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European Nanotechnology Gateway

2nd Nanoforum Report:

NANOTECHNOLOGY in the Candidate Countries

(Updated version)

March 2004

Nanotechnology in
the Candidate Countries
(Updated version)

Who's who and Research Priorities

www.nanoforum.org
March 2004

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Nanoforum is a thematic network funded by the European Commission's under the Fifth Framework Programme (Growth programme, grant number G5RT-CT-2002-05084). The contents of this report are the responsibility of the authors.

This second Nanoforum report is downloadable from the network WEB site at www.nanoforum.org

An updated version of the 2nd Nanoforum Report: Nanotechnology in the Candidate Countries is available. This new version includes the information submitted by the participants in the first Nanoforum Eastern European workshop, which was held during October 5-7, 2003 in Sinaia, Romania. It also added in contributions delivered to the nanoforum from researchers who are involved on nanotechnology in the research networks and universities of the Candidate Countries.

The updated report is published on the nanoforum website www.nanoforum.org under the title: "2nd Nanoforum Report: Nanotechnology in the Candidate Countries (updated version)".

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1. Introduction

1.1. General information about R&D in the candidate countries

The European Union (EU) is preparing for enlargement by at least 10 candidate countries in 2004(see Figure 1). At the moment the R&D advance of the candidate countries are behind the average of the current EU (see Table 1). The March 2002 Barcelona European Council has set the objective to increase the average investment level in R&D activities from 1.9% of GDP today to 3% of GDP by 2010. Two thirds of this investment level should be funded by the private sector. (http://europa.eu.int/comm/research/era/3pct/ pdf/action- plan.pdf). It is believed that research is one of the fields in which enlargement can offer the greatest potential benefits - both to the Member States and to the candidate countries. (Science in Slovenia, 2002).

Figure 1: Map of the candidate countries
(Source: http://forum.europa.eu.int/irc/dsis/candidate/info/data/candidatecountries/)

In fact, research is the first area where enlargement becomes reality. European Commissioner Philippe Busquin and the responsible ministers from the EU´s candidate countries signed an association agreement for the Sixth Framework Programme (FP6) on 29 October 2002. For the first time the candidate countries received the same entitlements as Member States. The financial contribution of the candidate countries to the FP6 budget is based on their GDP ratio. As the Commission is interested in the candidate countries being involved from the beginning of FP6, a reduction of 30% and 20% for the first two years of participation was agreed.

At the end of October 2003, the European Research Commissioner Busquin met the ministers and high level representatives of the 13 acceding and candidate countries again. At that time, they discussed their participation in the EU's Sixth Framework Programme for research 2002-2006 (FP6) and, more specifically, their response to the first calls for proposals. From a total number of 106 000 participants in FP6 proposals received to date, there are 13 450 participants from acceding/candidate countries (12.7% of the total). Of those proposals that have been successfully funded there were 1500 organisations from acceding/candidate countries (a success rate of 13%, while the corresponding rate for

Member States is 19%). The highest participation of the acceding/candidate countries is to be found in Nanotechnologies (21.8%). Acceding/candidate countries were involved in 40% of proposals.

(http://www.alphagalileo.org/index.cfm?fuseaction=readrelease&releaseid=16195).

The EU Fifth Framework programme for RTD was also open to participants from the candidate countries. The numbers of partners per specific programme and per country are monitored on the Enlargement pages on Cordis. To give an idea, the totals are shown in table 2.

Country	**R&D expenditure as % of GDP**	**R&D personnel as % of workforce**
EU	1.92	1.33
Bulgaria	0.59	0.89
Cyprus	0.25	0.52
Czech Republic	1.25	0.90
Estonia	0.75	0.94
Hungary	0.69	1.03
Latvia	0.40	0.54
Lithuania	0.52	0.82
Poland	0.75	0.74
Romania	0.41	0.42
Slovakia	0.68	0.88
Slovenia	1.51	1.28
Turkey	0.63	1.02

Table 1: Statistical overview of R&D in the candidate countries
(Source: RTD info Special edition. EU enlargement, October 2002)

Country	Total No. Participants
Bulgaria	240
Cyprus	136
Czech Republic	627
Estonia	171
Hungary	589
Latvia	136
Lithuania	125
Malta	44
Poland	851
Romania	263
Slovakia	234
Slovenia	329
Turkey	71

Table 2: Participants in FP5 per country
(Source: European Commission, last update 28 March 2003, http://www.cordis.lu/national_service/en/candidate_countries.htm)

Indeed, the participation of candidate countries in European projects can still be improved on. If the origin of the Expression of Interest for priority 3 (Nanotechnologies and nano-sciences, knowledge-based multifunctional materials and new production processes and devices) submitted to the EC in 2002 is taken as measure, only Poland with 9% is represented strongly, followed by Turkey with 4% and the Czech Republic with 2% (http://www.cordis.lu/fp6/eoi-analysis.htm).

Nanotechnology then plays a prominent role in strengthening the R&D collaborations between established EU member states and the candidate countries. Reasons for this include the dedication of thematic area 3 of the Sixth EU framework programme for RTD (FP6) to nanotechnology, materials and production technologies. Also the European Commission has stimulated the formation of centres of excellence in the candidate countries in the areas covered by this FP6, including nanotechnology. Governments and the research communities in these countries themselves also emphasise the strategic

importance of nanotechnology for their national economy and RTD scene.

This report aims to present who's who and an overview of research priorities in the candidate countries, which will join the EU in 2004 or later. It is prepared for the benefit of researchers, industrialists, policy makers, students, and the general public who search information on nanotechnology in Europe. It is also published on the Nanoforum website www.nanoforum.org.

The report starts with an overview of EU initiatives to foster EU-Candidate country collaborations in the area of nanotechnology. Then, we outline the status quo for each country in a separate chapter, dealing with the strategic priorities and national specialities in nanotechnology in the country, and who's who in government, research and industry working on nanotechnology. The report finishes with a concluding summary.

1.2. Acknowledgements:

Holger Hoffschulz has written this introduction.

2. EU and nano in the candidate countries

2.1. General information

The European Commission has been assisting the candidate countries for joining the EU over the last few years to prepare their economies and government structures and policies. R&D and innovation have been one of the areas of interest. However, this policy is not only relevant to the economic development of the candidate countries themselves. In a recent Commission Communication, the European Commission states that "Enlargement will significantly change the Union's innovation profile. The available evidence points to strong disparities in the innovation frameworks and performance of Candidate Countries compared to Member States..." The Candidate States are strong in transforming their economies, but there are still many remaining obstacles to innovation. The challenges are partly similar but worse than in Member States: risk aversion, under-investment in R&D, limited research- industry co-operation. More specific challenges to Candidate Countries include: legacies of centrally planned economies on institutional, educational and social frameworks; absence of innovation policies; lack of co-ordination between relevant policies; limited human and financial resources and weak capacity in businesses to absorb innovation. A potential strong point is then "necessity entrepreneurship" in the candidate countries. (European Commission, 2003)

The European Commission has identified five key challenges for innovation for the candidate countries:

1. Promote a culture open to innovation
2. Place innovation at the heart of regulatory reform
3. Increase the number of smaller innovative enterprises
4. Strengthen the diffusion of knowledge in the economy
5. Foster a policy making process conducive to innovation.

(Source: Commission Communication Innovation in a Knowledge driven economy, 2000; quoted in Reid et al, 2002)

Many candidate countries have adapted their innovation system and priorities in R&D funding to the model of the European Research Area (ERA). Most of them also follow the thematic priorities of the EU Sixth Framework programme. Therefore, most countries include nanotechnology or nanostructured materials among their national research priorities. The progress can be followed on the "Enlargement" pages on the Cordis web site of the European Commission. http://www.cordis.lu/national_service/en/candidate countries.htm

From about 2000 until 2002 or 2003, the European Commission funded 30 centres of excellence in the candidate countries in areas, which were relevant to the thematic priorities of FP6. The centres received funding to strengthen their international and regional networks and visibility. There are 34 Centres (http://europa.eu.int/comm/

research/news-centre/en/pol/ 02-03-pol04.html) from the Pre-Accession Countries that are funded under the Accompanying Measures within the INCO2 Programme. They are located in 11 of the Pre-Accession Countries: Poland (26%), Hungary (17.5%), Romania (11.5%), Bulgaria (9%), Czech Republic (9%), Cyprus (6%), Estonia (6%), Slovakia (6%), Lithuania (3%), Latvia (3%) and Slovenia (3%).

Figure 2: Centres of excellence in the candidate countries
(Source: http://europa.eu.int/comm/research/news-centre/en/pol/02-03-pol04.html)

Several of these centres were related to nanotechnology, e.g.:

- Designed molecules and macromolecules, their assemblies and biological functions (DESMOL) at the Polish Academy of Sciences Centre of Molecular and Macromolecular Studies. The activities at this centre include:
  - asymmetric synthesis of complex organic molecules;
  - NMR techniques of studying molecular structure of biological interest;
  - synthesis of macromolecules with desired topologies leading to materials for high-tech applications ranging from medical diagnostics to electronics; etc.
- High pressure: a competitive method for the advancement of multi-disciplinary research and industrial applications (HIGH PRESSURE), at the Polish Academy of Sciences - High Pressure Research Center. The activities on high pressure include:
  - nitrides technology for blue-light optoelectronics;
  - nanocrystalline ultra-hard materials;
  - pressure-induced structural changes in biological materials and food processing;
  - application of pressure-tuned laser diodes in medicine;
  - synthesis of nanopowders under high pressure in the presence of microwaves.
- Physics and Fabrication of Low Dimensional Structures for Technologies of

Future Generations (CELDIS), at the Polish Academy of Sciences - Institute of Physics. Its activities include:

- Solid-state physics, and in particular the physics of semiconductors and magnetic materials on the nanometer scale.

- Condensed Matter Research Centre (KFKI-CMRC), at the Hungarian Academy of Sciences-Research Institute for Solid State, Physics and Optics. The activities of this center include:
  - Study of solid and liquid materials including their structure, properties and synthesis.

- Centre for advanced material research and technology (CAMART), at the University of Latvia - Institute of Solid State Physics. Its activities include:
  - computer modelling of advanced materials;
  - semiconductors, insulator materials and thin film structures;
  - advanced dielectrics for multifunctional applications;
  - materials for ophthalmology and vision science;
  - solid-state ionics and devices.

2.2. The European Commission's webpages on nanotechnology

The European Commission is maintaining some webpages on the EC Cordis website dedicated to nanotechnology: www.cordis.lu/nanotechnology. This site includes information on past and current EU funded nanotechnology projects, EU and national funding and private finance. It also includes publications and information on national and EU networks, international collaboration, a mapping of excellence exercise and information for the press and young public. Then, the candidate countries are covered as well as the EU member states and other associated states.

Included in this site is a projects showcase, including fact sheets and images about 12 key projects. In two of these projects, a partner from a Candidate country is participating. In HiT, "A high-temperature testing technology for micro and nanomaterial", the Czech producer of scanning electron Microscopes Tescan contributes their SEM technology.

Figure 3: a project showcase of a candidate country
(Source: European Commission:
http://www.cordis.lu/nanotechnology/src/pressroom-pub.htm)

In the project Robosem, "Smart and small robots for the micro-world", the Polish research Institute of Electron Technology IET participates. The project aims to develop a smart nanorobot for Sensor Based Handling in a Scanning electron Microscope. http://www.robosem.de/Consortium/IET/iet.html

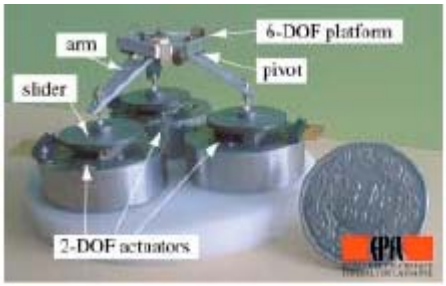


Figure 4: "Smart and small robots for the micro-world"
(Source: European Commission:
http://www.cordis.lu/nanotechnology/src/pressroom-pub.htm)

2.3. Joint Research Centre and the candidate countries

The European Commission's Joint Research Centre consists of seven scientific research institutes, which engage in policy oriented research for the benefit of the European Commission and other EU institutions including the Council and the Parliament. The institutes are:

- Institute for Reference Materials and Measurements, Geel, Belgium; http://irmm.jrc.cec.eu.int/
- Institute for Transuranium Elements, Karlsruhe, Germany; http://itu.jrc.cec.eu.int/
- Institute for Energy, Petten, Netherlands; http://ie.jrc.cec.eu.int/
- Institute for the Protection and Security of the Citizen, Ispra, Italy; http://ipsc.jrc.cec.eu.int/
- Institute for Environment and Sustainability, Ispra, Italy; http://ies.jrc.cec.eu.int/
- Institute for Health and Consumer Protection, Ispra, Italy; http://ihcp.jrc.cec.eu.int/
- Institute for Prospective Technological Studies, Seville, Spain; http://www.jrc.es/welcome.html

The JRC works on an enlargement action. This includes not only doing research aimed at solving the research and innovation needs of the candidate countries. The JRC also opened up its research programmes to participants and collaborators from candidate countries, and organises workshops and training for these countries. It also installed a network of national contact points NCPs. Between 1999 and 2002, 18 of the 100 JRC projects included extra funding for collaboration with the candidate countries. The JRC also participates in 40 FP5 projects together with about 60 partners from the candidate countries. http://www.jrc.cec.eu.int/enlargement/

In 2003, the JRC published a new call for expressions of interest for visiting scientists and detached national experts from candidate countries interested in a temporary stay at one of the JRC's institutes. This call also covered participation in workshops and training. http://www.jrc.cec.eu.int/enlargement/action2003/

The JRC's work programme 2003-2006 has not been published yet, but the key research areas do not explicitly include nanotechnology. However, several institutes are engaged in projects and activities related to nanostructured materials and nanotechnology. These can be for energy applications (catalytic converters, hydrogen technologies, solar cells, etc.), but also nano-biotechnology for medical applications or other applications, and measurements and testing for safety and consumer protection. www.jrc.cec.eu.int

2.4. European Commission funded support networks for innovation

The European Commission funds several support networks for innovation in the EU Member and Associated States. One EU initiative is the National Contact Points (NCPs) that supports consortia that want to submit proposals for EU calls for proposals. There are separate NCPs for each thematic priority, including NCPs for the nanotechnology thematic priority. The EC also funds an Innovation Relay Centres Network (IRC). These IRCs support international technology transfer in the EU and its associated countries. Other EU supporting networks include the Gate2Growth project aiming to match innovative entrepreneurs and venture capitalists, and Minanet, an online database of European microsystems and nanotechnology research projects. Last but not least, the European Commission funds Nanoforum, a thematic network that serves as a European Nanotechnology Gateway, including information services for researchers, industrialists, policy makers, students, and the general public. www.nanoforum.org

NCPs
There are 16 National Contact Points for the Nanotechnologies and Nanosciences, Knowledge Based Multifunctional Materials and New Production Processes and Devices (NMP) thematic programme in FP6, in the 13 Candidate Countries. See: http://www.cordis.lu/fp6/ncp.htm

IRCs
The Innovation Relay Centre network acts as a technology broker between companies in different European countries. They publish technology offers and requests, and frequently organise brokerage events, where companies can present their technology offers and needs. There are IRCs in the candidate countries Cyprus, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Romania, Slovakia and Slovenia.

Because European regions have different technological specialisation, the IRCs have formed thematic subgroups of IRCs whose clients have similar technological interests. Some Innovation Relay Centres recently established a thematic group on Nano and microtechnologies. This group has currently members in 11 countries. Cyprus is the only candidate country among the IRCs in this thematic group. http://irc.cordis.lu

Gate2Growth
Gate2Growth, an initiative from the European Commission, has developed a complete package of services that help entrepreneurs to identify the right investors, and to draw up business plans that will convince them to back their projects. The Gate2Growth initiative deploys a range of services and networks to make the process of attracting investment quicker and cheaper for young high-tech firms with substantial growth potential. They include an investor identification service, helping those seeking finance to hone their business plans, and introducing them to appropriate investment funds. The Gate2Growth.com portal is also an excellent tool for the many service providers and support organisations around Europe that assist entrepreneurs in building their

businesses. Entrepreneurs, investors, service providers and innovation professionals from Europe, including the candidate countries, can use the Gate2Growth services.

Linked to Gate2Growth are the pan-European thematic networks for investors and intermediaries. One of them, I-TecNet is an early-stage venture capital investors-network with special interest groups for biotechnology, ICT, aerospace and nanotechnology. The services of these networks include promoting good practice, both through documented guides and regular seminars, assisting in professional development and providing tools and resources. Application for these networks can be made online at www.gate2growth.com

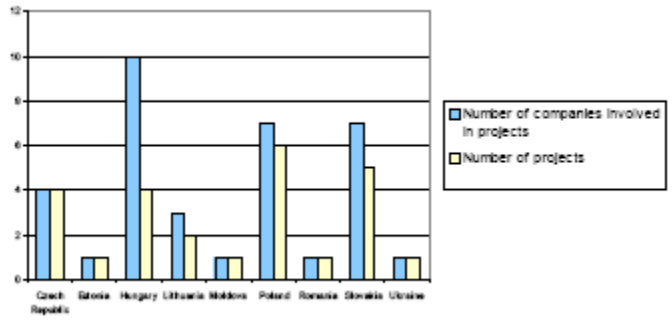
Minanet

Minanet is an online accessible database of European research projects in microsystems and nanotechnologies. The projects can be EU funded, national government funded or private funded. In April 2003, a team of experts analysed then 700 projects in the database. The team found that 200 of the projects were nanotechnology related (22% of the total). On average, nanotechnology projects are 50% private funded and 50% government or EU funded, with an average budget of €1.7 million. 56% of the nanotechnology projects use silicon as material. The database can be searched on country and some other characteristics, but not on keyword or nanotechnology-relevance. In April 2003, the database included the following project numbers per candidate country: Czech Republic and Poland both 7, Slovakia 6, Hungary 4, Bulgaria, Lithuania and Romania 2, Cyprus and Latvia 1. In total 33 projects. www.minanet.com

Nanotechnology projects in NAS

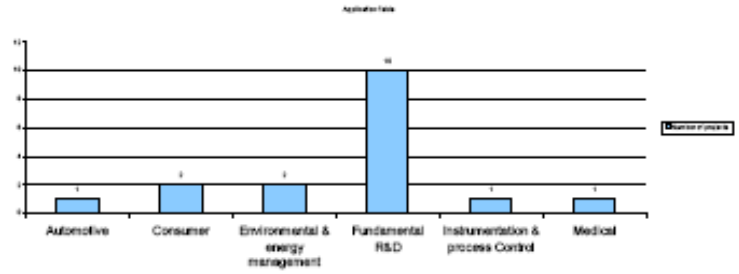
Minanet focuses on miniaturisation and nanotechnology projects funded by Public Authorities in Europe (European or national level). Among the 700 R&D projects gathered in the Minanet database 1/3-tackle nanotechnology issues and 17 projects include NAS companies or institutes in their consortia. The graph hereunder shows which eastern countries are the most proactive:

Nano projects in NAS



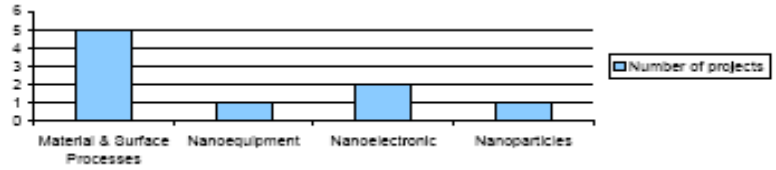
- NB several companies can be involved in the same project

Not surprisingly, most projects are fundamental research projects. However, it might be interesting to see which application fields are targeted.



