineering and biosensors)

Ing. Daniel Horák, CSc. – Nanomedicine (polymer magnetic nanoparticles)

Doc. RNDr. Čestmír Koňák, DrSc. – Nanomaterials, nanomedicine (optical methods for the supramolecular polymer materials, nanoclusters and nanoparticles)

RNDr. Libor Matějka, CSc. – Nanomaterials (nanocomposites, organic-inorganic and polymer nanostructured materials)

RNDr. Petr Štěpánek, CSc. – Nanomaterials (supramolecular nanostructured polymer materials)

RNDr. Jiří Dybal, CSc. – Computer modelling of chemical structures

RNDr. Jiří Pfleger, CSc. – Nanoelectronics (organic molecular electronics, nanoparticles in polymer matrices for solar cells)

Ing. Josef Pleštil, CSc. – X-ray and neutron structural analysis

RNDr. Miroslav Šlouf, PhD. – Morphology, TEM

Authorised

Codes: 1d, 1f, 2a, 2d, 2e, 3a, 3b, 3e, 4b, 6a, 7a

5.1.13. Institute of Molecular Plant Biology of the Academy of Sciences of the Czech Republic (ÚMBR CAS)

Branišovská 31, 370 05 České Budějovice

www.umbr.cas.cz

Brief workplace description

The Institute was founded on 1 July 1990 in connection with the division of the Institute of Experimental Botany of the Czechoslovak Academy of Science into two independent units with their registered addresses in Praha and in České Budějovice.

Research activities in the Institute reach from the molecular plant biology to agro-ecological studies. They are mainly focussed on the genetic plant engineering, molecular genetics, and cytogenetics, diagnostics of plant viruses and viroids, biophysics and physiology of the photosynthesis. The Institute participates also in the applied research in the area of plant biotechnologies. The Institute is divided into 5 departments (of gene handling, molecular cytogenetics, and molecular genetics, photosynthesis, and plant virology). Research of nanotechnologies (according to the nomenclature presented in Table I) takes place in the Department of molecular cytogenetics (the leading researcher is J. Macas), in the Department of photosynthesis (F. Vácha), and in the Department of plant virology (K. Petrzyk).

Research and development focus

Research will be focussed on the issues within the research intention AV0Z50510513 "Research of the structure of genetic plant information, pathogens at the molecular level, induction, and the analysis of targeted genome and plastom changes, and the study of photosynthetic processes and heritability reactions in the interaction with the environment and pathogens" in the period 2005–2010, the solver – Doc. Ing. Josef Špak, DrSc.

The solution objectives are as follows: 1) The molecular organisation of the plant genome and chromosomes and the mechanism of gene expression: Sequencing of the repetitive DNA genome of vetchy plants, the genetic and physical mapping; the functional genomics, the transgenosis and molecular biodiversity of flax and hop Arabidopsis; the analysis of the structure and function of chimeric cell RNAs, aberrant RNA and dsRNA in relation to the gene expression; the transformation of genomes and plastom for the purpose of studies of the expression of nuclear genes, the function of the photosystem II and the production of foreign proteins, 2) Molecular interaction of plant–pathogens: the variability of genomes, the structure and functions of viruses, viroids and phytoplasma; the mechanism of gene silencing and "antisensing"; the development of high performance pathogen detection methods, 3) Research of the photosynthesis: primary processes in transfers of light energy to energy and chemical bonds; the structure and the function of reaction centres of the complex photosystems II; the gas exchanges and the fixation effect of carbon oxide on the regulation of photosynthesis.

Works in the area of nanotechnologies

The Department of molecular cytogenetics organises the research in the area of the molecular DNA analysis, the research of repetitive sequences in the *Vicia* family and other kinds of vetchy plants. The DNA microarrays are utilised.

The Department of plant virology focuses on the area of diagnostics and molecular recognition – the issues in the development of biomarkers for the detection of fruit viruses, again with the use of the arrays technology.

The Department of photosynthesis studies the molecular mechanisms in the photosynthesis and the structure of the photosynthetic apparatus. A single molecule spectroscopy is utilised.

Projects solved in the area of nanotechnologies

GA CR project GA204/04/1207 "Structure and evolution of satellite plant DNA" (2004–2006), the solver – RNDr. Jiří Macas, PhD.

Co-operation in the solution of the GA CR project GA206/05/2739 "Structure and function of self-organising nanostructures based on bacteria-chlorophyllous aggregates" (2005–2007), the solver – RNDr. Jakub Pšenčík, PhD. (UK-MFF Praha), the co-solver on behalf of ÚMBR CAS – Doc. RNDr. František Vácha, PhD.
The main objective in this project is to gain information on the possibilities of utilisation the artificially prepared complexes containing bacteria-chlorophyllous (BChl) aggregates in nanotechnologies.

The solution of the MEYS project OC 853.001 (COST) "Development of biomarkers for the fruit viruses' detection with the arrays technology" (2002–2007), the solver – Doc. Ing. Josef Špak, DrSc.

Experts/Field

Doc. Ing. Josef Špak, DrSc. – Virology, Institute Director

RNDr. Jiří Macas, PhD. – Molecular cytogenetics

Doc. RNDr. František Vácha, PhD. – Biochemistry, the biochemistry and biophysics of the photosynthesis, the spectroscopy of a single molecule, kinetic spectroscopy

Authorised

Codes: 3d), 3f)

5.1.14. *Institute of Scientific Instruments of the Academy of Sciences of the Czech Republic (ÚPT CAS)*

Královopolská 147, 612 64 Brno, I.D. (IČO) 68081731

www.isibrno.cz

Brief workplace description

The Institute is involved in the research of physical methods, special technologies and unique instrument principles in scientific areas of the electron microscopy, nuclear magnetic resonance, and quantum light generators. It creates top technological items and processes in the fields of the ultra high vacuum, kryotechnics and superconductivity. The objective in the interdisciplinary research of the microstructure of matter is the gaining of results usable in biology, chemistry, medicine, ecology, and physics. The research is organised within the three following fields further divided into 20 solving teams:

- Field of electron optics
- Field of the nuclear magnetic resonance
- Field of coherent optics

Research and development focus

Research will focus on the issues within the research intention AV0Z20650511 "Development of experimental methods for the studies of physical properties of matter and their applications in advanced technologies" in the period 2005–2010, the solver – RNDr. Luděk Frank, DrSc., Institute Director.

The research intention is focussed on the areas of applied physics and technical science. The objective is the development of methodologies for the gaining of images and spectral information from atomic, molecular and cell structures, including the scanning and processing of biosignals, and the selected applications in biology, medicine and material science. The electron beams generated, controlled and detected with the newly developed processes should be used for the studies of substances and holographic phenomena and for the connection and micromachining of materials. The quantum radiation of light generators will be used for the creation of different kinds of optical traps for the non destructive handling of microobjects. There will be highly coherent lasers for the metrology of optical frequencies and interferometric measuring developed. The potential of the nuclear magnetic resonance methods for the study of living matter will be used and extended with the creation of image contrast by rare gases polarised laser and with the techniques of the spectroscopic imagining.

The Institute has already for years participated in the development of different methods used in the area of nanotechnologies. They are traditionally new imagining methods for electron microscopes and the microlithographic technologies utilising the electron lithograph and deposition of thin layers by the magnetron sputtering. The new original methods of the laser interferometry allow for the measurements of length changes in tenths of nanometres and there have been instruments designed (optical tweezers) that utilise the mechanical effect of the focussed laser beams for the space trapping and transfer of nanoobjects in the liquid environment.

Projects solved in the area of nanotechnologies

GA CAS project KJB2065405 "Study of nanostructures with the electron beam" (2004–2006), the solver – Ing. Petr Hrnčiřík

GA CR project 102/05/2325 "Electron lithography of nanostructures" (2005–2006), the solver – Ing. Vladimír Kolařík, PhD.

Project COST OC523.30 "Nanocomposite coatings as hard solid lubricants" (2000–2004), the solver – Ing. Jaroslav Sobota, CSc.

Co-operation in the solution of the GA CAS project IAA1065203 "Utilisation of the combination of laser microbeam and cytometric techniques for the study of the structure and dynamics in the human genome" (2002–2006), the solver – Prof. RNDr. Miroslav Liška, DrSc., VUT Brno. The co-solver on behalf of ÚPT CAS is Doc. RNDr. Pavel Zemánek, PhD. The basis of the project is the effort to utilise the methods and experimental sets of the optical tweezers, optical scalpel and automated cytometer, which were developed with the financial support during projects in the past, for the study of mechanical properties and arrangement of

the interphase chromatin in cores of living and fixed human cells. The theoretical and experimental experience in the interdisciplinary team of solvers will be used as follows: - For the fluorescent colouring of the chromatin in living cells, - For the laser induced fusion of living cells marked in the fluorescent way, - For the topological analysis of the arrangement in the coloured chromatin areas in cores of living and fixed cells, - For the introduction of the nanoprobes coloured in the fluorescent way to cores of living cells, the optical finding of the probe and determination, with the micrometre definition, of the space that remains not accessible for the probe, - For the study of mechanical properties of the chromatin with the utilisation of the optical handling by suitable probes.

6th FP EU project No. 508952 "Advanced techniques for the optical manipulation using novel 3D light field synthesis (ATOM3D)".

Co-operation in the solution of the GA CR project 202/05/0607 "Preparation of carbonaceous micro and nanostructures by plasma technologies", the solver – Mgr. Lenka Zajíčková, PhD., Masaryk University in Brno. The co-solver on behalf of ÚPT CAS – Mgr. Jiřina Matějková.
The KFE laboratory in the Faculty of Natural Science at MU Brno researches production possibilities related to carbonaceous nanotubes by the methods PECVD (Plasma Enhanced Chemical Vapour Deposition). The deposition takes place in high frequency (13.56MHz) or microwave (2.4GHz) charge under increased temperature to 500–800°C in the mixture of argon, hydrogen and methane gas and under the atmospheric pressure, or lowered pressure. The result is a thin layer consisting of carbonaceous nanotubes on a silicon substrate. This layer is then analysed by the UHR FE SEM methods (ultrahigh resolution field emission scanning electron microscopy) – the lining electron microscopy with the high definition and EDS roentgen microanalysis.
Co-participants: J. Matějková, A. Rek, Institute of Scientific Instruments of the Academy of Science of the Czech Republic in Brno. The project description – see MU-PřF.

Experts/Field

Ing. Jaroslav Sobota, CSc. – Deposition of thin layers by the magnetron sputtering

Doc. RNDr. Pavel Zemánek, PhD. – Optical tweezers, optical micromanupulation

Mgr. František Matějka – Electron lithography, holography

Doc. Ing. Vladimír Kolařík, CSc. – Electron lithography, holography

Mgr. Jiřina Matějková – High definition REM and EDS X-rays microanalysis, measuring of thin layers

Ing. Antonín Rek, CSc. – EDS (energy dispersion) and WDS (wave dispersion) X-ray microanalysis

Ing. Vladimír Romanovský, PhD. – Laboratory electron microscopy

Ing. Ondřej Číp, PhD. – Laser interferometry

Authorised

Codes: 1c, 1d, 3d, 3f, 7a, 7c, 7d, 7e

5.1.15. Institute of Radio Engineering and Electronics of the Academy of Sciences of the Czech Republic (ÚRE CAS)

Chaberská 57, 182 51 Praha 8, I.D. (IČO) 67985882

www.ure.cas.cz

Brief workplace description

Research and development activities by ÚRE CAS focus on the three following main areas: photonics, optoelectronics, and signals and systems. The research is organised in the three following sections further divided into departments:

- Section of photonics (the leading researcher J. Homola)
- Section of electronic systems and signals (J. Šimša)
- Section of materials (O. Procházková)

The research focussed on nanotechnologies is done in the Section of photonics, in the Department of optical sensors (J. Homola), and in the Section of materials, in the Department of semiconductor technology (D. Nohavica) and in the Department of diagnostics (P. Gladkov, J. Walachová).

Research and development focus

Research will focus on the issues within the research intention AV0Z20670512 "Materials, structures, systems, and signals in electronics, optoelectronics and photonics" in the period 2005–2010, the solver – Ing. Vlastimil Matějec, CSc., Institute Director.

The research task focuses, within the Institute orientation on the basic research in electronics, optoelectronics and photonics, in the three following areas – photonic structures, materials for optoelectronics, and systems for the generation, transfer and processing of signals. Within the area of photonic structures, the research focuses on the perspective passive, active and non linear photonic structures and systems using the principles of fibre and planar waveguides, diffractive structures and photonic crystals for the application in optical communications and sensors. The material research for optoelectronics focuses on the preparation and diagnostics for the new materials, structures and nanostructures usable mainly in special optical waveguides, radiation sources, optical amplifiers, detectors and solar cells. In the area of systems and signals, there are processes in the generation, transfer and processing of signals researched within the etalons of frequency and time, and in multiuser communication networks and speech systems.

Projects solved in the area of nanotechnologies

Co-operation in the solution of the GA CAS project IAA400500507 "Nanobiotechnology for the design of the interface between the biological environment and artificial objects" (2005–2007), the solver – RNDr. Eduard Brynda, CSc. (ÚMCH CAS), the co-solver on behalf of ÚER CAS – Ing. Jiří Homola, CSc.

GA CR project 202/05/0242 "In space differentiated ballistic electron emission spectroscopy on individual InAs/GaAs quantum dots confined between the AlGaAs barriers" (2005–2007), the solver – Ing. Jarmila Walachová, CSc.

MEYS project ME 697 “Creation and characterisation of self-organised pores in heterostructures of InGaP/GaAs” (2003–2005), the solver – Doc. Petar Gladkov, PhD.
The creation of a porous structure allows for the influencing of basic properties of semiconductor materials. Porous structures A3B5 have, when compared with the porous silicon, the main advantage in the direct zone band structure and in the possibility to change the width of the band gap.

Experts/Field

Ing. Jiří Homola, CSc. – Optical waveguides, photonic equipment, optical sensors

Doc. Petar Gladkov, PhD. – Porous semiconductor materials

Ing. Jarmila Walachová, CSc. – Characterising of nanostructures by the scanning tunnelling microscopy, ballistic emission electron microscopy and spectroscopy

Ing. Dušan Nohavica, CSc. – Technology of the epitaxial structures A3B5 and nanostructures, semiconductor lasers, LED(s), photodetectors and solar cells

Codes: 1d, 2b, 3e, 4b, 6a, 7a

5.1.16. Institute of Rock Structure and Mechanics of the Academy of Sciences of the Czech Republic (ÚSMH CAS)

V Holešovičkách 41, 182 09 Praha 8, I.D. (IČO) 67985891

www.irsm.cas.cz

Brief workplace description

Research activities range from the care after local seismic networks and assumptions of a seismic threat for important constructions, the findings about the structure, tension and disturbance of minerals and soils with the aid of spreading seismic waves, mineral testing for the purpose of underground construction stabilisation, research of dangerous slope movements and disturbances, the findings about geological risks threatening, inter alia, historical sites to the utilisation of carbonaceous materials for the waste processing and the preparation of carbonaceous composites. The research takes place in 7 departments.

The research in the area of nanotechnologies is marginal and takes place in the Department of composites with carbonaceous materials (K. Balík).

Research and development focus

Research will focus on the issues within the research intention AV0Z30460519 “Research of properties of geomaterials, the development of methods for their environmental use and the interpretation of geodynamic processes” in the period 2005–2010, the solver – Ing. Karel Balík, CSc.

Research of natural geomaterials (minerals in the soil or mineral environment), artificially designed geomaterials (geopolymers), and related materials based on carbon and silicon within the wide spectrum of sizes of structural parts – the nanometric, micrometric, milimetre, metre, and kilometre sizes. Chemical, mineralogical and petrographic consistence, mechanical, physical and physically–chemical properties of the researched materials and their hetero-

geneity, especially when related to not connected areas, and their space and time development. Impacts of the thermal and field force effects on the properties and the behaviour of materials. The multidisciplinary research will focus mainly on: 1) The assessment of dangerous impacts of natural and by the human activities caused geodynamic processes, 2) The dynamics in the Czech massif and in the structure of the Earth crust, 3) The environmental utilisation of raw materials also in connection with the liquidation of hazardous wastes, 4) The development of materials of not traditional precursors: biomaterials, heat resistant, construction, building, and sorption materials.

Projects solved in the area of nanotechnologies

GA CR project 106/03/1167 "Composite materials based on glass textiles and the siloxane matrix as the replacement and connecting items in orthopaedics" (2003–2005), the solver – Ing. Karel Balík, CSc.

The project solution will utilise the connection of excellent mechanical properties of composites (the mechanical strength is higher than that of a human bone, while the flexibility module (the firmness) is identical) with the bioactivity of hydroxy-apatite (HAP), which itself, as the ceramic material, shows a low value of its mechanical strength. The matrix of the composite is enriched with nano-hydroxy-apatite, which becomes effective mainly on walls of the opened pores of the size that is suitable for ingrowth in bone tissues.

Experts/Field

Ing. Karel Balík, CSc. – Carbonaceous materials, composites, Institute Director

Codes: 1b, 3d

5.1.17. *Institute of Systemic Biology and Ecology of the Academy of Sciences of the Czech Republic (ÚSBE CAS)*

Na Sádkách 7, 370 05 České Budějovice, I.D. (IČO) 67179843

www.usbe.cas.cz

Brief workplace description

The main subject of activities by the Institute of systemic biology and ecology of ÚSBE CAS is the scientific research focussed on the analysis of energy flows, of substances and information on inner biological systems. The research activities by ÚSBE CAS are oriented on the systemic approach strongly connected with the methodological contents of the wider term of systemic biology/ecology. The research takes place in three following sectors:

- Sector of the physical biology
- Sector of integral ecology
- Sector of the ecosystem processes

Research and development focus

Research will focus on the issues within the research intention AV0Z60870520 "Space and functional dynamics in biological, ecological and social-economic systems in the interaction with the global climate change" in the period 2005–2010, the solvers – Prof. RNDr. Michal V. Marek, DrSc., Institute Director.

The subject of the research intention is the study of the environment as the natural-social system, which develops within space and time. Natural systems are characterised with their space and functional dynamics, which could be monitored, after some simplification, on the basis of the analysis of the energy flow, of substances and information characteristic for the given system. The effect of the global change is understood not only as the important environmental factor, but also as the impulse for the introduction of new biotechnologies and nanotechnologies.

Department of biomagnetic techniques in the Sector of the physical biology is involved, in the area of nanotechnologies, in the preparation of biocompatible magnetic liquids, in preparations and the study and the utilisation of composite materials based on biological structures (e.g. microbic cells, lignocellulose materials) modified by magnetic liquids, in the preparation and utilisation of magnetic biopolymer microparticles, where the magnetic part is made of magnetic nanoparticles, and in the study of the design of magnetic biocompatible polymer nanoparticles in the role of potential drug carriers.

Projects solved in the area of nanotechnologies

GA CAS project IBS6087204 "Development and study of magnetic detection, separation and marking techniques and their utilisation in bioscience and biotechnologies" (2002–2005), the solver - Doc. Ing. Ivo Šafařík, DrSc. The solution utilises magnetic nanoparticles.

MEYS project 1P05OC053 "Magnetic separation of important biologically active substances from eggs" (COST 923: Multidisciplinary Hen Egg Research) (2004–2006), the solver – Ing. Mirka Šafaříková, PhD. The solution utilises magnetic nanoparticles.

GA CR project 203/03/1070 "Extraction of unionised tensides, alkyl phenols and phalathes from water by magnetic adsorbents" (2003–2005), the solver – Ing. Mirka Šafaříková, PhD. The solution utilises magnetic nanoparticles.

Experts/Field

Doc. Ing. Ivo Šafařík, DrSc. – Biomagnetic techniques – preparation of magnetic nano and microparticles and biocompatible magnetic carriers, the development of new methods and applications within the area of biochemistry, microbiology, (bio)analytical chemistry and biotechnology

Ing. Mirka Šafaříková, PhD. – Biomagnetic techniques – preparation of magnetic nano and microparticles and biocompatible magnetic carriers, the development of new methods and applications within the area of biochemistry, microbiology, (bio)analytical chemistry and biotechnology

Authorised

Codes: 1d, 2d, 3a, 3d, 7b

5.1.18. *Brief review of activities by the institutes of the Academy of Sciences of the Czech Republic*

Table II presents the review of activities by the institutes of the Academy of Science of the Czech Republic, according to the main fields as in the nomenclature of nanotechnologies (see **Table I**).

Table II.

Institute of CAS	1	2	3	4	5	6	7	8
BFÚ			X	X				
FZÚ	X	X		X		X	X	X
MBÚ	X		X	X				
TC								X
ÚACH	X						X	
ÚEM			X					
ÚFCHJH	X				X	X	X	
ÚFM	X	X					X	
ÚFP	X							
ÚCHP	X	X		X	X	X		
ÚJF	X					X	X	
ÚMCH	X	X	X	X		X	X	
ÚMBR			X					
ÚPT	X		X				X	
ÚRE	X	X	X	X		X	X	
ÚSMH	X		X					
ÚSBE	X	X	X				X	

Key: 1 – Nanomaterials, 2 – Nanoelectronics, 3 – Nanobiotechnology, nanomedicine, 4 – Nanosensors, 5 – Nano in the chemical technology, 6 – Long-term research, 7 – Instruments and technologies, 8 – Other

The highest number of areas is covered by: FZÚ CAS, ÚMCH CAS, and ÚRE CAS (in the case of ÚRE CAS, the capacity is low).

There are 13 institutes focussed on nanomaterials, 9 institutes focus on the issues in analyses and application technologies, and 8 institutes are involved in nanobiotechnologies and nanomedicine.

5.2. UNIVERSITIES

5.2.1. Charles University in Praha

Charles University was founded in 1348 and it belongs among the oldest universities in the world. Nowadays, it is one of the most important educational and scientific institutions in the Czech Republic. It is well known within the context of both European and the world education. Its scientific and pedagogical performance and unique historical traditions make it also an important cultural institution.

The University has currently got 17 faculties (14 of them in Praha, 2 in Hradec Králové, and 1 in Plzeň), 3 university institutes, 6 other workplaces for the educational, scientific, research and development and other creative activities, or for the provision of information service, 5 university-wide purpose-oriented facilities and the Office of the Chancellor, which is the executive management workplace for the Charles University (UK). The University has got more than 7 thousand employees, including 4 thousand academic and scientific workers. There are more than 42 thousand students studying at UK.

Scientific and research activities, which make up also the base for the doctor and master level study programmes, belong among the university priorities. The scientific performance of UK workplaces, measured according to the volume of gained funds provided to universities in the Czech Republic, presents about one third of these funds. The aim for UK is to profile itself as the "research university", which will be competitive within the framework of the world university and research sector.

The survey has shown that:

- Out of 934 registered programme projects solved at UK in 2005, nanotechnologies were involved in only about 30 of them and there were 4 related research intentions. The identification of the projects focussed on nanotechnologies was difficult, especially in medical faculties, because neither project names, nor their description show exactly if they belong to the area of nanotechnologies.
- The verified nanotechnology research runs, within varied scope, in 4 faculties. They are the following ones:

  Faculty of mathematics and physics

  Faculty of natural science

  1st Faculty of medicine

  2nd Faculty of medicine

Research activities belonging, according to the nomenclature, to the area of nanobiotechnologies and nanomedicine are done, within limited scope, probably also in other medical faculties at UK (3rd LF UK, LF in Hradec Králové, and LF in Plzeň) and in the Faculty of pharmacology in Hradec Králové. However, the authors of this publication have not obtained any required information.

5.2.1.1. Faculty of Mathematics and Physics (MFF UK))

Ke Karlovu 3, 121 16 Praha 1

www.mff.cuni.cz

Brief workplace description

The close connection of educational activities in physics, informatics and mathematics with creative scientific research has been a characteristic feature in activities organised in this faculty. Research focussed on nanotechnologies takes place in the Physical Section, which has been further divided into 16 departments and institutes. They are as follows:

- Institute of Astronomy (the leading researcher P. Harmanec)
- **Institute of Physics** (V. Baumruk)
- Division for the teaching of general physics (I. Stulíková)
- Department of the didactics in physics (L. Dvořák)
- **Department of electronics and vacuum physics** (V. Matolín)
- **Department of the physics of metals** (F. Chmelík)
- **Department of the physics of low temperatures** (J. Englich)
- **Department of the physics of electron structures** (R. Kužel)
- **Department of macromolecular physics** (M. Ilavský)
- Department of geophysics (J. Zahradník)
- **Department of chemical physics and optics** (J. Hála)
- Department of meteorology and air protection (J. Bednář)
- Institute of theoretical physics (J. Horáček)

Some departments are further divided into sections, groups and laboratories. Nanotechnologies and nanomaterials make subjects of research for workers in the bold above-written departments and institutes.

Research and development focus

Research in MFF UK will focus on the issues of two research intentions in the period 2005–2010:

Research intention of MEYS MSM0021620834 "Physics of the condensed phase: New materials and technologies", the solver – Prof. RNDr. Pavel Höschl, DrSc.

Research is focussed on the area of physics of the condensed phase, on a number of materials with unique physical properties ranging from highly pure materials for electronics, superconductors, materials with low dimensional structures to the synthetic diamond. This relates to the research of new technologies, which usually utilise molecular beams in the ultra-high vacuum, reactions taking place in plasma and high performance microwave generators, or in high temperatures and pressures. Works will focus also on materials, which do not exist in nature, e.g. supergrids, delta-quantum structures, and quantic wires and dots.

Research intention of MEYS MSM 0021620835 "Physics of molecular, macromolecular and biological systems", the solver – Prof. RNDr. Jan Hála, DrSc.

The complex research of physical processes in molecular, macromolecular and biological systems extends the former successfully resolved research intention MSM 113200001 “Physics of biological systems and synthetic macromolecular structures”.

The research focuses mainly on the physical behaviour of natural and modified nucleotides, natural and artificial photosynthetic systems, photosensitisers of yeasts, polymer networks, including nanocomposites and polyelectrolytic hydrogels. The theoretical interpretation will use the quantum theory, quantum-chemical calculations and modelling for the study of physical properties of biologically important complexes, intercalates and macromolecular structures. The existing spectroscopic methods are further developed and applied for the research of a structure, function, interaction, and dynamics of biological and macromolecular structures at the levels of molecules, macromolecules, membranes and cells.

Activities in the field of nanotechnologies

Workers in the Institute of Physics, in the Section of physics of biomolecules, are involved in the basic research done in the area of molecular biophysics oriented on the study of physical-chemical properties, the structure and interaction of biomolecules – especially nucleic acids, proteins and porphyria – and their biologically important analogies (J. Štěpánek, J. Baumruk, P. Mojzes). The Section of magnetic optics, Š. Višňovský is involved in the study of magnetic-optical phenomena in magnetic nanostructures. The Section of semiconductors and semiconductor optoelectronics studies some important properties of semiconductors and optical properties existing in a strong magnetic field (P. Höschl, R. Grill, P. Hlídek, M. Zvára, and others). They have a very strong electromagnet at their disposal (12 T).

The Section of physical electronics and vacuum physics organises the research in the fields of the vacuum physics, physics of surfaces and thin layers, physics of plasma and space physics, together with their application in diagnostics and modern material technologies. The following researches focus on nanotechnologies: V. Matolín, I. Ošťádal, P. Sobotík, P. Řepa, I. Matolínová, and others.

P. Lukáč and Z. Trojanová in the Department of the physics of metals focus on the study of nanocomposites of magnesium alloys. F. Chmelík works on nanostructural materials and P. Málek and M. Janeček focus on the design of ultra-fine structure of metallic materials by the ECAP method.

Department of the physics of low temperatures, I. Procházka and J. Čížek, studies properties of alloys of ultra-fine structures.

The main focus in the Department of the physics of electron structures is on the study of structures and electron properties of materials. The structure and microscopic electron properties of thin layers, magnetic multilayers and intermetallic compounds with f- and d-electrons are studied by the dispersion of roentgen radiation and synchrotron radiation methods and with the aid of the dispersion of neutron beams. Bulk properties, especially the magnetic behaviour, the transport, thermodynamic and cohesion properties, the phase transformations and diffusion processes are measured within a wide spectrum of temperatures, external pressures and magnetic fields. There is also the research of modern materials, e.g. nanocrystalline powders, two-dimensional surface structures, liquid crystals, and carbonaceous materials studied. Nanotechnologies make the subjects of research by R. Kužel, V. Sechovský, D. Rafaja, and others.

The Department of macromolecular physics, the Group for the plasma polymers, is involved in the plasma polymerisation processes serving for adjustments of surfaces and micro and nanocomposite materials, metals, or semiconductors inserted into the matrix of a plasma polymer (H. Biederman, D. Slavínská). The group of workers involved in the physics of conductive polymers and inorganic semiconductors within the Group for the physics of conductive polymers and inorganic semiconductors, J. Prokeš and others, organise the research of conductive polymer nanofilms.

The Department of chemical physics and optics, the Section of quantum optics and optoelectronics, focuses on the ultra-fast laser spectroscopy (the femtosecond and picosecond time differentiation). In the field of "nano", it focuses on the study of ultra-fast processes taking place in semiconductor nanocrystals (especially CdSe, CdS, and Si), including the studies of the dynamics of in spin polarised charge carriers (the spintronics). The Section is involved also in the development of the preparation technology related to the thin nanocrystalline films of CdS and CdSe by the method of the chemical deposition from solutions. Generally, it is the basic research with potential applications in optoelectronics, photonics and spintronics (P. Malý, F. Trojánek, P. Němec, and T. Ostatnický). In the Section of the optical spectroscopy, the primary processes in photosyntheses are studied by J. Hála and J. Pšenčík. J. Dian studies photoluminescence and electroluminescence of semiconductors, while J. Valenta and P. Janda deal with the spectroscopy of semiconductor nanocrystals. P. Čapková and M. Pospíšil, in the Section of quantum and non linear physics, are involved in different aspects of polymer nanocomposites.

Projects solved in the area of nanotechnologies

Project of the Academy of Science of the Czech Republic IAA1010316 "Microcrystalline and nanocrystalline semiconductors for photonics: Electron phenomena within the scale of nanometres and femtoseconds" (2003–2007), the solver – Prof. RNDr. Petr Malý, DrSc.

MEYS project LZ1K03022 "Dynamics of the electron spin in semiconductors" (2003–2005), the solver – Doc. RNDr. Petr Malý, DrSc.

GA CAS project IAA050313 "Conductive polymer nanofilms" (2003–2007), the solver – RNDr. Jan Prokeš, CSc.

GA CAS project IAA2112303 "Modelling of the deformation behaviour of magnesium alloys" (2003–2005), the solver – Prof. RNDr. Pavel Lukáč, DrSc.

GA CR project 106/03/0790 "Super-finet-grain aluminium materials prepared by the method of the intensive plastic deformation" (2003–2005), the solver – Doc. RNDr. Přemysl Málek, CSc.

GA CR project 106/05/0073 "Study of the microstructure and thermal stability of ultra-fine-grain Mg alloys prepared by the strong plastic deformation" (2005–2007), the solver – Mgr. Jakub Čížek, PhD.

GA CR project 106/05/2347 "Complex study of modern materials prepared by the ECAP method" (2005–2007), the solver – Doc. RNDr. Miloš Janeček, CSc.

GA CR project 106/03/0819 "Study of the real structure of the nanocrystalline thin layers with the aid of the X-ray diffraction" (2003–2005), the solver – Prof. RNDr. David Rafaja, CSc.

GA CR project 202/03/0776 "Magnetic-optical phenomena in magnetic nanostructures" (2003–2005), the solver – Prof. Ing. Štefan Višňovský, DrSc.

GA CR project 202/03/0789 “New silicon nanomaterials for optoelectronics” (2003–2005), the solver – Doc. RNDr. Jan Valenta, PhD.

GA CR project 202/03/0792 “In space differentiated scanning tunnelling spectroscopy of metals on the Si surface” (2003–2005), the solver – RNDr. Pavel Sobotík, CSc. Among other, the observation of nanoclusters.

GA CR project 202/05/0244 “Reactivity of bimetallic nanostructures based on transition metals” (2005–2007), the solver – Mgr. Iva Matolínová, Dr.

GA CR project 203/03/0900 “Optical sensors, based on porous silicon, with high definition properties” (2003–2005), the solver – RNDr. Juraj Dian, CSc.

GA CR project 206/05/2739 “Structure and functions of self-organising nanostructures based on bacteria-chlorophyll aggregates” (2005–2007), the solver – RNDr. Jakub Pšenčík, PhD.

GA CR project 205/03/D111 “Structures of clay minerals intercalated by organic molecules for the application in nanotechnologies” (2003–2006), the solver – RNDr. Miroslav Pospíšil, PhD.

MEYS project 1P05ME754 (the international co-operation) “Nanocomposites metallic oxide/organic layer” (2005–2007), the solver – Prof. RNDr. Hynek Biederman, DrSc. Preparation of nanocomposite layers metallic oxide/plasma polymer.

MEYS project 1P05ME788 (the international co-operation) “Optimising of magnetic-optical nanostructures for high frequency applications” (2005–2007), the solver – Prof. Ing. Štefan Višňovský, DrSc.

MEYS project LZ1K03022 “Dynamics in the electron spin in semiconductors” (2003–2005), the solver – Prof. RNDr. Petr Malý, DrSc.

MEYS project LZ1K03023 “Development of an efficient analytical technique for the study of biomolecules based on Raman dispersion (SERS) strengthened on the surface” (2003–2005), the solver – Doc. RNDr. Josef Štěpánek, CSc.

MEYS project LZ1K03025 “Study of defects in ultra-soft-grain materials” (2003–2005), the solver – RNDr. Ivan Procházka, CSc.

MEYS project OC 527.10 (the COST programme) “Plasma polymers prepared by the high frequency polymer sputtering” (2002–2005), the solver – Prof. RNDr. Hynek Biederman, DrSc. The study of processes of plasma polymerisation by high frequency polymer sputtering and of the impact of this process on the applied thin layers of plasma polymers. The layers are applied to modify surfaces of solid substances and for the preparation of new materials. This relates especially to the preparation of composites and nanocomposites of two or more component materials.

Participation in the MEYS project LC 510 “Centre of nanotechnologies and materials for nanoelectronics” (2005–2009), the solver – RNDr. Jan Kočka, DrSc., FZÚ CAS. The co-solver on behalf of UK-MFF is Doc. RNDr. Jan Valenta, PhD.

Participation in the project ARC Discovery – Project Grant DP0343308 Silicon photonic devices, (2003–2005), the leading solver – Prof. R.G. Elliman, Australian National University, Canberra, Australia, the co-solver at UK MFF is Doc. RNDr. Jan Valenta, PhD.

Co-operation in the 6th FP project (STREP) NANOCHEMSENS – “Nanostructures for Chemical Sensors” (2004–2007), the solver – Prof. RNDr. Vladimír Matolín, DrSc.

Co-operation in the 6th FP EU NANOFUN-POLY (see – Institute of Macromolecular Chemistry of the Academy of Science of the Czech Republic)

Co-operation in the solution of the project "Oxide-Based Nanostructures as Innovative Gas Sensors", the solver – Prof. RNDr. Vladimír Matolín, DrSc.

Research co-operation with the National Institute for Material Science in Tsukuba, Japan, focussed on the wide spectrum of problems, inter alia, "Design of Nano-scale Reactivity Systems", the solver – Prof. RNDr. Vladimír Matolín, DrSc.

NATO Grant No. CLG 980670: "Composition and electronic structure of In_2O_3 film's surface: Interrelation with gas response", (2004–2007), the solver – Prof. RNDr. Vladimír Matolín, DrSc.

Experts/Field

Prof. RNDr. Pavel Höschl, DrSc. – Quantum structures, technologies of semiconductors, nanostructures

Doc. RNDr. Vladimír Baumruk, DrSc. – Optical spectroscopy of complex biomolecules (especially the nucleic acids and proteins)

Doc. RNDr. Josef Štěpánek, CSc. – Biophysics, the study of biomolecules by the optical spectroscopy, the development of measuring and analysis of data gained by the Raman and absorption spectroscopy methods

Doc. RNDr. Peter Mojzes, CSc. – Study of the structure of biomolecules and macromolecules (nucleic acid, proteins, porphyria) by the optical spectroscopy methods

Prof. Ing. Štefan Višňovský, DrSc. – Magnetic-optical nanostructures

Prof. RNDr. Vladimír Matolín, DrSc. – Physics of surfaces and thin layers, the research of the structure and reactivity of a single and multicomponent metallic systems

Doc. RNDr. Ivan Ošťádal, CSc. – Heteroepitaxial growth of metals on the silicon surfaces, the STM technique

Doc. RNDr. Petr Řepa, CSc. – Vacuum technique and technology, the measuring of nanomaterial properties, the method of balanced nanostructures

Doc. RNDr. František Chmelík, CSc. – Acoustic emission in solid substances, the structure and physical properties of alloys and composites based on aluminium and manganese, the plastic non stability (the doubling, the Portevin–Le Châtelier phenomenon), materials with sub microcrystalline and nanocrystalline structures

Prof. RNDr. Pavel Lukáč, DrSc. – Physics of materials, nanostructures

Doc. RNDr. Radomír Kužel, CSc. – X-ray diffraction studies of polycrystalline materials (nanostructural materials)

Doc. RNDr. David Rafaja, CSc. – Powder X-ray diffraction, the X-ray dispersion on ultra-thin layers, magnetic multilayers and quantum dots, diffusion processes in solid substances

Prof. RNDr. Hynek Biederman, DrSc. – Plasma polymerisation

Prof. RNDr. Vladimír Sechovský, DrSc. – Physics of condensed substances, the electron structure and properties of new materials, magnetism

Prof. RNDr. Jan Hála, DrSc. – Molecular spectroscopy, biophysics of photosynthesis

Doc. RNDr. Petr Malý, DrSc. – Quantum optics and optoelectronics, ultra-fast laser spectroscopy, semiconductor nanocrystals, spintronics

Doc. RNDr. František Trojánek, PhD. – Study of ultra-fast processes in semiconductor nanocrystals

RNDr. Petr Němec, PhD. – Study of ultra-fast processes in semiconductor nanocrystals

Prof. RNDr. Pavla Čapková, DrSc. – Molecular simulation (the structure and properties of intercalates, etc.), the development of nanocomposites polymer-clay, the structure and properties of biological membranes

Doc. RNDr. Jan Valenta, PhD. – Semiconductor nanocrystals, nanophotonics, optical spectroscopy of individual molecules and nanocrystals

Authorised

Codes: 1d, 1e, 1f, 2a, 2b, 2d, 2e, 4a, 6a, 7a

5.2.1.2. Faculty of Science (PřF UK)

Albertov 6, 128 43 Praha 2

www.natur.cuni.cz

Brief workplace description

Activities in PřF are very extensive and focussed on the teaching and research of modern natural science that is characterised by the interdisciplinary and transdisciplinary nature, and the best-known representation of which is the complex study of the environment. There is also teaching and research organised in the field of biomedical science that has its importance in many aspects of our life. There is the complex area of geological-geographic studies of natural resources and their utilisation and protection taught and researched as well as the area of the chemistry of modern technological materials. The research focussed on nanotechnologies has been identified especially in the Chemistry Section. The Section has been divided into the following departments:

- Department of analytical chemistry (the leading researcher K. Štulík)
- **Department of inorganic chemistry** (I. Lukeš)
- Department of biochemistry (M. Stiborová)
- **Department of physical and macromolecular chemistry** (J. Vohlídal)
- **Department of organic chemistry** (M. Kotora)
- Department of teaching and chemistry didactics (H. Čtrnáctová)

Some departments are further divided into sections and groups. The departments involved in the research of nanotechnologies have been highlighted by the bold fonts.

One worker in the Institute of geochemistry, mineralogy and mineral resources, in the Section of geology, deals, inter alia, with the study of the occurrence of fullerenes in the geologic environment (Doc. RNDr. Jan Jehlička, DrSc.).

Research and development focus

The research of nanotechnologies has not been currently supported with any research intention. The research takes place in small groups, or by individuals.

In the Department of inorganic chemistry, in the group for solid materials, they research magnetic nanocomposites and use the methods of their preparation – the sol-gel method (Daniel Nižňanský).

In the Department of the physical and macromolecular chemistry, they are involved in the research of nanotechnologies in the group "Associating polymers" (Karel Procházka, Jan Sedláček), in the group "Surface strengthened Raman dispersion" (Blanka Vlčková), and in the group "Theoretical chemistry" (Filip Uhlík). For other details see the list of projects.

In the Department of organic chemistry, Jaroslav Pecka is involved in materials for the molecular electronics.

Projects solved in the area of nanotechnologies

GA CAS project IAA0504060 "Surface strengthened photophysical processes on metallic nanoparticles in polymer nanocomposites" (2004–2007), the solver – Doc. RNDr. Blanka Vlčková, CSc.

GA CAS project 1ET401110505 "Fullerenes and nanotubes as the building blocks in nanotechnologies" (2005–2007), the solver – RNDr. Filip Uhlík, PhD.

GA CR project 203/04/0490 "Self-organised nanostructures based on polyelectrolytes with the new architecture sensitive to external stimulants" (2004–2006), the solver – Prof. RNDr. Karel Procházka, DrSc.

GA CR project 203/04/0688 "Utilisation of selected molecule kinds for the preparation of metallic nanostructures showing strong optical resonances" (2004–2006), the solver – Doc. RNDr. Blanka Vlčková, CSc.

GA CR project 203/05/2194 "Mesoporous hybrid catalysts for the preparation of special polymers" (2005–2007), the solver – RNDr. Jan Sedláček, Dr.

GA CR project 203/04/0921 "Synthesis of linear pyridine-phenylene oligomers for the utilisation in molecular electronics" (2004–2006), the solver – RNDr. Jaroslav Pecka

GA CR project 205/03/1468 "Occurrence of fullerenes in minerals by the thermal cracking of bitumen precursors" (2003–2005), the solver – Doc. RNDr. Jan Jehlička, DrSc.

MEYS project 1P05ME790 (the international co-operation) "Targeted preparation of metallic nanostructures with molecular bridges for the spectroscopy of the super-strengthened Raman dispersion" (2005–2007), the solver – Doc. RNDr. Blanka Vlčková, CSc.

Experts/Field

Doc. RNDr. Blanka Vlčková, CSc. – Nanomaterials and nanocomposite materials with nanoparticles of Ag and Au, plasmonics

Prof. RNDr. Karel Procházka, DrSc. – Self-assembling polymers

RNDr. Daniel Nižňanský, PhD. – Nanocomposites in magnetic and ferroelectric materials

RNDr. Filip Uhlík, PhD. – Fullerenes, carbon nanotubes

Prof. RNDr. Jiří Vohlídal, DrSc. – Nanoporous heterogeneous catalysts for polymerisation reactions

Authorised

Codes: 1c, 1e, 1f, 2a, 2d, 5b, 5c, 6a

5.2.1.3. 1st Faculty of Medicine (1st LF UK)

Kateřinská 32, 121 08 Praha 2

www.lf1.cuni.cz

Brief workplace description

The 1st Faculty of Medicine has made a part of the Charles University in Praha since 1348 and it is the oldest faculty of medicine in Central Europe. It teaches future doctors in medicine and in stomatology, but only in full-time courses. There are also the university courses for undergraduates organised in the fields of nursing, ergotherapy, physiotherapy, and healthcare instruments. There are also the consequent master studies in the fields of healthcare instruments and informatics and courses for teachers of healthcare subjects at advanced education schools. The extensive research in the fields of medicine and biology is undertaken in 74 institutes and clinics. According to Prof. MUDr. Vladimír Tesař, DrSc., Faculty Subdean, the research and works belonging, according to the nomenclature described in **Table I**, to the area of nanobiotechnologies and nanomedicine implemented in the following institutes and clinics:

- Institute of pathological physiology (Director is E. Nečas)
- Institute of cell biology and pathology (I. Raška)
- Institute of pharmacology (M. Perlík)
- Institute of hereditary metabolic defects (M. Elleder)
- 1st Internal Clinic (P. Klener) - Laboratory of the molecular haematology
- 2nd Internal Clinic (A. Linhart) – Clinic of cardiology and angiology, the research angiology laboratory
- 3rd Internal Clinic (Š. Svačina) – Laboratory for endocrinology and metabolism

Research and development focus

In the 1st LF UK, there will be two research intentions solved in the period 2005–2011. They include, in their contents, also parts related to the nanobiotechnology and nanomedicine:

Research intention MSM0021620806 "Molecular biology and cell pathology in standard and selected clinically serious pathological processes", the solver – Prof. MUDr. Milan Elleder, DrSc.

The research task is represented by twelve basic biomedical areas focussed on the selected problems in standard and pathological situations. The superior objective is the mutual convergency of biomedically focussed research workplaces at the same molecular and cell levels of methodological centres as the necessary prerequisite for the perspective biomedical research. In such a way oriented research, the important source of relevant information about cell processes operating in standard and pathological situations and for their understanding is the development of new therapeutic processes. The priorities are the structural biological studies of the nucleus compartment, especially the description of the nucleus structure from the rRNA synthesis and replication of ribosomal genes points of view, the studies of the dynamics in chromosome territories in connection with their replication and the analysis of the mutual positions of the chromosomes in the nucleus, the analysis of the position of the "linker" histone in the chromatin fibre, the study of the function of the Cajal element and of the nuclei spots, the modification and remodelling of the chromatin in the regulation of transcription, the identification of new proteins, etc.

Research intention MSM0021620808 "Molecular-biological, genetic and epigenetic aspects in the creation and development of model tumours in adult age. The importance for epidemiology, early diagnostics and the treatment", the solver – Prof. MUDr. Pavel Klener, DrSc.

Research works will bring new knowledge for the field of the cell and molecular biology and physiology, which are important for the basic research (the knowledge of some of the regulation mechanisms in growth, differentiation and transformation of cells), but also for clinics (cells for the cytostatic treatment). The research task results should allow for the identification of molecular goals and cell regulation processes allowing for the prediction, in time diagnostics, continuous monitoring of the development of the illness, etc. Another objective is the design of new biologically active substances interfering with the tumorous progression both at the level of the transformed cell itself and at the level of the impact on the immune system.

Works having the character of bionanotechnology or nanomedicine are done in the following institutes and laboratories:

The Institute of pathological physiology develops bioaffinity, immunoaffinity and enzyme reactors as parts of microchip equipment for the finding of auto-antigen epitopes. There are magnetic micro or nanoparticles used for the preparation of enzyme reactors.

Laboratory of the gene expression in the Institute of Cell Biology and Pathology organises the research of the function organisation in the cell nucleus.

Laboratory of the molecular haematology in the 1st Internal Clinic does the molecular diagnostics of haematologic malignant illnesses with the use of PCR (the polymer chain reaction).

The Institute of pharmacology, the Department of clinical pharmacology, organises the DNA analysis of genes for the metabolism and transport of xenobiotics.

The Research angiology laboratory in 2nd Internal Clinic provides for the separation of lipoproteins and characterises their sub fraction (5–1200 nm).

The Institute of hereditary metabolic defects uses in its studies of hereditary metabolic illnesses the techniques of molecular biology (the analysis of genes connected with the studied illness – the sequencing of PCR, the position cloning, the study of the gene expression, and protein studies).

Laboratory for the endocrinology and metabolism in 3rd Internal Clinic, they focus on the DNA analysis in the research of hyperlipoproteinaemia, arterial hypertension and diabetes.

Projects solved in the area of nanotechnologies

Ministry of Health project 1A8239 "Development of DNA chip application for the needs of diagnostics and the study of pathogenesis and treatment of hereditary metabolic illnesses" (2004–2006), the solver – Prof. MUDr. Milan Elleder, DrSc.

GA CR project 304/04/0692 "Function, structure and dynamics in the nuclear ribosome factory" (2004–2006), the solver – Prof. RNDr. Ivan Raška, DrSc.

Experts/Field

Prof. MUDr. Pavel Klener, DrSc. – Haematology, oncology

Prof. MUDr. Milan Elleder, DrSc. – Cell pathology of hereditary illnesses

Prof. MUDr. Ivan Raška, DrSc. – Functional organisation of the cell nucleus

Doc. MUDr. Karel Smetana, DrSc. – Cell biology and tissue engineering, development of biocompatible implants and the engineering of tissue replacement

Codes: 2d, 3d

5.2.1.4. 2nd Faculty of Medicine (2nd LF UK)

V Úvalu 84, 150 06 Praha 5

www.lf2.cuni.cz

Brief workplace description

The 2nd faculty of Medicine was founded by the division of the Faculty of Medicine at the Charles University. It was created in 1953 as the Faculty of Children Medicine at the Charles University in Praha. The academic senate of the Charles University approved, on 7 September 1990, of the proposal to change the faculty name to the 2nd faculty of Medicine at Charles University in Praha. The main faculty mission has been the training and scientific research within medical science. The Faculty has been divided into 22 institutes and 29 clinics. The sector of science and research in the 2nd LF UK is accompanied with the scientific and research activities conducted in the Teaching Hospital in Motol. The research in the field of nanomedicine takes place probably in several faculty institutes, but necessary information has not been obtained. The Faculty has been solving, since 2005, the MEYS project "Centre for the cell therapy and tissue replacements" under the leadership of Prof. MUDr. Eva Syková, DrSc. The project is focussed, up to a certain level, on the area of nanomedicine. The works extend activities of a similar centre, which had developed its activities in the period 2000–2004.

Research and development focus

The 2nd LF will solve the co-ordinated MEYS project 1M0538 "Centre for the cell therapy and tissue replacements" in the period 2005–2009, the solver – Prof. MUDr. Eva Syková, DrSc. *In addition to 2nd LF, the following institutes will also participate in this project solution: Institute of Animal Physiology and Genetics of the Academy of Sciences of the Czech Republic (Prof. MVDr. Jan Motlík, DrSc.), Institute of Macromolecular Chemistry of the Academy of Sciences of the Czech Republic (RNDr. František Rypáček, CSc.), Institute of Experimental Medicine of the Academy of Sciences of the Czech Republic (Doc. RNDr. Alexandr Chvátal, DrSc.), Institute of Clinical and Experimental Medicine (Ing. Milan Hájek, DrSc.), Institute of Haematology and Blood Transfusion (MUDr. Petr Kobylka, CSc.), and other workplaces.*

The cell therapy is an alternative for the treatment of degenerative and civilisation diseases, including the nerve ones. It is especially about the so-called regeneration medicine. The objective of the cell therapy, especially with the aid of stem cells, is to replace, repair and improve functions of damaged tissues. This can be achieved with the aid of implanted isolated and

well-characterised cells in the targeted organ, of the satisfactory number and quality, in order to enable them to initiate again the correct function. A part of this project is also the research of biocompatible hydrogels and their ability to support the renewal and to replace damaged tissues, and increase the possibility of regeneration. The project objective is the organisation of clinical tests and the utilisation of open processes in the clinical practice.

Code: 3c

5.2.2. Masaryk University in Brno

Masaryk University combines in its activities high demands on its own original exploratory activities with the systematic efforts to create conditions for the access, as wide as possible, to the university education at the level corresponding with student abilities and the needs, which are required by the labour market, in relation to qualifications, in the modern society. Masaryk University in Brno is the second biggest university in the Czech Republic, thanks to the number of students in the accredited study programmes. The offer of study opportunities is based on the disciplines undertaken in the relevant faculties: Jurisdiction, Medicine, Natural Science, Philosophy, Paedagogy, Economy-Administration, Informatics, Social Science, and Sports. The University has got 10 faculties and the research of nanotechnologies is organised, within smaller scope, only in the Faculty of Science. Out of 352 programme projects solved at the university in 2005, only two projects and two research intetions relate to nanotechnologies.

5.2.2.1. Faculty of Science (PřF MU)

Kotlářská 2, 611 37 Brno

www.muni.cz/sci

Brief workplace description

The Faculty of Science has been profiled as a research faculty providing for the university education closely related to the basic and applied research in the science fields of mathematics, physics, chemistry, biology, and the Earth science. In physical science, research focuses on the research of thin layers and lateral structures on the surface of semiconductors, they study plasma-chemical reactions in the low temperature plasma and in the area of the theoretical physics, they research the optics of charged particle beams, the theory of strings, and the general relativity theory. Research in the chemistry areas focuses on the structure and bond situations, properties and the analysis of synthetic and natural molecules, and their arrangement. In biological science, they research time-space dynamics in the biodiversity in ecological systems existing in the Central Europe, but also the issues related to genomes and their functions in the case of different organisms, including humans. The research of nanotechnologies is done in the Department of physical electronics (J. Janča, I. Ohlídal, L. Zajíčková) and in the Institute of the Physics of Condensed Matter (J. Humlíček, V. Holý, D. Munzar).

Research and development focus

PřF MU will solve two research intentions including also parts related to nanotechnologies and nanomaterials in the period 2005–2011.

The research intention MSM0021622410 "Physical and chemical properties of advanced materials and structures" (2005–20011), the solver – Prof. RNDr. Josef Humlíček, CSc.

The subject of the research intention is the study of new materials and phenomena, which require the complex physical and also chemical approach. The intentionk focuses on (1) the self-assembled nanostructures, supergrids, quantum wells, wires and dots, (2) high temperature superconductors, (3) technologically important bulk materials and their impurities, (4) polymers with the silicon spine, (5) thermodynamic properties, phase transformations, diffusions and the arrangement processes in the advanced intermetallic compounds and thin layers, and (6) the preparation of materials by non conventional methods and the study of these processes' mechanisms.

The research intention MSM0021622411 "Study and application of plasma-chemical reactions in non isothermal low temperature plasma and its interactions with the surface of solid substances" (2005–2010), the solver – Prof. RNDr. Jan Janča, DrSc.

The research intention focuses on the study of the kinetics in plasma-chemical processes by the methods of optical, weight and microwave diagnostics, research and methodology related to the technology of plasma-chemical application of thin polymer, nanocomposite, super hard, semipermeable, and semi-sorption layers and the research of mechanical, chemical and electric properties of prepared deposits, and other areas.

The Department of physical electronics organises the preparation of nanostructured and nanocomposite materials by plasma technologies, especially by the plasma-chemical deposition from the gas phase (PECVD). At the same time, they organise the analysis of materials, including the ultra-thin surface layers, and use the depth-sensitive methods.

The Institute of the Physics of Condensed Substances founded in the period 1996–2000 the Laboratory of thin layers and nanostructures. Its activities progressively merged with the activities of the Institute, which are focussed on the experimental and theoretic physics of solid substances. In this connection, there is also the research in the area of semiconductor nanostructures, modelling of small-size structures, and experimental study, with the aid of spectroscopic methods and AFM, organised.

Projects solved in the area of nanotechnologies

GA CR project 202/03/0148 "Anomalous dispersion of the X-ray radiation in semiconductor nanostructures" (2003–2005), the solver – Prof. RNDr. Václav Holý, CSc.

GA CR project 202/05/0607 "Preparation of carbonaceous micro and nanostructures by plasma technologies" (2005–2007), the solver – Mgr. Lenka Zajíčková, PhD.

The project studies the growth of carbonaceous nanotubes (CNT) and nanofibres (CNF) by the method of the plasma-chemical deposition from the gas phase (PECVD) and there will be different discharges compared (microwave, high frequency CCP and ICP, and the modified system of the magnetron sputtering). The objective is the production of CNT at low temperature, in the atmospheric discharge, and the growth of single wall CNTs. Also, there will be the synthesis of carbonaceous nanostructures (structured polymers, CNT, and fullerenes) done

in the pulse high frequency glow discharge. They will study the impact of the pulse duration on the deposition. There will be micro and nanocrystalline diamond deposited by the PECVD method and its properties will be then controlled by the change of the crystallite sizes and by depositing other elements, e.g. boron. The nanocomposite layers containing CNT and CNF will be prepared by the PECVD method. The layers will be studied from the mechanical, optical and electric properties' points of view. The carbonaceous nanostructures will be prepared, while the functional considerations are taken into account (emitters, standards for the estimation of the AFM tip bluntness) and for the modification of material surface properties.

Experts/Field

Prof. RNDr. Jan Janča, DrSc. – Plasma-chemical preparation of nanocomposite thin layers, the diagnostics of plasma

Prof. RNDr. Josef Humlíček, CSc. – Physics of thin layers and nanostructures, spectroscopy, ellipsometry

Prof. RNDr. Václav Holý, CSc. – Self-organising processes in the epitaxial growth of semiconductors, the X-ray dispersion on nanostructures

Doc. Dominik Munzar, Dr. – Theory of the electron structure

Prof. RNDr. Ivan Ohlídal, DrSc. – Optics of thin layers and surfaces of solid substances, AFM

Mgr. Lenka Zajíčková, PhD. – Preparation of carbonaceous nanostructures and the study of their properties

Authorised

Codes: 1c, 1e, 2a, 6a, 7a, 7c

5.2.3. Czech Technical University in Praha (ČVUT)

Czech Technical University trains future experts in technical fields. ČVUT supports scientific activities, trains new scientists, and focuses also on other activities within the scientific and pedagogical areas in technical disciplines. It develops the scientific and pedagogical research and creative technological activities in accordance with requirements by the society, the world trends, and freedom principles applying on intellectual activities. ČVUT has got 7 faculties, 2 university institutes, and other workplaces. The research in the field of nanotechnologies is organised, within varied scope, in the following faculties:

- Faculty of Civil Engineering
- Faculty of Mechanical Engineering
- Faculty of Electrical Engineering
- Faculty of Nuclear Sciencies and Physical Engineering

Out of 415 solved programme projects, only 4 projects and only 3 research intentions, out of 15 ones, are focussed on nanotechnologies.

5.2.3.1. Faculty of Mechanical Engineering (FS ČVUT)

Technická 4, 166 07 Praha 6

www2.fs.cvut.cz

Brief workplace description

Currently, there are 14 institutes and 2 research centres, which organise research and development in addition to the training, in this Faculty. Research of nanotechnologies starts to develop and the issues make the subjects of activities in the Institute of Physics and in the Institute of Material Engineering.

Research and development focus

The research in the Institute of Physics (the leading researchers are B. Sopko, F. Černý, R. Novák, and M. Solar) focuses on the technologies for the creation of thin nanolayers for microelectronics (PACVD, the plasma, and the methods using ion and electron beams).

The research in the Institute of Material Engineering (the leading researchers are J. Steidl and V. Starý) focuses on the study of thermoplastic nanocomposites for technical applications. This workplace also studies the impact of surface properties (from the nanometre area to the micrometre one) on the biocompatibility and on the tribologic material properties used in biomedicine.

Projects solved in the area of nanotechnologies

MIT project FD-K3/104 "Consortium for the research and application of nanostructure coatings improving the tribologic properties of mechanical parts" (2003–2005), the solver – Doc. RNDr. Ing. Rudolf Novák, DrSc.

Co-operation within the project of the 6th FP EU OKXNMP 515846 "NAPOLYDE" (2005–2008) "Processes of the deposition of nanostructured layers for the energy and intelligent systems", the solver – Prof. Ing. František Černý, DrSc.

Co-operation in the solution of the MIT project FT-TA2/018 "Advanced beam technologies for the creation and processing of layers in manufacturing practice in electronics" (2004–2008), the grantee – ELCERAM, a.s., Hradec Králové, the solver - Ing. Karel Strobl, the co-operation on behalf of ČVUT-FS – Prof. RNDr. Bruno Sopko, DrSc.

Co-operation in the solution of the research task of SVUM, a.s., Praha, MSM 2579700001 in the part "Research of thermoplastic nanocomposites' properties".

"The impact of nanoparticles on the disturbance and lifespan of thermoplastic composites" (lodged with GA CR for the period 2006–2008).

"Local and integral mechanical properties of thermoplastic composites" (the Czech-Slovak project, 2006–2007).

The MEYS research intention No. 64707712 "Transdisciplinary research in the area of biomedical engineering".

Co-operation with the company Beznoska, s.r.o. in the area of the application of biomaterials determined for hip joint endoprostheses.