The themes tackled by these projects

NanoProcesses



Finally, it is interesting to notice that all the NAS nanotechnology projects included in the Minanet database are funded by the European Commission: there is no national programme dedicated to nanotechnologies in NAS to our knowledge. Nanotechnologies seem not to be a priority in NAS for the moment.

Author: Dr. Elodie Garcia, Minanet.

Figure 5: Nanotechnology projects in NAS

Nanoforum

The European Nanotechnology Gateway Nanoforum is an EU funded thematic network specialising in communicating about nanotechnology research, commercial opportunities and societal aspects to different audiences. Nanoforum regularly publishes news, articles, publications, events, information on institutions, and funding opportunities on the nanoforum website. This information also explicitly covers nanotechnology in Candidate countries. Furthermore, nanoforum organises regular seminars, conferences and summerschools for different user groups. Each year, one of these conferences is held in a candidate country. This conference series aims to stimulate networking of nanotechnology researchers and companies in these countries and in international projects and networks. The Nanoforum report on "Nanotechnology in the Candidate Countries" aims to lay the basis for this conference series, by collecting who's who and information on the research priorities in the 13 candidate countries. www.nanoforum.org

NEXUS

The NEXUS project has been funded largely by the European Commission but has recently been launched as a “not for profit” Association. Its aim is to provide high added value services to its members on a long-term basis. NEXUS offers information services to nano- and microsystems professionals. The services have a fee. This includes access to reports containing the most up-to-date analysis of markets, technologies, applications, and long-term trends. This association also provides information through the web portal, regular e-mail bulletins, MST News pages, thematic workshops, and also conferences. Since Nexus is an association it accepts members who can benefit of its services at different levels. The Nexus facilitates are provided from two perspectives: market sectors and topics affecting the sectors. Nanotechnology is considered one of the topics that affect the market sector. The web site of Nexus is http://www.nexus-mems.com. The nano- and microsystems professionals of the candidate countries can benefit from the Nexus information services.

PHANTOMS

On the 1st of December 2000, the European Commission launched its new European Nanotechnology Network (PHANTOMS) within the framework of the Information Society Technologies (IST/FET) Programme.

PHANTOMS is a network of Excellence, whose mission is to provide a platform of services and information for researchers active in Nanotechnologies directed towards information processing and storage. This mission is accomplished by offering to its members up-to-date news, article repositories, newsletters, roadmaps, a software hub, specific studies, job offers, etc.

PHANTOMS is of a truly interdisciplinary character and currently involves 226 partners from 32 countries worldwide (around 2100 researchers).

The key aspect of such an emerging technology network is interaction, and this is being achieved in the following ways:

- A WEB based source of information: this site provides nanotechnology news, features and resources to over 25.000 visitors a month.
- Exchange of information during Workshops organised within the network (NID and PHANTOMS)
- Scientific exchanges between partners by short research visits of scientists and students (PHANTOMS grants)
- A bimonthly PHANTOMS Newsletter
- Focused reports
- Resources for research and information exchange (PHANTOMS Hub, preprint archive, etc.)

PHANTOMS network currently allows a nanotechnology community building and integration within the European Research Area (ERA) and represents a "single entry point" for those seeking information about Nanotechnology and especially Nanoelectronics.

WEB site: http://www.phantomsnet.com

Indeed, Phantoms is an IST (Information Society Technology) nanoelectronics network. The PHANTOMS Network scheme promotes European science and research through a pluri-national networking action, put together research capacities present in the various European regions and stimulates commercial nanoelectronic applications. One of its goals is to make industry aware of the strategic importance of nanoelectronic research for the future of information technology (IT) in general and of microelectronics in particular. The research areas addressed by the PHANTOMS Network are the following: Modelling, Lithography, Nanoimprint/Micro contact Printing Architecture, Nanoprobes, Silicon/Industry, Superconductors, Magnetoelectronics, Molecular and Bioelectronics (Fullerenes, biomolecules, etc.), Nanoscale Optics and Self-assembly/combination of Silicon technology and molecular based electronics.

The Phantoms membership is restricted to research groups active in the field of "Nanotechnology for Information Processing and Storage". Phantoms have among its members research groups of the candidate countries. For instance, since 2003, the Laser Photochemistry Laboratory of the National Institute of Lasers, Plasma and Radiation, Magurele-Bucharest, Romania participates in the PHANTOMS network. Phantom is supporting the research and the fabrication of nanomaterials obtained by laser pyrolysis, a technique developed at the Laser Photochemistry laboratory.

2.5 Networks of Excellence supported by the European Commission

The European Commission supports the merger of expertise and knowledge in the field of nanotechnology to keep Europe as a competitive partner of the US and Japan and to make it a leader in nanotechnology. The fusie of nano expertise and knowledge forms EU networks of excellence. To really be nano leader, the networks will develop activities to incorporate the scientific community of the candidate countries to them. The initiatives in that direction are in progress, for example the Join Programme of the Nano2Life.

Nano2Life (N2L)
The aim of N2L is to merge existing European expertise and knowledge in the field of nanobiotechnology to make Europe a leader in nanobiotechnology transfer during a 5 years time. N2L provides a frame to improve European competitiveness in nanobiotech by integrating excellent organisations, offering access to the largest and most advanced multidisciplinary expertise, facilities and know-how. The N2L has defined a Joint Programme of activity to achieve the goals. N2L is tackling fragmentation of European nanobiotechn by joining 24 partners, 170 researchers and 4 types of legal status. Integration is achieved by co-ordinating research, training and communication in academia and industry. In 2007, Nano2Life will establish the European Institute of Nanobiotech (EIN) with 200 integrated researchers and 1 legal status. The envisioned permanent EIN will guarantee long term integration. According to the co-ordinator of the N2L, Patrick Boisseau, there are 5 organisations of the Candidate countries that are associated to Nano2Life. As associate partners, they can take part to the entire Joint Programme of Activity but at their own costs. They are not taking part in the management of the network or in its working groups. Also as associate partners, they could apply as full members in the future and the Governing Board will decide then on their application. The associate members and the contact points with the co-ordination of the N2L are as follows:

Associated Member	Institute	Contact Person
National Centre on Nanotechnology, Sofia, Bulgaria	Sofia University	Proykova Ana
Institute for Materials Science and Technology (BAYATI); Institute of Chemistry Budapest, Hungary	Institute of Chemistry	Kalman Erika
National Institute for Microtechnologies (IMT), Bucharest, Romania	National Institute for R&D in microtechnologies	Dascalu Dan
“Petru Poni” Institute of Macromolecular Chemistry, Iasi, Romania	Petru Poni Institute of Macromolecular Chemistry	Simionescu Bogda
Faculty of Electrical Engineering University of Ljubljana, Slovenia	Faculty of Electrical Engineering, University of Ljubljana	Amon Slavko

2.6. Participation in FP6 – Priority 3

The Thematic Priority Area 3 "Nanotechnologies and Nanosciences, Knowledge-based Multifunctional Materials and New Production Processes and Devices" includes a wide-ranging programme on nanosciences and nanotechnologies research and on development activities. The programme may mobilise total financial resources of one billion Euro over the four-year period of the 6th Framework Programme. Two global objectives are defined:

- to stimulate the introduction of innovative nanotechnologies in existing industrial sectors;
- to stimulate breakthroughs, which can lead to entirely new materials, new devices, new products and new industries.

The programme covers essentially all nano-material types and related device and process developments. It includes long term research, research into techniques and instruments, nano-structured structural and functional materials, and related application development.

The primary objective of the Thematic Priority Area 3 is to promote real industrial breakthroughs, based on scientific and technical excellence. This requires real integrated approaches, either "vertical", combining materials sciences, nanotechnologies and production technologies, as well as other technologies based e.g. on information technologies or biotechnologies, or "horizontal", combining multi-sectoral interests.

The participation of Candidate Countries to FP6 – Priority 3 at the first call for proposals in 2003 was relevant in terms of organisations involved and topics covered by the proposals. This participation can summarised as follows:

> Candidate Countries were involved in all FP6 instruments (Ips, NoEs, STREPs, SSAs, and CAs) with a success rate of 16 % on average for Ips and NoEs, and 12 % on average for STREPs.
>
> 667 Candidate Countries organisations were involved in the IP submitted proposals, and 1062 in the NoE submitted proposals. After the first step of evaluation, 1st NANOFORUM Workshop Sinaia (Romania) October 5-7, 2003 there were 129 Candidate Countries participants involved in IP proposals, and 132 in NoE proposals.
>
> 726 Candidate Countries organisations participated in the STREP's call for proposals, and 102 came out of the evaluation process in Sinaia.

For additional information, see: http://www.nanoforum.org/events/workshop/tomellini.pdf

2.7. Other European research related associations

Except for the European Commission, there are three organisations fostering research networking in Europe, Eureka for applied research, and the European Science Foundation (ESF) for fundamental research and COST for both.

Eureka
Eureka is a pan-European organisation fostering applied research networking. This organisation is intergovernmental, and has 33 European countries and the European Union as members. Eureka also has associated states, or NIPs in several Central and Eastern European countries. Of the candidate countries, Cyprus, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovakia, Slovenia and Turkey are members. Bulgaria is a NIP country. www.eureka.be

European Science Foundation
The European Science Foundation (ESF) is a pan-European association of national funding councils for fundamental research. They have members in 29 countries, including Bulgaria, Cyprus, Czech Republic, Estonia, Hungary, Poland, Romania, Slovakia, Slovenia and Turkey. The ESF funds networking, conferences and exchange visits between scientific projects funded by their member organisations. Nanotechnology related ongoing ESF programmes include Natribo. This project has 14 partners including Estonia, Poland and Turkey. www.esf.org

COST
The European Co-operation in Scientific and Technical Research COST co-ordinates nationally funded research projects by funding meetings and travel. Scientists themselves can propose COST actions, which can start if at least five of the national authorities in the COST member countries have signed a new COST action. COST has 34 member states, one co-operating state and nine states with co-operating institutions. Bulgaria, Cyprus, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Romania, Slovakia, Slovenia and Turkey are among the member states.

There are currently six COSTS actions in the nanosciences. In the past, there have been six more actions in nanosciences (COST NanoSTAG, 2003). So far, all relevant COST actions have been part of disciplinary domains: physics, chemistry or materials. Recently, COST started a new domain nanosciences, to achieve better co-ordination between the disciplines. In the current COST action 523 (1998-2004) on Nanostructured materials, 24 countries participate including Bulgaria, Czech Republic, Hungary, Lithuania, Romania, Slovakia, Slovenia and Turkey. http://cost 523.epfl.ch/. The participation of the candidate countries in the COST actions is as follows:

- In the COST action D15 (1998-2003) on Surfaces and Interfaces, 21 countries participate including Bulgaria, Czech Republic, Hungary, Poland, Romania and Slovenia.
- In the COST action D14 (1999-2004) on Functional Molecular Materials,

19 countries participate including Czech Republic, Hungary, Poland and Turkey.

- In the COST action 525 (1999-2005) on Advanced Electroceramics: Grain Boundary Engineering, 18 countries participate including Czech Republic, Latvia, Lithuania, Slovenia and Turkey. http://www.ii.ua.pt/uimc/cost/
- In the COST action D19 (2000-2005) on Functionality specific to the nanoscale, 19 countries participate including Hungary, Latvia, Poland, Slovenia and Turkey.
- In the COST action D22 (2000-2005) on Protein-lipid interactions, 17 countries participate including Hungary, Latvia, and Slovenia. http://cost.cordis.lu/src/home.cfm

2.8. Literature and web-links

European Commission (2002): "Innovation policy issues in seven candidate countries: Romania, Bulgaria, Slovakia, Latvia, Lithuania, Malta and Turkey" ftp://ftp.cordis.lu/pub/innovation-policy/studies/studies_seven_candidate_countries_interim_report.pdf

European Commission (2003): .Communication from the Commission to the Council, the European Parliament, the European Economic and Social Committee and the Committee of the Regions; Innovation Policy: Updating the Union's approach in the context of the Lisbon strategy., Brussels, 11.3.2003, COM (2003) 112 final, p 11

Reid, Alasdair, et al (2002): .Innovation policy in six candidate countries; Cyprus, Czech republic, Estonia, Hungary, Poland and Slovenia., http://www.cordis.lu/innovation-policy/studies/geo_study1.htm

Yole Development (2003): "European Micro and Nanotechnologies Status: Minanet Analysis", paper presented at Hanover Messe, Hanover, 8 April 2003, www.minanet.com

Enlargement web-pages of the European Commission: http://europa.eu.int/comm/enlargement/

Cordis web-site enlargement information: http://www.cordis.lu/national_service/en/candidate_countries.htm

Information on the EU recognised centres of excellence in candidate countries: http://europa.eu.int/comm/research/news-centre/en/pol/02-03-pol04.html

European Microsystems Network: http://www.nexus-mems.com

Nanotechnology network for Information Technology and Storage: http://www.phantomsnet.com

A list of European semiconductor labs outside the European Union:http://www.semiconductors.co.uk/research_laboratories/resrchlbrs_europenoneu.htm

"First European Network of Excellence for Bringing NANOtechnologies TO LIFE"1st Nanoforum Workshop Nanomaterials and Applications, October 5-7, 2003 Sinaia-Romania: http://www.nanoforum.org/events/workshop/Boisseau.pdf

“Mixed Phases Of Tio2 Nanopowders Prepared By Laser Pyrolysis: Synthesis And Characterization”, 1st Nanoforum Workshop Nanomaterials and Applications, October 5-7, 2003 Sinaia-Romania: http://www.nanoforum.org/events/workshop/tomellini.pdf

2.9. Acknowledgements

Ineke Malsch has written this chapter, with invaluable contributions from the following persons: Holger Hoffschulz, Bernd Reichert, Elodie Garcia (Minanet, France), and Sien Buys (Gate2Growth, Belgium).

3. Bulgaria

3.1. General information

Bulgaria is an Eastern European country with 7.7 million estimated inhabitants (Pop2000). Gross expenditure on R&D was 0.59% in 1999 (Expend1999). The country is preparing for accession to the European Union in 2007. Until then, the Bulgarian government is committed to "reinforce research-related administrative capacity and infrastructure, in order to increase the benefits from association with the relevant Community Framework Programmes including the 6th Framework Programme (2002-2006)" (Accession partnership, European Commission, March 2003, p 18).

Among the government priorities (2003-2006) are Communications and High Technologies. This includes plans to set up an investment fund for high tech SMEs in the IT and software sectors. In fact, the government wants to develop the IT industry and open R&D centres in Bulgaria to do telework for big companies worldwide. http://www.government.bg/English/Government/Program/2003-06/

The ministry of Education and Science is responsible for research policy. The national strategy on Science Technology and Innovation is in an early stage of development, as outlined in the position paper "Science, Technology and Innovation in Bulgaria, Strategy and Implementation", of September 2002. The authors of this position paper made some suggestions to modernise the national research system and to invest US$ 633 million between 2004 and 2013. These funds should come from the Bulgarian government (30%), and the rest from a loan from the World Bank, or others. This investment should come on top of the current budget for R&D. The relevant authorities are currently discussing this strategy. The Bulgarian Position Paper is entitled "Science, Technology, and Innovation in Bulgaria Strategy and Implementation" (Position2002).

According to Ms Albena Voutsova, "Scientific Research" Director at the Ministry of Education and Science of Bulgaria, there are five national research programmes, adopted by the Council of Ministries. These cover Genomics, ICT, Nanotechnology, Space Research and Social and Human Sciences (Interview2003).

Figure 6: Map of Bulgaria
(Source:http://forum.europa.eu.int/irc/dsis/candidate/info/data/candidatecountries/)

NATIONAL CONTACT POINT
NMP Thematic Programme of the EC Sixth Framework Programme (FP6)

Prof. Dr. Ana Proykova
Address: Sofia University .St. Kliment Ohridski., Faculty of Physics
5, James Bourchier,BG-1126, Sofia, BULGARIA;
Phone: +359 2 81 61 828 Mobile: +359 887 43 00 60
URL: http://cluster.phys.uni-sofia.bg:8080/ and http://www.bas.bg/nano/
E-mail: Anap@phys.uni-sofia.bg
Programme acronym: FP6-NMP

3.2. National programmes and Networking

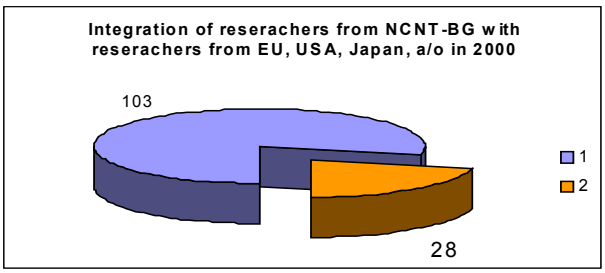
The national research program on Nanotechnology opened the first call for proposals in the late autumn of 2002 (November). Thirty-two proposals were considered for funding and two of them were announced as successful in September 2003: one project was based at the University of Sofia, and another - at the Bulgarian Academy of Sciences. The average number of collaborators per proposal was 21, and the number of institutions was 3.

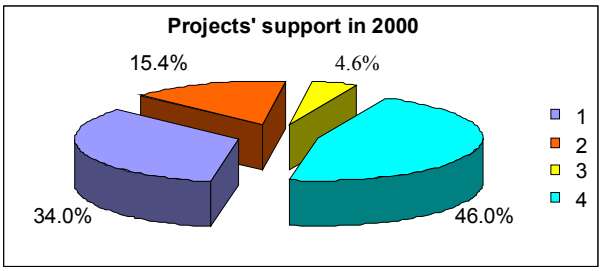
The researchers, working in the field of nanotechnology, organised themselves in 1998 a network, which became the basis of the National Centre on Nanotechnology (NCNT) established in 1999 under the auspices of the Bulgarian Academy of Sciences. The host institute of the NCNT is the Central Lab of Electrochemical Power Sources (CLEPS-BAS). The NCNT has three types of partners: research institutes (16), university (6), and SMEs (3). The structure of the Centre and the names of the thematic-group-leaders can be found in http://www.bas.bg/nano/.

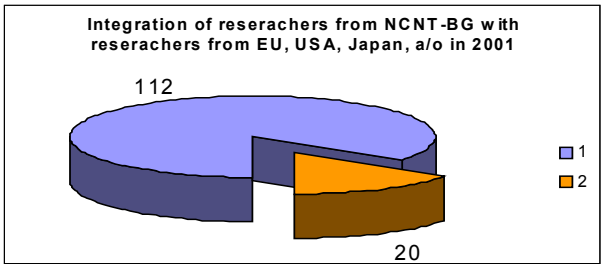
The density of projects and researchers working on nanotechnology in the period 2000 - 2003 has been reported in the report for 2003 of the NCNT. Concerning to number of projects, In 2000 there were 65 project, this number has increased from 71 projects in 2001 to 122 in 2003. The report presents as a measure of the researchers in nanotechnology the number of participants in the annual workshops of the NCNT. This number has also increased in this period. In 2000 and 2001 there were 131 and 132 participants while this number has growth to 203 in 2002 and to 300 in 2003. Additional information of this report is shown in Figure 7: the support of the government and non-government organisations to the projects within NCNT and the researchers who have participated in these projects.