Experts/Field

Prof. RNDr. Bruno Sopko, DrSc. – Physics of semiconductors

Prof. Ing. František Černý, DrSc. – Thin layers, the modification of surface material properties

Doc. RNDr. Ing. Rudolf Novák, DrSc. – Physics of thin layers, the plasma depositions of coatings, the assessment of coating parameters

Prof. Ing. Josef Steidl, CSc. – Plastics and composites (nanocomposites)

Doc. RNDr. Vladimír Starý, CSc. – Materials for the biomedical applications

RNDr. Michael Solar, CSc. – Thin layers, nanotechnologies – the standardising, semiconductor parts and their technology

Authorised

Codes: 1d, 1f, 3d, 8d

5.2.3.2. Faculty of Electrical Engineering (FEL ČVUT in Praha)

Technická 2, 166 27 Praha 6

www.fel.cvut.cz

Brief workplace description

The Faculty of Electrical Engineering within ČVUT is nowadays a prestige Czech technical university workplace. It develops scientific activities, trains new scientists and is the centre of research and training activities in the areas of electrical engineering, communications, automation, informatics, and computing technology. The structure of the Faculty is made up of 20 departments and centres. The research of nanotechnologies is organised in the Department of mechanics and materials (V. Bouda, J. Sedláček, and A. Mlích), in the Department of microelectronics (M. Husák, P. Hazdra, and J. Voves), in the Department of electrical engineering (P. Mach), and in the Department of measuring (P. Ripka).

Research and development focus

The research in the field of nanotechnologies covers:

- *Department of mechanics and materials.* The research of composite materials containing colloid functional particles for electronics and electrical engineering focuses on the self-induced growth of conductive and semiconductive aggregates of the carbonaceous nanoparticles in the non conductive environment and on its management by electric field and the composition of the surroundings. The modelling of muscle cell functions and the nanotechnology for the application. The preparation and studies of the properties of thin layers. Co-operation in the research intention MSM6840770021 "Material diagnostics" (2005–2010), the solver – Prof. Ing. Stanislav Vratislav, CSc., ČVUT-FJFI,
- *Department of microelectronics*. The design of microelectronic and nanoelectronic semiconductor structures with the use of commercial and own designing systems and programmes. The decreasing of channel length in MOS structures with the transition to nanostructures. The study of nanometre semiconductor layers and quantum dots prepared by the MOVPE

and MBE methods. The mechanism of the radiation recombination in the sub nanometre InAs/GaAs laser structures. The research and development of sensors for the applications in electronics. The co-operation in the research intention MSM6840770014 “Research of perspective information and communication technologies” (2005–2010), the solver – Prof. Ing. František Vejražka, CSc., ČVUT-FEL,

- *Department of electrical engineering*. The research and development of conductive adhesives. The co-operation in the research intention MSM6840770021 “Material diagnostics” (2005–2010), the solver – Prof. Ing. Stanislav Vratislav, CSc., ČVUT-FJFI,
- *Department of measuring*. The research and development of sensors for applications in electronics and electrical engineering. Nanostructured magnetic layers.

Projects solved in the area of nanotechnologies

GA CAS project IAA1010318 “The mechanism of the radiation recombination in the sub nanometre InAs/GaAs laser structures” (2003–2005), the solver – Doc. Ing. Pavel Hazdra, CSc.

MEYS project ME695 (the international co-operation) “Nanostructured magnetic layers for technical applications” (2003–2005), the solver – Prof. Ing. Pavel Ripka, CSc.

Co-operation in the research intention MSM6840770021 “Material diagnostics” (2005–2010), the solver – Prof. Ing. Stanislav Vratislav, CSc., ČVUT-FJFI.

Co-operation in the research intention MSM6840770014 “Research of perspective information and communication technologies” (2005–2010), the solver – Prof. Ing. František Vejražka, CSc., ČVUT-FEL

Co-operation in the 6th FP EU project SENPIMAG – “A novel technology for ultra sensitive reliable integrated magnetic sensors: A new era in magnetic detection” (2004–2006), the solver – Prof. Ing. Pavel Ripka, CSc.

Experts/Field

Prof. Ing. Václav Bouda, CSc. – Nanoelectrical-mechanical systems

Prof. Ing. Miroslav Husák, CSc. – Nanosensors for MEMS

Doc. Ing. Pavel Mach, CSc. – Research of the electricity conducting adhesives

Prof. Ing. Pavel Ripka, CSc. – Magnetic sensors, nanostructured magnetic layers

Doc. RNDr. Jan Voves, CSc. – Nanoelectronics

Authorised

Codes: 1b, 1c, 1d, 2a, 2d, 2f, 4a, 6a

5.2.3.3. Faculty of Nuclear Science and Physical Engineering (FJFI ČVUT)

Břehová 7, 115 19 Praha 1, I.D. (IČO) 68407700

www.fjfi.cvut.cz

Brief workplace description

The Faculty, originally founded within the Czechoslovak Nuclear Programme in 1955, has progressively extended its activities into a wide spectrum of mathematical, physical and chemical fields. It has been divided into 10 departments. The research relating to nanotechnologies is organised in the Department of materials (J. Siegl), in the Department of physical electronics (P. Fiala, A. Fojtík, I. Richter, and M. Kálal), and in the Department of the Solid Matter Engineering (S. Vratislav, I. Kraus, N. Ganev, M. Dlouhá, L. Kalvoda, Z. Bryknar, and Z. Potůček).

Research and development focus

FJFI ČVUT will solve 2 research intentions, which relate in their solution areas to issues of nanotechnologies and nanomaterials, in the period 2005–2010:

Research intention MSM6840770021 "Material diagnostics" (2005–2010), the solver –Prof. Ing. Stanislav Vratislav, CSc.

The subject of the solution is the basic research of mechanical, electrical, magnetic, optical, and other physical properties of solid substances and of their relations to the structural and sub structural parameters. The works focus on relations between structure-sensitive substance properties, their technological history and usable parameters.

Research intention MSM6840770022 "Laser systems, radiation and modern optical applications" (2005–2010), the solver – Prof. Ing. Pavel Fiala, CSc.

The subjects of the solution are the modern laser systems and the study of selected optical interaction processes within the coherent or not coherent electromagnetic radiation within the environment of a wide spectrum (from XUV to IR). The objective is to gain new knowledge and to understand better the new processes of optical methods, in optoelectronics, technologies, medicine, and also in the further research undertaken within the optical physics.

Nanotechnology issues in the above-mentioned departments relate to the following areas:

Department of materials: The works in this area could be divided into two following main directions:

1. The study of relations between microstructural parameters and mechanical properties of different kinds of construction materials (the preparation of materials with ultra-fine grains, alloys suitable for hardening, the study of the degradation of solid solution in model alloys, the utilisation of methods of the transmission electron microscopy with the atomic resolution and the auto-emission ion microscopy with the tomographic atomic probe).
2. The study of the first stages in the growing fatigue cracks in relation to the characteristic structural parameters, the monitoring of construction materials in the nanostructural area.

Department of physical electronics: The research in the area of nanotechnologies relates to:

1. The utilisation of nanostructures in the quantum electronics (the light generation on quantic dots).

2. The utilisation of nanostructures for the light recording and formation (the diffractive effects, the recording of optical information based on nanocrystals AgX and photopolymers, the study of photonic crystals and effects of their aperiodicity, the not linear optical properties of nanostructural systems.
3. The chemical creation of nanoparticles for optoelectronic and biologic purposes, especially the semiconducting and dielectric, possibly also the magnetic purposes. The description and modelling of their properties.

Department of Solid Matter Engineering. The research focuses as follows:

1. The study of macro and microstructures of technically important materials and optical properties of solid substances, recently also the issues within the studies of the properties of polymers and polymer nanocomposites in relation to the technological processing and the resulting properties (the preferential orientation on the studies determining the share of the crystalline phase in the amorphous matrix).
2. Improvements in methodologies and diagnostics related to technically important materials, the study leading to the clarification of influences acting on the phase transitions in thin layers; They are the methods like, for example, TEM, SEM, XRD (the morphology of composites), the diffraction of neutrons and the X-ray radiation, light dispersion, and also the silicates, organic silicates and oxides of transition metals; The measuring of photoluminescence, thermoluminescence and optical absorption of pure and spectroscopic active ions (Cr_{3+}, Mn_{4+}, Fe_{3+}, etc.), doped thin layers, thin layer structures of $Ba_xSr_{1-x}TiO_3$, and other materials of the perovskite kind, which allow for their utilisation.
3. The development of simulation programmes for the study of transport properties of semiconductor heterostructures.

Projects solved in the area of nanotechnologies

None was received.

Experts/Field

Prof. Ing. Pavel Fiala, CSc. – Laser and optical technologies, diffractive optics and applications

Doc. Ivan Richter, Dr. – Optical physics, quantum physics and electronics, photonic crystals

Ing. Anton Fojtík, CSc. – Lasers, chemical preparations, measuring and properties of nanoparticles

Ing. Jan Siegl, CSc. – Mechanical properties of structural materials, interference processes, SEM, plasma applied layers

Prof. RNDr. Ivo Kraus, DrSc. – X-ray diffraction, material research

Doc. Ing. Nikolaj Ganev, CSc. – X-ray diffraction, material research

Prof. Ing. Stanislav Vratislav, CSc. – Neutron diffraction, material research

RNDr. Maja Dlouhá, CSc. – Neutron diffraction, material research

Ing. Ladislav Kalvoda, CSc. – Nanocomposites, electron diffraction

Prof. Ing. Zdeněk Bryknar, CSc. – Optical properties, material research

Ing. Dr. Zdeněk Potůček – Optical properties, material research

Doc. Ing. Milan Kálal, CSc. – Interaction of laser radiation with plasma and its diagnostics, high performance lasers, complex interferometry

Authorised.

Codes: 1d, 1e, 1f, 2b, 5c, 7a

5.2.3.4. Faculty of Civil Engineering (FSv ČVUT)

Thákurova 7, 166 23 Praha 6

www.fsv.cvut.cz

Brief workplace description

Faculty of Civil Engineering has got in its status the task of training civil engineers in mutual co-operation of professional fields, departments and faculty workplaces. This applies for all study forms and should ensure the learning of the knowledge necessary for the solution of the technical and technical-economic development within the industry of construction, to ensure the level of scientific works, their complexity and orientation on solutions of important tasks in the development of the construction science. It wishes to become also a centre of cultural activities in the area of construction. The Faculty has been divided into 27 departments. The research of the nanotechnology character has been identified in the Microscopy laboratory in the Department of ground constructions (L. Berka) and in the Department of mechanics (Z. Bittnar, L. Kopecký, and J. Němeček).

Research and development focus

FSv ČVUT will solve the research intention, which relates in its parts also to the research of nanotechnologies, in the period 2005–2011.

Research intention MSM6840770003 "Development of algorithms for computer simulations and their application in the engineering", the solver – Prof. Ing. Zdeněk Bittnar, DrSc.

The main topic in the research task is the multilevel modelling and simulation (VMS). The primary VMS applications are in the material engineering. VMS serves for the understanding of the most important properties of materials and structures. The description of materials (the constitutive relations) starts at the nano level and progressively transfers to the macro level. In addition to the description of the mechanical behaviour of materials, it relates also to the description of the behaviour of structures and their mutual interactions. Even the very advanced mathematical model cannot predict well the reality, unless reliable entry data are put into it. For VMS, there will be non standard data gained about the mechanical properties, from the micro level down to the nano level as well as other information.

The Microscopic laboratory in the Department of ground constructions organises the theoretical and experimental studies of the influence of structure on deformation processes and on the disturbance of solid substances (especially the polycrystals), the modelling and microscopic analysis of deformations of the polycrystalline structure and the study of the thin layers' toughness (about 500 nm).

The Department of mechanics organises the research of possibilities of the applications of nanotechnologies in the production of concrete and develops the methodology for the nanoindentation during the research of cement paste properties.

Projects solved in the area of nanotechnologies

GA CR project GD 103/05/H506 "Computer and experimental analysis of the structure and properties of new building materials, from the nano level up to the macro level" (2005–2008), the solver – Prof. Ing. Zdeněk Bittnar, DrSc.

Experts/Field

Prof. Ing. Zdeněk Bittnar, DrSc. – Application and development of numerical methods in building mechanics, the research of quasi soft materials with the aid of the unique experimental equipment

Ing. Jiří Němeček, PhD. – Nanoindentation and micromechanics, concrete structures and bridges, the numerical simulation and modelling

Ing. Ladislav Berka, CSc. – Mechanics of materials, microscopic analysis

RNDr. Lubomír Kopecký – Optical polarisation microscopy, electron microscopy, microanalyses, nanoindentation (the micromechanics of cement pastes, concretes and composite materials)

Codes: 1b, 7a

5.2.4. Brno University of Technology (VUT)

Scientific research activities at VUT are focussed on a wide spectrum of technical sciences and a number of art disciplines. VUT has got 8 faculties. Research in the area of nanotechnologies is organised, within varied scope, in the following faculties:

- Faculty of Mechanical Engineering
- Faculty of Electrical Engineering and Communication Technologies
- Faculty of Chemistry

There are only 12 projects and partly 3 research intentions, out of 299 programme projects, 8 research intentios respectively, focussed on nanotechnologies.

5.2.4.1. Faculty of Mechanical Engineering (FSI VUT)

Technická 2, 616 69 Brno

www.fme.vutbr.cz

Brief workplace description

The Faculty has been now, in addition to being a provider of high quality education, also a well-known institution in the area of science and research. In addition to traditional mechanical engineering fields of the design and technological character, it develops intensively applied science in disciplines like, for example, applied mechanics, precise mechanics and

optics, quality management, engineering informatics, material engineering, etc. The Faculty has been divided into 13 institutes, which organise, in addition to training activities, also research. Some of the institutes are further divided into sections. Research in the area of nanotechnologies takes place in the Institute of Physical Engineering (T. Šikola, J. Pokluda, P. Šandera, M. Ohlídal, and R. Kalousek), in the Institute of Material Science and Engineering (J. Cihlář, J. Švejcar, and M. Trunec), and, within smaller scope, in the Institute of Mechanical Engineering Technology (B. Bumbálek).

Research and development focus

FSI VUT will solve one research intention focussed on the nanotechnology in the period 2005–2010.

Research intention MSM0021630508 "Inorganic nanomaterials and nanostructures: Creation, analysis, and properties" (2005–2010), the solver – Prof. RNDr. Jaroslav Cihlář, CSc.

The research intention is focussed on the creation and research of nanoparticle and nanostructure materials, especially not metallic materials and their composites with metals and polymers, but also on the creation and research of low dimensional structures like nanowires and nanodots. The subject of the research intention is the description of physical and chemical interactions in nanoparticle and nanostructured systems and gaining new knowledge about the unique properties, which result from these relations, especially in multi phase ones from the point of view of the behaviour of nanomaterials and nanostructures, their surfaces and interfaces. The solution of this requires the research and development of processes and facilities for the creation of the required structures, the design of new and modified already existing methods for the experimental research of nanostructures and for the creation of a theoretical explanation of observed phenomena on the basis of processed gained information.

The works in the Institute of Physical Engineering are focussed on the creation of nanostructures with the aid of SPM for purposes of nanoelectronics and plasmonics, on the preparation and characterisation of ultra-thin layers, multilayers and the 1D-0D nanostructures with the aid of PVD. There is also the analysis of microstructures organised by the optical microscopy (BF, DF, DIC, and the polarisation microscopy), the confocal microscopy, and LCIM. They develop photoluminescent/reflection optical microscopy and spectroscopy.

The works in the Institute of Material Science and Engineering:

Within the Section of ceramics, they do the following works: The synthesis of inorganic nanoparticles in non conventional conditions (the hydrothermal syntheses, syntheses in ultrasound and microwave fields), the preparation of nanostructured coatings, the preparation of the nanostructured bulk ceramics, the study of surface properties of nanoparticles, and the study of microstructure and the properties of nanostructured coatings and units.

In the Section of the structure and phase analysis, they organise the structural the TEM, STEM, SEM, X-ray, and other analyses.

In the Institute of the Mechanical Engineering Technology, in the Section of machining technology, Prof. Ing. Bohumil Bumbálek, CSc. is involved in the monitoring and assessment of integrity of the surfaces of parts finished with the ultra precise machining methods (the nanomachining).

Projects solved in the area of nanotechnologies

GA CAS project IAA1010413 “Nanoscience and nanotechnology with probe microscopes: From phenomena on the atomic level to material properties” (2004–2008), the solver – Prof. RNDr. Tomáš Šikola, CSc.

Nanoscience applies different nanotechnological processes in order to modify and consequently study the properties of nanoobjects. The especially attractive, within these sizes, is the utilisation of quantum phenomena. The organised research focuses on the several following fields: The structural, electron and spectroscopic properties at the atomic level, the characterisation of nanoclusters, the nanolithography with SPM, the macroscopic and topographic data combined with the local spectroscopy of the electric conductivity, the electrical luminescence, local density of phases, diffusion, exit works and photovoltaic phenomena. The physical properties are also studied in the theoretical way.

GA CR project 106/04/1206 “Preparation of the bulk nanocrystalline ceramics of nanometric powders” (2004–2006), the solver – Ing. Martin Trunec, Dr.

GA CR project 106/04/0422 “Influence of sub micron and nanometric particles of the modifier on the crystallisation of metallurgical Mg alloys”, the solver – Prof. Ing. Luděk Ptáček, CSc.

MEYS project OC D32.001 (the international co-operation) “Ultra-sound sonochemical sol-gel syntheses of nanometric oxide particles and sols” (2003–2008), the solver – Prof. RNDr. Jaroslav Cihlář, CSc.

GA CR project 106/05/0274 “Multilevel studies of the relations between the mechanical and microstructural characteristics of materials” (2005–2007), the solver – Prof. RNDr. Jaroslav Pokluda, CSc.
The main objective of the project is the finding of new and more physically substantiated quantitative relations between the mechanical properties and structural characteristics of materials with the aid of multilevel experimental and theoretical research. For the achievement of this objective, there will be multilevel tests of the hardness, 2D and 3D quantitative metallography and primary principle calculations of mechanical properties used as the basic methods. This should allow for the assessment of the mechanical response and the microstructure of studied materials at the mutually interconnected macro, micro and nano levels.

GA CR project GP 202/04/P125 “Measuring of surface profiles with the aid of non contact microscopy of atomic forces” (2004–2006), the solver – Ing. Radek Kalousek, PhD.

Experts/Field

Prof. RNDr. Jaroslav Cihlář, CSc. – Synthesis of nanoparticles of ceramic oxide materials, nanoceramic layers and volume materials, catalytic electrochemical and co-ordination systems

Prof. RNDr. Tomáš Šikola, CSc. – Ultra-thin layers, ion and molecular beam technologies, ion beam etching of micro/nanostructures, the creation of nanostructures with the SPM methods, the development and application of methods for the *in situ* and *ex situ* surface analyses, thin layers and nanostructures (UHV STM/AFM, TOF-LEIS, XPS, SIMS, ellipsometry/reflectometry, and LEED/AES)

Prof. RNDr. Jaroslav Pokluda, CSc. – Mechanical properties of materials, physics and micromechanics of deformations and fissures

Prof. Ing. Jiří Švejcar, CSc. – Structural analytics (TEM, AEM, SPM, etc.)

Doc. RNDr. Pavel Šandera, CSc. – Limit material states, computer modelling and simulations, *ab initio* calculations of mechanical properties of solid substances

Prof. RNDr. Ivan Ohlídal, DrSc. – Optics of thin layers and surfaces of solid substances, AFM

Prof. Ing. Bohumil Bumbálek, CSc. – Micro and nano machining

Authorised

Codes: 1a, 1b, 1c, 1d, 1e, 5c, 7a, 7d. 7e

5.2.4.2. Faculty of Electrical Engineering and Communication Technologies (FEKT VUT)

Údolní 53, 602 00 Brno

www.feec.vutbr.cz

Brief workplace description

FEKT VUT focuses on the training and research in the areas of electrical engineering and communication technologies. This relates especially to microelectronic systems, electronic communication systems and technologies, the optimal utilisation of electric energy, automation of technological and manufacturing processes, information and management systems, applied cybernetics, etc. Activities in the Faculty have been assigned to 12 institutes, which are divided, in some cases, into laboratories. The research of nanotechnologies takes place only within limited scope and it has been identified in the Institute of Physics (P. Tománek) and in the Institute of Microelectronics (R. Vrba, J. Hubálek).

Research and development focus

FEKT VUT will solve the research intention, which has been largely focussed on nanotechnologies in the period 2005–2010.

Research intention MSM0021630503 "New trends in microelectronic systems and nanotechnologies (MICROSYN)" (2005–2010), the solver – Prof. Ing. Radimír Vrba, CSc.

Research task puts stress on the issues of advanced microelectronic circuits, microsystems and structures on chips. All problem areas in the research task are focussed on new and perspective prepared micro, nanosystems, and technologies within the time horizon before the end of 2010. The task of the basic and applied research focuses on the five following research fields: 1. Theory, design and diagnostics of low voltage and a low intake integrated circuits in sub micron technologies, 2. Modelling and simulation of integrated circuits, 3. Microsystems and nanosystems, 4. Advanced technologies for microelectronics and nanoelectronics, 5. Modern diagnostics of materials and parts. Objectives of the research intention in its individual fields relate to the gaining of original results during the research of new microelectronic systems, progressive methods for their solution and optimising in the applied research of new micro and nanotechnologies for the preparation of new electronic structures and semiconductor parts of new generations.

The Institute of Physics develops, for a long time, activities within the Laboratory of the optical nanometrology under the leadership of Prof. RNDr. Pavel Tománek, CSc. The Laboratory

organises non contact and non destructive research of material surfaces with the cause super differentiation and uses for it the optical lining tunnelling microscopy working within the reflection and permeable modes. The main objectives are the topography, local spectroscopy and the fluorescence of semiconductor surfaces, and the manufacture of probes for microscopes.

The Institute of Microelectronics, the Laboratory for the research and development of microsensors, is involved in the applications of nanomaterials in chemical sensors detecting heavy metals, measurable conductivity, and gases. In the field of thin layers, they focus on the research of techniques for the creation of MEMS and NEMS.

Projects solved in the area of nanotechnologies

GA CR project GP 102/04/P162 "Micro and nanostructures implemented in microelectronic technologies" (2004–2006), the solver – Ing. Jaromír Hubálek, PhD.

Project GA CAS 1QS01710508 "Impedimetric chemical microsensors with the nanomachined electrode surface" (2005–2009), the solver – Ing. Jaromír Hubálek, PhD.

MEYS project 1K05018 "Application of nanotechnologies and nanomaterials in chemical sensors" (2005–2005), the solver – Prof. Ing. Radimír Vrba, CSc.

Experts/Field

Prof. RNDr. Pavel Tománek, CSc. – Optical nanometrology, the study of local optical and electric properties

Prof. Ing. Radimír Vrba, CSc. – Microelectronics

Ing. Jaromír Hubálek, PhD. – Self-assembling nanostructures, nanowires, nanotubes, MEMS and NEMS, chemical microsensors, nanoelectronics

Authorised

Codes: 2a, 2f, 4a, 6a, 6c, 7a, 7e

5.2.4.3. Faculty of Chemistry (FCH VUT)

Purkyňova 118, 612 00 Brno

www.fch.vutbr.cz

Brief workplace description

Scientific research activities make, together with paedagogic activities, an inseparable part of the mission of FCH VUT in Brno. Specific activities in that area are based on the expertise of individual institutes within the Faculty. The Institute of Physical and Consumer Chemistry focuses especially on the issues in physical chemistry of colloid and macromolecular systems, photochemistry, plasma chemistry and physics, and on computer applications in chemistry, chemical technology and physics. The Institute of the Chemistry of Materials focuses on the activities related to the study of chemistry and technology and of the properties of silicate, metallic, polymer, and composite materials with the direct utilisation of the gained knowledge in the manufacturing technology and in the processing in accordance with the required

material applications. The scientific and research expertise in the Institute of Chemistry and Technology in the Environment Protection focuses on the area of the chemistry and technology in the water treatment, protection of soil and air. The Institute is also involved in the issues of the special industrial toxicology and ecotoxicology and in the issues related to the waste liquidation and recycling. The Institute of the Chemistry of Food and Biotechnologies resolves, within its scientific activities, the issues in the area of biology, theoretical and experimental biochemistry, microbiology, bioengineering, and the technologies in the food manufacturing. The research of nanotechnologies has been identified in the Institute of Physical and Consumer Chemistry (M. Weiter), the Institute of the Material Chemistry (V. Čech, J. Jančář), and in the Institute of the Chemistry of Food and Biotechnologies (M. Fišera).

Research and development focus

FCH VUT will solve the research intention that has been largely focussed on nanotechnologies and in which all FCH VUT institutes will be involved during the period 2005–2009.

Research intention MSM0021630501 "Multifunctional heterogeneous materials based on synthetic polymers and biopolymers" (2005–2009), the solver – Prof. RNDr. Josef Jančář, CSc.

The research intention is focussed on the research of advanced methods for the preparation and characterisation of heterogeneous materials, especially the polymer mixtures, nanostructures and composites, but also on the research of low dimension structures – the ultra-thin layers/multilayers.

In the Institute of Physical and Consumer Chemistry (the leading researcher is Doc. Ing. Miloslav Pekař, CSc.), the activities focus on the simulation of conformation relaxations of the chains of different sizes of the statistical segment and with different interaction potential between the nanoparticle surface and segments, including the effect of temperature and external force fields. The objective is the prediction of molecular structures of the chains either with the maximised or minimised nanoeffects. Activities of the institutes are also focussed on the study of transport phenomena in solid substances, the study of the molecular electronics, and the research of photochemical and photocatalytic processes at the molecular level.

The Institute of Material Chemistry (the leading researcher is Doc. RNDr. Vladimír Čech, PhD.) focuses its activities on the area of nanotechnologies related to the preparation, characterisation and application of thin and ultra-thin layers applied in the low temperature plasma (the plasma polymerisation) and with wet chemical processes (the sol-gel), or in their combination. Current works focus on the managed deposition of functionally nanostructured and gradient layers determined for the design of compatible interlayers usable for multicomponent materials (the composites and nanocomposites strengthened with fibres). The objective is the preparation of custom-made materials of beforehand defined physical-chemical properties.

The Institute of the Chemistry of Food and Biotechnologies (the leading researcher is Doc. Ing. Miroslav Fišera, CSc.) organises the research works belonging to the area of nanobiotechnologies. They are, for example, the isolation and characterisation of plant and bacterial enzymes usable in the industry (pectates, glucans, and the protease) and the possibility of their immobilisation and utilisation in the enzyme reactors. In the area of proteomics, this relates to the utilisation of microbial expressive systems for the manufacture of metabolites, food raw materials and components within the laboratory scale, with the possibility of a pilot plant adjustment.

Projects solved in the area of nanotechnologies

MEYS project OC 527.110 (COST) "Thin layers of plasma polymers prepared in the RF induction bound system" (2001–2005), the solver – Doc. RNDr. Vladimír Čech, PhD.

GA CR project 104/03/0236 "Optimised interphases in the composite system glass fibre/ polyester resin" (2003–2005), the solver – Doc. RNDr. Vladimír Čech, PhD.

MEYS project 1P05OC087 (COST) "Creation of plasma polymer structures" (2005–2007), the solver – Doc. RNDr. Vladimír Čech, PhD.

GA CR project 203/03/63D133 "Light-managed molecular flow switch" (2003–2006), the solver – Ing. Martin Weiter, PhD.

Experts/Field

Prof. RNDr. Josef Jančář, CSc. – Synthetic polymers and biopolymers

Doc. RNDr. Vladimír Čech, PhD. – Preparation, characterisation and the use of thin layers, with fibre strengthened polymer composites, material interfaces, composite interphases

Ing. Martin Weiter, PhD. – The preparation and study of optoelectronic properties of organic semiconductor materials

Doc. Ing. Miroslav Fišera, CSc. – Element and species analysis by the AAS, AFS, ICP-AES, and ICP-MS methods, the sensory food analysis

Authorised

Codes: 1d, 1f, 2a, 2e, 3d, 6a, 7c

5.2.5. Institut of Chemical Technology in Praha (VŠCHT)

The Institute of Chemical Technology in Praha is the biggest educational institution of its kind in the Central and Eastern Europe. It extends the more than 170 years long traditions of the training in the field of technological chemistry in the area of now the Czech Republic. Research and development are organised in all chemical fields. VŠCHT has got 4 faculties. The research of nanotechnologies is organised in the Faculty of Chemical Technology and in the Faculty of Chemical Engineering.

There are 13 programme projects and 2 research intentions focussed on nanotechnologies, out of the 216 solved ones, 6 research intentions respectively.

5.2.5.1 Faculty of Chemical Technology (FCHT VŠCHT)

Technická 5, 166 28 Praha 6

www.vscht.cz

Brief workplace description

The Faculty of Chemical Technology was founded by joining the faculties of inorganic and organic technologies and both these basic chemical directions are represented also in the area of the basic and applied research. The scientific research tasks of the Faculty are tightly interconnected with the pedagogical activities and might be divided into two following mutually related areas:

Material chemistry and technology focusing on the solution of complex relations between the composition, preparation and properties of new materials and the issues of the improvement in usable properties of the traditional metallic and non metallic inorganic materials and polymers.

Chemistry and chemical technology with the focus on the research at the molecular level of the structure of inorganic and organic substances and their reaction mechanisms and on the process and operational sides of their industrial production.

The Faculty has been divided into 10 institutes and one laboratory. The research in the area of nanotechnologies is organised almost in every institute: Institute of Inorganic Chemistry (the leading researcher V. Flemr), Institute of Inorganic Technology (K. Bouzek), Institute of Metallic Materials and Corrosion Engineering (P. Novák), Institute of Glass and Ceramics (A. Helebrant), Institute of the Chemistry of Solid Substances (B. Kratochvíl), Institute of Organic Chemistry (I. Stibor), Institute of Organic Technology (L. Červený), Institute of Polymers (V. Ducháček), and the Institute of the Solid Substance Engineering (V. Švorčík).

Research and development focus

FCHT VŠCHT will solve the research intention that is partly focussed on nanotechnologies in the period 2005–2009.

Research intention MSM6046137302 „Preparation and research of functional materials and material technologies with the use of micro and nanoscopic methods" (2005–2009), the solver – Doc. Ing. Aleš Helebrant, CSc.