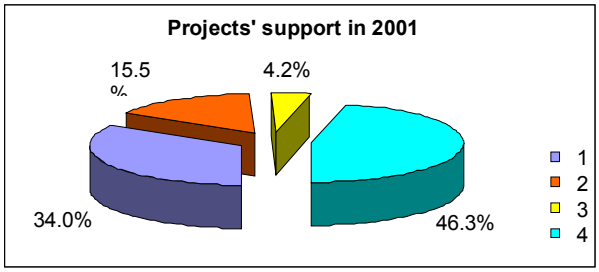
Integration of researchers from NCNT-BG with reserachers from EU, USA, Japan, a/o						
year	Bulgarian authors		Foreign authors		total	
	1		2			
2000	103	78.6%	28	21.4%	131	100.0%
2001	112	84.8%	20	15.2%	132	100.0%
2002	155	76.3%	48	23.7%	203	100.0%

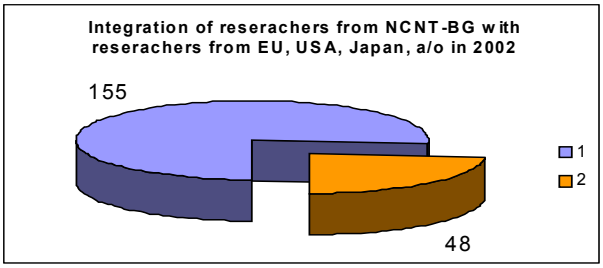
Support of research projects elaborated within NCNT-BG					
year	Budget support	National programs	Bulgarian SMEs	Foreign partners	Total
	1	2	3	4	
2000	34.0%	15.4%	4.6%	46.0%	100.0%
2001	34.0%	15.5%	4.2%	46.3%	100.0%
2002	27.9%	15.6%	2.5%	54.0%	100.0%

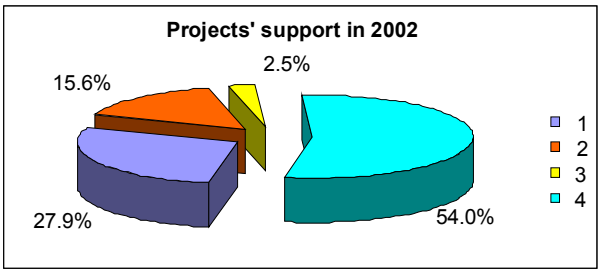












The NCNT organised 5 workshops on nanotechnology starting in 1999. The talks and reports given at the meetings have been published and can be purchased via Internet, for instance http://www.pensoft.net/authors/dragievai.stm.

The NCNT is structured as follows:

National Centre on Nanotechnology (NCNT) Central Laboratory of Electrochemical Power Sources	
Address:	Bulgarian Academy of Sciences Bonchev Street, Block 10, 1113 Sofia, Bulgaria
General Institute Contacts:	**Tel:** +359 2 722 545 / **Fax:** +359 2 722 544 **E-mail:** nanotechnology_bg@yahoo.com **Website:** http://www.bas.bg/nano/
Description:	The nanotechnology research community in the country was established in 1999 through the National Centre on Nanotechnology (NCNT). It is part of the Bulgarian Academy of Sciences (BAS) and advised by the National Expert Council on Nanotechnology. The Centre works on the basis of equipment, experience and knowledge of several institutions from the Bulgarian Academy of Science, six Bulgarian Universities, hi-tech parks and industrial institutions.

	As a bridging institution, NCNT concentrate the efforts of the scientific community in the field of nanoscience and nanotechnology in order to meet the requirements of the technological era and to make the achievements in this promising field available to the society in Bulgaria and in the Balkan region. The research in the field of nanotechnology is very wide. The following thematic groups present the interests of the community.
Group: Clusters, nanoparticles, complexes and composites	
E-mail:	Prof. A. Proykova mailto:anap@phys.uni-sofia.bg
Description:	Clusters are an important state of matter, consisting of atoms and molecules that are small enough to have some properties different from those typical for the bulk liquid and solid. Quantum states in clusters are size-dependent, leading to new electronic, optical and magnetic properties. Clusters offer attractive possibilities for innovative technological applications in even smaller devices and the ability to "tune" properties, especially in semiconductors, may produce novel electronics and magnetic capability.
Group: Ultra thin films and multilayer nanosystems	
E-mail:	Prof. D. Malinovska dmalinovska@hotmail.com
Description:	By reducing the film thickness to the nanometer scale, the general properties of the parent bulk material can be drastically changed extending applications of thin films and multilayer nanosystems as: sensors, memory devices, membranes, solar cells and photoresists.
Group: Submicron regions and inhomogenities in bulk materials	
Contact:	Prof. N. Stoichev n_stoichev@ims.bas.bg
Description:	Engineering of nano phases by means of appropriate precursors creates materials with new unexpected properties. The correlation between the size of the nanophase, its structure and the electric, magnetic and catalytic properties of the system is a subject of investigation.
Group: Molecular and atomic design	
Contact:	Prof. R. Kotsilkova kotsil@bgcict.acad.bg

Description:	New materials are developed by means of specific molecular design for producing nanoparticles applicable in medicine, agriculture and ecology. The relationship between the macromolecular design and the properties of Nan- and micro dimensional bioactive polymer systems is explored in order to produce novel medical materials for controlled drug release. These materials involve natural polymers chemically or physically modified with synthetic amphiphilic/biodegradable polymers.
Group: Nanometrology and applications	
Contact:	Prof. I. Dragieva iovka@cleps.bas.bg
Description:	Ionic sources are developed for application in ultra-high resolution lithography and surface processing systems. Evanescent-wave holographic measuring system is developed (interferometry, relaxation spectroscopy, refractometry) for nanometric studies.
Group:Finance and Strategy of Research	
Contact:	sstavrev@phys.bas.bg

Another network - international - has recently been established: COSENT, which stands for Co-operation of Southeast European (SEE) Countries in the field of Nanotechnology (Contracts No: UVO - ROSTE 875.589.2 2002 and – ROSTE 875.669.3 2003 UNESCO) Partners from BULGARIA (National Centre of Nanotechnology-NCNT). The contribution of the Bulgaria can be found at http://cosent.dir.bg/bulgaria.html

The objectives of this network can be summarised as follows:

- Create a research and development infrastructure for a more effective utilisation of the theoretical and experimental basis of the SEE Countries in the field of Nanotechnology.
- Assist closer integration of the region into the European Research Area with its theoretical and experimental achievements as an equal and desirable partner for research, development and implementation of high technologies based on nanostructured materials and devices.
- Stimulate the organisation of university lectures, regional training courses, summer schools and conferences for the dissemination of knowledge in the field of Nanotechnology.
- Develop an attractive research environment appealing to the imagination of young scientists thus preventing the emigration of well-trained students and researchers.

3.3. The research institutes and their expertise

There are sixteen relevant research institutes, which are part of the Bulgarian Academy of Sciences. They are dedicated to nanotechnology in different fields. The following tables list the institutes and their fields of expertise.

Central Laboratory of Electrochemical Power Sources, CLEPS-BAS	
Address:	1113 Sofia Acad. G. Bonchev Str., Bl. 10 Tel: (+359 2) 72 25 45 Fax: (+359 2) 72 25 44
General Institute Contacts:	Director: Z. Stoynov Tel: (+359 2) 72 25 43 E-mail: stoynov@mbox.cit.bg Web: http://www.bas.bg/cleps
Description:	Nano research activities supported by the CLEPS are summarised as: • Clusters, nanoparticles and complexes • Ultrathin films and multilayered nanosystems • Nanocomposites • Molecular and atomic design • Nanometrology and applications Further CLEPS participates in projects on: • Wave-absorbing polymer composites based on carbon and ferroxide nanostructures • Polymer-diamond nanocomposites: novel wear resistant materials • Polymer/layered silicate nanocomposites as protective coatings

Central Laboratory of Physical Chemical Mechanics, CLPhChM-BAS	
Address:	1113 Sofia, Acad. G. Bonchev St., Bl. 1; Phone: (+359 2) 718182 Fax: (+ 359 2) 8 70 34 33 E-mail: clphchm@bgcict.acad.bg
General Institute Contacts:	Director: Prof. Georgi ZACHARIEV, DSc Tel. 71 81 82 http://www.cl.bas.bg/BAS/directory/tech/clphchm1.html
Description	The Central Laboratory of Physico-Chemical Mechanics undertakes research in the field of material science of non-metal construction composite materials (NCCM). Research topics are: Synthesis and characterizastion of polymer nanocomposites; The role of interfaces in nanocomposites; Effects of processing technology

	on the structure and properties; Reinforcement effects of nanoparticles in polymers; Rheology, viscoelasticity, relaxation spectra modeling; Structure-properties relationships; Mechanical properties, thermal resistance, abrasion and ware, adhesion at different sutfaces. The scientific staff comprehends 1 corr. member, 6 professors, 7 assoc. professors, 5 have DSc degrees, 12 have PhD degrees
Contact Person	Assoc. Prof. Dr. Rumiana Kotsilkova (Head of Tematic Projects "Polymer Nanocomposites") Phone: +359 2 979 3939 E-mail: kotsil@clphchm.bas.bg

Central Lab of Solar Energy and New Energy Sources, CLSENES-BAS	
Address:	1784 Sofia,72 Tzarigradsko chaussee Blvd. Tel:(++359) 2 77 84 48, Fax: (++359) 2 75 40 16; E-mail: solar@phys.bas.bg; pv-sys&phys.bas.bg
General Institute Contacts:	Director: Assoc. Prof. Petko Vitanov, PhD Tel:(++359) 2 75 40 16, E-mail: vitanov@phys.bas.bg http://www.senes.bas.bg/
Description	The laboratory activities are grouped in: • Solar Cells, Modules, Systems and Devices: Physical investigations of photocells and optoelectronic devices, Modelling and technological design. • Photoelectric materials: Preparation and study on the electrical, optical and structural properties of amorphous material thin films: a-Si: H, a-SiGe, a-SiC, ZnO transparent conductive coatings; Porous-Si and silicon suboxides- SiO: H, SiO: C. • Multinary Compounds for Solar Cells: Thin film ternary compounds for solar cells absorber, Electrodepositon and physical vapour deposition of CuInSe2 films Chemical deposition of buffer layers for heterostructure thin film solar cells. • Photothermal Solar Energy Conversion: Selective sol-gel coatings, electrochromic CVD thin films of transient metals oxides: W, Mo -oxides, TiO2 Solar thermal systems analysis, hot air solar collectors assembling.

Institute of General and Inorganic Chemistry, IGICh-BAS	
Address:	1113 Sofia, Acad. G. Bontchev str., bldg.11,

General Institute Contacts:	Fax: (+359 2) 705024, E-mail: info@igic.bas.bg http://www.igic.bas.bg/
Description	The activities of the Institute of General and Inorganic Chemistry Include basic and applied research, consultancy works, expert investigations, industrial practice and training of specialists in inorganic and analytical chemistry and in inorganic materials science. The nano activities of IGIC concern developing methods and technologies for synthesis of inorganic compounds and systems, determining their structure and reactivity and preparing, on their basis, polycrystalline and single crystalline materials with preset magnetic, optical, semiconductor, superconductor, ferroelectric, adsorption, catalytic, biological etc. properties.

Institute of Catalysis, IC-BAS	
Address:	Acad. G. Bonchev St., Bldg.11, Sofia 1113, Bulgaria.
General Institute Contacts:	Tel: +359 2 9793563; Fax: +359 2 9712967; e-mail: icatalys@ic.bas.bg http://ic.bas.bg/
Description	The Institute develops basic research in the field of catalysis, catalytic reaction kinetics, and catalytic processes for environmental protection and applied research in catalyst production technologies and kinetic models of industrial processes. One of its research areas concerning to nanotechnology is Quantum chemical methods in catalysis and theoretical methods for quantum chemistry.

Institute of Electronics, IE-BAS	
Address:	72, blv. Tsarigradsko Chaussee, Sofia 1784, Bulgaria
General Institute Contacts:	Tel: (+359 2) 875 0077 Fax: (+359 2) 975 3201 http://ie-bas.dir.bg/
Description	In the Institute of electronics, both type nanostructures - thin films and nanopowders are synthesized using different techniques: spray pyrolysis, magnetron sputtering, thermal plasma conversion, laser ablation etc. Various type of materials such as ferrites, Fe2O3, YBCO (pure and doped), SiO2, etc. are produced and characterized. Modeling the processes of nanostructure formation by gas-to-particle conversion route is also carried out. The Institute also carries out research and educational activities

	and disseminates scientific knowledge in the fields of Physical Electronics, Quantum Electronics, and Radiophysics. Its research areas are: • Physical electronics that focuses on studying the processes of generation and control of beams of electrons, ions and photons, and especially on their interaction with matter. • Quantum electronics that comprises studies of the physical processes involved in the interaction of laser radiation with matter and development of technologies for laser cutting and thin-film formation etc. • Radiophysics that concentrates on studying the processes of generation and propagation of electromagnetic waves and the non-linear properties of oscillations and waves in a wide frequency range. Radiophysics also includes the scattering of electromagnetic waves from homogeneous and inhomogeneous media, detection of signals and development of techniques and means of data acquisition and processing, development of radioelectronic systems for the microwave and optical ranges and systems for remote sounding of the atmosphere, the sea and earth surface.

Institute of Solid State Physics, ISSPh-BAS	
Address:	Bulgarian Academy of Sciences (ISSPh-BAS) 1784 Sofia, 72, Tzarigradsko chausse Blvd., Sofia, Bulgaria
General Institute Contacts:	**Fax:** +359 2 975 36 32 **Website:** http://www.issp.bas.bg/
Description:	This Institute is specialised in fundamental and applied research in the field of condensed matter physics, optics, spectroscopy and laser physics. The main scientific achievements of the Institute are in the field of condensed matter physics, laser physics, and theory of solid state and phase transitions. The applied achievements include superconductivity and superconductive materials, physics of low temperature, of liquid crystal and of atom and plasma, and the development of high precision thermometers, optical fibres, acoustic-electronic and microelectronic sensors.
Nanotechnology relevant activities	Two different laboratories are working on projects related to nanotechnology. The Physical Problems of Microelectronics laboratory is working on the physics and technology of metal-oxide-silicon structures (MOS capacitors, MOS and polysilicon transistors), thin dielectric, semiconductor magnetic and metal layers for the modern nano- and microelectronic microsystems. The second laboratory of Biomolecular Layers is working on Basic research and application in the field of living matter physics, bilayer lipid membranes and biomembranes, ultra thin molecular layers on

	solid substrates, smectic and lyotropic systems, nanostructured liquid crystals, surface liquid crystal physics.
Contact persons:	Biomolecular Layers, Prof. Alexander Petrov agpetrov@issp.bas.bg
	Physical Problems of Microelectronics, Assoc. Prof. Valentin Georgiev, sens@issp.bas.bg

Institute of Polymers, IP-BAS	
Address:	Bulgarian Academy of Sciences Acad. G. Bonchev Str., block 103-A BG - 1113 Sofia Bulgaria
General Institute Contacts:	Director: **Prof. D.Sc. Kolio Troev** Tel. : +359(2)971-28-17 Fax: +359(2)870-75-23 e-mail: ktroev@polymer.bas.bg http://www.polymer.bas.bg/
Description	The research activity of the Institute covers new methods for synthesis and modification of polymers. Studies on creating polymeric materials for application in medicine and microelectronics are also carried out. Its main research areas are ionic polymerisation, synthesis and investigations of new polymers with special properties - thermo- and flame-resistant, conductive, bioactive and amphiphilic.

Institute of Engineering Chemistry, IECh-BAS	
Address:	Address: Acad.G.Bonchev str., Bl.103, 1113 Sofia, Bulgaria Phone: (+359 2) 870 42 49 (+359 2) 979 32 76 Fax: (+359 2) 870 75 23 E-mail: ichemeng@bas.bg
General Institute Contacts:	Director: Prof. Venko BESCHKOV, D.Sc. Phone: (+359 2) 870 20 88 E-mail: bioreac@bas.bg http://www.bas.bg/iceng/index.html
Description	The research activities of the Institute concern • hydrodynamics, heat and mass transfer processes in multiphase systems; • methods for optimal use and storage of energy; • chemical engineering problems in catalysis; • practical aspects of biochemical processes; • computer simulation and control of chemical systems.

Institute for Metal Science, IMS-BAS

Address:	1574 Sofia, 67 Shipchenski prohod St.; Fax: (+359 2) 70 32 07 E-mail: imst@bgcict.acad.bg
General Institute Contacts:	**Director**: Corr. Mem. Yanko ARSOV, DSc Tel. 971 32 19 http://www.cl.bas.bg/BAS/directory/tech/ims1.htm
Description	The Institute carries out fundamental and applied research in the field of metal science and heat treatment, casting, crystallisation, structure and properties of metals and alloys, plasticity and fracture of materials. The activities of the institute also include interaction of gases, metal and non-metal materials, production of high nitrogen steels under high pressures; foamed thermoplastics, physics and mechanics of welding processes, ceramics and composites, thermal electric and magneto hydrodynamic processes in molten metals. Scientific staff comprehends 5 professors 37 assoc. professors, 6 have DSc degrees, 73 have PhD degrees

Central Lab Optical Storage & Processing of Information, CLOSPI-BAS	
Address:	CLOSP_-BAS, Sofia - 1113 Acad. G. Bontchev St. - 101 P.O.Box 95
General Institute Contacts:	http://www.optics.bas.bg/
Description	The aim of the investigations in the Institute is the creation of new high-efficiency optical materials, methods of information recording, optical measurements and non-destructive control, provision of elemental basis and algorithms for optical methods of information processing. In particular, this is related to the creation of new materials and technologies for the optics industry, design of new devices for optical control of the environment, early diagnostics of cancer in medicine, pattern recognition for the automation of production processes, man-machine dialogue and non-algorithmic computing devices.

Space Research Institute, SRI-BAS	
Address:	6 "Moskovska" str., Sofia 1000, BULGARIA tel.(03592)9883503, fax.(03592)9813347
General Institute Contacts:	Director: Prof.Dr. Peter Getsov Tel.(+3592)9883503;9861683;718351 Fax:(+3592)9813347 e-mail:/director@space.bas.bg/ http://www.space.bas.bg/
Description	The activities of the Institute ranges over

	fundamental and applied investigations in space physics, astrophysics, image processing, remote sensing and life sciences. Mainly, its activities are in the field of probe methods for studying of space plasma.
Contact person:	Prof. S. Stavrev

Geophysical Institute, GI-BAS	
Address:	Acad. G. Bonchev str, bl.3 Tel: +359 2 700128 1113 Sofia BULGARIA
General Institute Contacts:	Director: Dr. Nikolay Miloshev Tel. +359 2 971 2677 Fax: +359 2 971 3005 e-mail: office@geophys.bas.bg http://www.geophys.bas.bg/
Description	The research areas of the Institute are seismology, geomagnetism, gravimetry, and physics of the atmosphere, ionosphere and geospace.

Central Laboratory of Photo-Processes, CLPhP-BAS	
Address:	Acad. G. Bonchev Str., Bl. 109 Sofia 1113, Bulgaria Tel: (++3592) 72 00 73 Fax: (++3592) 72 24 65 E-mail: clf@clf.bas.bg
General Institute Contacts:	Director: Dr. Atanas Buroff, Senior Research Associate, Tel: (359 2) 72-00-73, email: tassi@clf.bas.bg http://www.clf.bas.bg/
Description	The research of the institute is on materials and processes for information recording media, optoelectronics, infrared and integral optics, and microphotolithography, micromechanics and sensor technique. Besides, the institute has technological lines for production of circular and linear encoder gratings, as well as technologies for microstructuring of different layers.

Institute of Physical Chemistry, IPhCh-BAS	
Address:	Bulgarian Academy of Sciences Acad. G. Bonchev St., block 11 Sofia 1113, Bulgaria
General Institute Contacts:	**Phone:** + 359 2 727 550 / **Fax:** + 359 2 971 2688 **E-mail:** physchem@ipchp.ipc.bas.bg

	Website: http://www.ipc.bas.bg
Description:	The Institute of Physical Chemistry (IPC) is a research and educational unit within the Bulgarian Academy of Sciences (BAS) and it was established in 1958.
Group: Electro-Optics	
Head of Department:	Prof. S. Stoylov, e-mail: stoylov@ipchp.ipc.bas.bg
General Description:	The investigations of the "Electro-Optics Group" are directed to characterisation of the structure and the dynamics of colloid dispersions. The main scientific topics are the following:
Surface dipolar	Surface dipolar (permanent and induced) electric properties of suspended inorganic and organic nanosupramolecular structures, which in many cases are more essential for the understanding their behaviour in electric fields than the volume (e. g. dielectric) electric properties. Several methods are used: light scattering, electrophoresis, potentiometric titration, conductivity measurements and non-conventional instruments for electric light scattering and other electro-optic methods
Non-conventional inter-molecular and inter-particle interactions	Non-conventional inter-molecular and inter-particle interactions related to the above interfacial electric properties. Colloid stability and the processes of particle aggregation. Assembly of biopolymers and their complexes. The correlation of colloid systems stability to nanoparticle surface electric properties (including their heterogeneity and dynamics) and particularly to the sensitive optic, electric and electro-optic parameters present a convenient method for the study of aggregation kinetics and mechanism and of the properties of the aggregates.
Phase transitions	Phase transitions and variation in the viscoelastic properties of the disperse systems. The sensitivity of the electro-optic methods to electro-acoustic effect helps the analysis of the dynamic modes in colloidal systems.
Adsorption	The changes in surface charge distribution and density upon adsorption of ions and molecules on the particle surface allows the study of the adsorption process by means of electro-optics. The particular sensitivity of electric light scattering to particle dimensions helps the investigation of the kinetics of polymer adsorption on rigid surfaces. Conformation of polymers on nanoparticles and origin of life.

Nanoparticles	Nanoparticle average size (from 5 to 1000 nm, in some cases up to 5000 nm) determination by the relaxation of the electro-optic response. Nanoparticles of smaller size are studied after their electrosorption on big anisodiametric model particles. Several methods are used for evaluation of polydispersity. Investigations are accompanied by electron microscopic measurements.
Investigations of applied significance	Considerable efforts of the group are directed to the creation of methods, which can be used for on-line control and certification of some environmental and industrial products (suspensions, gels, liquid crystals, products of cosmetics and food industry, ceramics, etc.) and in nanotechnology. Also de group have created new methods of electrical treatment of water (electrocoagulation, electroseparation and electrolysis). Moreover, there is creation of new materials of specially designed composite and/or hybrid nanoparticles. Particular advantages for applications on biology, biotechnology and medicine are presented by the optic and electro-optic investigations on biopolymers, membranes, viruses, bacteria, etc. and by behaviour of biopolymers in inhomogeneous electric fields. The last investigation includes production and application of biochips.

Institute for Organic Chemistry (IOCCP)	
Address:	Address:"Acad. G. Bonchev" Str., Bl .9, 1113 Sofia, BULGARIA Phone: (+359) (2) 724 817, Fax: (0359) (2) 9 700 225 E-mail: iochem@orgchm.bas.bg
General Institute Contacts:	Director: Prof. Dr. Yuri Stefanovsky Tel.: (+359 2) 73 11 42; yuri@orgchm.bas.bg http://www.orgchm.bas.bg/
Description	The research topics of IOCCP include fundamental and applied investigations in structure and reactivity of organic compounds, natural product chemistry, bioorganic chemistry, and fuel chemistry. The IOCCP staff (about 225 persons) numbers comprehends one Academision, ten full professors, forty associate professors, eighty two research fellows, ten DSc, ninety four PhD, graduate students

	and supporting administrative and technical personnel.

3.4. Universities

University of Sofia "St. Kliment Ohridski"	
Address:	James Bourchier Street 1, Sofia, Bulgaria
General University Contacts:	**Phone:** 359 2 85 81; 359 2 8739 96; 359 2 85 82 07 **Fax:** 359 2 94 60 255 **E-mail:** Rectorat@admin.uni-sofia.bg **Website:** www.uni-sofia.bg
General Description:	Sofia University is the oldest university in Bulgaria. Founded in 1888. Today Sofia University "St. Kliment Ohridski" is the largest and most prestigious educational and scientific centre in the country. It is also an academic institution of developing prestige within Europe. Sofia University's staff comprises 2.703 lecturers engaged in teaching and research. Thirty-eight percent of its lecturers are professors and associate professors.
Dept. of Chemistry General Contacts:	**Phone:** 359 2 62 56 303; 359 2 62 23 36 **Fax:** 359 2 62 28 08 **E-mail:** dekan@chem.uni-sofia.bg
Department of Chemistry Activities:	EC Project: Acronym: **H-SORPTION IN MG** Title: Improved hydrogen sorption kinetics in new magnesium composites for clean energy storage and transport
Contact Person:	Prof. Dr. Veneta Kaltcheva Chair of Inorganic Chemical Technology

Collaborating universities of the National Centre of Nanotechnology (NCNT)

University of Chemical Technology and Metallurgy	
Address:	Blvd. Kl. Ohridski 8, Sofia-1756, Bulgaria
General University Contacts:	**Phone:** +359 2 68 2105 **Website:** http://www.uctm.acad.bg/
Department of Silicate Technology activities:	Glass formation, Glass ceramic materials, Nanostructures, Structure of non-traditional glasses, containing TeO2, V2O5, SeO2, Bi2O3, TiO2, MoO3, PbO, Fe2O3, Equilibrium phase diagrams and Synthesis of new materials. The last includes optical glasses, semiconducting glasses, solid electrolytes, superconducting ceramics, sol-gel methods, and ion exchange technology.
Contact Person:	Yanko-Borissov Dimitriev, yanko@uctm.edu

"St. Neofit Rilski" South-West University, Blagoevgrad	
Address:	66 Ivan Mihailov St., 2700 Blagoevgrad, Bulgaria
General University Contact:	**Phone:** +359 7 33 48 73, **Fax:** +359 7 38 55 16 **E-mail:** info@aix.swu.bg **Website:** http://www.swu.bg/index_en.htm

Technical University, Sofia	
Address:	Technical University of Sofia, 8 Kliment Ohridski St. Sofia-1000, Bulgaria
General University Contact:	**Phone:** +359 2 62 30 73, **Fax:** +359 2 68 53 43 **Admin. Office:** office_tu@tu-sofia.bg **Rector's Office:** rector@tu-sofia.bg **Website:** http://www.TU-Sofia.bg
	
Faculty of Physics	
Address:	Phone+359 2 81 61 447 FAX: + 359 2 962 52 76
General Institute Contacts:	URL: http://www.phys.uni-sofia.bg/
Description	The research activities are modelling of nanosized systems-phase changes and self-organisation, and phase transitions of poly (heptamethylene P, P-bibenzoate) measured by time-resolved X-ray scattering, DSC and SEM. Other activities include numerical simulation of super-band gap SPV transients related on Si surfaces, Electronic states of diffused GaAs/AlGaAs quantum wires and multi quantum wells of PbS/PbSe -optical characterisation and electronic properties.
Contact person:	Prof. Dr. Ana Proykova, Head of Computational Theoretical Physics Group (Monte Carlo Group); Phone:+359 2 81 61 828 E-mail: anap@phys.uni-sofia.bg

"Nicola Vaptzarov" Naval Academy, Varna	
Address:	73 Vassil Drumev St., 9026 Varna, Bulgaria
General University Contact:	**Phone:** +359 52 632 015 **Fax:** +359 52 303 163 **Website:** http://www.naval-acad.bg/

Technical University, Rousse	
Address:	University of Rousse, 8 Studentska Str., 7017 Rousse, Bulgaria
General University Contacts:	**Phone:** +359 82 888 355, **Fax:** +359 82 845 708 **E-mail:** dir-vor@ru.acad.bg **Website:** http://www.ru.acad.bg/index_en.php
Materials & Manufacturing Engineering	Assoc. Prof. Dr. Rusko Shishkov, rish@ru.acad.bg

3.5. Companies

In Bulgaria, there is a program called "Hybrid microelectronics and systems". Two clusters of SMS (one in Sofia and a second in Botevgrad) together with the Technical University - Sofia and The Sofia University were joint there R&D efforts and created this program named.

The SMS partners in this program are: Hybrid Microelectronics Ltd; Hybrid Integrated Circuits Ltd; Institute Of Microelectronics-97 Ltd; Bulgaria Software Services Ltd; Conel Ltd; Innovative Microsystem Ltd; Expect Ltd; Melexis Ltd; Epiq Electronic Assembly Ltd; Sky Gate Ltd; Semcotech Engineering Ltd and others with more than 1500 employees and common annual turnover more than 45 Million Euros.

The strong aspects of those enterprises are:

- relatively high turnover per one employee and much higher participation of employee in the formation of GDP (Gross Domestic Product) times more than the average for Bulgaria;
- 100 % export-oriented production (for the Western European, States and Canadian markets);
- relatively high investments for Bulgarian standards;
- innovative activities – annually more than 130 original projects of integrated circuits and 24 patents registered abroad (France, Belgium, United States, etc.)
- many new positions for well educated personnel- more than 70% of the personnel are young people, most of whom employed in the last years;
- support of the University education.

The enterprises design ASIC's and integrated sensors, for their own production needs of integrated structures, as well as for orders from companies from Western Europe, The United States and others. The common for the projects of integrated circuits, done in Bulgaria, is the high intellectual added value. These are specialized mixed-signal ASIC's, including precise analog part, powerful DSP and specific, usually high-voltage interface with applications in:

- automotive electronics;
- industrial electronics and automation;
- entertainment electronics;
- home electronics;
- low speed switchings of modern telecommunications;
- military electronics.

The Front end microelectronics activities in the above companies include the production of:

- silicon wafers with integrated circuits or integrated sensors;
- thin film and thick film hybrids, modules and circuits;
- micromodules and Microsystems;
- micromechanics**.**

The Back end microelectronic activities include:

- packaging of integrated structures;
- testing and diagnostics of integrated structures and circuits, of micromodules and microsystems;
- SMD assembly of elements on structures, including “chip-on-board”;
- programming of integrated structures and circuits;
- burnings and live tests, EMC testing and other activities;
- realization of microelectronics products and the development of specific equipment and tooling to secure the above mentioned activities;
- other activities, connected with the microelectronics production.

The products of Bulgarian microelectronics companies are at the highest level of quality with competitive prices and they contain lots of intellectual added value. Bulgarian microelectronics products cannot rival the top technological achievements of the leading companies but **they are competitive** in ASIC’s with mixed structure or in smart sensors where the amount of the added value is crucial. And this is not due only to the high quality at balanced price.

The main task of the Program is to organise and control the common efforts of the above companies in the research and development for classic micro technologies and for the new hybrid technologies in the:

- Fault modeling;
- Simulation;
- Design for testability and build-in self-test;
- Test generation and Diagnosis.

All topics covered extensively from fundamental concepts to advanced techniques and technologies connected with the interface between micro- and nanoelectronics.

There are also companies that collaborate with the NCNT.

Collaborating Companies of the National Center of Nanotechnology (NCNT)
Speciality Polymers Co. Ltd.
Advanced Technologies Co. Lt http://www.keytech.ntt-at.co.jp/link_e.html
Microelectronic Technological Centre: "Institute of Microelectronics" SP J-St. Co. http://www.mi.government.bg/eng/priv/prom/card.html?id=266 Contact person: Prof. DSc. Eng. Kamen Fillyov Tel.: (+359 2) 974 3072, kamen@tcime.bg

3.6. Literature and Web-Links
Interview with Albena Voutsova, Director "Scientific Research", Ministry of Education and Science of Bulgaria http://www.cordis.lu/greece/ press31.htm
Strategy paper for a new national policy on Science, Technology and Innovation: Science, Technology, and Innovation in Bulgaria Strategy and Implementation
Rumiana Kotsilkova, "Cooperation of South East European Countries on Nanotehcnology, "COSNET", 1st Nanoforum Workshop Nanomaterials and Applications, October 5-7, 2003, Sinaia-Romania: http://www.nanoforum.org/events/workshop/kotsilkova2_cosent.pdf
COSENT Project website for Bulgaria http://cosent.dir.bg/
Earth and Man National Museum: http://www.clmc.bas.bg/minsoc/Mineralogical%20museums/National%20Museum%20-%20Earth%20and%20Man.htm Contact person: Assoc. Prof. Dr. M. Maleev; Tel.: (+395 2) 8656942, Fax: (+395 2) 8661455, maleev@museum.web.bg

References:

(Pop2000) Source: http://www.rferl.org/nca/features/2002/08/ 27082002142636.asp

(Expend1999) Source: http://europa.eu.int/comm/research/rtdinfo/ pdf/rtdenlarg_en.pdf

(Position2002) Source: http://forum.europa.eu.int/irc/dsis/candidate/info/data/candidatecountries/

(Interview2003) Source: An Interview with Cordis Focus, 2003, http://www.cordis.lu/greece/interviews.htm

3.7. Acknowledgements

CMP Cientifica as a Nanoforum member has written this chapter in collaboration with Ineke Malsch and Todor Donchev.

The updated version of this chapter was written with the collaboration of Prof. Dr. Ana Proykova and information supplied by Prof. Iovka Dragieva.

4. Cyprus

4.1. General information

Cyprus is the third largest island in the Mediterranean (9.251 sq. km), situated in its eastern part. It is at the crossroads between Europe, Asia and Africa and plays a bridge building role. The island's main economic activities are banking, tourism, craft exports and merchant shipping. Over the years the economy gradually developed into a modern economy, with dynamic services, industrial and agricultural sectors and advanced physical and social infrastructure.

Figure 7: Map of Cyprus

The Island of Cyprus is divided in a Greek-Cypriot and a Turkish-Cypriot part. Cyprus has 726.000 (2002) inhabitants excluding the Turkish Cypriot part. In terms of per capita income, estimated at US $17.000 for the year 2003, Cyprus is classified among the high-income countries. Nevertheless, the division of the country affects economic affairs. The Turkish Cypriot economy has less than one-half the per capita GDP of the south and remains heavily dependent on agriculture and government service.

The R&D expenditure was 15.832.000 C£ (about 28M€) in 2001 for 1.733 employees (690 full-time equivalent). The Government of Cyprus attaches great importance to Research and Technological Development (RTD), as it recognises its contribution towards the attainment of the development objectives in the fields of productivity and competitiveness. Its contribution also includes the acquirement of new knowledge and the adoption of advanced technology, across the whole spectrum of the productive process. Up until the early nineties, most of the research activities were undertaken by the public sector. Since financing of these activities was provided directly through the annual Development Budget of the Republic, there was little incentive for competition to secure the required funding.

During the last few years, however, RTD activities in Cyprus have been significantly expanding, mainly as a result of the establishment of the University of Cyprus and the increase of research activities undertaken by a number of research organisations, in the public as well as in the private sector. The establishment of the Research Promotion Foundation was also an important step towards the promotion of RTD in Cyprus.

Moreover, the participation of Cyprus in the Fifth Framework Programme for Research, Technological Development and Demonstration Activities of the European Union is considered of utmost importance. In fact, it plays a catalytic role for the expansion of research activities and enables Cypriot scientists to create networks of co-operation and interact with their European colleagues.

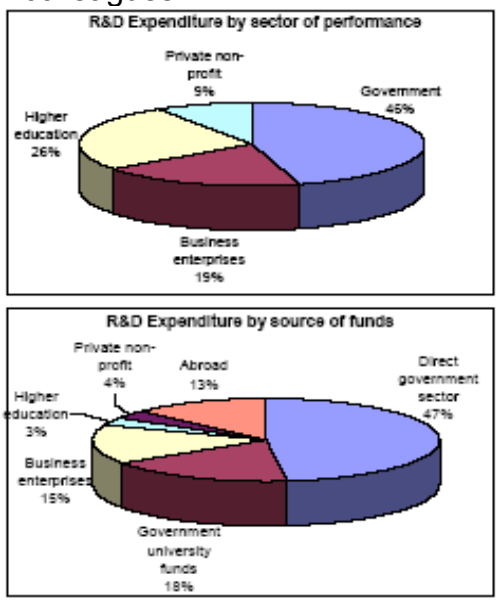


Figure 8: R&D Expenditure in Cyprus

The high level of development of Cyprus has been a significant factor in the very recent decision of the Commission of the European Communities to include Cyprus in the group of the ten countries for the first wave of enlargement to take place in 2004. But only the Greek-Cypriot part will join the EU.

Faced with this situation the Ministry of Commerce, Industry and Tourism has proposed a New **Industrial Policy** (adopted in June 1999). The New Industrial Policy, which has been adjusted to become compatible with the European Union regulations, consists of twelve chapters. The first two chapters refer to the promotion of high technology industries in Cyprus through the establishment **of incubators** and the **creation of a Center for carrying out applied research and technological development in high technology fields**. These new institutions in combination with the existing research centers like the Agricultural Research Institute, the existing research institutes of the University of Cyprus and the newly established Polytechnic School of the University of Cyprus. They will form the core of the necessary infrastructure for the promotion of the High Technology Industry of Cyprus. Both the **Incubators** and **Research and Development Centre** aim at promoting the development of new innovative products in the industrial sector and at bridging the gap between theoretical research and industry.

- The government of Cyprus plans to invest €87 000 in five incubators in 2002-2004. The government also plans to invest €204 000 in high technology development projects in start-up companies, in the two coming years. (Rolaids, 2002).

- The Research **Promotion Foundation** is responsible for co-ordinating and supporting research activities and promoting networking inside Cyprus and internationally. One of its activities is the strengthening of research infrastructure in Cyprus. Regarding the funding, it is organised through the annual programme for funding research projects, a funding programme for young researchers, a programme for pupils in research and a competition for undergraduate students. Foreign scientists can also apply for funding if they collaborate with Cypriot researchers.