The most important issue in the research intention is the study of relations between conditions of the material preparation and the material composition, structure and properties. This should allow for the targeted preparation and development of new kinds of materials with defined properties and for the improvement in properties and functions of their applications. From the application point of view, the research includes the three main following areas: 1) Materials for technological applications, 2) Materials for the human health, 3) Materials for the protection of the environment. The research shifts, in correspondence with the European and worldwide trends, to the area of nanomaterials and nano and microscopic layers. Objectives of the individual partial areas can be made more general and divide them into groups, which go across the individual areas:

- Finding and generalising the relations between the composition, structures and conditions of the preparation of special materials and substances with the beforehand selected chemical, pharmacological, physical and physical-chemical properties, and the development of chemical methodologies,
- Preparation of surface modifications and secondary surface layers on materials and their transfer into the technological practice,
- Optimising of technological processes, the application research in the area of new techniques and technologies with the utilisation of computer simulations,
- Clarification of physical-chemical processes taking place in material contacts with the surrounding environment and the design of ways utilised for the prevention of corrosion and material degradation,
- Modelling of material structures and processes during their preparation at the microscopic and nanoscopic levels, the development of analytical methods allowing for their verification.

There are two partial research projects solved within this research intention:

- "Preparation and properties of nanocrystalline metals", the solvers – Ing. Jan Šerák, PhD. and Doc. Dr. Ing. Dalibor Vojtěch. The goal of this project is to prepare powders of nanocrystalline metals by different methods.
- "Nanocrystalline thermally stable aluminium alloys produced with the technology of powder metallurgy", the solvers – Doc. Dr. Ing. Dalibor Vojtěch and Ing. Jan Verner. The project deals with the preparation and the study of properties of nanocrystalline aluminium alloys with transition metals (Cr, Ni, Fe, Zr, Ti, etc.). The alloys are manufactured with the technology of the powder metallurgy, which includes the ultra-fast cooling of melts and the compacting of the occurring powders.

The Institute of Inorganic Chemistry, in the team involved in superconductors and other materials based on transition metals, D. Sýkorová deals with the research that should improve the quality of high temperature superconductors by the use of nanotechnologies.

The Institute of Inorganic Technology, in the working group involved in catalytic processes, the issues of nanofiltration and projects focussed on nanotechnologies are solved by B. Bernauer, V. Fila, and J. Krýsa.

The Institute of Metallic Materials and the Corrosion Engineering solves the issues of nanocrystalline metals – D. Vojtěch and J. Šerák.

The Institute of Glass and Ceramics, the group dealing with the chemistry and technology of glass, is involved in the research of active surface nanolayers (J. Matoušek). Another involved worker is V. Hulínský.

The Institute of Solid Substance Chemistry, the group interested in the applied mineralogy – D. Koloušek, deals with the research of zeolite applications.

The Institute of Organic Chemistry, F. Hampl and R. Cibulka, they study the reactivity on the phase interface of nanoaggregates in micelles and microemulsions.

The Institute of Organic Technology deals with nanotechnologies in connection with the study of the material properties for catalysis, optoelectronics and the conversion of solar energy.

The Institute of Polymers organises the study of the synthesis of macromolecular substances, polymerisation mechanisms and the physical-chemical characteristics with the focus on the synthesis of polyamides, polyesters, polyesteramides, and their nanocomposites.

The Institute of the Solid Substance Engineering researches biomaterials for the tissue engineering (V. Švorčík), the materials for electronics and optoelectronics (I. Hüttel and J. Leitner), and the technologies for the preparation of thin layers by the pulse laser deposition (V. Myslík).

Projects solved in the area of nanotechnologies

GA CAS project 1QS401250509 "Ceramic materials with the hierarchy porous structure for the membrane separation technologies" (2005–2008), the solver – Doc. Ing. Bohumil Bernauer, CSc. The membrane technologies become an important alternative to the classic technologies. The completely ceramic membranes are important in high temperature processes. The project has been inspired by the need to lower costs of the preparation of micro and nano-filtration membranes with the hierarchy porous structure. The route to the lowering of the production requirements related to the hierarchy structures of membranes led through the lowering in the number of transition layers in the nanofiltration membranes. The nanofiltration layers will

be based on zeolites silicalit-1, NaA, NaY a DD3R. The main objectives in the project are as follows: (i) Gaining of laboratory processes for the preparation of ceramic carriers of the standard quality with the minimal number of transition layers (ii) Gaining of processes for the preparation of nanofiltration layers of the standard quality on these layers. The main result will become the materials for the consequent industrial research and development.

GA CR project 103/03/0506 "Composition, properties, characterisation, and utilisation of clay minerals for the preparation of composites for special uses" (2003–2005), the solver – Ing. David Koloušek, CSc. The objective of this project is to contribute to the study of relations of nanostructures and the reactivity of some burnt clay materials for the consistent industrial assessment of the so far not satisfactorily utilised rich stock of these raw materials in the Czech Republic for the manufacture of binders.

GA CR project 203/04/0488 "Properties of the phase interface in nanoaggregates and their impact on the chemical reactivity" (2004–2006), the solver – Doc. Ing. František Hampl, CSc.

GA CR project 203/05/0114 "Bismuth superconductors with nanoparticles of dopants" (2005–2007), the solver – Doc. Ing. Dagmar Sýkorová, CSc.

GA CR project 106/03/1626 "Polymers for the tissue engineering" (2003–2005), the solver – Prof. Ing. Václav Švorčík, DrSc. The objective of this project is to study the relation between the physical-chemical properties of modified polymers and their biocompatibility. There are polymer non biodegradable films modified (PE, PMMA, and PTFE) as well as the hydrogels based on 2-hydroxyethyl-metacrylate. The polymers are exposed to an ion beam, UV-excimer lamp and plasma in different atmospheres. The method in vitro is used for the study of the interaction of modified polymer surfaces with skin and soft muscle cells. The result of the project should contribute to the treatment of lost skin cover, or possible for the transplanting surgery in the area of artery prostheses. The project includes nanobiotechnologies.

Co-operation in the solution of the MEYS project 1M0577 "Research centre for nanosurface engineering" (2005–2009), the solver – Ing. František Peterka, PhD., ATG, s.r.o., Praha. The co-solver on behalf of FCHT VŠCHT – Doc. Ing. Josef Krýsa, Dr. (see 6.2.1).

Co-operation in the EU 6th FP project NANOMEMPRO – "Expanding membrane macroscale applications by exploring nanoscale material properties" (2004–2008), the solver – Doc. Ing. Bohumil Bernauer, CSc.

Co-operation in the EU 6th FP project CIDNA – "Control of assembly and charge transport properties of immobilized DNA" (2004–2007)

Co-operation in the solution of MIT project FT-TA2/049 "Support of research and development of technologies based on zeolite catalysts in BorsodChem MCHZ Ostrava" (2005–2008), the solver – Ing. Petr Machek, the co-solver on behalf of VŠCHT-FCHT – Prof. Ing. Josef Pašek, DrSc.

Experts/Field

Prof. Ing. Václav Švorčík, DrSc. – Biocompatibility of modified polymers, thin metallic films

Prof. Ing. Josef Matoušek, DrSc. – Glass chemistry and technology

Doc. Dr. Ing. Dalibor Vojtěch – Nanocrystalline metals and their alloys, nanocrystalline surface layers, light alloys of Al, Mg, Ti, and metallic composite materials

Ing. Jan Šerák, PhD. – Nanocrystalline materials, plasma nitriding of tool steels, quality optimising and management in the case of aluminium alloys, the issues of intermetallic phases in aluminium alloys

Doc. Ing. Bohumil Bernauer, CSc. – Chemical technology, reactor engineering, membrane reactors and processes, process modelling

Doc. Dr. Ing. Josef Krýsa – Photocatalysis, electrochemical and material engineering

Doc. Ing. Václav Hulínský, CSc. – Electron microscopy and the microanalysis of inorganic materials (glass, ceramics), TEM, SEM, and nanoporous membranes

Prof. Ing. Josef Pašek, DrSc – Organic technologies, zeolite catalysis

Doc. Ing. Ivan Hüttel, DrSc. – Technology for the preparation of passive and active elements and structures in the integrated optics (the semiconductor lasers, optical waveguides, optical sensors).

Prof. Ing. Jindřich Leitner, DrSc. – Thermodynamic properties of mixed oxides, nitrides of elements in the 3rd sub group for the application in electronics and optoelectronics

Doc. Ing. Vladimír Myslík, CSc. – Laser technologies for the modification and transfer of inorganic and organic substances, the preparation of thin layers sensitive to reduction and oxidation atmosphere, the study of chemical and electrophysical properties of deposited layers, the preparation of chemical conductive sensors and their testing

Authorised

Codes: 1d, 1e, 1f, 2b, 3c, 4a, 5a, 5b, 5c, 7c

5.2.5.2. Faculty of Chemical Engineering (FCHI VŠCHT)

Technická 5, 166 28 Praha 6

www.vscht.cz

Brief workplace description

FCHI focuses in the teaching and in research mainly on the following areas: Process engineering, molecular engineering, bioengineering, analytical and physical chemistry, process management, and the measuring and control technology. The Faculty has been divided into 7 institutes. The two of them – Institute of Analytical Chemistry (the leading researcher is K. Volka), Institute of the Chemical Engineering (the leading researcher is V. Machoň), are involved in nanotechnologies.

Research and development focus

The Faculty organises solutions of two research intentions in the period 2005–2009 and the topic related to nanotechnologies is represented especially in the research intention MSM6046137307 "Physical-chemical methods in the analysis and description of chemical systems and biosystems", the solver – Prof. Ing. Karel Volka, CSc.

The subject of the research activities within the research intention is the gaining new or better quality physical-chemical data characterising the chemical and biochemical, or biological systems with the aim to describe or predict their thermodynamic properties and phase behaviour,

to clarify their chemical composition and structures, to propose systems with defined analytical or other usable properties, or to suggest new analytical methods. The research focuses on several areas, including the following ones, which relate to nanotechnologies:

- Phase balances, fluid phase balances in systems with technological importance, the theoretical, pseudo-experimental and experimental studies of balanced and metastable phase transfers in macroscopic and nanostructured systems.
- Phenomena on phase interfaces and in membranes, in the inter-phase between the two fluid volume phases and between the solid and fluid phases, the sorption of long-term bio-toxic radionuclides on natural sorbents, the transport of gas and vapour mixtures through polymer membranes, the interaction on surfaces of nanoparticles and films.

The Institute of Analytical Chemistry, the Laboratory of the molecular recognition, Prof. RNDr. Vladimír Král, CSc. is leading the following works: The preparation and characterisation of nanoparticles, the modification of Au nanoparticles by selective receptors, the preparation of nanoparticles of metal-boron nanoclusters, the preparation of porphyrine nanoparticles for the utilisation in medicine, ceramic nanoparticles with photosensitisers for the PDT application, ceramic nanoparticles with immobilised metal-porphyrines for the catalysis (the oxygenation of olefines), the functionalisation of dendrimers.

The Institute of Chemical Engineering organises the studies of transport phenomena in the micro and nanostructured systems and executes theoretical and experimental analyses of possibly usable, especially chemical and biological, processes and their combinations, which might be done within the microscale more efficiently than within the macroscale, or which can be done only within the microscale (D. Šnita and J. Lindner).

Projects solved in the area of nanotechnologies

GA CAS project KJB01280501 "Functionalised polymers" (2005–2007), the solver – Ing. Tomáš Bříza. This is about the functionalisation of dendrimers.

GA CR project 104/04/1442 "Transport of matter, temperature and momentum in ion-chemically reacting micro and nanosystems" (2004–2006), the solver – Doc. Ing. Dalimil Šnita, CSc.

GA CR project 104/03/D005 "Transport phenomena around acid-subsilicic interfaces in the space micro and nanostructured systems under the influence of the external electric field" (2003–2006), the solver – Ing. Jiří Lindner, PhD.

MIT project 1H-PK/24 "Microtechnology and nanotechnology in the chemical, process and biological engineering: Methods in the study of micro and nanostructured materials" (2004–2008), the solver – Doc. Ing. Dalimil Šnita, CSc.

Experts/Field

Prof. RNDr. Vladimír Král, CSc. – Molecular recognition

Doc. Ing. Dalimil Šnita, CSc. – Transport phenomena in micro and nano systems

Codes: 1c, 3g, 5c, 6d

5.2.6. University of West Bohemia in Plzeň (ZČU)

ZČU, the only university in the region of West Bohemia, prepares experts within the following fields: Mechanical engineering, electrical engineering, informatics, applied mathematics, physics and mechanics, economy, pedagogy, philosophy, philology, social and cultural anthropology, archaeology, jurisdiction, and public administration. Research in the above-mentioned fields is organised, according to the capacities of the University. ZČU has been divided into 7 faculties. The research of nanotechnologies is organised, within limited scope, in the Faculty of Applied Science and in the Faculty of Mechanical Engineering.

There are 3 programme projects and one research intention out of 86 programme projects and 5 research intentions respectively related to nanotechnologies.

5.2.6.1. Faculty of Applied Sciences (FAV ZČU)

Univerzitní 22, 306 14 Plzeň

www.fav.zcu.cz

Brief workplace description

FAV ZČU is the faculty of the engineering-natural science kind. The scientific research activities are organised within the informatics and in the computing technology, mathematics, cybernetics, physics, and mechanics. The Faculty has been divided into 5 departments. The Department of physics is involved in nanotechnologies (the leading researcher is J. Vlček).

Research and development focus

FAV ZČU will solve the research intention, which has been partly focussed on nanotechnologies, in the period 2005–2010.

Research intention MSM4977751302 "Processes in discharge plasma and new thin layer materials having unique properties" (2005–2010), the solver – Prof. RNDr. Jaroslav Vlček, CSc.

The subject of the research intention is the solution of fundamental problems in the area of the discharge plasma physics, plasma chemistry, the physics and engineering of surfaces, the physics of thin layers, the physics of solid substances, electrical engineering, and vacuum technologies in connection with the utilisation of thin layer materials of unique physical and functional properties. These materials are designed mainly in non conventional processes in the varied discharge plasma mostly by the magnetron and microwave discharges. The main attention is turned onto the modelling and diagnostics of not balanced discharge plasma, the study of layer growth processes and to the modification of surfaces, the design and research of new plasma sources for the deposition of thin layers and the surface modification, the characterising of created surfaces, and also to the study of thermomechanical processes taking place in materials. The research activities are focussed mainly on new nanostructured thin layer materials, the new thin layer materials based on ternary and four-ternary systems of carbon, silicon, boron, nitrogen, and other materials.

The issues related to nanostructured materials (layers) have made one part of the main directions for the Department of physics already for 10 years. There is the research of the technology for the preparation of layers (the magnetron sputtering, non conventional plasma processes), but also the research of these layers' properties organised. The objective of these works is the practical application of the solution results.

Projects solved in the area of nanotechnologies

GA CR project GP 106/03/D009 "Reactive deposition and characterisation of thin layers based on new compounds" (2003–2006), the solver – Ing. Petr Zeman, PhD. There are the following issues studied: a) Photoactive titanium oxide – TiO_2, b) Nanostructured materials based on nitrides or oxides, c) The quaternary system Si-B-C-N. The subject of the research is also the nanocrystallisation from the amorphous state.

MEYS project ME673 (the international co-operation) "New plasma sources for the creation of thin layers" (2003–2007), the solver – Prof. RNDr. Jaroslav Vlček, CSc.

Co-operation in the solution of the 5th FP project PHOTOCOAT "Advanced materials and manufacturing technologies for photocatalytically active surfaces" (2003–2007), the solver – Prof. Ing. Jindřich Musil, DrSc.

Experts/Field

Prof. RNDr. Jaroslav Vlček, CSc. – Plasma physics, plasma chemistry, physics of thin layers and physics of solid substances

Prof. Ing. Jindřich Musil, DrSc. – Nanostructured and nanocomposite layers, PVD and PVD+CVD methods of sputtering, the technology for the preparation of layers with the manageable sizes of grains, within the scope 1–10 nm

Ing. Petr Zeman, PhD. – Nanocrystallisation from the solid state

Codes: 1b, 1d, 7c

5.2.6.2. Faculty of Mechanical Engineering (FST ZČU)

Univerzitní 22, 306 14 Plzeň

www.fst.zcu.cz

Brief workplace description

FST ZČU in Plzeň belongs among the biggest and oldest university faculties in Plzeň. It organises the teaching and research of several disciplines related to mechanical engineering. The Faculty has been divided into 6 departments. The research of nanotechnologies, within limited scope, is done in the Department of materials and machinery metallurgy (the leading researcher is V. Mentl).

Research and development focus

The scientific research activities in the Department are focussed on the structure of metal and other than metal materials, their mechanical properties and heat processing, forming of difficult materials, including the numerical simulation of forging and thermal processing, special methods of welding, non conventional ways of casting, and the engineering of thin layers and surfaces. The last mentioned area relates to the research of nanotechnologies. It assesses especially the mechanical properties of thin layers and nanostructured materials by the nanoindentation method. This workplace pays attention also to bulk materials containing structural nanosize phases.

Projects solved in the area of nanotechnologies

GA CR project GP 106/03/P092 "Contribution of progressive nanolayers and sandwich thin layers in the machining process" (2003–2005), the solver – Doc. Dr. Ing. Antonín Kříž.

Co-operation in the solution of the research intention MSM2631691901 "Metal materials of the sub micron and nanometric structures prepared by the methods of the intensive plastic deformation" (2004–2009), the solver – Prof. Ing. Jozef Zrník, CSc (COMTES FHT, s.r.o., Plzeň).

Experts/Field

Prof. RNDr. Jaroslav Fiala, CSc. FEng. – X-ray analysis, crystallography, material engineering

Prof. Ing. Jozef Zrník, CSc. – Metal forming by the large plastic deformation (ECAP), metal alloys

Doc. Dr. Ing. Antonín Kříž – Thin wear-proof layers, their analysis (the tribology, microhardness, structure, and adhesive-cohesive properties) and the industrial applications

Ing. Olga Bláhová, PhD. – Mechanical properties and the microstructure of thin layers, material properties within micro and nano volumes, nanoindentation

RNDr. Ivo Štěpánek – Optimising of the thin layer depositions, especially by the PVD technologies, properties and behaviour of (especially mechanical) systems with thin layers – in the substrates and in localities on the material surfaces - in the micron, sub micron to nanometric areas, especially the nanoindentation measuring, and nanoindentation

Authorised

Codes: 1c, 1d, 7a

5.2.7. Technical University in Liberec (TUL)

TUL has become, since 1989, when it was a usual university technologically focussed with two faculties, a well-known university, which is respected both in the country and abroad. It is now the university with six faculties and it interconnects technical training with humane education. The research in the field of nanotechnologies of limited scope has been identified in the Faculty of Mechanical Engineering, Faculty of Textiles, and in the Faculty of Mechatronics and Interdisciplinary Engineering Studies.

There are two, out of 57, programme projects focussed on nanotechnologies.

5.2.7.1. Faculty of Mechanical Engineering (FS TUL)

Hálkova 6, 461 17 Liberec

www.fs.vslib.cz

Brief workplace description

The Faculty of Mechanical Engineering is the oldest faculty within the Technical University in Liberec. It provides for the teaching and research in the fields of the mechanical technology, applied mechanics, the design of machines and facilities, and manufacturing systems

and processes. The Faculty has got 11 departments. The research of nanotechnologies, within very limited scope, is organised in the Department of materials (the leading researcher is P. Špatenka).

Research and development focus

The scientific research activities in the Department are focussed on the material engineering. It specifically deals with the thermal processing, especially the surface one, the testing of materials, surface adjustments and thin layers, intermetallic compounds, and composites and technical ceramics. The subject of the research of nanotechnologies is the creation of plasma thin layers, the preparation and assessment of thin layers with the use of the PVD and CVD technologies and the assessment of mechanical properties, wear-resistance, life span, and other usable properties, including biocompatibility.

Projects solved in the area of nanotechnologies

Co-operation in the solution of the MEYS project 1M0577 "Research Centre for the nano-surface engineering – NANOPIN" (2005–2009), the grantee – ATG, s.r.o., Praha, the solver – Ing. F. Peterka, PhD. (see 6.2.1). The co-solver on behalf of TUL-FS – Prof. RNDr. Petr Špatenka, CSc.

Participation in the work by the Centre of Excellence (5th FP) NANODIAM "New Technologies for Medical Applications: Studying and production of carbon surfaces allowing for controllable bioactivity" (2003–2005), the solver – Prof. Ing. Petr Louda, CSc.

Experts/Field

Prof. RNDr. Petr Špatenka, CSc. – Plasma technology, the deposition of biocompatible layers

Doc. Ing. Petr Louda, CSc. – Plasma technology, properties of thin layers

Codes: 1d, 3d, 7c

5.2.7.2. Faculty of Textiles (FT TUL)

Hálkova 6, 461 17 Liberec

www.ft.vslib.cz

Brief workplace description

FT TUL was founded in 1960, thanks to the influence of the traditions of the textile industry all around. Currently, it organises education and research of the complex textile issues. The Faculty has got 8 departments. Workers from the Department of non woven textiles are involved in the research in the field of nanotechnologies.

Research and development focus

The research is focussed on the preparation technologies for polymer nanofibres, their properties and ways of further processing. There is also the research of nanofiltration organised.

The research applications – facilities for the manufacture of nanofibres NANOSPIDER (see Elmarco, s.r.o. in Liberec).

Projects solved in the area of nanotechnologies

MIT project 1H-PK2/46 "Nanofibres and their composites for technical and biomedical applications" (2005–2008), the solver – Prof. RNDr. Oldřich Jirsák, CSc.

Experts/Field

Prof. RNDr. Oldřich Jirsák, CSc. – Non woven textiles, technical textiles, fibres, nanofibres

Ing. Jakub Hrůza – Fibre filters, filtration properties of fibrous materials

Codes: 1f, 5a, 7d

5.2.7.3. Faculty of Mechatronics and Interdisciplinary Engineering Studies (FM TUL)

Hálkova 6, 461 17 Liberec

www.fm.vslib.cz

Brief workplace description

Research and development in FM TUL are focussed on the electrical engineering, electronics, the management and measuring technologies, the mathematical modelling of processes, and on the natural science engineering. The Faculty has been divided into 8 departments and the International Centre for the Research of Piezo-electricity. The research in the field of nanotechnologies has been found in the Department of process modelling, in the Redevelopment technologies section.

Research and development focus

The research is focussed on the creation of a mathematical model usable for the analysis of the utilisation of metal nanoparticles during reconstructions related to underground water and the mineral environment.

Projects solved in the area of nanotechnologies

GA CAS project ET408040515 "Mathematical modelling of the migration and interaction of nanoparticles" (2005–2007), the solver – Dr. Ing. Miroslav Černík, CSc.

Experts/Field

Dr. Ing. Miroslav Černík, CSc. – Mathematical modelling

Codes: 1a, 8b

5.2.8. Jan Evangelista Purkyně University in Ústí nad Labem (UJEP)

The Jan Evangelista Purkyně University in Ústí nad Labem, founded in 1991, boasts of the name of the worldwide famous scientist of the 19th century – born in the Northern Bohemia, in the nearby municipality of Libochovice. The University consists of 5 faculties and 5 institutes. The research of nanotechnologies is organised in the Faculty of Science.

5.2.8.1. Faculty of Science (PřF UJEP)

České mládeže 8, 400 96 Ústí nad Labem

http://sci.ujep.cz

Brief workplace description

The Faculty of Science was founded on 4 November 2005 by the transformation of the former Institute of Natural Science within UJEP. Its mission is the education and development of knowledge about natural sciences. The main attention is focussed on the plasma physics, plasma chemistry, physics of thin layers, the computing in physics, the computing method, biotechnology, microbiology, and the biology of plants and animals, the applied geography, the environmental geography synthesising physical-geographic and social-geographic aspects of landscape, the organic chemistry, modelling, calculations in chemistry, the instrumental methods within the analytical chemistry, the computer simulation and numerical analysis of problems within the pressurised flows, radio-biologic processes in living cells, and the self--organising imagining. The Faculty has got six departments (biology, physics, geography, chemistry, informatics, and mathematics). The research of nanotechnologies is organised in the Department of biology (the head of the department is J. Hajer) and in the Department of physics (the head of the department is Z. Moravec).

Research and development focus in the field of nanotechnologies

Characteristics of the activities by the Department of biology:

The characterising of surfaces of the monolayers of immobilised biomolecules (proteins and nucleic acids) with the aid of AFM methods, the finding of relations between the nanostructure of the enzyme electrode surfaces and their responses, the study of the utilisation of nanostructured electrodes for the improved transfers of matter, the study of the utilisation of the UV photolithography of spontaneously organising monolayers (SAM) for the design of enzyme electrodes, the research of the targeted electrochemically managed immobilisation of biomolecules on the surface of micro(nano)-electrode field of the electrochemical biochip.

Characteristics of the activities by the Department of physics:

The research of the structure and morphology of thin layers prepared with the assistance of plasma focussed on new nanostructured materials for gas sensors (based on SnO_2), the preparation of thin oxide layers (Al_2O_3, SnO_2) by the method of plasma oxidation, the deposition of nanocomposite layers metal/polymer, the experimental characterising of the structural properties (SIMS – the weight spectrometry of secondary ions) and the surface morphology (AFM – the microscopy of atomic forces) of different materials, the study of mutual relations between the surface morphology (AFM) and the structural properties (SIMS, RBS, and XPS) of thin layers of the oxides prepared by the plasma oxidation in relation to the plasma parameters, the study of morphologic and electric properties of thin layers by the methods of the computer modelling.

Projects solved in the area of nanotechnologies

Co-operation in the GA CAS project 1ET400720409 "Application of advanced simulation methods for the study of the structure, physical-chemical properties and the preparation of composite materials and nanomaterials" (2004–2008), the solver 1 – Prof. RNDr. Ivo Nezbeda, DrSc., ÚCHP CAS, the solver 2 – Doc. RNDr. Stanislav Novák, CSc., Department of physics, PřF UJEP, Ústí nad Labem. The project deals with the development of new methods and algorithms for the computer modelling and molecular simulations in the areas of material research and its applications, especially in the area of the utilisation of nanomaterials as nanoreactors in the area of materials with complex surface or volume structures.

The Department of physics is involved in the international action COST P12 – "Structuring of Polymers" with the solution of the project "Nanocomposite films Sn or SnO_2 with hydrocarbon polymer matrix" (2005–2007), the solver – Doc. RNDr. Jaroslav Pavlík, CSc., Department of physics, PřF UJEP, Ústí nad Labem. The project relates to the study of the deposition process and to the study of properties (the structure, morphology, and electric and optical properties) of thin nanocomposite layers of the kind Sn, SnO_2/plasma polymer.

Co-operation in the MIT project FT-TA/089 "IBIS – Intelligent biosensoric system for the detection of pesticides and herbicides in the environment" (2004–2007), the solver – RNDr. J. Krejčí, BVT Technologies, a.s., Brno. The co-solver – Mgr. Jan Malý, Department of biology PřF, UJEP, Ústí n. L. The project relates to the study of properties and to the design of the design of an intelligent biosensoric system for the detection of herbicides and pesticides.

Experts/Field

Doc. RNDr. Stanislav Novák, CSc. – Computer modelling, the morphology of thin layers, composites, nanocomposites, plasma chemistry

Doc. RNDr. Jaroslav Pavlík, CSc. – Experimental characterising of structural properties, nanostructured materials for gas sensors (based on SnO_2), nanocomposite Sn layers, the SnO_2/plasma polymer

Mgr. Jan Malý – Electrical engineering of the managed immobilisation of biomolecules on the surface of the micro(nano)-electrode field of the electrochemical biochip

Authorised

Codes: 1d, 1f, 3c, 3d, 4b, 6a, 7a

5.2.9. University of Pardubice (UPCE)

The University of Pardubice develops more than fifty year-long traditions of university education in the City. It started with a single faculty focussed on chemistry and it is now an institution providing for the university kind education. It has been called the University of Pardubice since 1994. UPCE has got 5 faculties and 2 university institutes. The research focussed on the area of nanotechnologies is organised in the Faculty of Chemical Technology.

5.2.9.1. Faculty of Chemical Technology (FCHT UPCE)

Nám. Čs. legií 565, 532 10 Pardubice

www.upce.cz

FCHT is the faculty that has got fifty-five years long traditions of a high credit both in the Czech Republic and abroad. It has developed into an important centre for the education and research in the fields of chemistry and technical chemistry, material engineering, chemical technologies, biological and biological-chemical fields, and management processes. The Faculty has been divided into 14 departments and 2 institutes. The research belonging, according to the definition, to nanotechnologies is organised in the Department of general and inorganic chemistry (the head is P. Lošťák), in the Research Centre LC 523 "Perspective inorganic materials" (M. Frumar), and within limited scope in the Institute of Chemical Engineering (Z. Palatý) and the Institute of Polymer Materials (J. Šňupárek).

Research and development focus

The main activities in the research of nanotechnologies relate to the solution of the project within the MEYS programme "Centres for the basic research – LC 523" – "Perspective inorganic materials". The Institute of Inorganic Chemistry of CAS participates in the solution. The project subject is the basic research of new inorganic materials, organometalloid and organometallic compounds with the perspective utilisation in electronics, optics, optoelectronics, in the glass and ceramics industries, in nanotechnologies, and in the role of pigments. There are oxides and chalcogenides of transition and non transition metals studied for the utilisation in nanotechnologies. Nanoparticles of different metallic oxides, photocatalytically active materials based on TiO_2, and the microstructure and the creation of new phases in the RuO_2-TiO_2 system are also studied. The main efforts focus on the preparation of these materials and on their characterising. There are possibilities for the increase in stability of nanoparticles during their warming up and in colloid systems looked for. The looking for the synthesis of photocatalytically active TiO_2 from the industrially accessible raw materials and intermediate products, during the manufacture of pigments based on TiO_2, also makes a part of the research. There is also the method sol-gel studied for the preparation of highly homogeneous materials, for the design of very small (nm) particles for the synthesis of ferroelectric, magnetic and semiconducting materials and materials for the non linear optics and the information recording. In the areas of the information recording and the materials for optics and optoelectronics, there are the thin layers of amorphous and crystalline semiconductors, their phase changes, the luminescence, the non linear optical properties, and the thermic properties, including their adjustments, studied. Nanocomposite magnetic materials are interesting not only for the preparation of high density recording media, but also for the theoretical studies of the magnetic interactions of monodomain structures and the study of the surface magnetism. There are new kinds of magnetic nanocomposites of the spinel structure (e.g. $CoFe_2O_4$, $NiFe_2O_4$) and new matrices based on TiO_2, Al_2O_3, and others prepared and studied. The method sol-gel will be applied also on the preparation of photonic materials – the area that promises new physical properties and new applications.