So, Innovation Policy in Cyprus is in its early stages. The most important innovation activities are the Regional **Innovation Strategy Programme (RISC)**, the services offered by the Innovation **Relay Centre (Hephaestus)** and the **New Industrial Policy** (1999) including a business incubator scheme and a **Centre of Research and Technological Development**.

In Cyprus, there is no single entity responsible for the design, promotion and co-ordination of innovation policy measures. The innovation system in Cyprus is structured on **policy, intermediary** and **implementation** levels:

- At policy *level*, the Planning *Bureau* (responsible for the overall economic policy) has a central role in the design of the Cypriot RTDI strategy and in the promotion of international scientific co-operation. The *Ministry of Commerce, Industry and Tourism carries* responsibility for the promotion of high-tech companies, the reconstruction of traditional industry and for attracting foreign investment. The Technical *Committee*, an inter-departmental unit for innovation matters in Cyprus, is responsible mainly for the promotion of high-tech industry.
- At the intermediary *level*, the Research *Promotion Foundation* (RPF) communicates the RTDI strategy to the research community. The Cyprus *Institute of Technology* (CIT) aims at enhancing the competitiveness of Cypriot firms by focusing on their technological and innovation upgrade. *RTD Talos,* a private sector initiative, acts as an intermediary through its active role in the Cyprus RITTS.
- The *Cyprus Institute of Neurology and Genetics,* the *University of Cyprus*, the *Higher Technical Institute*, the State *General Laboratory*, the Agriculture *Research Institute and* the Cyprus *Productivity Centre operate* at the implementation level. Other key actors are the Intercollege, the Frederick *Institute of Technology*, the *Cyprus College the* newly established Business *Incubators* and private enterprises.

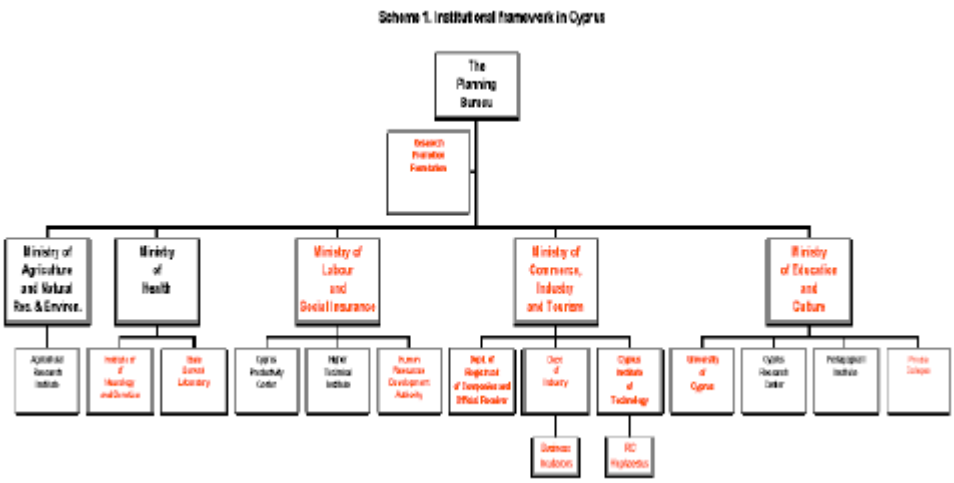


Figure 9: Institutional framework in Cyprus

In Cyprus, the funded research themes are the following:

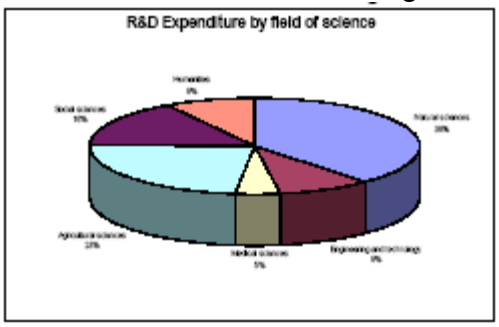


Figure 10: R&D Expediture by scientific field in Cyprus

It seems that there is no national programme dedicated to nanotechnology.

4.2. Networks

Programmes for the mobility of students, research workers and teachers

The following programmes support, mainly indirectly, mobility of research workers, students, and teachers in Cyprus:

- The "Common Programme for Scientific and Technological Co-operation" for the period 2000-2002, which is still implemented. The programme is basically financing the exchange of scientists from the two countries. HEIs, Research Centres, Enterprises and Organisations of the public and private sector, which are involved to R&D projects, were eligible to submit proposals. A call for proposals was launched in May 2000 and 27 common projects were selected for implementation. The Research *Promotion Foundation is* the Cypriot agency responsible for the implementation of this measure, while the GSRT is responsible for the Greek side.
- The connection of Cyprus with the European *Research and Academic Network QUANTUM/QMED*, the COST Programme for research co-operation in Europe, as well as the *EUREKA* programme promote researchers mobility.
- Within the framework of IAESTE (International Association for Exchange of Students for Technical Experience) Cyprus secures industrial placements abroad, for a number of Higher *Technical Institute students* during the summer vacations.

NATIONAL CONTACT POINT
NMP Thematic Programme of the EC Sixth Framework Programme (FP6)

Dr Constantinos Pitris
Organisation name: University of Cyprus, College of Engineering,
Dept. of Electrical and Computer Engineering
Address: 75 Kallipoleos Street, PO Box 20537, CY-1678 Nicosia
CYPRUS, Phone : +357-22-892297, Fax : +357-22-892254
URL: http://www.ucy.ac.cy/index.html
E-mail: cpitris@ucy.ac.cy
Programme acronym: FP6-NMP

- **Innovation Relay Centres Cyprus (IRC)**

Contact : Costas Konis
Organisation name: Cyprus Institute of Technology (CIT)
Address: P.O. Box 20783
Ionion Nison 1, 7th Floor
CY.1663 Lefkosia, CYPRUS
Phone: +357 2 813114 / Fax: +357 2 317333
E-mail: think@cy.net
Organisation URL: http://www.technology.org.cy

4.3. Universities

The largest R&D actor in Cyprus is the University of Cyprus with a total budget of 14M€ for the year 2000.

The University of Cyprus, Engineering school, Department of mechanical and manufacturing engineering, Nicosia	
Address:	Department of Mechanical and Manufacturing Engineering / University of Cyprus 75 Kallipoleos P.O. Box 20537 Nicosia 1678 CYPRUS
General Institute Contacts:	**Phone** : 22892250; Fax : 22892254 **E-mail** : engineering@ucy.ac.cy **Website** : http://www.eng.ucy.ac.cy/MME/MMEHome .htm
Description:	Research in the Department of Mechanical and Manufacturing Engineering focuses on a number of areas such as fluid mechanics and energy systems, turbulent flow, environmental engineering, biomedical engineering, machine intelligence and robotics, materials processing, mechanical systems and controls, automated design and **Micro- and Nano-technology (ex: nano-electromechanical systems)**.
Contact:	*Andreas N. Alexandrou (Interim Head)* **Phone:** +357-22892256 **Fax:** +357-22892254 **E-mail:** andalexa@ucy.ac.cy

The University of Cyprus, Faculty of Pure and Applied Sciences, Department of Physics	
Address:	Department of Physics / University of Cyprus P.O.Box 20537 1678 Nicosia CYPRUS
General Institute Contacts:	**Phone :** +357 2 892180; Fax : +357 2 339060 **Website :** http://www.ucy.ac.cy/~phyweb/
Description:	The aim of the Department of Physics is to promote research and knowledge in the area of Physics. Research is conducted in areas of both Fundamental and Applied Physics, in Theory as well as Experiment. Members of the Department take part in international research programs and collaborate with Research Centers and Universities abroad. The Department includes the following research groups: high energy physics, nuclear physics, photothermal sciences,

	ultrafast science, biophysics, condensed matter physics, strong interaction physics. Some of the research groups interests are semiconductor physics (ex: quantum **dots** and low-dimensional semiconductors, nanostructures), light-matter interactions, non-linear phenomena, ultrafast optical phenomena and devices, photothermal science (ex: **nanostructure** formation in Hydrogen films) and laser design. Example of EU projects dealing with nanotechnologies: "Fabrication Organisation and Use of Memories obtained by Focused Ion Beam" (*cf. paragraph FP6 and FP5 collaborations*)
Contact:	*Contact : Stavros Theodorakis (Chairperson)* **Phone :** +357 22 892192 **Fax :** +357 22 339060 **E-mail :** stavrost@ucy.ac.cy

The University of Cyprus, Faculty of Pure and Applied Sciences, Department of Biological Sciences	
Address:	Department of Biological Sciences / University of Cyprus P.O. Box 20537 1678 Nicosia CYPRUS
General Institute Contacts:	**Phone :** +357 22335066 ext. 30 **Fax :** +357 22334825 **Website :** http://www.ucy.ac.cy/biology
Description:	The newly established Department of Biological Sciences at the University of Cyprus aims to provide high quality training through its postgraduate program and research, in line with international trends in Biological Sciences. Research in the laboratory analyses the function of **molecular motors** in mammalian neurones, using concerted molecular cell biological approaches. In particular, work focuses on the kinesin -like superfamily of microtubule-based motor proteins. Interest in these motor proteins derives from their dynamic role in most cell biological processes: they have been implicated in biological phenomena as diverse as cell division, chemosensory transduction, early development, signal transduction pathways and axonal transport. The specific interests of the laboratory are currently pursued in 3 distinct projects : • The functional characterisation in the nervous system of several new members of the kinesin superfamily that have recently been cloned in the laboratory from hipocampal neurones. • The cloning, study of alternative gene expression and the

	functional characterisation in the nervous system of a new family of membrane-bound intracellular receptor proteins for kinesins. • The investigation of the role of motor proteins in human neurodegenerative disease. The aim is to contribute to the understanding of motor neurone disease, the elucidation of the molecular mechanism that leads to cell death, the identification of putative therapeutic targets and the design of patient molecular diagnostics. In the framework of these three projects, the laboratory has respective collaborations with the University of Dundee, the Hellenic National Research Institute, the University of Singapore, and the Cyprus Institute of Neurology and Genetics and an EU-funded network (7 laboratories in 5 European countries). This network includes the EMBL (Germany), the DKFZ (Germany), the DESY (Germany), and the University of Milano (Italy), the University of Crete (Greece) and the Biotechnology Company Diverdrugs (Spain).
Current projects:	• Identification and functional characterisation of kinesin-like motors that are expressed in the developing mammalian nervous system. • Identification and characterisation of a new family of membrane-bound intracellular receptor proteins for kinesins, the kinectin-superfamily. • Investigating the role of kinesin-like proteins in human neurodegenerative disease. Investigation of the Coiled Body by the identification and functional characterisation of Colin-interacting proteins.
Contact:	*Constantinos Deltas (Professor and Chairman of the Department)* **Phone:** +357 22335066 ext. 30 **Fax:** +357 22334825 **E-mail:** Deltas@ucy.ac.cy *Other Contact: Niovi Santama (Assistant Professor)* **Phone:** +357 22335066 ext. 30 **Fax:** +357 22334825 **E-mail:** santama@ucy.ac.cy

Diogenes	
Address:	University of Cyprus 75 Kallipoleos St., P.O. Box 20537 1678, Nicosia CYPRUS
General Institute Contacts:	**Phone:** 00357-2-892000 **Fax:** 00357-2-892100 **Website:** http://www.ucy.ac.cy/index.html
Description:	The University of Cyprus is also setting up a high technology and innovation business incubator sponsored by the Ministry of Commerce's New Industrial Policy called Diogenes. This is the first time the university has registered a limited company. The university hopes to attract innovative and high technology business adventures from around the world. The incubator offers clients a working area, access to academic services, legal and business facilities, administrative services, access to funding and sponsorship and a network of relevant contacts. The incubator will review for approval business ideas in biotechnology, automated systems, micro-technology, nano-**technology**, information systems and telecommunications.
Contact:	*Christos Schizas (Vice-Rector of International Relations, Finance and Administration of the University of Cyprus and Incubator co-ordinator)* **Phone:** + 357-22-892705 **Fax:** + 357-22-892701 **E-mail:** schizas@ucy.ac.cy **Personal Website:** http://www.cs.ucy.ac.cy/webPages/PEOPLE/faculty/Schizas/index.html

The other research institutes existing in Cyprus (such as Intercollege, Frederick Research Centre) do not seem to work on nanotechnologies. There are no "nano" activities clearly displayed.

4.4. Companies

Rosseter Holdings Limited	
Address:	4 Nikiforou Lytra P.O. Box 57220 3310 Limassol CYPRUS
General Contacts:	**Phone:** +357 255 91600 **Fax:** +357 255 91888 **Mobile phone:** +357 994 60171 **E-mail:** contact@e-nanoscience.com **Website:** http://www.e-nanoscience.com/
Description:	Rosseter Holdings Limited is a company that specialises in large-scale production of carbon nanotubes (SWNTs and MWNTs) and related materials (nanohorns, onions.). Rosseter holdings Limited was established in 1998 by Mrs M. Xenophontos-Ioannou and Dr. Vladislav Ryzhkov and has now 5 employees. The technology is based on the decomposition of hydrocarbons driven by a low-voltage contact auto-regulated arc-discharge in aromatic-based hydrocarbon liquids. It permits the production of nanotube deposits with yields of 2-3 g/min per pair of electrodes with a very low specific consumption of electric energy of 20-100 kW-hour per 1 kg of deposit produced. Current production is 100-200 g/day and the price is around 20-25 US$/g. Modifying the regimes allows Rosseter to change composition of the deposits dramatically. At the moment the company has mainly developed 5 different raw carbon nanoproducts. R&D activities are focused on methods and innovative processes of production as well as the development of the product for use in certain applications like electron emission, hydrogen absorption, nanocomposites, electronic devices, fuel Cells, etc. For example, Rosseter has set up a partnership with an unnamed Taiwanese company for the manufacture of carbon nanotubes for use in flat panel displays and lithium batteries. The firm has received $1.3 million in investments since the founding in 1998, of this, $700,000 came from Rosseter employees. And, although specific sales figures are unknown, Rosseter did sell 700 grams of carbon nanotubes in 2001 at $20 per gram, which indicates minimum revenue of $14,000. In addition to selling nanotubes and licensing, Rosseter would like to co-develop products that incorporate nanotubes. The company expects to go public in Europe by the year 2006.
Contact:	• *Dr. David Tománek, Chairman* (tomanek@e-nanoscience.com). Tomanek has written more than 150

	publications in scientific journals and holds several patents related to nanotechnology. • *Maria Xenophontos-Ioannou, Managing Director and founder of the company* (xemaria@e-nanoscience.com) • *Dr Vladislav A.Ryzhkov, Research and Development Director* (slava@e-nanoscience.com) • *Tony Antoniou, Senior Vice President Operations Europe* (Antonis@e-nanoscience.com)
Latest news:	See the list of literature and weblinks at the end of this chapter.

RTD Talos Ltd	
Address:	Another private company not dedicated specifically to nanotechnologies but important to mention is RTD Talos Ltd. Address: not found
General Contacts:	**Phone:** +357 22 451 455 **Fax:** +357 22 451 458 **E-Mail:** talos@talos-rtd.com **Website:** http://www.talos-rtd.com/ngcontent.cfm?aid=116
Description:	The Development Organisation Talos was established in September 2000 as a private limited company. Tales strategically placed itself between industry, academia, financial institutions and public authorities with the core mission of supporting the development of Smells in Cyprus. Talos hosts the National Contact Point for SMEs for the 6th Framework Programme and is the scientific co-ordinator of the Regional Innovation Strategy (RIS) project for Cyprus. Talos provides its clients information, technical support, counselling and training services in R&D, assessment & transfer technology, innovation management, start-up creation and innovation financing. Its services are the following : • Technology Brokerage (Advisory services on innovation and technology transfer issues, representation of companies in technology transfer meetings, follow-up of technological developments and promotion to the customer of technologies and research results that are in its scope of interest) • Partners search (Identification of suitable partners for joint ventures, research and technological co-operations) • Support in the submission of proposals (Development of proposals for government schemes or European Programs in economic and technological development and management of their implementation) • Studies - Project Management **(**Feasibility Studies, Business Plans, Project Management, Start-Up Support)

	• Industrial Research (Applied industrial research) • Training (Organisation of training programs on subjects that concern the exploitation of European programs as well as specialised technological subjects) • Information Brokerage (Collection, evaluation, analysis and benefit of information to the customers relative to the legislation, the policy, the programs and the initiatives of European Union) • Electronic Information. Alert Systems (Structured information and alert systems with exploitation of modern technologies of information technology and telecommunications) • Publications (Publications relative to European subjects) Its main customers are the European Commission, institutes of higher education, consultants and industrial companies. TALOS is a member of "Innovating Regions of Europe", SME NCP Network, Lefkosia Chamber of Commerce & Industry and Cyprus Institute of Technology. It also participates in the ERMIS Research & Incubator Center (ERIC). The ERIC was founded in February 2003 aiming the establishment of a centre of support for new enterprises (start-ups). The initiative belongs to the four co-founders of the Incubator : Cyprus College, TALOS Development Organisation, Scientific and Technological Park of Crete and Spidernet (an internet company).
Contacts:	*Dr. Alexandros Michaelides, General Director* Phone: +357 22 451 455 Fax: +357 22 451 458 Email: am@talos-rtd.com *Elias Kouloumis, EU Programmes Co-ordinator* e-mail: ek@talos-rtd.com *Christina Naziri, Project Manager -TENDINFO Co-ordinator* e-mail: cn@talos-rtd.com *Georgios Charalampous, Industrial Research Consultant* e-mail: talos@talos-rtd.com

4.5. FP5 and FP6 collaborations

Within the 5th **framework**, the University of Cyprus has one project dealing with nanotechnologies, "*FORUM FIB: fabrication organisation and use of memories obtained by focused ion beam"*
Project Reference: IST-2000-29573
Organisation: University of Cyprus/Faculty of Pure and Applied Sciences/Department of Physics/Photonic and Optoelectronics research laboratory.
Starting date: 2001-07-01, Ending date: 2004-06-30.
Abstract: The objectives of the project are to develop and assess the potential for FIB nano-patterning for the microelectronics requirements in the sub 10 nm domain and to demonstrate new generation of nano-crystals memories with potential mass fabrication and full compatibility with CMOS technology.
Other partners: Centre de Recherche sur les Mécanismes de la Croissance Cristalline, Laboratoire de Physique de la Matière, Institut für Schicht und Ionentechnik, Institute of Microelectronics, ST Microelectronics, Philips Electron Optics, Universita Tor Vergata Roma.

For FP5, we can also mention the project "***eFORESEE***" (Exchange of Foresight Relevant Experiences for Small European and Enlargement Countries (start date January 2002):

> eFORESEE is a two-year EU funded project aimed at anticipating and responding to the needs of policy makers, involved in the formulation and implementation of foresight activities in EU15+ smaller economies and regions. It will define and highlight the strategic role of foresight in the accession process, and in the integration of accession states into a European Research Area. eFORESEE will address decision-making processes involved in setting up foresight activities, as well as the challenge of managing and implementing specific foresight actions. It will look at the Knowledge Management needs of foresight and explore the possibility of applying benchmarking techniques to improve the efficiency of foresight over time. The project will carry out six pilot foresight actions in three countries: Malta, Cyprus and Estonia. It will focus its effort on the following domains: Nanotechnology and material sciences, environmental sciences, biotechnologies in agriculture, aquaculture and medicine, as well as tourism and cultural heritage.

For **FP6**, Cyprus has 4 EoI dealing with nanotechnologies, 3 integrated projects and 1 network of excellence:

- **IP "3-D NANOCONTROL** : a novel synthesis method for the production of tailor-sized nano-structures"
  The consortium is composed of 17 academic and private European research centers and 10 industrial research centers from 13 European countries. Organisation: Nanomaterials Research Center / Department of Mechanical and Marine Engineering / Higher Technical Institute / Nicosia Contact person: Dr. Angastiniotis Nicos (phone: +357-22-406384, E-mail: nano@spidernet .com.cy)

Abstract: The invention relates to the formation of amorphous metal powders and, in addition, relates to a method of producing amorphous refractory metals and their alloys with chromium, iron, copper, cobalt and nickel and, further, to the use of these powders to form refractory metal compounds of nanocrystalline grain size. In addition to being useful for the formation of silicides, carbides and nitrides and other refractory composition, the invention is also useful in the elemental form to provide amorphous and tailor-sized nano-grained coatings and the like. They can also be blended with compositions for alloying and used in any application in which elemental metal is employed.

The research approach entails 4 processing steps:

- Spray drying of chemically homogeneous precursors with compositional constituents mixed at an atomic level,
- Fluid bed thermochemical conversion of the precursors powders and subsequent if needed compositional enrichment for the realisation of tailor-sized nanostructures phases,
- Development of nanostructured coating application parameters based both on simulation of the interaction between particles and thermal source and deposition with different thermal spraying technologies by varying process parameters in a systematic way,
- Fabrications of dense nanostructured net-shaped components at exceptionally low temperatures

These steps will lay the foundations of a new manufacturing technology for the large-scale production and utilisation of nanostructured particulate materials. The primary application fields that will be targeted are thermal-barrier coatings for high temperature applications (e.g. turbine engines), hard coatings for prolonging the life of tools or machine components (e.g. valve stems, shafts, wire spools) subjected to severe working conditions and high-density net-shaped parts with high electrical and thermal conductivity.

- **IP "Enhanced CNTs: carbon nanotubule enhancement for commercial battery production"**
  Organisation: Rosseter Holdings Ltd
  Contact person: Mrs Xenophontos Ioannou Maria (Phone: +35725 591888, E-mail: xemaria@e-nanoscience.com)
  Other participant: Duracell
  Abstract: The use of graphite in commercial battery production is well established playing a role as a conductive element or more recently as a structure for the intercalation of both positive and negative species.
  Nanotubules open the possibility of their use in both conductive and intercalative roles. A cost-effective treatment that enhances the metallic character of nanotubules mixture would be of benefit in the production of Alkali and MnO2/Li cells. Whereas a method of enhancing either the p or n semiconductive character of mixtures would provide a useful feedstock for self-assembly onto microcircuits to form optical displays and arrays of transistors etc. It is proposed

to explore chemical methods of matrix modification using both chiral and self-assembling molecules to preferentially modify the electronic nature of the nanotubule.

- **IP "NANOPOL: nanostructured polymer composites for advanced materials and optoelectronic components"**
  The consortium is composed of 16 academic and private research centers and industrial research centers (among which Rosseter Holdings Ltd).
  Organisation: High Technical Institute
  Contact person: Dr. Kalli Kyriacos (Phone: 35722406537, E-mail: kkalli@cytanet.com.cy)
  Abstract: Design and manufacture of polymer matrices having enhanced physical and electrical properties, through the introduction of nano-materials directly into the polymer. The process will be combined with advanced conjugated polymer design for the preparation of fully functional and nano-structured polymer composites. Techniques for the preferential orientation of nano-structures within the polymer matrix will offer a composite matrix having high levels of homogeneity for improved mechanical, electrical and thermal material properties. Finally, we will design and fabricate new polymer-based opt-electronic devices in order to develop advanced polymer-based photogenic technology platforms, characterised by low loss, long-term thermal and mechanical stability, and novel electrical properties.

- **NoE "Rosseter Nanotubes: Development of new low cost carbone nanotube materials"**
  Organisation: Rosseter Holdings Ltd
  Contact person: Mrs Xenophontos Ioannou Maria (Phone: +35725 591888, E-mail: xemaria@e-nanoscience.com)
  Abstract: The ever-growing need for super strong, super efficient, environmentally friendly materials makes carbon nanotubes the most sought after material today. The impact of carbon nanotubes on efforts to save energy, combat global warming and protect the environment will be significant.
  Rosseter Holdings Ltd with the development of a proprietary technology based on the decomposition of hydrocarbon liquids (PCT/IB00/00406 published in October 2000) is already a producer of five different raw carbon nanoproducts. Our research will focus on further improving our methods and devices in order to develop low cost, novel, functional and structural materials of high purity and superior performance by controlling and categorising their nanostructures.

Search for partners:

- The University of Cyprus looks for partners on applications of nanotubes as flow sensors and nanogenerators in biomedical and aerospace applications (7/3/2003).
- Rosseter Holdings wants to develop carbon nanotube materials (9/8/2002) and looks for end-users of smart materials to join the network of excellence "Rosseter nanotubes".

4.6. Literature and web-links
Cyprus Government Web-site http://www.pio.gov.cy/
Cyprus Institute of Technology (Cyprus Innovation Relay Center) Address: Ionion Nison 1, 2006 Nicosia, CYPRUS or P.O.Box 20783, 1663 Nicosia, CYPRUS Phone: +357-22-317288; Fax +357-22-318087 http://www.technology.org.cy/index1-eg.html
Cyprus Research Centre http://www.mfa.gov.cy/mfa/mfa.nsf/mfa?OpenForm
The Research Promotion Foundation http://www.research.org.cy/english.html
University of Cyprus http://www.ucy.ac.cy/index.html
Rosseter Holdings Limited http://www.e-nanoscience.com/
Development Organisation TALOS http://www.talos-rtd.com/ngcontent.cfm?a_id=116
European Commission / Enterprise Directorate-General / Innovation-SMEs Programme, "European Trend Chart on Innovation, Country Report: Cyprus" http://trendchart.cordis.lu/Reports/Documents/Cyprus_CR_September_2002.pdf
Consultancy Unit-Intercollege, ADE, .Innovation policy in six candidate countries: the challenges; Innovation Policy Profile: Cyprus., Final version, September 2001 ftp://ftp.cordis.lu/pub/innovationpolicy/studies/studies_six_candidate_countries_cyprus_2001.pdf
Oger, Genevieve (2002): "Totally tubular Rosseter tries to take miracle molecule to next level", in Small Times 2 December 2002 www.smalltimes.com/print_doc.cfm?doc_id=5126
Rolandis, Nicos (2002): Speech by the minister of Commerce, Industry and Tourism Mr. Nicos A. Rolandis at the State University of New York on the issue: "Cyprus: recent developments in science and technology and opportunities for the future", 21.10.2002 www.pio.gov.cy/news/special_issues/special_issue104.htm
Cyprus Mail : News Articles in English, 03-04-08 "University sets up new incubator with aim of luring hi-tech projects" http://www.hri.org/news/cyprus/cmnews/2003/03-04-08.cmnews.html
6th May 2002 - nine-MSN "Scientists focus on small technology" http://www.e-nanoscience.com/06050nmsn.html
30th April 2002 - Le Monde "La nanotechnologie: à l'aube d'une nouvelle révolution industrielle" http://www.e-nanoscience.com/300402lm.html
2nd April 2002 - Flight International "Carbon offers added mettle" http://www.e-nanoscience.com/020402fi.html
29th March 2002 - The Engineer "Nanotubes set for market rollout" by Rob Coppinger http://www.e-nanoscience.com/290302te.html
6th March 2002 - Nano Investor News "Rosseter Holdings Appoints Pioneer in Quantum Phenomena as Board Chairman" by Anthony Kennaway

http://www.e-nanoscience.com/060302nin.html
6th March 2002 - Small Times "Brief: Professor to lead Rosseter's board" http://www.e-nanoscience.com/060302st.html
12th February 2002 - Small Times by Jayne Fried http://www.e-nanoscience.com/120202st.html
14th December 2001 - Small Times "Companies in hot pursuit of secret to mass-producing supermolecule" by Candace Stuart http://www.e-nanoscience.com/141201st.html
20th November 2001 - Nano Investor News "Rosseter Holdings Announces a Technological Breakthrough to Become the World's First Commercial Producer of Nanotubes" by Anthony Kennaway http://www.e-nanoscience.com/201101nin.html
19th November 2001 - Fuel Cell Today "Carbon Nanotubes Now on Open Sale; Could Lead to New Hydrogen Storage Technologies" by Mark Cropper http://www.e-nanoscience.com/191101fct.html
17th October 2001 - Nano Tech News "Foreign Makers to Launch Carbon Nanotube Businesses in Succession. by Jonathan Després" http://www.e-nanoscience.com/171001ntn.html
4th October 2001 - Financial Times "Inside Track: Cutting the cost of nanotubes TECHNOLOGY WORTH WATCHING" by Fiona Harvey http://www.e-nanoscience.com/041001ftc.html

4.7. Acknowledgements

Sandrine Locatelli and Carole Nicollet have written this Chapter.

5. The Czech Republic

5.1. General information

Since 1989, the Czech Republic has been busy reforming the organisation of its state structure. It is a country with about 10 million inhabitants. In 2000, the Gross expenditure for R&D was 1.35% of its GDP, including 0.59% by the state. The R&D policy is one of the areas affected by the change, towards a system of grants and public tenders. The Ministry for Education, Youth and Sports is the ministry with responsibility for research, but also other departments fund research. The Research and Development Council of the government is another key player shaping the R&D system. There are five national grant agencies, which fund research. Traditionally, the institutes of the Academy of Sciences of the Czech Republic AS CR carry out the research, and the universities are more responsible for higher education. As part of the change, university departments are now more involved in research. Source: www.czechrtd.info - this web site provides a "gateway" to the Czech RTD landscape, providing useful information and relevant links.

Figure 11: Map of the Czech Republic
(Source: http://forum.europa.eu.int/irc/dsis/candidate/info/data/candidate countries/)

In an attempt to effectively reorganise financing of oriented / targeted research (as opposed to the fundamental research) the Czech Government adopted a strategic policy document, National Research and Development Policy, on the basis of which the first technology Foresight exercise was launched in 2000. The Ministry of Education, Youth and Sports of the Czech Republic represented the Government as the ordering party (the sponsor). The Technology Centre AS CR was the project co-ordinator, co-operating with the Engineering Academy of the CR. The main objective of the project was to identify key research direction (priorities) having the potential of both boosting

Czech economy and increasing the welfare of its citizens. Also supporting crosscutting measures were to be recommended. A separate task of the exercise was to propose a scheme for the implementation and management of a new National Research Programme (NRP). A basic condition for the whole exercise consisted in the assumption that the project results are to be arrived at under the consensus of a broad spectrum of stakeholders. Hundreds of top scientists, engineers, industrial managers, managers of medical institutions, entrepreneurs and representatives of professional organisations and industrial unions participated. Their work resulted in a proposal of a National Research Programme (NRP). A scheme of its implementation and management was also proposed as a project outcome. The Czech government discussed it on 22 May 2002, and asked the competent government bodies to come up with an amended proposal for a National Research Programme, taking into account also the new Research and Development Act of 1 July 2002. The government intends to decide on the new NRP by 31 March 2003, to become effective in 2004. However, due to inter-governmental discussions the final approval was postponed - to April 2003.
The foresight exercise recommended to include nanotechnologies and nanomaterials research in the emerging technologies sub-programme of the Thematic programme on "Competitiveness and Sustainable Development". This is one of the five thematic programmes and three cross cutting programmes. The project outcome was the result of the work of fourteen thematic, three cross cutting and one systematic panel. Five of the thematic panels mentioned nanotechnologies among the expected trends or key research directions. The thematic panel Health Care ranked technological aspects of research in medicine including nanotechnologies second in the list of key research directions. The thematic panel on Pharmaceutics included nanotechnologies in the strategic trend of development of new technologies applicable in pharmaceutics, but did not explicitly include it in the key research directions. The thematic panel on Materials and Technologies of Their Production foresaw a strengthening of the concentration on nanomaterials and nanotechnologies and other advanced materials. They ranked nanotechnologies and nanomaterials first among the key research directions. The thematic panel on Instruments and Devices foresaw a trend in instruments and equipment for the creation and examination of micro- and nanostructures. They included instruments to create micro- and nanostructures and nanolayers in the two top key research directions. The thematic panel on Chemical Products and Processes ranked nanotechnologies fifth in the key research priorities.
Seven of the thematic panels identified strategic key technologies through which the Czech Republic might establish itself in the international market. For the Pharmaceutics panel, nanotechnologies are such a key technology, in particular "the preparation and characterisation of new substances and gene therapy methods resulting from gene engineering methods" (p. 27 of the brochure available on www.foresight.cz in "Publications"). The materials panel spotted "nanotechnologies aimed at controlling material structure (both organic and inorganic) in nanodimensions and utilising completely new phenomena in electronics, chemistry, medicine and pharmaceutics, power engineering, mechanical engineering, etc". (p. 28) And the Chemical Products and Processes panel included "nanotechnologies - synthesis of thin organic layers (material protection, medicinal compatibility, membranes, composites), preparation of new skeletons of polymers (supramolecular chemistry). Application areas - external

polymer parts of the automobile body, coatings barrier packaging, cosmetics, waste water treatment, catalysts, abrasion resistant coating of machine parts, next generation lubricants, plasma coating of very thin compact layers, nanosensors for implantation in the human body. They also include self-disinfecting sanitary ceramics, parts of computers of a new generation, electroceramics, and new types of solar cells and batteries. They also include new materials for microelectronics and optics, biocatalysts and membranes for medicine". (p. 28) Source: www.foresight.cz.

According to Dr. Jitka Kubatova of the Technology Centre, basic nanoscience research in the Czech Republic focuses on: "nanoparticles, nanocrystals, nano coatings, nanolayers, nanostructures, quantum dots, biomaterials, nanocomposites and nanodiagnostics." Applied research and applications are in: "micro and opto electronics, holography, electron microscopy, electron lithography, biomaterials, sensors and coatings." (Presentation at European Research conference, Brussels, 11 November 2002, http://www.airi.it /minatech/atti/brus021111/progbru.htm)

NATIONAL CONTACT POINT
NMP Thematic Programme of the EC Sixth Framework Programme (FP6)

Ms Jitka Kubatova
Organisation name: Technology Centre AS CR
Address: Rozvojova street 135, CZ-16502, Prague 6, CZECH REPUBLIC,
Tel: +420-2-20390728, Fax: +420-2-20922698
URL: http://www.tc.cz
E-mail: kubatova@tc.cas.cz
Programme acronym: FP6-NMP

5.2. National programmes and projects

In the mean time, the Czech national nanotechnology research community is busying self-organising. The Czech Society for New Materials started a Nanoscience and Nanotechnology section (June 2002). Beginning of 2003, the section already had more than 100 members. According to Chairman Dr. Tasilo Prnka, they installed eight committees, focusing on:

- "Political dimensions of the nanoscience and nanotechnology
- Education and training on selected universities and colleges; terminology
- National research program
- International co-operation
- Organisation of conferences and other events
- Public relation
- Membership basis development
- Technology transfer support "

The participants at the Nano '02 conference in Brno laid the basis for a national research agenda (19-21 November 2002). The aims of this conference were to map the existing scientific and research activities in the Czech Republic in nanotechnologies and nanomaterials; to stimulate researchers to meet and develop new collaborative projects; to inform researchers about orientation and results of national and international nanotechnology research and co-operation. Participants presented 62 papers and 25 posters.

The main themes were an overview of nanotechnology in the research institutes of the Academy of Sciences and in Universities, properties of nanocrystalline materials; characterisation and properties modelling of nanomaterials, properties of nanomaterials; and nanomaterials and nanotechnologies in bio-applications. (Švejcar and Šandera, 2002).

5.3. The research institutes and their expertise

The institute of physics of materials IPM of AS CR, Brno	
Address:	Zizkova 22 CZ-61662 BRNO, Czech Republic
General Contacts:	**Phone:** +420-541212286 **Fax:** +420-541212301 **E-mail:** secretar@ipm.cz www.ipm.cz
Description:	The focus of nanoresearch is the relation between structure and properties of selected nanomaterials. The expertise is on mechanical behaviour and microstructural analysis of metallic materials. The institute produces metallic nanopowders, and is involved in precision engineering projects such as nanoindentation, creep behaviour, fatigue tests and properties of nanocomposites. The IPM has altogether 110 employees. 32 of them are scientists (PhD degree or equivalent), about 30 of them are technicians with university education and the rest are technicians and auxiliary personnel. The infrastructure and equipment includes instruments for creep and fatigue, tensile strength, fracture mechanical, hardness testing, light, electron microscopes and X-ray equipment, spectrometers, electrical and magnetic measurement and heat treatment. Part of this information is available also at www.ipm.cz. There are more than 50 running projects funded by different grant agencies. (Sources: Petr Luká. and Václav Sklenièka, in Švejcar and Šandera, 2002, p 16, and Petr Lukas)
Contact:	Professor Petr Lukas: lukas@ipm.cz

The institute of macromolecular chemistry IMC of AS CR, Prague	
Address:	Heyrovski sq. 2 16206 Prague Czech Republic
General Contacts:	www.imc.cas.cz
Description:	The institute specialises in inorganic-organic nanocomposite materials preparation and characterisation, nanotechnology for electronics and nanobiotechnology. Research methods include optical, X-ray and neutron scattering, AFM and EEM, and FTIR spectroscopy. The institute is also an EC Marie Curie Training site in organised polymer nanostructures for application in biology and technology, until 31 December 2003. http://www.imc.cas.cz/en/imc/mcts/index.htm (Eduard Brynda, in Švejcar and Šandera, 2002, p 17)
Contact:	Professor Eduard Brynda, brynda@imc.cas.cz

The Institute of Scientific Instruments ISI in AS CR, Brno	
Address:	Královopolská 147 612 64 Brno Czech Rep.
General Contacts:	**Phone:** +4205 4151 4256 **Fax:** +4205 4151 4404 http://info.isibrno.cz
Description:	The institute specialises in Nuclear Magnetic Resonance, Electron Microscopy and Coherent Optics. They engage in five nanoactivities: Optical trapping of nanoparticles, nanometrology through interferometry, Scanning Electron Microscopy, E-beam lithography and using nanocomposite coatings as lubricants. (Jaroslav Sobota, in Švejcar and Šandera, 2002, p 18)
Contact:	Professor Jaroslav Sobota, Sobota@ISIBrno.Cz

The institute of Physics AS CR, Prague	
Address:	Na Slovance 2 18221 Prague Czech Rep.
General Contacts:	www.fzu.cz
Description:	Nanoresearch is part of research plan A on Experimental and Theoretical Research into Condensed Systems with Pronounced Physical Properties. This is one of three five-year plans of research in the institute. The institute uses an UHV-Variable Temperature STM to study silicon and GaAs on silicon surfaces, specialising in fundamental nanoelectronics. Professor Karel Kral: "I do theoretical research in zero dimensional nanostructures - quantum dots, with some emphasis put on nonequilibrium transport properties, optical properties and electronic relaxation in quantum dots and quantum dot aggregates. The application potential of my present work may be quantum dot lasers, infrared photodetectors and future realisations of quantum computation elements." (Jan Kocka, in Švejcar and Šandera, 2002, p 19, Karel Kral)
Contact:	Professor Karel Kral, kral@fzu.cz

The Institute of Inorganic Chemistry, AS CR, Rez	
Address:	V Holesovickách 41 180 00 Prague Czech Rep.
General Contacts:	**Phone:** +420 266 00 93 31 **Fax:** +420 266 00 93 31 http://www.iic.cas.cz/nano.htm

Description:	The research focuses on synthesis and characterisation of photocatalysts for environmental applications; lamellar sandwich type pigments based on mica coated with metal oxide layers; and nanocomposites based on metal oxide or metal sulphide nanoparticles in a SiO2 matrix. (Jan Subrt, in Švejcar and Šandera, 2002, p 22).
Contact:	Professor Jan Subrt: subrt@iic.cas.cz

Institute of Chemical Technology, Prague	
Address:	Technická 5 CZ-16628 Praha 6, Czech Rep.
General Contacts:	**Tel:** +420 224 355149, **Fax:** +420 224 310 337, www.vscht.cz
Description:	The institute of Chemical Technology consists of four faculties: Chemical Technology, Environmental Technology, Food Technology and Chemical Engineering. The Institute specialises in Higher education in Chemical technology, and has 3000 students. 370 academic staff members engage in teaching as well as R&D. Nanotechnology related activities: The Department of Solid State Engineering in the Faculty of Chemical Technology specialises in materials for electronics, and other R&D on new materials and materials science. They use a range of equipment for thin film deposition and studies of materials properties, mainly electronic and magnetic properties. The Czech Grant Agency and the Development fund of Universities fund the research. The department has 10 staff members. Their nanotechnology related activities include thin film deposition on materials surfaces.
Contact:	Department head Prof. Vaclav Svorcik, vaclav.svorcik@vscht.cz

Czech Metrological Institute, Brno	
Address:	Okružní 31, 638 00 Brno Czech Rep.
General Contacts:	**Phone:** (+420) 545 223 727 **Fax:** (+420) 545 222 183 **General homepage:** http://www.cmi.cz/
Description:	The Czech Metrological Institute is the national measurements institute. The institute engages in new national standardisation activities, international collaboration and certified measurements and testing. They have 291 staff members working in four divisions. These are the Laboratories of Fundamental Metrology in Prague, Branch Inspectorate Prague, Branch Inspectorate Brno and Inspectorate for Ionizing Radiation in Prague.