Works take place especially in the Department of General and Inorganic Chemistry and in a number of service laboratories within the Faculty (M. Frumar, M. Vlček, T. Wágner, P. Němec, and others).

Z. Palatý works in the Institute of Chemical Engineering on the solution of nanofiltration issues.

The Institute of Polymer Materials organises activities in the field of nanotechnologies within the co-operation with ÚACH CAS. They research anticorrosion pigment mixtures (J. Šňupárek, P. Kalenda, and A. Kalendová).

Projects solved in the area of nanomaterials and nanotechnologies

MEYS project Research Centre LC523 "Perspective inorganic materials" (2005–2009), the solver – Prof. Ing. Miloslav Frumar, DrSc.

GA CR project 203/05/0524 "Photonic glasses and amorphous layers" (2005–2007), the solver – Prof. Ing. Miloslav Frumar, DrSc. The project prepares and studies pure and doped photonic glasses created of binary and ternary chalcogenides Ge, As, Sb, Ga, and others, and their thin amorphous layers within nanosizes.

Project 6th FP (STREP) CAMELS "ChaAlcogenide MEmory with multiLevel Storage" (2005–2008), the solver – Prof. Ing. Miloslav Frumar, DrSc.

Project NSF USA "International Materials Institute" with the University of Pennsylvania, Lehigh University and other EU, Japanese and US universities "New Functionalities of Glasses", on behalf of the Czech party – VzC LC523 "Perspective inorganic materials" (M. Frumar).

GA CR project GP 203/04/P087 "Optical properties of amorphous chalcogenides" (2004–2006), the solver – Ing. Petr Němec, PhD.

Co-operation in the MIT projects FD-K3/062 "Implementation of multifunction nanostructures of the titanium ion exchanging nanoplates with the polymer nanolayer as the photostabilised electroactive anticorrosion pigments" (2003–2005), the solver – RNDr. Zdeněk Kváča (ÚACH CAS) and FI-IM2/107 "Implementation of exfoliates of nanomolecular annexed phases of additive metal and titanium salts as the selective anticorrosion pigments for the environmentally friendly painting systems" (2005–2007), the solver – RNDr. Zdeněk Kváča. The co-worker is, in both cases, Doc. Ing. Petr Kalenda, CSc. from the Institute of Polymer materials.

Co-operation in the solution of the MIT project FI-IM/077 "Research of the technologies of membrane separations for the preparation areas of pigments and cleaning of liquid chemical wastes" (2004–2005), the solver – Ing. Luboš Víšek, VÚOS, a.s., the co-operation on behalf of UPCE – Doc. Ing. Zdeněk Palatý, CSc.

Experts/Field

Prof. Ing. Miloslav Frumar, DrSc. – Amorphous chalcogenides, the chemistry of solid substances, photostructural phenomena

Prof. Ing. Miroslav Vlček, CSc. – Amorphous chalcogenides, the preparation of deep-etch stencils and high resolution memory parts, optoelectronic applications, diffraction optics

Prof. Ing. Tomáš Wágner, CSc. – Material engineering, the chemistry of solid substances, the study of the preparation and properties of amorphous and glass chalcogenides, photostructural phenomena, reactions in the solid phase, physical and chemical methods of the preparation of thin layers

Prof. Ing. Jaromír Šňupárek, DrSc. – Macromolecular chemistry, polyacrylates, solution and polymer colloids - water dispersions of synthetic polymers (latexes), the study of their synthesis and properties, the development of manufacturing and application technologies

Doc. Ing. Petr Kalenda, CSc. – Painting agents and organic coatings

Doc. Ing. Andréa Kalendová, Dr. – Synthesis and the study of effects of anticorrosion pigments in painting agents, pigment particles, processes of dispersion, properties of heterogeneous mixtures

Authorised

Codes: 1a, 1d, 2b, 2c, 5a

5.2.10. VŠB – Technical University in Ostrava (VŠB)

Nowadays, VŠB is the university with the polytechnical and economic focuses. The scientific and research activities make a substantial part of the university activities and they have the key importance for the successful restructuring of the Moravian-Silesian region. It develops these activities in the following fields: Metallurgy, material engineering, mechanical engineering, electrotechnology and electronics, information technologies, mining and geology, civiil engineering, economy, and other fields.

VŠB has got 7 faculties and several institutes. The research of nanotechnologies, within limited scope, is organised in the Faculty of Metallurgy and Materials Engineering, in the Faculty of Mechanical Engineering, in the Institute of Physics, and in the University Institute of the Materials Chemistry.

Six projects, out of the 196 solved ones, and one research intention, out of 5 solved ones, relate to nanotechnologies.

5.2.10.1. Faculty of Metallurgy and Materials Engineering (FMMI VŠB))

17. listopadu 15, 708 33 Ostrava-Poruba

www.fmmi.vsb.cz

Brief workplace description

The Faculty of Metallurgy and Materials Engineering is the only Czech university institution looking after the expertise within the material engineering in its complexity, from the manufacture to the utilisation. The Faculty has been divided into 13 departments and some of them are further divided into institutes. The project solutions of the character of nanotechnologies have been identified in the Department of material forming (the leading researcher is J. Kliber).

Research and development focus

The Faculty of Mechanical Engineering solves, in co-operation with the Department of mechanical technology, the issues of the creation of ultra-fine structure of metallic materials (Fe, Mg) by the plastic deformation.

Projects solved in the area of nanotechnologies

MIT project FI-IM/033 “Research and utilisation of nanotechnologies and the manufacture of nanostructured materials of high strength for modern constructions” (2004–2007), the solver – Doc. Ing. Miroslav Greger, CSc.

GA CR project 106/04/1346 "Study of the impacts of non conventional forming technologies on the forming, structure, and mechanical properties of magnesium alloys" (2004–2006), the solver – Doc. Ing. Miroslav Greger, CSc. Nowadays, the industrially advanced countries develop new technological processes for the forming and for the better utilisation of magnesium alloys in the modern material design. The reason is based on the specific usable properties of magnesium alloys, especially in relation to their strength and density. Magnesium alloys are characteristic with the lower plastic properties and thus their suitability for the non conventional forming technologies. The basic objective of the mentioned grant project is the utilisation of non conventional forming technologies for the gaining of a very fine structure (nanostructure). They study the impact of non conventional forming technologies – ECAE (equal channel angular extrusion), Semi-solid Casting (thixoforming), CEC (cyclic extrusion compression), TC (torsion with compression), and super plastic forming on the forming, structure and mechanical properties of magnesium alloys during the hot and cold forming. They also study the impact of the metallurgy and also of the forming technology on the forming characteristics, the structure, and mechanical properties.

Experts/Field

Doc. Ing. Miroslav Greger, CSc. – Material forming by large plastic deformations

Codes: 1e, 7d

5.2.10.2. Faculty of Mechanical Engineering (FS VŠB)

17. listopadu 15, 708 33 Ostrava-Poruba

www.fs.vsb.cz

Brief workplace description

The scientific research activities in FS VŠB are focussed mainly on the machinery design, robotics and manufacturing processes, innovation of manufacturing technologies, materials and their properties, and management of machinery and processes. The Faculty has been divided into 10 departments, one institute and two laboratories. The research of nanotechnologies is organised in the Department of mechanical technology (the Head is J. Hrubý) and in the Laboratory of loose materials (the Head is J. Zegzulka).

Research and development focus

Doc. Ing. Stanislav Rusz, CSc. from the Department of mechanical technology, the Institute of Forming, has been involved, for a long time, in the research of technologies of the large plastic deformations with the objective to achieve the ultra-fine-grained structures of formed metals. He uses especially the ECAP method. The works currently take place within the framework of projects of Doc. Ing. M. Greger, CSc. from FMMI VŠB (see above).

In the same department, in the Institute of Machinery Materials and Surface Designs, Doc. Ing. František Kristofory, CSc. solves a project focussed on the sub micron composite systems with the matrix extracted in the cathodic way.

The Laboratory of loose materials is involved in the issues of storage of nanoparticles, the modifications of the surface of the microparticles of corn starch by hydrophobic nanoparticles

of SiO_2 for the purpose of changes in their interaction properties, the measuring of geometrical and mechanical-physical properties of nanoparticles, etc.

Projects solved in the area of nanotechnologies

GA CR project 106/03/0951 "Sub micron composite systems with the matrix extracted in the cathodic way" (2003–2005), the solver – Doc. Ing. František Kristofory, CSc. Galvanically extracted composite systems have used so far the finely dispersed particles of sizes above 1um. However, the progress, which has taken place in the field of very fine loose materials, allows for the creation and processing of materials with grains of the sizes within the order of 10nm. This should lead to further improvement in the quality of protection galvanic coatings. The subject of the research is the way of creation of new composite systems.

Co-operation of the Laboratory of loose materials in the solution of the research intention MSM6198910016 "Synthesis, structure and properties of nanomaterials based on the intercalated sheet silicates" – see 5.2.10.4.

Experts/Field

Doc. Ing. František Kristofory, CSc. – Surface modification, electrochemical plating, functional galvanic coatings, electric forming, machinery materials, non conventional machinery materials

Doc. Ing. Jiří Zegzulka, CSc. – Operations and processes with particular materials, the preparation, transport and storage of micro and nano powders, the technology designs, designs of machinery and processes

Ing. Aleš Slíva, PhD. – Behaviour of nanoparticles, micro and nanobonds in the interparticular bond, surface modifications of microparticles by nanoparticles for the purpose of the improvement of flow properties in transport, handling, and storage systems

Doc. Ing. Stanislav Rusz, CSc. – Machinery forming, super plasticity, the forming of powder materials, non conventional forming methods, the development of new manufacturing technologies producing ultra-fine-grained materials, the mathematical modelling of non conventional forming technologies

Authorised

Codes: 1a, 1b, 1e, 7d, 7e

5.2.10.3 Institute of Physics VŠB – TU Ostrava (IF VŠB)

17. listopadu 15, 708 33 Ostrava-Poruba

www.if.vsb.cz

The Institute of Physics at VŠB lectures physics throughout the university. The scientific activities of the Institute of Physics have been concentrated in two professional groups. One of them – called the Section of the nanostructure physics – organises the basic and applied research in the area of nanostructures and nanotechnologies.

Research and development focus

The Institute of Physics, the Section of nanostructure physics, is led by Prof. Ing. Jaromír Pištora, CSc. and studies theoretically and experimentally the magnetic-optical phenome-

na in magnetic nanostructures. The research relates to the practical utilisation of magnetic nanostructures for the magnetic and magnetic-optical information recording, in sensors of the magnetic field and in parts in spin electronics. The solution takes place in co-operation with MFF UK and several foreign workplaces (RIE Hamamatsu, FIT Fukuoka, EP Paris, UB Białystok, etc.).

Projects solved in the area of nanotechnologies

Co-operation in the solution of GA CR project 202/03/276 "Magnetic-optical phenomena in magnetic nanostructures" (2003–2005), the solver – Prof. Ing. Štefan Višňovský, DrSc., MFF UK. The co-solver – Prof. Ing. Jaromír Pištora, CSc.

Co-operation in the project within 6th FP TOK NANOMAG-LAB (FP6-003177) "Combined study of nanostructured magnetic materials" (2004–2007), the solver – Prof. Andrzej Maziewski, University of Bialystok. The co-solver – Prof. Ing. Jaromír Pištora, CSc.

Experts/Field

Prof. Ing. Jaromír Pištora, CSc. – Magnetic-optics, nanostructures, optics of planar structures, the Head of the Institute

Doc. Dr. Mgr. Kamil Postava – Magnetic-optics, ellipsometry

Doc. RNDr. Petr Hlubina, CSc. – Fibre optics, interferometry

Doc. Ing. Michal Lesňák, CSc. – Computer management of physical experiments

Doc. Dr. RNDr. Jiří Luňáček – Metallic structures

RNDr. Dalibor Ciprian, PhD. – Modelling of periodic structures

Mgr. Karla Barčová, PhD. – Mössbauer phenomenon

Authorised

Codes: 2d, 7a, 7b

5.2.10.4. University Institute of Materials Chemistry (VÚCHEM VŠB)

17. listopadu 15, 708 33 Ostrava-Poruba

www.vsb.cz/vuchem

Brief workplace description

VÚCHEM was founded in 1992 as the Central analytical laboratory of the Technical University in Ostrava and it has got its current status in 2002. The Institute has been divided into four following sections: Inorganic chemistry, organic chemistry, nanostructures, and material testing. All sections take their parts in the research of nanotechnologies within the research task.

Research and development focus

VÚCHEM VŠB and other university workplaces solve the research intention that has been fully focussed on nanotechnologies in the period 2005–2011.

Research intention MSM6198910016 "Synthesis, structure and properties of nanomaterials based on intercalated sheet silicates and ferromagnetics" (2005–2011), the solver – Prof. Ing. Jaromír Pištora, CSc. The research intention focuses on the preparation and characterising of sheet silicate nanoparticles, which occur by the delaminating of precursors prepared in the intercalation way and which will be consequently used for the preparation of nanocomposite polymer-layered silicate. They test direct delaminating techniques (e.g. the mechanical micronisation, microwave procedures) and also in-mixing. Other nanomaterials of photofunctional, luminescent, sorption, catalytic properties (for the envisaged utilisation as the photofunctional units, sorbents for the immobilisation of gas and water pollutants), and catalytic effects (with the objective to utilise them for the selective reduction of nitrogen oxides). They will be prepared by the intercalation of organic molecules and polycations for the interlayers in sheet silicates. Special attention is paid to the analysis of their structural arrangement. A part of this objective is also the study of the role of sheet silicates in friction composites. They will also test the mechanical-physical and geometric properties of the studied nanoparticles of sheet silicates. The knowledge will be also utilised in the application of the model of an ideal loose material on plate structures.

Projects solved in the area of nanotechnologies

GA CR project 205/05/2548 "Nanomaterials based on the structurally modified clay minerals" (2005–2007), the solvers – RNDr. Marta Valášková, CSc. and Prof. RNDr. Pavla Čapková, DrSc. The subject of this project solution is the synthesis and characterising of the structure and properties of the structurally modified clay minerals usable as sorbents, catalysts, photofunctional units and nanocomposites polymer-clay.

The MEYS development project No. 555 "Nanotechnology" – the preparation of the interdisciplinary study (2003–2005).

Experts/Field

Prof. RNDr. Pavla Čapková, DrSc. – Structural characterising of nanomaterials with the aid of the combination of molecular modelling, X-rays diffraction and the IR spectroscopy, Institute Director

Prof. Milan Rieder, PhD. – Structural analysis of nanomaterials with the aid of the X-ray and electron diffractions

Doc. Ing. Vladimír Tomášek, CSc. – Utilisation of the electron microscopy and X-rays spectrometry during the study of material nanostructures

Doc. Ing. Jana Seidlerová, CSc. – Utilisation of the methods of the atomic emission and absorption spectrometry for the analysis of the chemical composition of materials

RNDr. Marta Valášková, CSc. – Technology of the preparation of intercalated sheet silicates and their X-rays diffraction analysis

Ing. Monika Šupová, PhD. and Ing. Vlastimil Matějka, PhD. – Utilisation of the microscopy of atomic forces in the study of material nanostructures

Ing. Zdenek Lacný – Utilisation of the methods of gas and liquid chromatography for the analysis of organic substances and the assessment of the sorption and catalytic properties

Ing. Jan Michálek – Testing of the mechanical properties of friction composite materials

Authorised

Codes: 1b, 2d, 7a, 7b

5.2.11. Palacký University in Olomouc (UPOL)

This University in Olomouc is the second oldest university in Bohemia, Moravia and Silesia. Currently, the Palacky University has got the seven following faculties: Cyril-Method Faculty of Theology, medical, philosophic, natural science, pedagogic, juridical, and the Faculty of Physical Education. The research of nanotechnologies is organised in the Faculty of Science.

There are 2 projects, out of 192 solved ones, and one research intention, out of 10 intentions, related to nanotechnologies.

5.2.11.1. Faculty of Science (PřF UPOL)

tř. Svobody 26, 771 46 Olomouc

www.upol.cz/fakulty/prf

Brief workplace description

The Faculty of Science provides for the professional university education in the following sciences: Mathematics, physics, chemistry, biology, geography, and protection of the environment. It organises research in all these disciplines. The Faculty has been divided into 6 sections (mathematics, physics, chemistry, biology, Earth sciences, and the Faculty facilities), which are further divided into departments and laboratories. The research of nanotechnologies is organised in the Department of experimental physics, in the Department of inorganic chemistry, and in the Department of physical chemistry.

Research and development focus

PřF UPOL will solve the research intention that has been largely focussed on nanotechnologies in the period 2005–2011.

Research intention MSM6198959216 "Complex compounds and oxides of transition metals with the utilisation in bio-applications and nanotechnologies" (2005–2011), the solver – Prof. RNDr. Zdeněk Trávníček, PhD.

The intention envisages the synthesis of complex compounds of transition metals, oxides of transition metals, and elementary metals with properties suitable for their utilisation in bio--applications (cancerous statics) and in nanotechnologies (catalysis, biomagnetic separation, and nanopigments). The research activities consist of the three basic steps and includes progressively the synthesis of complex compounds and nanometarials, their complex physical--chemical characterisation, and the practical testing in selected areas of nanotechnologies and bio-applications. Among partial subjects of the research activities, we can mention the study of the mechanism of selected reactions in solutions, but also in the solid phase, or the study of the impact of surface adjustments and interparticle interaction on the magnetic properties of nanoparticles.

The Department of experimental physics focuses its works on the solution of the MEYS project 1M0512 "Centre for the research of powder nanomaterials", the solver – Prof. RNDr. Miroslav Mašláň, CSc. The Department of inorganic chemistry and the Department of physical chemistry co-operate with this Department.

They try for the synthesis of nanoparticles of metallic oxides and elementary metals with properties suitable for their utilisation in bio-applications and nanotechnologies within this

project. The research activities consist of the three basic steps and includes progressively the synthesis of powder nanomaterials, their complex physical-chemical characterisation and the practical testing in the selected areas of nanotechnologies and other applications. Among partial subjects of the research activities, we can mention the study of the mechanism of selected reactions in solutions, but also in the solid phase, or the study of the impact of surface adjustments and interparticle interaction on the magnetic properties of nanoparticles.

There are especially amorphous and nanocrystalline oxides of transition metals and also the ferromagnetic spinel structures, including ferrites (Ni, Co, Mn, Zn, and Cu) synthesised in the form of nanoparticles by the way of the thermally induced reactions in the solid phase. These thermic syntheses, which can be managed with the reaction conditions and with the properties of precursors, are targeted in the direction for the achievement of a suitable combination of size, morphologic, surface, structural, magnetic, and other properties (catalytic, sorption, and optical) of nanoparticles allowing for their utilisation in the areas of nanopigments, the preparation of standards for the microscopic techniques, in the areas of the sorption-purification processes, biomagnetic separations (the detoxication processes, dialysis), in ferrofluid technologies, magnetic cooling, or catalysis. It is envisaged that a wide spectrum of precursors will be used, including complexes of transition metals and salts of organic acids. Their structural properties and the low conversion temperature allow for the preparation of nanopowders with narrow size distribution, large surface area and the required magnetic properties (the superparamagnetism and ferrimagnetism). The reduction way in the solid phase, but also in a solution will be used for the synthesis of nanoparticles of elementary metals (Fe, Ag) with the use of iron oxides and the complex compounds of silver in the role of precursors. Nanoparticles will be tested from their antibacterial, sorption, catalytic, and magnetic properties utilisation points of view.

The Department of experimental physics focuses on the development of analytical methods usable for the research of nanotechnologies (Mössbauer spectroscopy – the development of modern automated measuring methods and systems, and their application in the analysis of substance structures, the microscopy with a scanning probe, and the analysis of the surface at the sub microscopic level) – M. Mašláň and R. Kubínek.

The Department of chemistry organises the synthesis of complex compounds usable in different industries as the high pressure lubricants, floatation agents, antioxidation agents, insecticides, or in the roles of precursors for the preparation of nanoparticles (Z. Trávníček).

The Department of physical chemistry organises the synthesis of nanoparticles of iron oxides in the way of thermally induced reactions in the solid phase, including the preparation of rare structural forms, structural forms of the amorphous Fe_2O_3, ß-Fe_2O_3, ε-Fe_2O_3) of the defined properties (K. Zbořil, L. Kvítek).

UPOL presents its Internet pages at www.nanoup.cz, where the actual review of activities done at the university in the area of nanotechnologies exists.

Projects solved in the area of nanotechnologies

MEYS project 1M0512 “Centre for the research of powder nanomaterials” (2005–2009), the solver – Prof. RNDr. Miroslav Mašláň, CSc.

MIT project 1H-PK/44 “Technology for the manufacture of iron oxide nanoparticles (Centre for the innovation and transfer of technologies)” (2004–2007), the solver – Prof. RNDr. Miroslav Mašláň, CSc.

Experts/Field

Prof. RNDr. Miroslav Mašláň, CSc. – Mössbauer spectroscopy, synthesis of magnetic nanoparticles

Prof. RNDr. Zdeněk Trávníček, PhD. – Synthesis of new co-ordination substances

Doc. RNDr. Roman Kubínek, CSc. – Atomic force microscopy (AFM), nanoparticles (ferritic oxide)

RNDr. Radek Zbořil, PhD. – Synthesis of magnetic nanoparticles, the structural, magnetic and morphological characterising of nanoparticles

RNDr. Libor Kvítek, CSc. – Electrochemistry of organic-metallic and co-ordination compounds, the preparation and characterisation of inorganic colloids (Ag, TiO_2)

Authorised.

Codes: 1a, 7a, 7b

5.2.12. Tomáš Baťa University in Zlín (UTB)

UTB is a young and dynamically developing institution that has built an important position in the region of Zlín, in the City and also in the Czech Republic during its relatively short history. UTB has got 3 faculties (technological, managerial and economic, and multimedia communications). As from 1 January 2006, operations of the 4th faculty commence – the Faculty of Applied Informatics (FAI). The research in the area of nanotechnologies is organised in the Faculty of Technology.

Three solved projects, out of 42 ones, and one research intention, out of 3 ones, relate to nanotechnologies.

5.2.12.1. Faculty of Technology (FT UTB)

Náměstí T. G. Masaryka 275, 762 72 Zlín

www.ft.utb.cz

The scientific research activities in FT UTB are based on the long-term tradition and reflect the development trends, which include the following engineering areas: chemistry, technological chemistry, and ecology, materials, management, and automation, security of information, manufacturing processes, mechanical engineering, and interdisciplinary areas. The scientific disciplines focus mostly on chemistry and technology of polymer materials, the management of industrial processes, the manufacturing economics, and the application of information technologies in the management of industrial operations. FT UTB has been divided into 7 institutes, one centre and one institute. The research of nanotechnologies is organised in the Centre of polymer materials (the leading researcher is P. Sáha) and in the Institute of polymer engineering (the leading researcher is J. Šimoník).

Research and development focus

FT UTB solves the research intention that is partly focussed on nanotechnologies in the period 2005–2011.

Research intention MSM7088352101 „Multifunctional composite systems based on natural and synthetic polymers" (2005–2011), the solver – Prof. Ing. Petr Sáha, CSc.

The research intention focuses on the gaining new knowledge in the area of natural and synthetic macromolecular composite systems with the stress put on the dissemination of this knowledge in the sector of applied research. The selected multifunctional polymer composites with the inbuilt bio-part, optical, magnetic, or electric function, containing nanostructures, gel systems, or additive parts will be researched from the preparation, properties and processing points of view. The results should be new knowledge in the monitored areas, especially proposals of innovated products and manufacturing processes, including complex designs of management systems. It is envisaged that the achieved results will be used in the plastics, food, and automotive industries. Important benefits are expected also in the areas of healthcare materials and packaging.

Research in the area of nanotechnologies in the individual institutes

Centre of Polymer Materials: The preparation and development of nanocomposites based on silver dendrimer-colloid for optical applications, modifications and studies of the nanostructured materials' dimensionality, photovoltaic cells based on polymer volume heterotransitions (J. Šimoník, D. Měřínská, and A. Kalendová).

Institute of Polymer Engineering: The treatment of clay minerals by the intercalation and co-intercalation, the study of the product and intermediate product morphology, the technology for the preparation of polymer nanocomposites and the study of their properties (P. Sáha, F. Schauer).

Projects solved in the area of nanotechnologies

MEYS project 1P05ME737 (the international co-operation) "Preparation and development of nanocomposites based on silver dendrimer-colloid for applications in optics" (2005–2007), the solver – Prof. Ing. Petr Sáha, CSc. The study of nanocomposite materials based on the polyamide dendrimers and silver, the manufacture of for photons not permeable film.

MEYS project 1P05ME734 (the international co-operation) "Modification and study of the dimensionality of nanostructured materials" (2005–2007), the solver – Prof. Ing. František Schauer, DrSc.

MEYS project 1P05ME735 (the international co-operation) "Photovoltaic cells based on polymer volume heterotransitions" (2005–2008), the solver – Prof. Ing. František Schauer, DrSc. The synthesis of AiiBvi nanoparticles and the characterising of nanostructured materials.

EU Commission Network of Excellence NANOFUN-PoLY FP6-500361-2 (the international co-operation) "Nanostructured and Functional Polymers-Based Materials and Nanocomposites", the solver – Prof. Ing. Josef Šimoník, CSc (in co-operation with ÚMCH CAS).

GA CR project "Study of managed structures of polymer systems with the aid of intercalated filling particles", the solver – Prof. Ing. Josef Šimoník, CSc.

Experts/Field

Prof. Ing. Petr Sáha, CSc. – Polymer processes, rheology and electrorheology, not stable flows of polymer melts and blends, physical aging of polymers

Prof. Ing. Josef Šimoník, CSc. – Nanocomposites polymer-clay, the processing engineering of polymers

Prof. Ing. František Schauer, DrSc. – Vacuum and plasma depositions of amorphous and nanocrystalline inorganic and organic semiconductors, the characterising of deposition conditions with the aid of electric methods, the weight methods and optical spectroscopy, transport, optical and photoelectric properties of amorphous inorganic and organic semiconductors with the main stress put on the electron spectroscopy, recently on the tunnelling electron spectroscopy

Ing. Alena Kalendová, PhD. – Study of nanocomposite materials of the kind polymer/clay with the focus on polyvinyl chloride and polyolefines

Ing. Dagmar Měřínská, PhD. – Structure and morphology of polymers, the treatment of clay minerals with the intercalation and co-intercalation, the technology for composite and nanocomposite materials, study of nanocomposite materials

Authorised

Codes: 1f, 7a, 7c

5.2.13. University of South Bohemia in České Budějovice (JČU)

JČU organises the teaching and research especially in the areas of biology, agriculture, fishery, and paedagogy. The University has been divided into 5 faculties, 2 institutes, and the Research Fishery and Hydrobiological Institute. The research having the character of nanobiotechnologies is organised in theIinstitute of Physical Biology.

Two research programme projects, out of 128 solved ones, and one research task, out of 6 ones, relate to nanotechnologies.

5.2.13.1. Institute of Physical Biology (ÚFB JČU)

Zámek 136, 373 33 Nové Hrady

www.ufb.jcu.cz

Brief workplace description

The research objective of the Institute of Physical Biology (the Director is D. Štys) is the study of biological systems by scientific physical and chemical methods and with the consequent demanding and critical processing. Works take place mostly at two levels.

Biology of systems – The study of functions of living organisms and their communities at different regulation and to external condition adaptation levels. There are random and also target-mutated organisms utilised for this purpose. The development of new measuring techniques and mathematical methods for the processing of results and for the development of biotechnologies make a part of these research activities.

Structure and function of key proteins in a cell – All methods are utilised for the establishment of the structure and function of proteins and other biologically important molecules. Mathematical methods of the molecule modelling, including calculations *ab-initio* make a part of these activities.

The Institute has been divided into 7 sections. The research related to nanobiotechnologies is organised in the Section of the structure and function of proteins, which includes the

Laboratory for nanobiology (D. Kaftan). ÚFB JČU has got also several joint laboratories with the Institute of the Systemic Biology and Ecology of the Academy of Sciences of the Czech Republic, a part of which stays in the same building.

Research and development focus

ÚFB JČU solves the research intention partly related to nanobiotechnology in the period 2005–2011.

Research intention MSM6007665808 "Physical biology – new approaches in the biological research", the solver – Prof. RNDr. František Vácha, PhD.

The objective of the reserch is the utilisation of scientific physical, chemical and mathematical methods in the study of biology, from the level of an entire organism, the cell biology, and molecular biology to the biochemistry of proteins and individual biologically active molecules. The subjects of the study are the relations between the structure and the function of proteins, the molecular eco-physiology of the photosynthesis, photosynthetic biotechnologies, and the production of biologically active substances, the applied photobiology and imagining techniques, and the development of instruments. The objective is to contribute to the clarification of basic processes, molecular principles and regulations in the organism energy transformation, from individual proteins to the level of the entire organism.

Laboratory for nanobiology. The sector of the physical biology in the area of nanotechnologies deals with the development of approaches and methods for the high definition imagining of biological structures. The main researched topic is the imagining of the surface structure and the simultaneous monitoring of the function of protein complexes in the environment of the native membrane under physiological conditions, with the aid of the light microscopy and scanning probe microscopy.

Solved projects in the area of nanobiotechnologies

GA CR project GP 206/03/D061 "Crystallisation and structure studies of the photosynthetic proteins isolated from advanced plants" (2003–2006), the solver – Mgr. Ivana Kutá Smatanová, PhD.

MEYS project AKTION 39p11 (Austria) "Dynamics in the tylocoid structure and function: The study of the microscopy with a scanning probe" (2004–2005), the solver – Mgr. David Kaftan, PhD.