Nanotechnology related activities:	The institute can precisely measure dimensions in the micro and nanorange, and offers metrological services. The institute's equipment includes Atomic Force Microscopy, which is available for customers. CMI has an Accurex II.L AFM from TopoMetrix. They offer measurements of surface topography, point spectroscopy, magnetic properties and heat-carrying capacity, temperature and thermal capacity. The institute also collaborates in an international project for nanotechnology length and roughness measurements.
Contact:	AFM page: http://www.cmi.cz/index.php?act=49&lang=2 Contact person: pklapetek@cmi.cz

Inst. of Molecular Genetics, Czech Academy of Sciences, Prague	
Address:	Flemingovo n. 2, Prague 6, CZ-16637, Czech Republic
General Contacts:	**Phone:** +420 +2 24310234 **Fax:** +420 +2 24310955 **Website:** http://zeus.img.cas.cz/
Description:	The Institute of Molecular Genetics specialises in all modern methods of molecular genetics and cell biology. The institute is subdivided in 20 research groups. The institute covers some studies of nanotechnology using biological materials.
Contact:	deputy director professor Vladimir Viklicky: viklicky@biomed.cas.cz

Center for research and application of coatings increasing lifetime and reliability of machine elements, Czech Technical University, Prague, Faculty of Mechanical Engineering, Dept. of Applied Physics	
Address:	Faculty of Mechanical Engineering, Technicka 4 166 07 Praha 6 Czech Republic
General Contacts:	**Phone:** +420 605532907, +420 224352431 **Fax:** +420 224352439 Website: in Czech only, the English version is under reconstruction
Description:	Deposition of micro- and nanostructured coatings, composition and structure of nanocrystalline, nanocomposite and superlattice coatings with increased wear resistance, high microhardness, low friction coefficient (CoCr, CoCrN, Ti/TiN, TiCN etc.). Composition and structure of selflubricating coatings (MoS_2/M, MoSe2/M, WCo-C). Deposition method: sputtering with unbalanced magnetrons with d.c. or pulsed d.c. Supply incl. magnetrons in the

	closed field array. High temperature tribology of nanostructured coatings: Measurements of the temperature dependence of friction coefficient, wear etc. up to 800 °C. High temperature microindentation up to 1000 °C (collaboration with the Dept. of Structural Mechanics, Faculty of Civil engineering, CTU in Prague).
Contact:	Doc.RNDr.Ing. Rudolf Novák, DrSc. e-mail : novakr@fsid.cvut.cz

5.4. Universities

Faculty of Science, Charles University Prague	
Address:	Albertov 6, 128 43 Praha 2, Czech Republic
General Contacts:	**Phone:** +420-221951111 http://www.natur.cuni.cz/english_version/index.php
Description:	The Faculty of Science of Charles University in Prague consists of sections in biology, chemistry, geography and geology, and an institute of environmental science. Three research groups in chemistry deal with nanotechnology. (Source: Jehlicka, et al in Švejcar and Šandera, 2002, p 20)
Contact:	micka@natur.cuni.cz
The institute of Geochemistry	
Website:	http://prfdec.natur.cuni.cz/~ugmnz/index1.html
Description:	The institute of Geochemistry looks for naturally occurring fullerenes.
Department of Inorganic Chemistry	
Website:	http://www.natur.cuni.cz/~stepnic/
Description:	Researchers at the Department of Inorganic Chemistry deal with magnetic and opto-electronic nanocomposites.
Department of physical and macromolecular chemistry	
Website:	http://prfdec.natur.cuni.cz/pmc/
Description:	Researchers at the department of physical and macromolecular chemistry study self-assembly of copolymers, for applications in drug delivery and gene therapy; on molecule mediated assembly of silver and gold nanoparticles; and on nanocatalysts.

Faculty Mathematics and Physics, Charles University Prague	
Address:	Ke Karlovu 3, Prague 2, CZ-12116, Czech Republic
Department of Chemical Physics and Optics,	
General Contacts:	Doc. RNDr. Pavla Čapková, DrSc. Phone: +420-221911245 e-mail: capkova@karlov.mff.cuni.cz
Description:	The department specialises in molecular mechanics and molecular dynamics simulations in structure analysis of partially disordered crystal structures and supramolecular systems.

	The strategy of molecular simulations is based on experiments: x-ray and synchrotron diffraction, vibration spectroscopy, etc. Further, the problems solved using molecular simulations include: Structure and properties of intercalates (layered structures of silicates, phosphates, sulfates and graphite intercalated with organic and inorganic guest species), development of polymer-clay nanocomposites structure and properties of liquid crystalline polymers decomposition of energetic molecules structure and properties of biological membranes.

Institute of Condensed Matter Physics, Masaryk University, Brno	
Address:	Institute of Condensed Matter Physics Kotlarska 2, CZ-611 37 Brno, Czech Republic
General Contacts:	**Fax**: +420 541 211 214 **Phone** to the secretariat: +420 541 129 439 http://www.physics.muni.cz/kfpf/LTFN/index.html
Description:	The institute engages in several research-programmes in electronic and structural properties of self-organised semiconductor nanostructures. (Vaclav Holy and Josef Humlicek, in Švejcar and Šandera, 2002, p 21), It has an associated laboratory of thin films and nanostructures. This laboratory includes an X-ray group and an optics group.
Contact:	Prof. Josef Humlicek: humlicek@physics.muni.cz

The Faculty of Mechanical Engineering, University of West Bohemia, Plzen	
Address:	University of West Bohemia Univerzitni 8 306 14 Pilsen Czech Republic
General Contacts:	http://www.zcu.cz/index-en.html
Description:	The university of West Bohemia consists of seven faculties, a New Technologies Research Centre and, an institute of Interdisciplinary Studies and an Institute of Lifelong Education. The university offers education as well as fundamental and applied research. It is closely collaborating with local Institutes of the Czech Academy of Sciences. This is unique in the Czech Republic. Some nanotechnology related activities are carried out at the Faculty of Mechanical Engineering. This research focuses on deposition of thin films and methods of evaluation in surface engineering. An English overview of this department can be found on http://rko.zcu.cz/leon/detail_depart.php3?id=31 (See also Ivo Stepanek and Jaroslav Koutsky, in Švejcar and Šandera, 2002, p 23).

Contact:	Head of department Prof. Jaroslav Koutsky: koutsky@kmm.zcu.cz

The Institute of Physical Biology, University of South Bohemia, Nové Hrady	
Address:	Zamek 136, CZ-37333 Nové Hrady Czech Republic
General Contacts:	**Phone:** +420 386361259, **Fax:** +420 386 361219. www.greentech.cz
Description:	The institute aims to study biological objects by physical means. The institute educates students and engages in development, fabrication and application of physical biology and biotechnology. Research topics include photosynthesis and biomembranes. Applications include biomedicine, agriculture and biotechnology.
Contact:	Dr Dalibor Stys, stys@jcu.cz

Brno University of Technology, Brno	
Address:	Purkyòova 118, CZ 61200 Brno Czech Republic
General Contacts:	**Phone:** +420 541141111, **Fax:** +420 541 211697. www.vutbr.cz
Description:	There are several activities at the University in the area of nanomaterials and nanotechnologies. The university is interested in nanotechnology and nanomaterials research and even transfer of the technology to industry via their technology incubator.
Department of Physical Engineering	
Description:	Department of Physical Engineering has considerable efforts in the ultra thin layers on solid surfaces for microelectronic application (including quantum dots etc.).
Contact person:	Professor Liska, Department Head
Institute of Materials Science, Faculty of Mechanical Engineering	
Contact person:	Professor Cihlar, cihlar@ro.vutbr.cz
Description:	At this faculty, considerable effort exists in synthesis of Nanosize ceramic particles (HAP, ZrO2, Al2O3, etc.) for use in advanced bioceramics and other high-tech applications.
Institute of Materials Chemistry	
Contact persons	Assoc. Prof. Cech cech@fch.vutbr.cz, Prof. Dr. Josef Cancer jancar@fch.vutbr.cz www.fch.vutbr.cz

Description:	There are two nonmaterial and nanotechnology research groups in the Institute of Materials Chemistry. First is led by Assoc. Prof. Czech in the area of cold plasma deposition of nanosize organic layers on glassy substrates. The second is headed by Prof. Josef Jancar and focuses on synthesis of long chain intercalation agents, in the mechanics of nanocomposites and in preparation of nanocomposites with controlled life. In other words, this group works on systems where controlled degradation of polymeric matrix can be engineered to suit the actual application (biomedical bone adhesive, fertilizer-controlled release, disposable protective cloth, etc.). They are also involved in program on synthesis of complicated molecular nanostructures (biomedical devices, etc.).

Czech Technical University in Prague, Faculty of Electrical Engineering	
Address:	Department of Mechanics and Material Science, Department of Microelectronics Technicka 2, 166 27 Praha 6 Czech Republic
General Contacts:	www.cvut.cz
Description:	Attention of R&D in nanomaterials and nanotechnology is focused on electronics and nano-electro-mechanical systems. The spontaneous growth of the complex systems is studied. The complex systems consist of colloidal carbon, polymeric and metallic nano-particles embedded in polymer or fluid environments. The parameters that affect growth are electric field, temperature and ionic concentration. Conductivity and permitivity can be controlled in wide ranges in these structures. New materials can be used for designing sensors, transistors, memories etc. Biomimetic materials (such as artificial muscles for nano-actuators of high performance) are designed to copy the function of muscle cells. Applied research is focused on low dimensional structures - 2D, 1D, and 0D, electronic properties, possible applications. Epitaxial growth of layers, nanolitography, and methods of self-organised growth are studied. A new course "Nanotechnology" for master study at Faculty of Electrical Engineering is under preparation in English language version as well. In the publication NANO '02 devoted to the national conference in Brno, November 19-21, 2002, there is a short abstract of our contribution on page 71. Further collaborators are mentioned here also. (source Prof. Vaclav Bouda)

Contact:	Vaclav Bouda, Head of Department of Mechanics and Material Science, **Phone:** +420 22435 2162 **Fax:** +420 22431 1958 **E-mail:** bouda@fel.cvut.cz, http://volt.feld.cvut.cz/ Jan Voves, Department of Microelectronics, **Phone:** +420 22435 2861 **Fax:** +420 22431 0799 **E-mail:** voves@fel.cvut.cz

Tomas Bata University in Zlin, Faculty of Technology	
Address:	Nám. T.G.M. 275 762 72 Zlín Czech Republic
General Contacts:	**Dean of the Faculty of Technology** Prof. Ing. Josef Šimoník, CSc E-mail:simonik@ft.utb.cz **Phone:** +420 576 03 1324 **Fax:** +420 576 03 1328 HomePage: http://ft.utb.cz/english
Description:	The department is equipped with instruments, machines and computers to deal with various projects and issues. Nano research activities are carried out in various areas of polymer processing: 1. Study of nanocomposite systems – polymer/clay - from the point of view of intercalation theory. 1. Intercalation method and agents 2. Preparation and compounding of polymer nanosystems 3. Correlation of properties and mechanisms of processes 4. Study of nanosystems structure and application Currently, the department is mainly interested in polyolefin's, PVC and rubber nanocomposites. One of the project is on Nanocomposites based on Polyvinylchloride/Organoclay; http://www.nanoforum.org/events/workshop/orals/kalendovaAdvantagesofNanocomposites.pdf 2. Technology of thermofixation, application of general rules for process description, modelling of basic technological units 3. Correlation of technological conditions of processing with the structure and properties of polymer systems 4. Monitoring of mixing process based on continual measuring of

	electrical properties of the material in the mixing chamber of kneaders 5. Extrusions and unstable flow of polymers 6. Composites with polymer matrix and their properties 7. Thermomechanical analysis of polymer systems 8. Structure and properties of liquid crystals 9. Smart polymeric materials
Contact Person:	Ing. Alena Kalendova E-mail:kalendova@email.cz Address: UTB FT Zlin, Nam. TGM 275, 762 72 Zlin, Czech Republic

VŠB – Technical University Ostrava, Institute of Materials Chemistry	
Address:	17. listopadu 15, 708 33 Ostrava – Poruba, Czech Republic http://www.vsb.cz/vuchem
General Contacts:	**Director of IMACH** Prof.RNDr. Zdeněk Weiss, DrSc. Phone: +420-59 699 1571 e-mail: zdenek.weiss@vsb.cz
Description:	The nano research focus on composition of nanostrustures and its analysis: Supramolecular structures based on clays and modified clays • intercalates - their structure and properties • intercalation and grafting with inorganic and organic molecules • structure analysis of intercalates • application of intercalates (photo-functions, catalytic activities, polymer-clay nanocomposites) Nanostructure surface analysis of materials - metodology • Atomic force microscopy • Diffraction methods Crystallinity of karbon based materiále • Polytypism and disordered structures • Modelling of diffraction patterns for disordered structures • Analysis of crystallite sizes distribution

	Tribology – structure, composition and properties of fiction composites • Polymer matrix friction composites • Carbon based friction composites • Wear composition and structure • Analysis of surface interactions during friction processes • Modelling of friction processes in automotive brake system Crystal structure analysis of phyllosilicates • Refinement of various polytype structures and quantification of the deformation of co-ordination polyhedra • Determination of high-temperature and high-pressure structural changes Coal, solid combustion products and industrial wastes • Distribution of hazardous elements and compounds • Optimisation of leaching procedures • Utilisation of sequential leaching procedures and fractionation for determination of hazardous pollutants • Influence of leaching kinetics, particle sizes and phase composition on the leachibility of pollutants

5.5. Companies

According to MINATECH (2001a, b), Czech research institutes and companies have much experience in instrumentation, including micro and nanoscale. Some SMEs produce electron microscopes for medical applications, intraocular implants, opthalmology devices and biosensors. There are no SMEs active in the Czech Republic in nanosystems.