Experts/Field

Prof. RNDr. František Vácha, PhD. – Photosynthesis

RNDr. Ivan Šetlík, CSc. – Biomembranes

Dr. Rüdiger Ettrich, PhD. – Computer modelling

Mgr. David Kaftan, PhD. – Absorption and emission spectroscopy, fluorescent and confocal microscopy, the microscopy with a scanning probe – the imagining, the dynamic force spectroscopy, the isolation of soluble and membrane proteins, the development and application of new imagining and other than imagining spectroscopic methods

Codes: 3f, 7a

5.2.14. *Brief review of activities by the faculties*

Table III presents the review of activities organised in university faculties, according to main fields registered within the nanotechnological nomenclature (see **Table I**).

There were 28 faculties surveyed. As Table III shows, the vast majority focuses especially on the research of nanomaterials, their preparation, and the assessment of their properties.

Table III

FACULTY	1	2	3	4	5	6	7	8
MFF UK	X	X		X		X	X	
PřF UK	X	X			X	X		
1LF UK		X	X					
2LF UK			X					
PřF MU	X	X				X	X	
FS ČVUT	X		X					X
FEL ČVUT	X	X		X		X		
FJFI ČVUT	X	X			X		X	
FSv ČVUT	X						X	
FSI VUT	X				X		X	
FEKT VUT		X		X		X	X	
FCH VUT	X	X	X			X	X	
FCHT VŠCHT	X	X	X	X	X		X	
FCHI VŠCHT	X		X		X	X		
FAV ZČU	X						X	
FST ZČU	X						X	
FS TUL	X		X				X	
FT TUL	X				X		X	
FM TUL	X							X
PřF UJEP	X		X	X		X	X	
FCHT UPCE	X	X			X			
FMMI VŠB	X						X	
FS VŠB	X						X	
IF VŠB		X					X	
VÚCHEM VŠB	X	X					X	
PřF UPOL	X						X	
FT UTB	X						X	
ÚFB JČU			X				X	

Key: 1 – Nanomaterials, 2 – Nanoelectronics, 3 – Nanobiotechnologies, nanomedicine, 4 – Nanosensors, 5 – Nano in the chemical technology, 6 – Long-term research, 7 – Instruments and technology, 8 – Other

5.3. ALLOWANCE ORGANISATIONS IN SECTORS

5.3.1. Institute of Clinical and Experimental Medicine (IKEM)

Vídeňská 1958/9, 140 21 Praha 4, I.D. (IČO) 00023001

www.ikem.cz

Brief workplace description

IKEM is an allowance organisation directly managed by the Ministry of Health. It consists of 3 professional centres, 8 clinics, and 15 professional workplaces, bases and laboratories. There are 1 450 employees working in IKEM. The scientific research activities are supported in IKEM by the research intention and with a number of programme grants.

The research in the area of nanotechnologies focuses on the applications of nanoparticles in the field of molecular imagining. These methods make the subject of the research for the Department of magnetic resonance – spectroscopy (M. Hájek). The Department is a part of the Radio-diagnostics and intervention radiology base. The Department of MR spectroscopy (MRS) co-operates in the projects related to the molecular imagining solved within IKEM with the Diabetologia Clinic and within the Centre of cell transplants and tissue replacements with the Institute of Experimental Medicine of the Academy of Sciences of the Czech Republic, and other partners (ÚZVG CAS).

Research and development focus

In the period 2005–2009, IKEM solves the research intention of the Ministry of Health MZ0IKEM2005 "Research of cardiovascular diseases, diabetes, and transplants of vitally important organs" (2005–2009), the solver – Prof. R. Poledne, CSc. It includes parts of the nanomedicine research. These applications focus on the molecular imagining – the area of the *in vivo* MR spectroscopy and applications of specific contrast substances based on nanoparticles. The research intention in IKEM is focussed on the clinical and experimental research of cardiovascular diseases, diabetes and transplants, especially: The improvements in the surgery and catheterisation treatment of chamber tachycardia and the treatment of failures, the implementation of invasive detection vulnerable plates and the not invasive detection atherosclerosis for the improvement of the patient stratification, the optimising of the immunotherapy after transplants, the monitoring of the gene expression, and the immunodetection of the fraction complement and the tissue infections. It relates also to the gaining new knowledge about the key role played by the lipid mediators in the pathogenesis of the insulin resistance and the introduction of the transplanting method of the Langerhans islets into the clinical practice. The application of the MR imagining and the MR spectroscopy make parts of the most projects.

Projects solved in the area of nanotechnologies

The MRS Group solves the GA CR project 304/03/1189 "The use of superparamagnetic nanoparticles in the MR imagining of implanted cells" (2003–2005), the solver – Ing. Milan Hájek, DrSc. ÚEM CAS co-operates in the project.

The solved project studies implants of embryonic stem cells, the stem cells of the bone marrow marked with the superparamagnetic nanoparticles based on Fe_3O_4, to animals with CNS lesions (for example, ischaemic and photochemical cortex lesions, trans-sections of the

spinal chord). The fate of implanted cells and their behaviour in time are consequently dynamically monitored *in vivo* with the utilisation of the techniques of the magnetic resonance. The research subject relates, in addition to the monitoring of the physiological dependencies, also to the monitoring of physical-chemical properties of the newly occurred cellular contrast substances with the aid of relaxometry.

Co-operation in the project within 6th FP DiMI/512146 "Diagnostic Molecular Imaging: A Network of Excellence for Identification of New Molecular Imaging Markers for Diagnostic Purposes", the project co-ordinator – Prof. Andreas Jacobs, University of Cologne, Germany. The leading solver in ÚEM CAS – Prof. MUDr. Eva Syková, DrSc. Ing. M. Hájek, DrSc. and his team co-operates with IKEM.

Co-operation in the project within 6th FP ANGIOTARGETING/504743 "Targeting-Tumour-Vascular/Matrix Interactions", the co-ordinator – Prof. Rolf Bjerkvig, University of Bergen, Norway. The leading solver in ÚEM CAS – Prof. MUDr. Eva Syková, DrSc. Ing. M. Hájek, DrSc. and his team co-operates with IKEM (in the area of the application of cell contrast substances – the magnetic marking during the monitoring of cell migration in tumours).

Experts/Field

Ing. Milan Hájek, DrSc. – Molecular imagining (MI) – the study of living tissues by the MR imagining and MR spectroscopy

Mgr. Monika Dezortová – Molecular imagining (MI) – the clinical MR spectroscopy and relaxometry

Mgr. Vít Herynek – Molecular imagining (MI) – the MR spectroscopy and relaxometry

Authorised

Codes: 1a, 2d, 3b, 3f, 7a

5.3.2. Institute of Haematology and Blood transfusion (ÚHKT)

U nemocnice 1, 128 20 Praha 2, I.D. (IČO) 00023736

www.uhkt.cz

Brief workplace description

ÚHKT is an allowance organisation directly managed by the Ministry of Health of the Czech Republic. The Institute joins the medical haematological care, diagnostic and research laboratories, and the Department of transfusions. The Institute shows the integral connection of highly specialised medical care, the research departments, and high standard transfusion expert workplace with the super consulting and educational activities. The most important part of the Institute is made up of the three following professional sections: The clinical, transfusion, and research. There are 6 departments in the research section and the Department of biochemistry (the leading researcher J. E. Dyr), Department of cell biochemistry (Z. Hrkal), Department of molecular genetics (R. Brdička), and Department of cell physiology (L. Doležalová) organise the research that, thanks to its character, belongs into the areas of nanobiotechnology and nanomedicine.

Research and development focus

Research projects solved in the Institute focus on the development of new diagnostic and treatment methods and on the gaining new knowledge, especially about the blood physiology and blood creation, the biology of tumorous cells and about the tumorous process. In the period 2005–2011, UHKT will solve the research intention of the Ministry of Health, which will probably include also parts belonging to the research of nanotechnologies.

Research intention MZ0UHKT2005 "Importance of the molecular biological examination for the clarification of the pathogenesis, for the diagnostics of defects in blood creation, and for the utilisation of blood creating cells in the treatment of diseases related to the blood creation" (2005–2011), the solver – MUDr. Jaroslav Čermák, CSc.

The solution subject is the utilisation of molecular-biological examinations for the clarification of pathogenesis, for the diagnostics and treatment of defects in blood creation, the monitoring of the importance of changes in the structure and function of genome for the diagnostics, prognosis and treatment of inborn and gained diseases related to the blood creation. The monitoring of the importance of activation of individual parts of the coagulation system in tumour-related diseases of the blood creation, the clarification of the molecular fundamentals of the rare phenotypes of erythrocytes and some inborn defects of erythropoiesis, the utilisation of master blood creating cells in the treatment of diseases related to the blood creation and also in the treatment of other tissues, the handling of master blood creating cells for the cell therapy, the monitoring of the role played by blood creating cells in transplantations for the treatment of tumorous and other than tumorous diseases related to the blood creation, the monitoring of the safe mobilisation and separation of donors of blood creating cells obtained from the peripheral blood, and the monitoring of genetic factors influencing the success of transplants of blood creating cells.

Projects solved in the area of nanotechnologies

Co-operation in the solution of the GA CAS project IAA400500507 "Nanobiotechnology for the creation of the interface between the biologic environment and artificial objects" (2004–2007), the solver – RNDr. Eduard Brynda, CSc., ÚMCH CAS. The co-solver in ÚHKT – Prof. Ing. Jan Evangelista Dyr, DrSc. The progressive adsorption of proteins, polypeptides, charged polysaccharides, and natural or synthetic polyelectrolytes on solid pads managed by influencing the physical interactions between macromolecules is utilised for the creation of organised molecular sets creating the functional interfaces between artificial surfaces and biological liquids, or cells. At the same time, there are mechanisms taking place during contacts of solid surfaces with the blood plasma, blood, and during the adhesion and cell growth on support structures studied. There are sets developed, which (i) consist mainly of albumins and polysaccharides preventing the settling down of substances in the blood plasma, the adhesion of plates, and the blood coagulation, (ii) consist of antibodies immobilised on the surface of optical (SPR) immunosensors and magnetic particles allowing for the detection or separation of specific substances from the blood plasma or blood, and (iii) contain parts of the inter-cell matter and modified fibrinous nets supporting or regulating the adhesion, proliferation and differentiation of cells.

Experts/Field

Prof. MUDr. Pavel Klener, DrSc. – Haematology, oncology

Prof. Ing. Jan Evangelista Dyr, DrSc. – Biochemistry, molecular genetics, biomolecular sensors

Authorised

Codes: 3d, 3f, 3g, 4b

5.3.3. Masaryk Oncology Institute in Brno (MOÚ)

Žlutý kopec 7, 656 53 Brno, I.D. (IČO) 00209805

www.mou.cz

Brief workplace description

MOÚ is an allowance organisation directly managed by the Ministry of Health of the Czech Republic. It is a complex oncology centre with 230 beds. It provides, in addition to the treatment, also for research of all aspects of oncogenic diseases. MOÚ is divided into the Clinic for the complex oncological care, 11 professional departments, the Section of the experimental oncology with laboratories and the Group for tumour biology, and other supporting workplaces. Research in the area of nanobiotechnology and nanomedicine (according to the nomenclature) is organised especially in the Section of the experimental oncology (the leading researcher is B. Vojtěšek).

Research and development focus

In the period 2005–2011, MOÚ will solve the research intention of the Ministry of Health that includes also parts related to the research of nanobiotechnologies.

Research intention MZ0MOU2005 "Functional diagnostics of malign tumours", the solver – Doc. MUDr. Rostislav Vyzula, CSc. (MOÚ Director).

The intention subject is the development and implementation of the new conception in the integrated functional diagnostics of solid malign tumours, which is based on a whole number of applied molecular-biological, cytodiagnostic, histocultivation, and imagining methods and which should efficiently supplement the existing purely morphologic diagnostics of tumours with new parameters representing individual properties of tumours at the beginning and during the antitumorous treatment. The objective is to improve the treatment results with better targeted and individual therapy.

Section of the experimental oncology – the professional focus is as follows (the selection):

Group of tumour biology 1: The study of the function of the protein p53 and its homologues in the process of the malign transformation of cells, the monitoring of influences of the post--translation modifications of the antioncological gene p53 on its activity and possible activation of its non functional forms in a tumorous cell, the testing of the influence of synthetic inhibitors CDK on the protein expression regulating the cell cycle, the proteom analysis of a tumorous cell.

Group of tumour biology 2: The function analysis of the tumour suppressor p53

Group of the tumour immunology and immunotherapy: The cell and molecular predictive markers showing the effectiveness of the tumour immunotherapy, the transduction and transactivation proteins in cytokinetic signals, the monoclonal antibodies for the detection of bone cancer micrometastasis.

Projects solved in the area of nanotechnologies

None was reported.

Experts/Field

Doc. MUDr. Rostislav Vyzula, CSc. – Positron emission tomography

RNDr. Bořivoj Vojtěšek, DrSc. – Research of the tumour biology

Codes: 3d, 3g, 7a

5.3.4. Czech Metrology Institute in Brno (ČMI)

Okružní 31, 638 00 Brno, I.D. (IČO) 00177016

www.cmi.cz

Brief workplace description

ČMI is an allowance organisation directly managed by the Ministry of Industry and Trade. The basic function of the Institute is to fulfil the function belonging to the state administration in the area of metrology assigned to ČMI in the Act No. 505/1999 Coll. as later amended. ČMI organises services in all basic areas of the metrology: Fundamental metrology (the maintenance of state etalons, the etalon and measuring devices' calibration) and the legal metrology (the approval of measuring device types, the primary and consequent verification of measuring devices, and the state metrological supervision). ČMI solves, in accordance with the medium--term conception of the national metrological system, a set of tasks in the technical development, which, with their character, vary from the applied research to the solution of specific technical tasks. Activities of ČMI are organised by offices managed directly by the General Director (P. Klenovský), 10 regional inspectorates, 2 specialised workplaces – Laboratory of the primary metrology and the Inspectorate for ionising radiation, and 4 additional laboratories in different institutions. The activities related to nanotechnologies are organised mainly by the Department of the technical length (V. Zelený), Department of quantum length and laser metrology (P. Balling), the Laboratory of the primary metrology in Praha (M. Bartoš), and the Laboratory of modern metrology in Brno (P. Klapetek).

Research and development focus

They, in ČMI, precisely measure sizes at the level of micron and nanometre, establish the surface topography (with ATM), do the point spectroscopy, measure magnetic properties, etc. and organise research of new measuring methods in these areas. ČMI participates in activities by the European Virtual Institute for Geometry Measurements (EVIGeM) within the solution of the project of the EU 5th Framework Programme(Growth). They solve, inter alia, the issues of "Surfaces and Nanotechnology".

Projects solved in the area of nanotechnologies

Co-operation in the solution of GA CR project 202/05/0607 "Preparation of carbonaceous micro and nanostructures by plasma technologies", the solver – Mgr. Lenka Zajíčková, PhD., Masaryk University in Brno. Co-operation on behalf of ČMI – Mgr. Petr Klapetek, PhD. (for the project description see MU-PřF).

Co-operation in the solution of the 5th FP project EVIGeM "European virtual institute for geometry measurements" (2002–2007), the co-ordinator – Prof. G. Goch, Universität Bremen, Germany. The worker responsible for the co-operation is Ing. Vít Zelený, CSc.

Experts/Field

Ing. Vít Zelený, CSc. – Length measurements

Mgr. Petr Klapetek, PhD. – Microscopy of atomic forces and the related methods

Codes: 7a, 7e

5.4. RESEARCH WORKPLACES IN THE PRIVATE SECTOR

5.4.1. SYNPO, a.s.

S. K. Neumanna 1316, 532 07 Pardubice, I.D. (IČO) 465047711

www.synpo.cz

Brief description of the workplace

SYNPO, joint stock company, was founded in 1946 as the Research Institute of Synthetic Resins and Paints and it has always been the leader in the applied research and development in the area of polymers. SYNPO has been a profit making joint stock company since 1991 and it is involved in:

- The contractual research and development and in formulas in the area of synthetic polymers, especially paints, composites, and adhesives
- Application development
- Development of processes for pilot plant operations and manufacturing facilities
- Manufacture of special materials in the area of the polymer chemistry
- Analytics and testing in accredited laboratories

Research and development focus

Research and development of synthetic resins and products based on them progress until the pilot plant verification and the design of operational instructions. This is organised in the following areas: Emulsion polymerisation, emulsion and solution acrylates, epoxy resins, alkyd and polyester resins, polyurethanes, polymer nanocomposites, and the preparation (cleaning) of clay nanoparticles.

Projects solved in the area of nanotechnologies

Ministry of Defence project ONSYNPO0200301 "NANOCOMPOSITES – Materials based on polymer nanocomposites of high barrier effect" (2003–2005), the solver – Ing. Jiří Zelenka, CSc.

MIT project FF-P2/076 "Polymer nanocomposite materials based on the domestic clay" (2003–2005), the solver – Ing. Jiří Zelenka, CSc. The project focuses on the development of

polymer-clay nanocomposites based on domestic raw materials. The attention is paid to the cleaning of clays, the ways of their modification (hydrophobicity), the dispersant process, and the influence of the structures of modifying substances on the dispersion. There are nanocomposites of the treated clays prepared, which are based on the epoxy, polyester and polyol-cyanate resins.

MIT project FT-TA/013 "Barrier paints for concrete with the utilisation in nanocomposite materials" (2004–2007), the solver – Ing. Kateřina Zetková. The solution subject is the formulation of special paints determined for the protection against carbonation of reinforced concrete and also the creation of barrier substances for concrete floors with increased hardness and wear resistance. There are products used which are prepared on the clay basis, specifically montmorillonite. There are relations between the contents and the kinds of nanoparticles analysed in the relevant bonding materials. Also, they monitor their effect on the ability to block the penetration of chloride ions in the case of the reduction of substrate carbonation, i.e. the impact of the CO_2 penetration on the diffusion in water steam, on the absorbability, and the depth of the penetration.

Co-operation in the solution of MIT project 1H-PK2/46 "Nanofibres and their composites for the technological and biomedical applications" (2005–2008), the solver – Prof. RNDr. Oldřich Jirsák, CSc., TU Liberec. The co-worker on behalf of SYNPO, a.s. is Ing. Jiří Zelenka, CSc.

Co-operation in the solution of MIT project FD-K3/086 "Photocatalytic surfaces with self-cleaning properties (Development of the technology for new surface materials with self-cleaning and disinfection effects based on photocatalysis)" (2003–2005), the solver – Ing. František Peterka, PhD., A.T.G, s.r.o., Praha. The co-worker on behalf of SYNPO, a.s. – Prof. Ing. Štěpán Podzimek, CSc.

SYNPO, a.s. is a regular member of the Network of Excellence within the 6th FP NANOFUNPOLY "Nanostructured and Functional Polymer-Based Materials and Nanocomposites", co-operation within the consortium CRNCPM (see 7.3.3.). The liaison worker on behalf of SYNPO, a.s. is Ing. Ivan Dobáš, CSc.

Experts/Field

Ing. Ivan Dobáš, CSc. – Synthesis and transfer of technologies

Ing. Jiří Zelenka, CSc. – Polymer nanocomposites

Prof. Ing. Štěpán Podzimek, CSc. – Analysis of polymers and composites

Authorised

Codes: 1b, 1f

5.4.2. Institute of Nuclear Research, a.s. (ÚJV)

Husinec – Řež 130, 250 68 Řež

www.nri.cz

Brief description of the workplace

The Institute of Nuclear Research in Řež (ÚJV) was founded in 1955. It currently provides for a wide scope of expertise and services to operators of nuclear power plants in the Czech Republic and abroad, supports central state institutions in the Czech Republic in the area of

the strategic management of the power industry and the handling of nuclear waste (Ministry of Industry and Trade), organises independent professional expertise for the State Office for Nuclear Safety, organises the development of the utilisation of ionising radiation and the radiation exposure for the basic and applied research, health industry, and the industry in general. It provides for the research and services related to the liquidation of radioactive waste, organises the manufacture of radio-pharmaceuticals, organises education and training of professionals and scientists, and many other activities. In addition, ÚJV has got activities also in other than nuclear areas, for example, in the area of the classic power industry, chemical industry, and the protection of the environment.

Research and development focus

Research and development activities have been divided into the five following divisions: Nuclear safety and energies, the integrity and technical engineering, Energoproject Praha, reactor related services, and radio-pharmaceuticals. The divisions have been divided into 54 departments. The research focussed on nanotechnologies, on nanomedicine respectively, is organised within limited scope in the Division of pharmaceuticals, the main mission of which is the research and manufacture of radio-pharmaceuticals.

Projects solved in the area of nanotechnologies

In the period 2005–2009, they will solve the MEYS project 1M0505 "Centre of targeted therapeutics", the solver – Doc. MUDr. Vladimír Viklický, CSc., Director of the Division of radio-pharmaceuticals. The following workplaces co-operate: Institute of Microbiology of CAS (Prof. RNDr. Blanka Říhová, DrSc.), Institute of Molecular Genetics CAS (RNDr. Milan Fábry, CSc.), Institute of Macromolecular Chemistry CAS (Doc. Ing. Karel Ulbrich, DrSc.), Institute of Experimental Botany CAS (RNDr. Karel J. Angelis, CSc.), EXBIO Praha, a.s. (Ing. František Škrob), and Charles University – PřF (Doc. RNDr. Karel Bezouška, CSc.). The Centre is involved in activities related to nanomedicine.

The subject of the activities is the development of preparation technologies for radio-nuclides and the methods for the marking of antibodies, antibody fragments, and targeted structures (antibody – polymer). Within the solution framework, they will work with dendrimers (nanoparticles).

Co-operation in the solution of the GA CAS project IBS1048301 "Preparation of new radio--pharmaceuticals based on the monoclonal and recombined antibodies and peptides marked α and β radio-nuclides" (2003–2006), the solver – Ing. Rostislav Mach, DrSc., ÚJF CAS co--operates with Ing. Leo Kronrád, DrSc.

Co-operation in the solution of the MIT project FD-K3/001 "Development of new radio-pharmaceuticals based on monoclonal and recombined antibodies" (2003–2005), the solver – Ing. Miloslav Suchánek, EXBIO, a.s. co-operates with Ing. Leo Kronrád, DrSc.

Experts/Field

Doc. MUDr. Vladimír Viklický, CSc. – Cell engineering, biotechnological preparations

Ing. Leo Kronrád, DrSc. – Research of radio-pharmaceutical preparations

Codes: 3b, 3c

5.4.3. Research Institute of Inorganic Chemistry, a.s. (VÚAnCH)

Revoluční 84, 400 01 Ústí nad Labem, I.D. (IČO) 62243136

www.vuanch.cz

Brief workplace description

VÚAnCH, a.s. is a member of the Unipetrol Group and it centrally provides the Group for research and development. Research and development works are focussed on chemistry, technology and the utilisation of raw materials. It also organises the accredited emission measurements, water and liquor analyses, determines selected elements in fertilisers, composts, soils, sediments, sludge, and similar materials, identifies and analyses unknown samples, analyses and assesses wastes, reworks and liquidates wastes, etc. Recently, they do also research in the area of nanotechnologies.

Research and development focus

They organise the preparation of nanoparticles of tricalcium-phosphate for the suspension polymerisation of styrene, research nanostructures based on zeolites and molecule screens determined for the preparation of catalysts, prepare nanoparticles of Al_2O_3 for the manufacture of special ceramics and prepare nanofillers for plastics and rubber based on the intercalation of exfoliated clay minerals.

Projects solved in the area of nanotechnologies

MIT project FT-K3/040 "Development of special kinds of oxidation catalysts for the targeted synthesis of aromatic substances" (2004–2007), the solver – Ing. Gabriela Šťávová. Research focuses on the development of new kinds of nanomaterials based on molecule screens for catalytic applications in the synthesis of aromatic substances. They organise the development of new catalysts containing tin for the Baeyer-Villiger oxidation of cyclic ketones to lactones. The synthesis of these catalysts is optimised for the highly selective preparation of selected lactones from their relevant cyclic ketones (cyclopentanone, cyclohexanone, jasmine-ketone, macrocyclic ketones C14 and C18).

MIT project FT-TA/042 "Development of progressive kinds of alumina for the special applications" (2004–2007), the solver – Ing. Věnceslava Tokarová, CSc. This is the basic research with the objective to prepare a nanomaterial based on alumina with the structure of corundum and to develop the preparation process for mesoporous alumina. The finding of the application potential for nanoalumina in progressive ceramics and for mesoporous alumina in catalysis make a part of the solution.

Experts/Field

Ing. Věnceslava Tokarová, CSc. – Nanoceramics

Ing. Gabriela Šťávová – Nanocatalysis

Codes: 1a, 1f, 5b, 6d

5.4.4. Research Institute of Organic Syntheses, a.s. (VÚOS)

Rybitví 276, 532 18 Pardubice 20, I.D. (IČO) 60108975

www.vuos.cz

Brief workplace description

VÚOS is one of the biggest Czech companies involved in the research and development in the area of organic chemistry and toxicology. Activities of the Institute are well characterised with the following basic research directions: Research and development, manufacture of special chemicals, environmental service, and process engineering.

Research and development, concentrated mostly in the sectors of the colorants' research and organic research, focuses mainly on the area of organic colorants, pigments and the functional π-π systems, the development of custom-made syntheses of sophisticated molecules and key intermediate products for the pharmaceutical industry. VÚOS provides for the complex services, from the technological-economic study and the development and pilot plant operations to project documentation, or the introduction into operations.

Research and development focus

In the area of colorants, the research and development focus on organic colorants, pigments (especially the so-called High Performance Pigments), optically brightening agents, functional systems with the biological effectiveness, high-tech applications, UV stabilisers, and biocides.

In the area of the organic technology, the research specialises in the homogeneous and heterogeneous catalyses (including the nanocatalysis), electrophile and nucleophile substitutes, the chiral compounds, heterocyclic compounds, and phosgene chemistry.

Projects solved in the area of nanotechnologies

MIT project FI-IM/077 "Research of the membrane separation technologies for the area of colorants preparation and cleaning of liquid chemical wastes" (2004–2005), the solver – Ing. Luboš Víšek. The solution subject is the research of the preparation technology for liquid forms of colorants and the cleaning of industrial chemical and seepage waters by the method of the membrane separation. There are the research and selection of colorants and OZP suitable for the preparation in the liquid form running as well as the specification of waste waters from manufacturing operations and seepage waters from the area of Synthesia, a.s. and the preparation and testing of nanofiltration and reverse osmotic membranes. The objective is the setup of a pilot unit and its long-term testing.

Co-operation in the solution of the MIT project FT-TA/023 "SolarCat – Photocatalyst with the adjustable nanostructure for the use in removals of impurities from air and water, thanks to the effects of UV light, or the direct sunshine" (2004–2006), the solver – Ing. Jaroslav Přidal, CSc., the grantee – MICROPUR, s.r.o., Hradec Králové. The co-worker on behalf of VÚOS – Ing. Jan Rakušan, CSc.

MIT project FT-TA/036 "High-tech application of phthalocyanine derivatives" (2004–2006), the solver – Ing. Jan Rakušan, CSc. Research of the new highly clean phthalocyanine derivatives with marked electronic, optical and magnetic properties usable in high-tech applications in electronics during the development and manufacture of organic conductors, FET transistors,

photodetectors within the infra-red area, solar cells, CD media, special gas sensors, and in the area of fast developing molecular electronics.

Participation in the project within the 6th FP STREP "NANOEFFECTS – Nanocomposites with High Colouration Efficiency for Electrochromic Smart Plastic Devices" (2004–2006), the Consortium of 12 partners. The responsible person on behalf of VÚOS is Ing. Miroslav Nečas, CSc. Research focuses on new multifunctional nanocomposite systems of high colour efficiency and with the utilisation in the manufacture of plastic appliances presenting outstanding properties (stability, electrochromic switching characteristics, etc.).

Experts/Field

Ing. Miroslav Nečas, CSc. – Chemical synthesis, nanomaterials

Ing. Jan Rakušan, CSc. – Functional nanosystems

Ing. Lubomír Kubáč – Nanomaterials

Ing. Martin Kaja – Functional nanosystems

Ing. Luboš Víšek – Nanofiltration

Authorised

Codes: 1a, 5a, 5c, 6c

5.4.5. SVÚM, a.s.

Areál výzkumných ústavů, 190 11 Praha 9, I.D. (IČO) 25797000

www.svum.cz

Brief workplace description

The enterprise is one of the most important organisations within the applied material research and testing institutions in the Czech Republic. The activities cover the following areas: Research and development and expert activities, consulting, material tests in accredited laboratories, according to the ČSN EN ISO/IEC Standard 17025 (by ČIA, they have also the certificate issued by GE Aircraft Engines), the Certification centre for welders, training and publishing activities, and the specialised low volume manufacture. The manufacture includes self-lubricating bearing foil METALOPLAST® and foils of PTFE, the piston and sealing rings of PTFE, corrosion-proof coatings of fluoroplastics, DELTA-MKS® anticorrosion treatment of machinery parts, and the high performance permanent magnets.

Research and development focus

Research and development focus on a wide spectrum of materials and technologies, and their processing (metals, plastics and polymer composites, prediction of the lifespan of machinery parts, defect causes and assessment, hot processing technologies, forming, construction of instruments, tool steels, and welding. In the area of nanotechnologies, the Institute co-operates in the solution of the issues related to nanostructured coatings and it is involved in the research of material engineering properties of nanocomposites with the polymer thermoplastic matrix.

Projects solved in the area of nanotechnologies

Participation in the solution of the project within the 5th FP (Growth) NANOCOAT "Nanostructured coatings via environmentally friendly deposition techniques for demanding tribological applications", the co-ordinator – Microcoat SpA, Italy, the solver on behalf of SVÚM, a.s. is Ing. Jiří Krejčík, CSc. – General Director of the company.
The project objective is the development of new nanostructured coatings for different machinery applications (gearwheels), for automotive engine components (pistons, valve tappets) and new systems of coating adjusted for the pilot plant adjustments of existing parts with new methods of the impulse cluster beam, laser arc, and cluster CVD. Activities by SVÚM are focussed on the wear-resistance tests of coatings and on the measuring of friction coefficient, but also on the monitoring of fatigue properties of surfaces, i.e. bending and contact fatigue tests. The subjects of these tests are also the tests of the high temperature oxidation at temperatures within the range from 200 to 500°C and the monitoring of changes in surface structures.

A part of the research intention MSM 2579700001 – the experimental stage "Research of the time and temperature dependency of the strength and fragility-fracture characteristics of engineering plastics and polymer nanocomposites", the solver on behalf of SVÚM, a.s. Ing. Jaroslav Hell, CSc.
The task objective in the area of construction polymers is the higher level of knowledge about the properties of thermoplastic nanocomposites during the creep straining in tension and during the impact straining in multiple axis tension and in high speed deformation, including the problems of the mechanism of running disturbance processes.

Project under preparation

Development of nanostructured coatings for slide bearings based on ceramic nanopowders, e.g. SiC with a suitable connecting agent. This liquid composite material is sprayed on the bearing surface and this resulting coating is consequently hardened at higher temperature. There are also tribological properties of these coatings studied. There is the co-operation with ZKL – research and development, a.s. Brno in the development of hinged bearings. Together with the mentioned company and with the Technical University in Vienna, they prepare the presentation of a project within the EUREKA programme.

Experts/Field

Ing. Jiří Krejčík, CSc. – Tribology, surface adjustments

Ing. Ivo Černý, PhD. – Fatigue properties of surfaces, metallic composites

Ing. Dagmar Mikulová – Metallography

Ing. Josef Cizner, CSc. – Corrosion, high temperature oxidation

Ing. Jiří Kadlec, CSc. – Analyses of coatings, phase composition

Ing. Jaroslav Hell, CSc. – Material engineering of plastics and polymer composites

Ing. Robert Válek, PhD. – Material engineering of plastics and composites

Authorised

Codes: 1a, 1d, 7c, 7d

5.4.6. VÚK Panenské Břežany, s.r.o. (VÚK)

Panenské Břežany 50, 250 70 Odolena Voda, I.D. (IČO) 25604716

www.volny.cz/vuk

Brief workplace description

VÚK Panenské Břežany, s.r.o. is currently involved in the following activities:

- Applied research in the area of the development of new alloys, technologies for the manufacture and processing of materials and metallurgy products of non-ferrous metals and their alloys.
- Testing (it is a member on the Association of Czech Testing Places and Laboratories), the provision for the tests of mechanical properties (the static, impact, and fatigue ones), the metallographic analyses, chemical analyses.
- Organisation of the professional information centre within the area of non-ferrous metals, the provision for services of the professional library, the technical consulting in the areas of non-ferrous metal standards, the use and replacement of materials.

Research and development focus

Activities within the area of the applied research have been focussed on the development of new kinds of materials and on the development, adjustments, or optimising of technological processes for the manufacture of products of non-ferrous metals and their alloys. In the area of nanotechnologies, the Institute focuses on the research of methods of the creation of ultra-fine structure in non-ferrous metals.

Projects solved in the area of nanotechnologies

Co-operation in the solution of the GA CR project 106/05/0073 “Study of the microstructure and the thermal stability in ultra-fine-grained Mg alloys prepared by severe plastic deformation” (2005–2007), the solver – Mgr. Jakub Čížek, PhD., UK-MFF. The co-worker on behalf of VÚK is Ing. Vladivoj Očenášek, CSc.

Co-operation in the solution of the GA CR project 106/03/0790 “Super fine-grained aluminium materials prepared by the method of the intensive plastic deformation” (2003–2005), the solver – RNDr. Přemysl Málek, CSc. The co-worker on behalf of VÚK is RNDr. Margarita Slámová, CSc.

Co-operation in the solution of the MEYS research intention MSM2631691901 “Metal materials with the structure in the sub micron and nanometric areas prepared by the method of the intensive plastic deformation” (2004–2009), the solver – Prof. Ing. Josef Zrník, CSc., COMTES FHT, Plzeň. The co-worker on behalf of VÚK is Ing. Vladivoj Očenášek, CSc.
VÚK covers the area of the utilisation of the methods ARB and ECAP in the preparation of ultra-fine-grained materials of highly pure aluminium and AlMg, AlZnScZr, and AlMgScZr alloys.

Experts/Field

Ing. Vladivoj Očenášek, CSc. – Non-ferrous metals

RNDr. Margarita Slámová, CSc. – Physical metallurgy, non-ferrous metals, metallic nanomaterials, metallography

Authorised

Codes: 1e, 7a, 7d

5.4.7. COMTES FHT, s.r.o.

Lobezská E981, 326 00 Plzeň, I.D. (IČO) 26316919

www.comtesfht.cz

Brief workplace description

The company focuses on the research and development of metal materials. It organises the complete technological service for the forming and hot processing, numerical and physical simulations of forming processes, material analyses and the measuring of physical properties of metal materials. It provides for consulting to manufacturing companies and solves research projects.

Research and development focus

In the period 2005–2009, the research in COMTES FHT, s.r.o. will focus mainly on the solution of the MEYS research intention, which highly relates to the research of nanotechnologies.

Research intention MSM2631691901 "Metal materials with the structure in the sub micron and nanometric areas prepared by the method of intensive plastic deformation", the solver – Prof. Ing. Jozef Zrník, CSc.

The research intention deals with the creation of ultra-fine – sub microscopic and nanostructural materials by the application of the intensive plastic deformation (by the ECAP, ARB, and HPT ways) at the same time, when the selected materials are exposed to the managed temperature. There were steels and aluminium alloys mostly selected for the experimental programme. Within the project, there are different kinds of deformation techniques applied and they are accompanied by different temperature modes. In addition to the existing techniques, which COMTES FHT, s.r.o. has got at its disposal, there are also other ones tested and developed. They are suggested and modified on the basis of the knowledge and experience obtained during the intention solution. The processed materials are analysed in detail from the microstructure point of view, but also from the properties point of view. The most important objectives of this task are as follows: The theoretical knowledge of mechanisms of making grains finer – down to the nanostructured form, the finding about the physical limits with regard to the grain sizes and the structure stability, and the achievement of required mechanical material properties.

Projects solved in the area of nanotechnologies

"Integration of manufacturing systems for mass-manufacture of miniature/micro-products", the project integrated in the 6th EU Framework Programme, under the acronym MASMICRO focussed on the forming of microparts (they are partners in the Consortium of the solvers

under the leadership provided by the University of Strathclyde, Glasgow). The project has been approved of by EU at the end of 2004 and there was a contract executed on the solution in 2005, when works have commenced on the proposal of forming tools and on the development of the forming technology. The solution of the project has been planned for 4 years.

Experts/Field

Prof. Ing. Jozef Zrník, CSc. – Metal forming by intensive plastic deformation (ECAP), metal alloys, material engineering

Dr. Ing. Zbyšek Nový – Thermo-mechanical processing of metals

Ing. Libor Kraus – Hot processing, material analyses

Authorised

Codes: 1e, 7d

5.4.8. SVÚOM, s.r.o.

U Měšťanského Pivovaru 934, 170 00 Praha 7, I.D. (IČ) 25794787

www.svuom.cz

Brief workplace description

SVÚOM, s.r.o. is a company of the research orientation involved in the issues within the areas of corrosion, protection against corrosion, and the surface modification.

Research and development focus

The Institute focuses, within the solution of the project of the 6th FP, on the application and testing of sol-gel connecting agents based on SiO_2 used in coatings on glass or glass jewellery for the colouring with organic colorants and organic and inorganic pigments and colorants (the thickness of the coatings is within hundreds of nm), and for the creation of reflection layers based on aluminium pigments.

The Institute is also involved in the design of interferential colorants for jewellery products applied by the deposition of TiO_2 vapours in layers of 100–400 nm and in the protection of metal with the SiO_2 sol-gels against mechanical influences and corrosion.

The main task is the solution of the project NanoReflex, which deals with reflection paints based on aluminium pigments. Within the project, leafing and non-leafing paints are formulated and they are consequently applied on metal and glass substrates. They monitor the reflection of the prepared samples and test the mechanical and corrosion resistance and stability as against sunshine.

Projects solved in the area of nanotechnologies

Participation in the solution of the 6th FP (CRAFT) project NANOREFLEX "New Water-based Industrial Coating Technology for Environmental-friendly High Reflective Metalloid Coatings Based on Nano-coated Submicron Aluminium Pigments"

The project No.: COOP-CT-2004-508415, the co-ordinator – Reinhard Bolter (Austria).

Experts/Field

Dr. Ing. Lubomír Zahradník, CSc. – Silicates

Ing. Eva Týnová – Silicates

Ing. Jaroslava Benešová – Issues of corrosion

Authorised

Codes: 1a, 5c, 7c

5.4.9. Czech Technological Centre for Inorganic Pigments a.s. (ČTC AP)

Nábřeží Dr. E. Beneše 24, 751 62 Přerov

www.precheza.cz/www/technologie.htm

Brief workplace description

The Czech Technology Centre for Inorganic Pigments in Přerov, a.s. has been founded with the aim to speed up the transfer of the newest scientific knowledge to the industrial practice and to strengthen the application service for customers. The company is a subsidiary of PRECHEZA, a.s. The Centre has commenced its activities on October 1st, 2004.

Research and development focus

Research and development are focussed mainly on the titania while, ferrous pigments, and new products. The Physical-chemical laboratory and the Department of technical information make parts of ČTC AP. In the area of nanotechnologies, they organise research and development in the areas of inorganic pigments and new materials (nano-TiO_2, nano-Fe_2O_3, UV absorbers, HPP colour pigments, transparent pigments, etc.).

Projects solved in the area of nanotechnologies

The Institute participates in the solution of the MEYS project 1M0577 “Research Centre for the nanosurface engineering – NANOPIN” (2005–2009), the co-ordinator – ATG, s.r.o, Praha (F. Peterka). The co-operation on behalf of ČTC AP – Ing. A. Mlčoch, CSc.

Experts/Field

Ing. Antonín Mlčoch, CSc. – Director of ČTC AP, inorganic pigments

Codes: 1a, 1d, 6d, 7b, 8a

5.4.10. *Brief review of activities by the research workplaces in the private sector*

Table IV presents the review of activities by the research workplaces in the private sector, according to the main fields as in the nomenclature of nanotechnologies (see **Table I**).

Table IV.

	1	2	3	4	5	6	7	8
SYNPO	X							
ÚJV			X					
VÚOS	X				X	X		
VÚK	X						X	
COMTES	X						X	
SVÚOM	X				X		X	
CTČAP	X					X	X	X

Key: 1 – Nanomaterials, 2 – Nanoelectronics, 3 – Nanobiotechnology, nanomedicine, 4 – Nanosensors, 5 – Nano in the chemical technology, 6 – Long-term research, 7 – Instruments and technology, 8 – Other

6. MANUFACTURING COMPANIES

This Chapter deals with small, medium-size, and big enterprises, which utilise technologies belonging to the area of nanotechnologies. They manufacture products and parts, or materials of nanosizes, or they participate in the solution of research intentions, programme projects and projects of Framework Programmes of EU, or in other international projects. They differ from companies presented in Chapter 5 because their main activities relate to manufacturing.

6.1. LARGE COMPANIES (WITH 250 EMPLOYEES, OR MORE)

6.1.1. RSM Chemacryl a.s.

Tovární 2093, 356 80 Sokolov

www.hexionchem.com

Brief company characteristics

RSM Chemacryl (formerly Chemické závody Sokolov and Eastman Sokolov) is 99 % owned by Resolution Specialty Materials, USA, the company that has recently created, together with other companies, the multinational Group HEXION Specialty Chemicals, Inc. of the registered address in Columbus, OH, USA. RSM Chemacryl is involved in the manufacture and processing. They manufacture four basic esters of the acrylic acid (methyl-acrylate, ethyl-acrylate, butyl-acrylate, and 2-ethyl-hexyl-acrylate). Acrylic acid is used especially as the super-absorbing polymers (SAP), detergent polymers, flocculants, or copolymers. The company employs about 410 workers.

Activities in the area of nanotechnologies

They organise the research of possibilities to build nanoparticles into polymers with the aim to gain material properties, which are difficult to get otherwise (the specific mechanical properties – the self-cleaning and the disinfection effects, etc.). They also study the impact of added nanoparticles on properties of paints and other complementing chemical preparations and they develop products stabilising nanoparticles in the water environment.

The company participates in the solution of the MEYS project 1M0577 “Research Centre for nanosurface engineering – NANOPIN” (2005–2009), the co-ordinator – ATG, s.r.o, Praha (F. Peterka), with the aim to find commercially interesting products using photocatalytic phenomena.

Responsible worker: Ing. Petr Sedlák, CSc. – the Technical Director.

Codes: 1a, 1f, 5b

6.1.2. JABLONEX Group, a.s.

Palackého 41, 466 37 Jablonec nad Nisou

www.ornela.cz

Brief company characteristics

Jablonex Group, a.s. (Ornela, a.s. before 30 September 2005) manufactures in the Division Desenské sklárny in Desné in Jizerské hory different glass products and in the Division České perličky basically glass beads, imitation jewellery, Christmas decorations, etc. The number of employees: 2000.

Activities in the area of nanotechnologies

Co-operation in the research of the creation of reflection nanolayers on glass products with SVÚOM, a.s., Praha, and other workplaces.

Responsible worker: Ing. Jaroslav Halfar.

Code: 1d

6.1.3. Saint-Gobain Advanced Ceramics, s.r.o. (SGAC)

Přepeřská 1302, 511 01 Turnov

www.sgac-turnov.cz

Brief company characteristics

SGAC is a subsidiary of the Saint-Gobain Group, France. The company currently deals with three main manufacturing activities. The first one is the manufacture of ceramic seals – the cartridges for water mixing taps, the assembly and sales of complete water mixing taps (more than 20 million pieces a year). The second industry is the manufacture of ceramic filters for melted metals in the metallurgy – the volume of about 20 million pieces a year. The third area relates to special technical ceramics like, for example, cutting tools (exchangeable edge plates for the machining of metals), tools for the forming of pipes, parts of electroceramics and advanced products of high-tech ceramics. The number of employees: About 300.

Activities in the area of nanotechnologies

Development and manufacture of high-tech ceramic prototypes (based on sub micrometric Al_2O_3, ZrO_2, or other powders).

Solved projects

1. Science for Peace (NATO) “Alumina-Based Nano/Microcomposite Cutting Tools for High Speed Metal Cutting”, 2000–2003, the role of a co-solver.

2. EU 5th FP (GROWTH) – the project FGMSIA TOOL “A New Generation of Cutting Tools Based on Functionally Graded SiAlON for Solving the Machining Problems of the 21st Century” (2000–2003), the role of a co-solver.

The responsible person is Ing. Vladimír Šída, CSc. – Technical Director.

Codes: 1a, 1b

6.1.4. BorsodChem MCHZ, s.r.o.

Chemická 1, 709 03 Ostrava-Mariánské Hory

www.bc-mchz.cz

Brief company characteristics

The company is involved in the chemical production and in its own development of products. Aniline, cyclohexamine, diethyl oxalate, concentrated nitric acid, oxalic acid, special amines, and hydrogen – they all belong among the basic products. The number of employees: 600.

Activities in the area of nanotechnologies

The research workplace of the company solves, in co-operation with VŠCHT-FCHT, the MIT project FT-TA2/049 "Support of the research and development of technologies based on zeolite catalysts in BorsodChem MCHZ Ostrava" (2005–2008), the solver – Ing. Petr Maršolek. The solution subject is the preparation technology for the manufacture of special amines on the basis of catalytic reactions on zeolites.

Responsible person: Ing. Petr Maršolek.

Code: 5b

6.1.5. Lasselsberger, a.s.

Adelova 2549/1, 320 00 Plzeň-Jižní Předměstí

www.lasselsberger.cz

Brief company characteristics

LASSELSBERGER with its 62 manufacturing companies and 12 000 employees in 13 countries belongs among the leading enterprises in Europe in the sector of raw materials, building materials, and ceramic products. The company manufactures ceramic tiles in its plant in Rakovník, Czech Republic. The plant employs about 600 workers.

Activities in the area of nanotechnologies

The plant has been manufacturing and distributing ceramic cladding materials and tiles with a special surface coating within the commercial network of the German DSCB Group for about 5 years. The special coating has got cleaning and antibacterial properties. The trademark of these products is HYDROTECT 8. The technology is based on the application of thin transparent layers of nanoparticles of titanium oxide and of other inorganic components on the surface of the ceramic material and its consequent thermal treatment. The layer improves the hygienic properties of the ceramic tiles, thanks to the hydrophile and antibacterial effects of the surface. The production commenced on the basis of a Japanese licence.

Responsible worker: Ing. Pavel Košulič.

Codes: 1d, 8h

6.1.6. Brief review of activities by large companies

Table V presents the review of activities conducted in large manufacturing companies, according to the main fields, as in the nanotechnology nomenclature (see **Table I**).

Table V.

	1	2	3	4	5	6	7	8
RSM	X				X			
Jablonex	X							
SGAC	X							
BorsodChem					X			
Lasselsberger	X							X

Key: 1 – Nanomaterials, 2 – Nanoelectronics, 3 – Nanobiotechnology, nanomedicine, 4 – Nanosensors, 5 – Nano in the chemical technology, 6 – Long-term research, 7 – Instruments and technologies, 8 – Other

6.2. SMALL AND MEDIUM-SIZE COMPANIES (UP TO 250 WORKERS)

6.2.1. Advanced Technology Group, s.r.o. (ATG)

Beranových 65, 199 02 Praha 9-Letňany

www.atg.cz

Brief company characteristics

ATG is a Czech engineering company with ten years of experience. It works especially in the areas of qualification assessment and certification of technical personnel (NDT, welding, corrosion), inspection and supervision for the ASME Code. It also organises an independent supervision of the NDT testing. It is involved in the manufacture for NDT and supplies complete equipment to NDT workplaces, for all methods. There is also the "Centre for TiO_2 photocatalytic applications" (led by Ing. František Peterka, PhD.).

ATG has got about 80 employees.

Activities in the area of nanotechnologies

The main activities in the area of nanotechnologies relate to the co-ordination and solution of the MEYS project 1M0577 "Research Centre for nanosurface engineering – NANOPIN" (2005–2009), the solver – Ing. F. Peterka, PhD. The project is participated in also by TU Liberec – FS, VŠCHT – FCHT, ÚACH CAS, ÚFCHJH CAS, and other manufacturing companies.

The research activities' subject for the proposed centre is the complex study of the unique photocatalytic properties of nanocrystalline titanium oxide targeted on the consequent potential industrial applications in the areas of self-cleaning and hygienic surface designs, photocatalytic cleaning and disinfection of air, water and contaminated soils, the organic syntheses, and the utilisation of solar energy.

Partially researched topics are (i) the synthesis of highly photoactive nanoparticles of titanium oxide, including the doped or mixed materials with the spectral sensitivity expanded in the

visible area, (ii) the preparation of layers based on nanocrystalline titanium oxide from the gas phase by the technique of the plasma deposition, but also from the solution with the aid of different chemical processes, among others with the advanced methods using micelle as samples for the occurrence of a defined porous structure, (iii) characterisation of nanoparticles and nanocrystalline layers of titanium oxide focussed on the finding of direct relations between the material properties and the photoactivity, (iv) the development of standard methods for the testing of self-cleaning abilities and disinfection effects of photocatalytic surfaces, (v) the design of different kinds of laboratory photoreactors for the photocatalytic cleaning and disinfection of the gas, liquid, or solid phases and their testing for the purpose of optimising the working conditions, (vi) the study of the kinetics and mechanism of photocatalytic processes in the deactivation of microorganisms and the oxidation mineralisation of organic contaminants from the possible occurrence of hazardous degradation intermediate products' point of view, and (vii) the use of photocatalysis for purposes of the organic synthesis.

In addition to the described project, the following projects are also solved

MIT project FD-K3/086 "Photocatalytic surfaces with self-cleaning properties" (2003–2005), the solver – Ing. František Peterka, PhD. The development of a technology for the new surface materials with self-cleaning and disinfection effects based on the photocatalysis using the light energy.

Participation (the co-ordination) in the activity COST 540 PHONASUM "Photocatalytic technologies and novel nanosurfaces materials – critical issues", the solver – Ing. František Peterka, PhD. The activity has commenced in October 2005.

Responsible worker: Ing. František Peterka, PhD., Director of the "Centre for TiO_2 photocatalytic applications."

Codes: 1a, 1d

6.2.2. BVT Technologies, s.r.o.

Hudcova 78c, 612 00 Brno

www.bvt.cz

Brief company characteristics

The development and manufacture of custom-made electrochemical sensors and biosensors.

The number of employees: 5.

Activities in the area of nanotechnologies

Development of electrochemical sensors and biosensors, the creation of 3D structures with the thick layer technology, the finalisation of the development of nanostructured electrodes.

Solved projects: EU 5th FP – project GRD1-2001-4183 MICROPROTEIN, 2002–2005, (electrochemical sensors for the identification of biochemical substances, the field of electrochemical sensors, the solution of the cross-talk problem), it plays the role of a partner.

Responsible worker: RNDr. Jan Krejčí, Chairman of the Board

Code: 4b

6.2.3. CPN, s.r.o.

Dolní Dobrouč 401, 561 02 Dolní Dobrouč

www.cpn-contipro.com

Brief company characteristics

The company makes a part of Contipro Group Holding, Czech Republic. It organises the research, development and biotechnological production – the enterprise is one of the biggest producers of hyaluronic acid in the world (it is an active substance used in pharmacology, cosmetics and nutrition). They also produce other highly active substances used mostly in cosmetics. The number of employees: 105.

Activities in the area of nanotechnologies

1. Preparation of scaffolds based on nanofibres for the tissue engineering – the own research project
2. Preparation of carriers for the targeted delivery of drugs based on nano and microparticles – the own research project
3. Solution of the project within EU 6th FP – NanoBioSaccharides, "Nanotechnologies for Bio-inspired Polysaccharides: biological 'decoys' designed as knowledge-based, multi-functional biomaterials", a partner

Responsible worker: RNDr. Vladimír Velebný, Director

Codes: 3b, 3c

6.2.4. Crytur, s.r.o.

Palackého 175, 541 01 Turnov

www.crytur.cz

Brief company characteristics

The manufacture and development of scintillation materials and detectors, laser bars and components (mirrors), the precise optics and mechanics, sapphíre profiles. The number of employees: 46.

Activities in the area of nanotechnologies

Research and development of materials usable in nanotechnologies.

Solved projects:

MIT project FI-IM2/129 "Monocrystalline materials grown under oxidation conditions for lasers, scintillation detectors, el. microscopy, and nanotechnology" (2005–2007), the solver – Mgr. Jindřich Houžvička, PhD.

Responsible workers: Mgr. Jindřich Houžvička, PhD., Statutory Representative, and Ing. Karel Blažek, Director

Code: 1e

6.2.5. Delong Instruments, a.s.

Bulharská 48, 612 00 Brno
www.dicomps.com

Brief company characteristics

Development and manufacture of electron microscopes and other medical instruments.
The number of employees: 68.

Activities in the area of nanotechnologies

Development of equipments using the electron beam for the study, for the creation of nanostructures respectively, by the method of low voltage transmission and scanning electron microscopy. This allows for the study of structures of biological and macromolecular composites, but also of microelectronic, or micromechanical products. These structures can be also made with the aid of an electron beam. The special products by the company are the electron optical multiple beam instruments, which present the only possible approach to the solution of the productivity problem in nanolithography and in the mass inspection of semiconductor structures.

Solved projects: 6th EU FP (STREP) – RIMANA, "Radical Innovation Maskless Nanolithography" (2005–2008), a partner

Responsible worker: Ing. Tomáš Papírek, Member of the Board

Codes: 7a, 7d, 8h

6.2.6. ELCERAM, a.s.

Okružní 1144, 500 03 Hradec Králové
www.elceram.cz

Brief company characteristics

Manufacture of white and printed ceramic substrates (the corundum ceramics). The number of employees: 150.

Activities in the area of nanotechnologies

The solution of the project described below.

Solved projects:

MIT project FT-TA2/018 „Advanced beam technologies for the creation and processing of layers in the manufacturing practice in electronics" (2005–2008), the solver – Ing. Karel Strobl. The advanced technologies for microelectronics and sensorics based on the combination of technologies of energy beams (laser, UV radiation, ion beams, microwave radiation, etc.) and technologies of the micro and nanolayers applied by vacuum techniques, plasma techniques, and wet processes. The stress is put on the selectivity of processes with the pronounced high definition of route width and gaps in created structures.

Responsible worker: Ing. Karel Strobl, Chairman of the Board

Codes: 1d, 7c, 7d

6.2.7. ELMARCO, s.r.o.

V Horkách 76, 460 07 Liberec

www.elmarco.cz

Brief company characteristics

Development and manufacture of technologies for semiconductor and nanofibre industry – the supplier of CDS (Chemical Distribution Systems – systems for the batching of chemicals), which make a part of the technology used for the surface treatment of silicon plates. The number of employees: 80.

Activities in the area of nanotechnologies

– Development of the technology Nanospider for the industrial manufacture of nanofibre not woven textiles in co-operation with the Technical University in Liberec (www.nanospider.cz)
– Research and development of materials and end products made of nanofibres

Responsible worker: Ing. Ladislav Mareš, Director

Codes: 1f, 7d

6.2.8. EXBIO Praha, a.s.

Nad Safinou II 366, 252 42 Vestec

www.exbio.cz

Brief company characteristics

EXBIO Praha, a.s. is a manufacturer of monoclonal antibodies and other immunologic reagents. It produces about 150 own unique monoclonal antibodies and every year develops and introduces in the market tens of others. In addition to the manufacture of own antibodies, the company represents also a number of foreign companies in the Czech market. These companies offer products for immunology and molecular biology. The number of employees: about 30.

Activities in the area of nanotechnologies

Solution of the MIT project FD-K3/001 "Development of new radio-pharmaceuticals based on monoclonal and recombined antibodies" (2003–2005), the solver – Ing. Miloslav Suchánek, PhD.

Manufacture of monoclonal antibodies, proteins, etc.

Responsible worker: Ing. Miloslav Suchánek, PhD., Commercial and Marketing Director

Codes: 3, 8h

6.2.9. FEI Czech Republic, s.r.o.

Podnikatelská 2956/6, 612 00 Brno

www.feicompany.com

Brief company characteristics

Development and manufacture of electron microscopes. The number of employees: 200. The company is a subsidiary of FEI Electron Optics International B.V.

Activities in the area of nanotechnologies

The activities of the plant in Brno relate to the development and manufacture of transmission microscopes of the series Tecnai, Morgagni, Dual Beam TM, and the scanning microscopes of the series Quanta, which includes also machines combining electron and ion beams. The microscopes work with the nanometric and sub nanometric preciseness.

Responsible worker: RNDr. Jiří Očadlík.

Code: 7a

6.2.10. Generi Biotech, s.r.o.

Machkova 587, 500 11 Hradec Králové

www.generi-biotech.com/DNA_testy

Brief company characteristics

GENERI BIOTECH, s.r.o. is a Czech biotechnological company focussed on the molecular genetic diagnostics in medicine, the development and manufacture of biotechnological components for the molecular biology, and on the research of means for the gene therapy.

Activities in the area of nanotechnologies

Research and development in the area of nanobiotechnolgies.

Solved projects:

Project within the EU 6th FP (STREP) GENSENSOR-NANOPARTS "Nanobiotechnological components of an advanced bioanalytical micro-array system" (2004–2007), a partner, the solver on behalf of Generi Biotech Pharm – Dr. Radovan Haluza.

Ministry of Defence project ONGENER200301 „DETECTION – Design of the system for the molecular detection of microorganisms, which are considered for the use as the weapons of mass destruction, or bio-terrorism means" (2003–2005), the solver – PharmDr. Radovan Haluza.

Responsible worker: PharmDr. Radovan Haluza, Director

Codes: 3d, 3f, 4b, 6c

6.2.11. HVM Plasma, spol. s r.o.

Na Hutmance 347/2, 158 00 Praha 5-Jinonice

www.hvm.cz

Brief company characteristics

Manufacture and services: The technology of coating with the PVD and PACVD methods on order (hard layers, tribologic coatings – DLC, decorative coatings).

Research and development: The development of technologies of coating, the development of particle sources (magnetrons, arc and ion sources), the modelling, analyses of thin layers, and diagnostics of plasma. The number of employees: 60.

Activities in the area of nanotechnologies

Research of the technologies creating nanolayers and the research of their properties.

Solved projects:

Co-operation in the solution of the MIT project FD-K3/104 "Consortium for the research and application of nanostructured coatings improving the tribologic properties of machinery parts" (2003–2005), the grantee – ČVUT-FS, the solver – Doc. RNDr. Ing. Rudolf Novák, DrSc. Co-operation on behalf of HVM Plasma – Ing. Jiří Vyskočil, CSc.

MEYS project (COST) OC 527.80 "Hard MeC:H coatings: The key deposition parameters and the transfer of the technology from the laboratory to the industrial environment" (2000 –2005), the solver – Ing. Jiří Vyskočil, CSc.

Responsible worker: Ing. Jiří Vyskočil, CSc., Director

Codes: 1d, 7b, 7c

6.2.12. LAO Průmyslové systémy (Industrial Systems), s.r.o.

Na Floře 1328, 143 00 Praha 4

www.lao.cz

Brief company characteristics

Laser technologies of cutting, welding, and marking. The manufacture of laser machines. The service, consumable materials, and spare parts. Custom-made and single purpose systems. The integration in production lines, including the automation. The number of employees: 7.

Activities in the area of nanotechnologies

- Solution of customers' systems in the area of nanotechnologies and microtechnologies
- Lasers in the UV area and the relevant optical systems
- Excimer lasers from 157 nm, solid substance lasers from 266 nm

Responsible workers: Ing. Martin Klečka, Director

Codes: 7d

6.2.13. LIMTEK, s.r.o.

Čapkova 22, 678 01 Blansko

www.limteklaser.com

Brief company characteristics

Manufacture of laser measuring systems for the precise measuring in mechanical engineering, microelectronics, and metrology. The number of employees: 5.

Activities in the area of nanotechnologies

- Laser interferometers for the calibration of length shifts from 0 to 30 metres with the resolution of 1.25 nanometre and the angle turning from 0 to 20 degrees and the resolution of 0.01 arcsecond.
- Laser interferometers as the inbuilt 2 or 3 axis measuring systems for tables XY with the resolution of 5 nm.

Responsible worker: RNDr. Jiří Zeman, Statutory Representative

Codes: 7e, 8h

6.2.14. MICROPUR, s.r.o.

Wonkova 385, 500 02 Hradec Králové

www.mikropur.cz/

Brief company characteristics

Research, development and sales of facilities – filtration, membrane separation, microfiltration, nanofiltration, reverse osmosis, centrifugation, and the analysis of dissolved and not dissolved substances, photocatalysis, laboratory filtration system, and the decontamination of liquids. The number of employees: 3.

Activities in the area of nanotechnologies

- Development of (nano) filtration systems
- Laboratory and testing systems for the separations and filtrations
- Engineering solutions of filtration processes (including the nanofiltration) and of the membrane separation

Solved projects:

MIT project FT-TA/023: "SolarCat – Photocatalyst with the adjustable nanostructure for the use in removals of impurities from air and water, thanks to the effect of the UV light, or the direct sunshine" (2004–2006), the solver – Ing. Jaroslav Přidal, CSc.

Co-operation in the solution of the Ministry of Agriculture project QF 3044 "Verification of the usability of membrane-photocatalytic destruction of toxic pollutants in the combination with bioremedial technologies in agriculture" (2003–2007), the grantee – Research Institute

of Plant Production in Praha, the solver – Ing. Sergej Usťak, CSc. The co-worker on behalf of Micropur, s.r.o. – Ing. Jaroslav Přidal, CSc.

Responsible worker: Ing. Jaroslav Přidal, CSc., Director

Codes: 5a, 5b

6.2.15. OPTAGLIO, s.r.o.

Řež 199, 250 68 Praha-východ

www.optaglio.cz

Brief company characteristics

Optaglio is a manufacturer of holograms by the unique Czech technology ensuring the protection of products against falsification. It is the technology of electron lithography, or the optical holographic recording. The number of employees: 69.

Activities in the area of nanotechnologies

- Development of optical variable hologram parts and relief diffraction structures
- Design, calculations, optimising, and implementation of relief structures (typically with the resolution within the range up to 254 000 dpi, the relief depth usually 150–190 nm), or custom-made masks (4“ substrates, details min. 500 nm).

Responsible workers: Ing. Tomáš Těthal, CSc., Director, and Ing. Roman Houha, Production Director

Codes: 2c, 7d

6.2.16. SHM, s.r.o.

Průmyslová 3,787 01 Šumperk

www.shm-cz.cz

Brief company characteristics

Coating of instruments for machining, pressing, cutting, and forming with hard wear-proof PVD coats. Manufacture of diamond wheel dressers. The number of employees: 45.

Activities in the area of nanotechnologies

- Research and development of nanostructured wear-proof layers prepared with the PVD technologies
- Development and design of systems for the preparation of nanostructured PVD layers
- Preparation of nanostructured wear-proof layers for cutting and forming equipment

Solved projects:

EU 6th FP project MACHERENA "Development of tools and coatings for the machining of superalloys" (2004–2006), the development of nanocomposite coatings for tools.

Co-operation in the solution of GA CR project 106/03/0849 "Study of the real structure of nanolayers with the aid of roentgen diffraction" (2003–2005), the grantee – UK-MFF, the solver – Prof. RNDr. David Rafaja, CSc. Co-operation on behalf of SHM – RNDr. Michal Šíma (the preparation of layers).

Responsible worker: RNDr. Pavel Holubář, CSc., Director

Codes: 1d, 1e, 7a

6.2.17. SPOLSIN, spol. s r.o.

Moravská 1078, 560 02 Česká Třebová

www.spolsin.cz

Brief company characteristics

Development and manufacture of special textiles, the research and development of fibres, the manufacture of technical not flammable, antistatic, clean-room, acid-proof, antiabrasive, and filtration textiles, sport knitwear, wound cartridge filters. It is an accredited laboratory. The number of employees: 75.

Activities in the area of nanotechnologies

Processing of synthetic fibres modified, in their volume, with nanofillers. The company partly participates in the development of these fibres. It solves the processing technology of their insertion into textiles and is also involved in the development and sampling of these textiles.

Solved projects:

EU 6th FP project BIOCELSOL "Biotechnological Process for Manufacturing Cellulosic Products with Added Value", 2005–2007, the co-director on behalf of SPOLSIN – Ing. Karel Šanda, CSc.

Research and development of soluble cellulose with the use of enzymes instead of the dangerous CS2. Research partly relates to nanotechnolgies.

Responsible worker: Ing. Karel Šanda, CSc., Director

Codes: 1f, 7d

6.2.18. TESCAN, s.r.o.

Libušina 21, 634 00 Brno

www.tescan.cz

Brief company characteristics

Development and manufacture of electron microscopes. The number of employees: 70.

Activities in the area of nanotechnologies

- Development of scanning electron microscopes (MIRA LMU). The auto-emission scanning electron microscope with the high resolution and more vacuum modes – the resolution under 2 nm, the scanning electron microscopes VEGA)
- Computer processing and assessment of images

Responsible worker: Ing. Josef Melkes, Director

Codes: 7a, 8h

6.2.19. TTS, s.r.o.

Novodvorská 994, 142 21 PRaha 4

www.anet.cz/tts

Brief company characteristics

Designs and high volume manufacture of vacuum applied thin layers for the application in microelectronics (the hybrid IC, HCMOS IC, sensors, and precise resistor nets). The number of employees: 4.

Activities in the area of nanotechnologies

- Development and high volume manufacture of the specialised vacuum applied metal and dielectric layers of the thickness above 0.2 nm for the applications in microelectronics, X-ray optics, sensorics, etc.
- Ion etching of sputtered layers
- Special methods of deposition allowing for the creation of thin layers with sub nanometric structure

Solved projects:

Co-operation in the solution of the MIT project FT-TA2/018 "Advanced beam technologies for the creation and processing of layers in the manufacture of electronics" (2005–2008), the grantee – Elceram, s.r.o., the solver – Ing. Karel Strobl. The co-solver on behalf of TTS – RNDr. Jaroslav Merta, CSc.

Responsible worker: RNDr. Jaroslav Merta, CSc., Director

Codes: 1d, 2a, 2b, 7c

6.2.20. Brief review of activities by small and medium-size companies

Table VI presents the review of activities done in small and medium-size companies, according to their main fields, as in the nanotechnology nomenclature (see **Table I**).

Table VI.

	1	2	3	4	5	6	7	8
ATG	X							
BVT Techologies				X				
CPN			X					
CRYTUR	X							
DELONG Instruments							X	X
ELCERAM	X						X	
ELMARCO	X						X	
EXBIO			X					X
FEI							X	
GENERI Biotech			X	X		X		
HVM	X						X	
LAO							X	
LIMTEK							X	X
MIKROPUR					X			
OPTAGLIO		X					X	
SHM	X						X	
SPOLSIN	X						X	
TESCAN							X	X
TTS	X	X					X	

Key: 1 – Nanomaterials, 2 – Nanoelectronics, 3 – Nanobiotechnology, nanomedicine, 4 – Nanosensors, 5 – Nano in chemical technology, 6 – Long-term research, 7 – Instruments and technology, 8 – Other

Table VI shows that small and medium-size companies focus mostly on nanomaterials, equipment and technologies.

7. ACTIVITIES BY COMMERCIAL COMPANIES, EXPERT NON-PROFIT SOCIETIES, AND OTHERS

7.1. COMMERCIAL COMPANIES

This part describes characteristics of commercial companies with representation in the Czech Republic, which sell materials, equipment, and facilities for nanotechnologies. However, the list should not be considered complete.

7.1.1. Carl Zeiss, spol. s r.o.

Radlická 14/3201, 150 00 Praha 5-Smíchov

www.zeiss.cz

Brief company characteristics

Carl Zeiss, founded in 1846 in Jena, in its role of a workshop for fine mechanics and optics, presents nowadays a multinational enterprise focussed on the development and manufacture of top technologies. The company activities in the world markets focus on six following areas: The brand optics, microscopy, medical technology, optical-electronic systems, semiconductor technology, and the industrial measuring technology. The representation in the Czech Republic offers the complete assortment of the products.

Offers in the area of nanotechnologies

The company develops and manufactures different systems usable in v nanotechnologies in its plant in Oberkochen, Germany, in the Nano Technology Systems Division (www.smt.zeiss.com/nts). They are electron microscopes, technologies focussed on ion beams and facilities for nanolithography.

Codes: 7a, 8h

7.1.2. Edlin, s.r.o.

Koněvova 141, 130 83 Praha 3

www.edlin.cz

Brief company characteristics

The company supplies equipment and provides for services for the electron and optical microscopy. It represents FEI Electron Optics BV (the exclusive representation) and supplies products by EDAX, Soft Imaging Systems, Quantomix, Advanced Micro Beam, etc.

Offers in the area of nanotechnologies

They are mostly based on supplies of systems by FEI Electron Optics BV (see 6.2.8.).

Codes: 7a, 8b

7.1.3. JEOL (Europe) S.A.

ČVUT-FS, Karlovo nám. 13, 121 35 Praha 2

www.jeol.com; www.jeol.fr

Brief company characteristics

JEOL is an important world supplier of scientific instruments used in research and development in the areas like, for example, nanotechnologies, natural science, optical communications, judiciary, and biotechnologies. Research and manufacturing activities focus on five following areas:

- Electron optics (TEM, SEM, SPM, AES, etc.)
- Analytical equipment (NMR, mass spectrometry, Raman spectrometry, etc.)
- Equipment for the semiconductor industry (electron lithography, monitoring of the manufacture of Si wafers, etc.)
- Systems for the creation of thin layers (electron guns, plasma guns, systems with hot plasma, and energy sources for the application of coatings)
- Healthcare equipment (clinical biochemical analysers, laboratory information systems, analysers of amino acids, and laboratory automatic systems)

JEOL has been active on the Czech market already for several decades.

Offers in the area of nanotechnologies

Electron microscopy presents the basic area of manufacture in JEOL. A number of facilities and systems on the offer can be used in nanotechnologies, especially electron microscopes (TEM, SEM), microanalysers (EPMA, AES), scanning probe microscopes (SPM), photoelectron spectrometers (XPS), NMR, the equipment for nanolithography, etc. We should mention also the transmission electron microscope with the ultra-high voltage (1300 kV) JEM-ARM1300 with the highest resolution in the world (0.1 nm) used in the research of materials and in the biotechnological research.

Codes: 7a, 8b

7.1.4. MiT, s.r.o.

Klánova 56, 147 00 Praha 4

www.mit-laser.com

Brief company characteristics

MIT, s.r.o. was founded in 1992 as a commercial company trading goods belonging to the areas of laser technology and optoelectronics. The programme of sales includes almost everything manufactured within the area of laser technology and optoelectronics. One of the most important areas in the current programme of supplies is the emission and detection laser radiation equipment.

Offers in the area of nanotechnologies

In the area of nanotechologies, MiT, s.r.o offers products by the German company Physik Instrumente (PI). They are mainly the piezoelectric replacement systems, which achieve the determined position with the preciseness of nanometric units. They offer mainly very precise replacement tables for microscopes (xy or xyz), handling tables (x, xy, and xyz), microscope lens shifts, and other products (www.pi.ws).

Codes: 3f, 7d, 8h

7.1.5. NANOTRADE, s.r.o.

Mozartova 12, 779 00 Olomouc

www.nanotrade.cz

Brief company characteristics

The objective of this recently founded company is to find innovation materials, products and technologies and introduce them into the market. These products are designed and manufactured in laboratories around the world and are usable in nanotechnologies. The company organises research, development and sales in the area of nanotechnologies.

Offers in the area of nanotechnologies

1. Practical application of modern technologies
   - 1.1. Products with antibacterial effects (see www.nanosilver.cz)
   - 1.2. Products with protective effects (hydrophobic paints with nanoparticles)
   - 1.3. Additives for diesel fuel (the additive Cerox based on CeO_2 nanoparticles)
   - 1.4. Nanoparticles of Fe_2O_3, Fe_3O_4
2. Consulting activities
   - 2.1. Assistance in finding a suitable manufacturing programme in the area of nanotechnologies
   - 2.2. Sales of materials
   - 2.3. Development and designs of manufacturing process technologies
   - 2.4. Popularisation and promotion of nanotechnologies
3. Co-operation in research and development

Co-operation in the solution of the MEYS project 1M0512 “Centre for the research of powder nanomaterials” (2005–2009), the grantee – Palacky University in Olomouc, the solver – Prof. RNDr. Miroslav Mašláň, CSc. The co-solver on behalf of Nanotrade – Ing. Jiří Oborný.

Codes: 1a, 8h

7.1.6. Scientific Instruments Brno, spol. s r.o.

Havlíčkova 66, 602 00 Brno

www.sib-bruker.cz

Brief company characteristics

The company is the exclusive representative of several divisions of the Bruker Group, USA (Bruker Biospin – the manufacture of equipment for the NMR, EPR, and MRI spectroscopy, Bruker Optics – the manufacture of equipment for FT-IR, Raman, FT-NIR, and LR-NMR spectroscopy, Bruker Daltonics – the manufacture of systems for FT-MS, MALDI-TOF, LC-ESI-TOF, etc.). It also sells different equipment, materials and aids for the electron microscopy (TEM, SEM/EDS), for AFM and SPM and others by Structure Probe, Inc., USA.

Offers in the area of nanotechnologies

The above-described offers often relate to nanotechnologies.

Codes: 7a, 8h

7.1.7. Sigma Aldrich, s.r.o.

Pobřežní 46, 186 21 Praha 8

www.sigmaaldrich.com/Area_of_Interest/Europe_Home/Czech_Republic/kontakt.html

Brief company characteristics

Sigma-Aldrich is a globally active company supplying biochemical products and organic chemistry products for the scientific and genomic research, biotechnologies, pharmaceutical research and development, and for the diagnostics of diseases. The enterprise is active in 35 countries and employs more than 6 800 workers. The Czech representation has been 100 % owned by Sigma-Aldrich Foreign Holding Co.

Offers in the area of nanotechnologies

Offers of chemicals and other substances usable in nanotechnologies are extensive. For example, they offer the following nanomaterials: Dendrimers, dispersed nanoparticles, nano-powders, carbonaceous nanotubes, fullerenes, silsesquioxans, etc. For further details, please, see the address:

www.sigmaaldrich.com/Area_of_Interest/Chemistry/Materials_Science/Nanotechnology.html

Codes: 1a, 1c, 1f, 3d, 8h

7.1.8. Brief review of activities by commercial companies

Table VII presents the review of offers by commercial companies, according to the main fields as in the nanotechnology nomenclature (see **Table I**).

Table VII.

	1	2	3	4	5	6	7	8
C.ZEISS							X	X
EDLIN							X	X
JEOL							X	X
MiT			X				X	X
NANOTRADE	X							X
SCI.INSTR.							X	X
SIGMA	X		X					X

7.2. EXPERT NON-PROFIT SOCIETIES

Among expert non-profit societies, especially the Czech Society for New Materials and Technologies focuses on the support of the development in nanotechnologies.

Individual Czech and foreign authors present information about nanotechnologies in professional events and in professional journals of other expert non-profit societies (Crystallographic Society – www.xray.cz, Chemical Society – www.csch.cz, Czechoslovak Microscopy Society – www.microscopy.cz, Jan Marek Marci Spectroscopy Society – www.spectroscopy.cz, etc.).

7.2.1. Czech Society for New Materials and Technologies (ČSNMT)

Novotného lávka 5, 116 68 Praha 1

http://csnmt.fme.vutbr.cz

Brief characteristics of the Society

The Czech Society for New Materials and Technologies (ČSNMT), found in 1993, is a voluntary association of individual and collective members, who have their address (the registered address) in the Czech Republic. It is governed by its own Status. Since 1993, it has been a member of the Federation of European Material Societies (FEMS) associating 22 material societies from 20 European countries. Since 2004, it is a member of the Czech Union of Scientific Technological Societies (ČSVTS), which is the voluntary association of 66 independent scientific societies in the Czech Republic.

Activities of ČSNMT are focussed on the general extension of creative skills and professional knowledge of its members, the satisfying of their professional and social needs, the support of scientific technological development in the area of new materials and technologies, including their applications in manufacturing operations, and the support of the international co-operation. ČSNMT is also the solver of research projects. The Society President is Doc. Ing. Karel Šperlink, CSc.

Activities in the area of nanotechnologies

- Within ČSNMT, there is the Section "Nanoscience and nanotechnology" organising its activities. It has got currently 115 members. The Chairman of the Steering Committee of the Section is Prof. Ing. Petr Louda, CSc., TU Liberec, (http://csnmt.fme.vutbr.cz/nano).
- Since 2002, ČSNMT in co-operation with VUT-FSI Brno and COMTES FHT, s.r.o., Plzeň, have been organising international conferences "NANO". The fourth conference "NANO 05" took place in Brno on 8–10 November 2005 (http://csnmt.fme.vutbr.cz/nano05). The guarantor of the conferences was Prof. Ing. Jiří Švejcar, CSc.

Statistics of the NANO conferences are presented in **Table VIII**.

Table VIII.

	2002	2003	2004	2005
Total number of participants	128	93	102	148
Foreign participants	5	5	7	30
Number of lectures	60	32	43	69
Number of posters	32	20	24	41

- ČSNMT has published within the MEYS project OK 427 "Professional contact organisation for the research of materials and technologies" (2000–2003), the solver – Doc. Ing. Karel Šperlink, CSc., the publication "Research of nanotechnologies and nanomaterials in Europe and USA", 7/2001, the author – Ing. Tasilo Prnka, DrSc., 68 pages, ISBN 80-86122-86-7. The publication is accessible also in the electronic form at www.scienceworld.cz (in Czech).
- ČSNMT has published within the MEYS project OK 446 "Professional contact organisation for the research of materials, technologies and manufacturing processes in the Czech Republic" (2003–2006), the solver – Doc. Ing. Karel Šperlink, CSc., the publication "Nanotechnologies", 8/2004, the authors – Ing. Tasilo Prnka, DrSc. and Doc. Ing. Karel Šperlink, CSc., 68 pages, ISBN 80-7329-070-7. The publication is accessible also in the electronic form on the web pages of the Nanosection (in Czech).
- Solution of the MEYS project LA249 "Participation of ČSNMT in the development of the research of nanotechnologies" (2005–2008), the solvers – Prof. Ing. Petr Louda, CSc., Prof. Ing. Václav Bouda, CSc., and Ing. Tasilo Prnka, DrSc. partial projects: DP1 – International dialogue on the responsible research of nanotechnologies, DP2 – Project MNT ERANET, DP3 – Nanotechnologies in the Czech Republic – publication.
- A workshop has taken place for the first time in the Czech Republic within the conference "NANO 05". It was titled "The responsible approach to the research of nanotechnologies" and it was organised by the ČSNMT Section "Nanoscience and nanotechnologies". There were presented 7 lectures. The workshop was guaranteed by Prof. Ing. Václav Bouda, CSc. and Ing. Jiřina Shrbená.

7.3. OTHER ACTIVITIES

7.3.1. Czech Nano-Team

Institute of Physics of the Academy of Sciences of the Czech Republic

Cukrovarnická 10, 162 53 Praha 6

www.fzu.cz/~nanoteam

The Czech Nano-Team is an informal virtual centre for the physics of nanostructures and nanotechnologies founded on 25 November 2003 by 17 scientists representing teams of 3–20 researchers. The objective of the Nano-Team is the co-operation in research at a high professional level and participation in education.

Members of the Nano-Team are: Antonín Fejfar (FZÚ AC ČR), Luděk Frank (ÚPT CAS), Eduard Hulicius (FZÚ CAS), Josef Humlíšek (MU-PřF Brno), Vladimír Cháb (FZÚ CAS), Ladislav Kavan (ÚFCHJH CAS), Jan Kočka (FZÚ CAS), Petr Malý (UK-MFF), Miroslav Mašláň (UPOL-FPř), Dušan Nohavica (ÚRE CAS), Ivan Oščádal (UK-MFF), Václav Paidar (FZÚ CAS), Jaroslav Pavlík (UJEP-FP Ústí nad Labem), Jan Petzelt (FZÚ CAS), Emil Pollert (FZÚ CAS), Tomáš Šikola (VUT-FSI Brno), Ludvík Smrčka (FZÚ CAS) and Milan Vaněček (FZÚ CAS). The Managing Committee consists of: Jan Kočka, Petr Malý and Tomáš Šikola.

The Nano-Team has organised two public working meetings so far (4/2003, 4/2004) and co-organised the international summer school IUVSTA "Science and Technology at Nanoscale" in Tři Studně (6/2005). Members of the Nano-Team published four articles popularising nanotechnologies in the Technický týdeník (Technology Weekly) in the period 2003–2004.

7.3.2. "MOVPE" network

The Institute of Physics of the Academy of Sciences of the Czech Republic

Cukrovarnická 10, 162 53 Praha 6

www.fzu.cz/oddeleni/polovodice/movpe/index.php3

It is an informal network of 6 workplaces co-operating in the research of heterostructures and nanostructures of semiconductors prepared by the MOVPE method (Metal Organic Vapour Phase Epitaxy). The laboratory MOVPE, in the Section of semiconductors within FZÚ CAS, prepares structures (quantum dots, quantum wells, and superlattices) and equipment (lasers, detectors), which are then studied, tested, and measured by partners at universities. The workplaces are connected in solutions of many different projects, especially the grant ones. The network has been active since 1993. The guarantor of the network is Ing. E. Hulicius, CSc. from FZÚ CAS.

The network members are: FZÚ CAS, UK-MFF, VŠCHT-FCHT (Institute of the Engineering of Solid Substances), ČVUT-FEL (Department of Microelectronics), MU-PřF (Institute of Physics of the Solid Phase), and ÚRE CAS.

The network maintains also international contacts.

7.3.3. Consortium for the Research of Nanostructured and Matrix Polymer Materials (CRNCPM)

ÚMCH AV ČR, Heyrovského nám. 2, 162 06 Praha 6

www.imc.cas.cz

The Consortium was founded in June 2003 with the following objectives:

- Co-operation in the research of nanostructured and matrix polymer materials: Experimental and theoretical studies in chemistry, physics and material sciences.
- Support of education and dissemination of knowledge at the master and postgradual levels and the organisation of international conferences and workshops.
- Participation in international research projects and international training programmes.
- Support of contacts with the industry with the objective of creation of innovations, products and technologies, and the stimulation of results of the research in use satisfying needs of the society.

Members of the Consortium are: ÚMCH CAS, UK-MFF (Department of Macromolecular Physics), UPCE-FCHT (Institute of Polymer Materials), SYNPO, a.s. Pardubice, and UTB-FT (Centre for Polymer Materials and Technologies). The Chairman of the Managing Consortium Committee is Prof. Dr. Karel Dušek, ÚMCH CAS.

Since 2004, the Consortium has been a member of the Excellence Network within the EU 6th FP NANOFUN-POLY "Nanostructured and Multi-Functional Polymer-Based Materials and Nanocomposites" (2004–2008), the network of 25 subjects (see – www.nanolink.net/nanofunpoly.htm).

7.3.4. NANOTECH ČVUT group

A number of contributions on the topic of nanotechnologies occurred during the preparation of the conference WORKSHOP 04 at ČVUT in Praha. The authors were invited to a special seminary, which took place during the conference on 22 March 2004. There were several selected lectures presented on the topic of nanotechnologies. During the discussions, the participants got the idea to create a group that would allow for more permanent mutual informing about activities in the area of nanotechnologies at ČVUT. The constituent meeting of this group of workers, who are involved in the research or in applications of nanotechnologies at ČVUT, took place on 30 June 2004. The meeting has elected the Group Chairman – Prof. Ing. Václav Bouda, CSc. from ČVUT-FEL, and the Deputy Chairman of the Group – Martin Zikmund, a student at FEL ČVUT. The Group has not got an official status yet and the established objectives and activities can be changed at any time.

The main activities relate to the exchange of information on the experimental possibilities of individual workplaces, on the possible help in the area of qualified workers, on new projects, conferences and seminaries, the exchange of experience from the solution of tasks in the area of nanoscience and nanotechnologies, the attracting new students to bachelor, master and doctor study courses, etc.

Members of the Group are: Ing. Ladislav Berka, CSc. (Department of constructional mechanics FSv ČVUT), Prof. Ing. Václav Bouda, CSc. (Head of the Department of mechanics and materials FEL ČVUT), Doc. Ing. Ivan Fořt, DrSc. (Section for the scientific and research activities at the Chancellor's Office of ČVUT, Institute of the Process Technology FS ČVUT),

Doc. Ing. RNDr. Rudolf Novák, DrSc. (Institute of Physics FS ČVUT), Doc. RNDr. Jan Voves, CSc. (Department of microelectronics FEL ČVUT), Martin Zikmund (a student of the master studies in FEL ČVUT), Prof. Ing. Miroslav Husák, CSc. (Head of the Department of microelectronics FEL ČVUT), Ing. Andrej Mlích (lecturer with the Department of mechanics and materials FEL ČVUT), Prof. Ing. František Černý, DrSc. (Deputy Head of the Institute of Physics FS ČVUT), Doc. Ing. Jiří Němeček, PhD. (Department of the constructional mechanics FSv ČVUT), Doc. Ing. Jaromír Sodomka, CSc. (Department of mechanics and materials FD ČVUT), Prof. Ing. Pavel Fiala, CSc. (Head of the Department of physical electronics FJFI ČVUT), Prof. Ing. Jaroslav Král, CSc. (Department of physical electronics FJFI ČVUT), Prof. Ing. Svatava Konvičková, CSc. (Head of the Institute of Mechanics FS ČVUT) and Prof. Ing. Miroslava Vrbová, CSc. (Dean of the Faculty of Biomedical Engineering ČVUT).

The current membership of the Group covers all faculties at ČVUT (with the exception of the Faculty of Architecture) and it is open to all other interested persons at ČVUT, or outside.

7.3.5. NANOMAT

NANOMAT is the so-called ETI initiative (Economic and Technological Intelligence) within the 6th Framework Programme of EU that is determined to support small and medium-size enterprises (SME) active in the areas of nanotechnologies and intelligent multifunctional materials in the European Research Area with participation in research projects and technological development.

The project implemented in the period from December 2003 to June 2006 associates 10 subjects from 10 different member and associated countries of the European Union, including the Czech Republic.

A partner from the Czech Republic in the project is Inova Pro, s.r.o., Hostivice, the solver – Ing. Jiřina Shrbená.

Activities:

- Information about calls and individual topics, about projects prepared by foreign co-ordinators, and about the possibility to get involved with the Consortium.
- Help in writing and lodging an own project and in founding a Consortium.
- Seminaries focussed on the management of innovations and the utilisation of modern technologies with the participation of foreign lecturers.

For more information, please, check: www.innova-europe.lu/nanomat or www.inovapro.cz

7.3.6. NENAMAT

NENAMAT (Network for Nanostructured Materials of ACC, 2003–2006) is a project within the EU 6th FP (INCO-CT-2003-510363) that associates 10 subjects from EU countries and associated EU countries. The project objective is the creation of communication contacts among individual centres involved in nanotechnologies, the monitoring, sharing, and the development of the infrastructure, the improvement in education and mobility, the exchange of knowledge, and the preparation of joint projects. The co-ordinator of the project is J. Dusza from ÚMV SAV in Košice and the co-solver, on behalf of the Czech Republic, is J. Švejcar from VUT-FSI in Brno. The activities focus mainly on the organisation of workshops.

7.3.7. Situation in the implementation of standards in the area of nanotechnologies in the Czech Republic

There was the working group called WG 166 created in 2003 under the auspices of CEN (Commission Europeenne pour la Normalisation), the European Institute for Standardisation. The Group was asked to map needs of the EU member countries related to the area of nanotechnologies. The Commission (the member of which is also a representative of the Czech Republic delegated by the Czech Normalisation Institute) did the mapping of these needs in 2004 by using a questionnaire. After it analysed the gained information, it recommended founding of a new Technical Commission (TC) under the auspices of CEN, for the area of nanotechnologies, to the European Commission in June 2005. It recommended, at the same time, to the EU member countries founding their own Technical Commissions within national standardisation institutes. In the meantime, there was a new TC for nanotechnologies founded on the basis of ISO initiative (there are more parallel structures existing in the area of standardisation and this applies also for the Czech Republic). This Commission, TC 229, was later recommended as a replacement for the new TC within CEN in order to prevent the doubling.

Currently, ČNI is founding its own TC for the Czech Republic, which should work in co-operation with TC 229 - ISO.

(Prepared by RNDr. Michael Solar, CSc., ČVUT-FS.)

8. CONCLUSIONS

The presented report offers information about the programme organisation of the research and development funded with public funds, about the running research and development in the institutes of the Academy of Sciences of the Czech Republic, at universities and in the private sector, and about experts, who are involved in it and about manufacturing companies using nanotechnologies, commercial enterprises selling "nanoproducts" and equipment and materials for the nanotechnology. The report does not provide for information about experimental facilities necessary for the research of nanotechnologies, or about manufacturing facilities. However, extensive knowledge was received also from this area. It has become apparent, however, that a vast majority of the used facilities are quite common in experimental activities also in other fields. Some special and unique equipment necessary for the research of nanotechnologies was mentioned in the text.

This publication is published at the time, when the process of approval of the European Commission document COM (2005) 243 "Nanoscience and nanotechnology: Action plan for Europe 2005–2009", presented on 7 June 2005, was finalised. The document has been accepted both by the EU Competition Council on 24 September 2005 and by the meeting of the European Economic and Social Committee on 10 November 2005. This means that it has been recommended for implementation within the European Union, and within the individual member countries.

The data presented in this report can serve for the implementation of the above-mentioned Action Plan in the Czech Republic and for the management of the new research programme "Nanotechnologies for the Society".

The report deliberately does not include the assessment of the found information because this is not within the authors' competence and it has not been an objective of the solved project LA 249.

NANOTECHNOLOGIES IN THE CZECH REPUBLIC 2005

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