Nanotechnology activities in the Czech Republic include in ICT: nano-electronics, In healthcare and biotechnology: diagnostic tools, endoscopy, controlled drug release, gene therapy and cell manipulation. And in instrumentation: Sensors, E-beam lithography, surface analysis and metrology. (www.airi.it/minatech)

Meopta, Prerov	
Address:	Kabelikova 1, 750 02 Prerov, Czech Republic
General Contacts:	**Phone:** +420 581 24 1111 **Fax:** +420 581 24 2222 http://www.meopta.cz/
Description:	This company started in 1991. It produces optical components including lenses, scopes, enlargers, projectors, measuring instruments and software.
Contact:	meopta@meopta.com

Metra Blansko, Blansko	
Address:	Poříčí 24 678 49 Blansko, Czech Republic
General Contacts:	**Phone:** +420 516 59 11 11 **Fax:** +420 516 41 75 57 http://www.metra.cz/
Description:	This well-established company (1911) is active in the electrotechnical industry. Among other things it produces precise measuring systems based on laser interferometers.
Contact:	metra@metra.cz

DELONG INSTRUMENTS, Brno	
Address:	Bulharska 48, Brno 612 00, Czech Republic
General Contacts:	**Phone:** +420-541 214 462, +420-541 210 691 **Fax:** +420-541 217 976 http://www.dicomps.com/micro/w_lvtem.htm
Description:	This company produces special electron microscopes, including Low Voltage Transmission Electron Microscopes, X-ray photoemission and low energy emission microscopes, and electron beam welding machines.
Contact:	sale@dicomps.com

TESCAN, Brno	
Address:	Libusina trida 21 623 00 Brno Czech Republic
General Contacts:	**Phone:** +420 547 130 412 **Fax:** +420 547 130 415 **Mobile:** +420 603 479 753 http://www.tescan.cz/an/index.html
Description:	This company develops and manufactures scientific and laboratory instruments for scanning electron microscopy and hardware and software for image analysis. The company employs 51 people, about 30% (15) are R&D workers. It started in 1991, as a spin off from TESLA, special electron microscopes. The company collaborates with sales representatives all over Europe.
Contact:	info@tescan.cz

LIMTEK, Blansko	
Address:	Capkova 22 CZ - 678 01 Blansko Czech Republic
General Contacts:	**Phone:** +420 608 47 52 10 +420 602 57 74 83 http://www.limteklaser.com/english/actual.htm
Description:	This company started in 1992 as a spin-off from Metra Blansko, and develops and produces precise laser measuring systems for dimensions and shapes for industrial applications. Customers include machine tool and microelectronics industries, metrology institutes and universities.
Contact:	limtek@limteklaser.com

Ceramed, Prague	
Address:	1442/35 CZ-18200 Praha 8 Czech Republic
General Contacts:	**Fax**: +420 541 211 214 **Phone** to the secretariat: +420 541 129 439 http://www.physics.muni.cz/kfpf/LTFN/index.html
Description:	The American producer of nanoparticle coatings CeRam-Kote has a representative in the Czech Republic.
Contact:	Zdenek Vyroubal Dablicka, ceramed@volny.cz

FEI company, Brno	
Address:	not found
General Contacts:	Web site: http://www.feicompany.com/
Description:	The multinational nanotechnology instruments company FEI Company has production facilities in the Czech Republic, with 164 employees. In February 2003, they announced the opening of new production, R&D and services facilities in Brno. The company will move production of some electron microscopes and focused ion beam and SEM, and system modules manufacturing to Brno.
Contact:	Jiri Ocadlik, General Manager of FEI Brno, +420-533311101, or jo@cz.feico.com ; Dan Zenka, APR, Senior Manager of Corporate Communications of FEI Company, +1-503-844-2695, or dzenka@feico.com

Optaglio, SRO	
Address:	Institute of Condensed Matter Physics Kotlarska 2 CZ-611 37 Brno Czech Republic
General Contacts:	Website: www.optaglio.com
Description:	This subsidiary of the British firm Optaglio Ltd. specialises in high-resolution electron beam holographic imaging that can capture nanotechnology elements. So far, main applications are in the field of anti-counterfeit devices.
Contact:	Dr.Zbynek Ryzi, Head of Mastering +420 220 941 073; Dr. John Drinkwater, Technical Director, +44 1264 336 510. E-mail: postmaster@optaglio.com

5.6. Literature and web-links
MINATECH (2001a): "Micro and Nanotechnologies; European Report on Applications/Market", published by AIRI, Associazione Italiana per la Ricerca Industriale, Italy, www.airi.it/minatech
MINATECH (2001b): "Micro and Nanotechnologies; European Report on Technologies", published by Consiglio Nazionale delle Ricerche, Dipartimento Attivita Scientifiche e Technologiche - Reparto V, Italy, www.airi.it/minatech
Švejcar, J, Šandera, P (eds.) (2002): "Nano '02; organised by Czech Society for New Materials, Nanoscience and Nanotechnology Section, and Brno University of Technology, Faculty of Mechanical Engineering", Brno, November 19-21, 2002, Czech Republic, ISBN 80-7204-258-0. Also available online at http://csnmt.fme.vutbr.cz/nano02/ in Czech but with English abstracts.
"Institute of Physics of Materials", CAS (2001), booklet on organisation and activities. contact: secretar@ipm.cz , www.ipm.cz
A central English web-site with information on and access to research and technology development in the Czech Republic: www.czechrtd.info
The web site of the Czech foresight exercise: www.foresight.cz

5.7. Acknowledgements

Inked Mallet has written this chapter, with valuable contributions from the following persons:

- Dr. Tasilo Prnka, mail.tastech@tiscali.cz, secretary of the Nanoscience and Nanotechnology Group of the Czech Society for New Materials and Technologies.
- Dr Karel Kral, Institute of Physics, CAS, kral@fzu.cz
- Professor Eduard Brynda, IMC, CAS, brynda@imc.cas.cz
- Professor Jaroslav Sobota, ISI, CAS, Sobota@ISIBrno.Cz
- Ms. Kristina Kadlecikova, Technology Centre CAS, Kadlecikova@tc.cas.cz
- Prof. Dr Josef Jancar, Director Institute of Materials Chemistry, Vice Rector Research and Technology Transfer, Brno University of Technology, jancar@fch.vutbr.cz
- Jaroslav Klima, Managing Director TESCAN, s.r.o, klima@tescan.cz
- Dr. Rudolf Novák, DrSc. CTU in Prague, Dept. of Applied Physics, novakr@fsid.cvut.cz

6. Estonia

6.1 General information

Estonia is a Baltic States, with a population of 1.4 million inhabitants. In 1999, Gross expenditure on R&D (GERD) was 0.76% of GDP. In 2001, the Estonian parliament adopted a Research and Development Strategy for the period 2001-2006. The strategy is called Knowledge *Based Estonia.* Among others Knowledge *Based Estonia* includes the aim to increase the GERD by a total of 1.7% by the year 2006.
The strategy also implies focusing the R&D activities on three strategic areas: information society technologies, biomedicine, materials and nanotechnologies. Universities are the main centres for generating new knowledge. Also minor institutes and research and development centres can benefit from public sector investment in R&D. (Tiits & Kaarli, 2001)

Figure 12: Map of Estonia
(Source: http://forum.europa.eu.int/irc/dsis/candidate/info/data/candidate countries/)

Estonian Technology Agency www.estag.ee is the main public body for financing applied research or development projects. It is not specific to nanotechnology, but it is also not excluding it. The ultimate purpose of the projects financed by the Estonian Technology Agency (ESTAG) consists in the introduction of elaborated technologies and innovations in the Estonian business sphere aiming at the improvement of the overall efficiency and performance of the Estonian enterprise sector. ESTAG pays special attention to projects the realisation of which advances the economic activities of as many enterprises as possible and creates prerequisites for the creation of new enterprises in the Estonian economy. ESTAG pays equal attention to both the technological quality and innovation of projects and the possibilities of realisation of the projects in the Estonian enterprise sector.

A consortium of companies and Research Institutes are trying to establish a *Competence Centre Programme.* The final decision on whether the competence centre

is going to be realised or not will be taken in October 2003. Should the Competence centre Programme be realised it would also be a funding possibility.

Of further interest is the Estonian Academy of Science. The Academy shall, relying on the intellectual power of its Members, develop and represent Estonian science. The primary mission of the Academy as an association of scientists is to assist, independently and with high academic professionalism, in resolving issues concerning the development of science in Estonia as well as social and economic development of the whole nation.

NATIONAL CONTACT POINT
NMP Thematic Programme of the EC Sixth Framework Programme (FP6)

Dr Rein Kaarli
Address: Archimedes Foundation, Innovation Centre, Kompanii 2 EE-51007 Tartu ESTONIA Tel: +372-7-350215, Fax: +372-7-350220
URL: http://www.irc.ee
Email: rein.kaarli@hm.ee
Programme acronym: FP6-NMP

6.2 National programmes and projects

Tartu Science Park Foundation:	
Address:	Tartu Science Park Foundation Riia 185 51014 Tartu Estonia
General Contacts:	http://www.park.tartu.ee/
Description:	Tartu Science Park is an independent non-profit foundation aiming to create innovation-friendly environment for local SMEs, offering both infrastructure and knowledge-based services, such as mentoring, assistance in finding financing, or help with technology transfer. It also facilitates the contacts between research and business communities. Founding members of the Tartu Science Park are Tartu City Government, Estonian Government (represented by Ministry of Economic Affairs and Tartu County Government), Tartu University and Estonian Agricultural University. Tart Science Park's nanotechnological activities are comprised of different business support activities for local nanotechnology companies. That is, however, not carried out as a specific program, but just as part of ordinary activities. Tartu Science Park is part of the pan-European Innovation Relay Centres network supporting the transnational transfer of European technologies in all sorts of fields, including nanotechnology.
Contact:	Project Manager Paul Pällin **Phone:** +372 7 428 177 **Fax:** +372 7 383 041 **E-mail:** paul@park.tartu.ee

Tartu Biotechnology Park	
Address:	Estonian Biocenter Riia 185, Tartu 51014, Estonia
General Contacts:	**Phone:** +372-7-383041 www.biopark.ee
Description:	Tartu Biotechnology Park is a Science Park, which has gathered research and knowledge within the areas of Medicine, physics, biotechnology etc. The aim of Tartu Biotechnology Park is to create a favourable

	and developing environment for the promotion of biotechnological entrepreneurship in Estonia. TBP offers infrastructure and related services for biotechnological development activities and entrepreneurship. To promote entrepreneurship TBP prepares and implements strategic development projects and diversifies various services offered to biotechnology companies. The Tartu Biotechnology Park offers services to foreign biotechnology companies who wish to start operations in Estonia and to Estonian companies who intend to establish branches abroad, helping them in the incorporation of companies and finding personnel and co-operation partners. The Tartu Biotechnology Park has no nanotechnological activities. In order to achieve its aims Tartu Biotechnology Park engages in active co-operation with Estonian and foreign biotechnology Companies, research and development institutions, foundations for the development of entrepreneurship and biotechnology and other organisations, including state agencies and local authorities.
Contact:	Andrus Tasa **Mobile:** +372-5098637 **E-mail:** atasa@ebc.ee

Competence Centre programme of Nanotechnology (under construction).
As the Competence Centre is still under construction contact should be taken to:
MikroMasch Eesti Ltd.
R&D
Narva Mnt. 13
10151 Tallinn
Estonia

The Competence Centre Programme consists of MikroMasch and other Estonian companies and Research Universities. Final decision on whether to realise the programme will be taken at the end of October 2003.

Competence centre's strategic development orientation No 1, objective of the strategic development orientation

Nanosensors

Development of novel nanostructural material technologies for application in various sensor technologies, primary short run focus will be related to thin film metal oxide semiconductor gas sensors (hazardous gases, oxygen). More generally, the goal is to gather critical mass for development of applied nanostructural sensor technologies.

Competence centre's strategic development orientation No 2, objective of the strategic development orientation

Nanotools

Development of technology for production of novel SPM probes. This includes but is not limited to application of Focused Ion Beam technology to manufacture of SPM probes, technology for sharpened probes with tip radius < 2 nm, probes with high aspect ratio, cantilevers with attached Carbon Nanotube tips.

Development of techniques and specialised nanotools for analysis of nanostructures of materials and their industrial applications, this includes analysis of molecular structure of polymers in manufacturing, control of CD and DVD production processes, nanoindentation of metals.

Competence centre's strategic development orientation No 3, objective of the strategic development orientation

Nanometrology

Development of calibration techniques and calibration structures (micro and nano standards) for quantitative analysis of nanoscale objects measured using various microscopy methods, nanolithography and nanoindentation.

Development of the basic concepts for nanometrology

Development of specialised equipment and software in the scope of nanotechnology, microscopy and microanalysis for educational purposes to be used in primary and higher schools.

Contact person:
Director Pavel Kudensky
Phone: +372 61 43 117
Fax: +372 61 43 118
E-mail: pavelk@MikroMasch.com

6.3 Universities

University of Tartu, Institute of Physics, Tartu	
Address:	University of Tartu Institute of Physics Riia 142 51014 Tartu Estonia
General Contacts:	Homepage: www.fi.tartu.ee
Description:	The Institute of Physics is a **Public** research and higher education centre. The Institute is one of the leading physics-research Institutions in Estonia. Historically the main field of research has been solid state physics on both fundamental and applied levels. New and emerging trends are nano-, biophysical, and optical technologies. Currently the institute employs about 100 scientific researchers and students, of which 15 are involved in the nanotechnological field. The nanotechnological activities at Institute of Physics are focused around three main areas. • Development of new and unique nanotechnology-related scientific apparatus and methods. Including combinatorial techniques like TEM-SPM, STM-SNOM, and SPM-laser techniques. • SPM studies of surfaces and nanostructres. • Thin film technologies (atomic layer CVD) Institute of Physics is operating with a wide range of scientific equipment. Among others two SPMs (Park Instruments and Smena), TEM (Phillips), atomic layer CVD reactor, various laser equipment including excimer lasers, various spectrometers from x-rays to IR regions for monitoring and laser vapour deposition set-up. Institute of Physics is taking part in the European Science Foundation (ESF)*'s NATRIBO programme and* in the European Commission's *Centre of Excellences* programme.
Contact:	Contact person: Ilmar Kink **Phone:** +372 526 2830 **Fax:** 372 738 3033 **E-mail:** ilmar.kink@fi.tartu.ee

Talinn Technical University	
Address:	Tallinn Technical University Department of Materials Science Ehitajate tee 5 19086 Tallinn
General Contacts:	Homepage: www.ttu.ee
Description:	TTU, the only university of technology in Estonia, is committed to high level basic and applied research significant on the global and national scale, implemention in teaching and promotion of innovation. The University aims at enhancing its Contribution to Estonia's science policy, based on key international trends and local industry needs and social and economic changes in the society. Major co-operation partners in Estonia are *Eesti Energia*, *Eesti Põlevkivi* and *Norma.* Research and development activities are arranged through departments, research centres and R&D institutions: Estonian Institute of Economics, Institute of Geology, Institute of Cybernetics, Institute of Marine Systems, Institute of Oil Shale Research, Estonian Institute of Energy Research. The strategic research areas at TTU are innovative industrial technologies of the information society, chemistry and materials sciences, bio- and gene technology, energy saving and sustainable environmental technologies, and socio-economic research. In order to promote economy a spin-off programme has been developed at TTU, which aims at commercialising research and development products and creating favourable conditions and motivation for promoting economy. The programme is carried out in co-operation with the TTU Innovation Centre. The research at TTU is directed to the chemistry, physics and technology of different A2B6, CIS, dielectrics and electroconductive polymers with the aims to determine processes responsible for the properties of materials. The basic and applied studies of thin film and powder composite structures will perform with the aim of development of new cheap solar cells and technologies of their production. The nanotechnological activities at TTU are based around nanocrystalline thin films and thin film structures for PV solar energetics. About 30 persons are involved in the nanotechnological field. The Laboratory area at TTU is 250 m2. The equipment consist of following instruments: Scanning Electron Microscopy (LEO, with EDX, EBIC), FTIR Spectroscopy (Perkin Elmer), UV-VIS Spectroscopy, XRD equipment (Bruker AXS), Impedance

	spectroscopy, (AUTOLAB) Photoluminescence Spectroscopy, (liq He), Magnetron sputtering equipment, (AJA International), E-gun evaporator, (Vacuumservice OY) and thermal analysis TG/DTA/DTG coupled to EGA-FTIR. It also includes equipment for electrochemical deposition of thin films, equipment for spray pyrolysis deposition of thin films, equipment for sol-gel spin coating deposition of thin films and equipment for chemical bath deposition of thin films. TTU is an initiator in developing a research-intensive enterprise environment. It is in the process of setting up a Technology Park and Technophiles in Mustamäe, Tallinn. Open to international co-operation, TTU participates in several European Union programmes, is involved in international research and development agreements, and has acquired over a hundred individual research grants from different foundations and organisations. More specific TTU participates in the following European Union projects: *PV-EST*, *ETA Solar Cell, EURO PSC*, *PV-NET-NAS*, and in national programs and Estonian Scientific Foundation projects, R&T&D projects with the industry.
Contact:	Contact person: Ph.D. Senior researcher Malle Krunks **Phone:** +372 620 3363 **Fax:** malle@staff.ttu.ee

6.4 Companies

Maico Metrics, Tartu	
Address:	Maico Metrics 39 Aardla Str., 50110 Tartu, Estonia
General Contacts:	Homepage: www.maicometrics.ee (is under construction) See http://www.hightechestonia.com/2520 for information on Maico Metrics.  Scanning Probe Microscope "Eduscope"
Description:	Maico Metrics is a private company founded in 1992 by the physicists of Institute of Physics as a spin-off from the University of Tartu. Maico Metrics now includes the best SPM experts in Estonia. The company produces an educational Scanning Probe Microscope. The scanning probe microscope "Eduscope" is used for precise studying of surfaces for scientific, technological and educational purposes. The advantages of the scanning probe microscope compared to similar devices are lower price, durability, and ease of use and suitability for teaching purposes. The scanning probe microscope Eduscope can be applied: • For teaching of the practical part of nanotechnology and material science in universities. • For checking of quality of surfaces, e.g. in electronics industry. • For teaching purposes in physics and material science, for teaching of materials and nanotechnology • In biology, for observation of changes in live materia (e.g. conjoining of prosthesis and tissue) • For quality checks in electronics industry • In machine building, for checking of quality of new covering materials and paints • In food industry, in development of environment and human friendly packaging materials
Contact Person:	CEO Mr. Indrek Reimand **Phone:** +372 514 8720 **E-mail:** info@maicometrics.ee

MikroMasch Eesti Ltd, Tallinn	
Address:	MikroMasch Eesti Ltd. R&D Narva Mnt. 13 10151 Tallinn Estonia
General Contacts:	Homepage: www.MikroMasch.com
Description:	MikroMasch is a private company with a wide range of research, development and marketing activities. The most important are: Research and development of Micro Electro Mechanical Systems and MEMS technologies. Accessories for Scanning Probe Microscopy (SPM cantilevers; calibration and test gratings; special design cantilevers and structure for SPM). Silicon sensitive elements for sensors of physical values (pressure; force; acceleration; radiation etc.). Pressure sensors, transducers and transmitters. Marketing and distribution web in the MEMS field. MikroMasch is a worldwide company dealing with North America (USA, Canada), European Union, Asia (Japan, China, South Korea, Taiwan) and Australia. The nanotechnological activities in Mikromash can be divided into nanotools and nanometrology: Regarding Nanotools MikroMasch is developing technology for production of novel SPM probes. This includes, but is not limited to application of Focused Ion Beam technology to manufacture of SPM probes, technology for sharpened probes with tip radius < 2 nm, probes with high aspect ratio, cantilevers with attached Carbon Nanotube tips. Development of techniques and specialised nanotools for analysis of nanostructures of materials and their industrial applications. This includes analysis of molecular structure of polymers in manufacturing, control of CD and DVD production processes, nanoindentation of metals. Regarding Nanometrology MikroMasch is developing calibration techniques and calibration structures (micro and nano standards) for quantitative analysis of nanoscale objects measured using various microscopy methods, nanolithography and nanoindentation. Further MikroMasch is developing the basic concepts for nanometrology. Currently 15 people are involved in the nanotechnological field. MikroMasch Eesti R&D department consist of: A MEMS technology group (2 persons); a SPM accessories and applications group (3 persons); a Metrology group (2 persons); a sensors of physical values group (4 persons); an Electronics group (2 persons), and an Engineering group (2 persons). The R&D staff includes 2 professors and 3 persons with PhD

	degree. The research at MikroMasch is developed in collaboration with: Digital Instruments; Molecular Imaging; NIST of USA; UCLA; Image Metrology; Danish Institute of Fundamental Metrology (DFM), JEOL. MikroMasch is involved in the creation of a Competence Centre Programme of Nanotechnology. The final decision on whether or not the programme will be realised will be taken at the end of October 2003.
Contact Person:	Director Pavel Kudensky **Phone:** +372 61 43 117 **Fax:** +372 61 43 118 **E-mail:** pavelk@MikroMasch.com

AS Clifton	
Address:	AS Clifton Tartu Science Park Foundation Riia 51014 Tartu Estonia
General Contacts:	http://www.park.tartu.ee/
Description:	AS Clifton is a private incubation company, which develops and manufactures GaAs semiconductors for power electronics. AS Clifton is part of the Tartu Science park co-operation network.
Contact Person:	CEO Roland Pärn **Phone:** +372 (07) 301 540 **Fax:** +372 (07) 383 041 clifton@park.tartu.ee

Evikon MCI	
Address:	Evikon MCI Riia 185, 51014 Tartu, EE Estonia
General Contacts:	**Phone:** +372 7 302646 **Fax:** +372 7 383041 Homepage: www.evikon.ee or info@evikon.ee
Description:	The private engineering company Evikon MCI, specialised in design, production and distribution of measurement and automation equipment, was founded in 1991. Since 1994 the facilities are located at Tartu Science Park. Evikon MCI is part of the Tartu Science Park Foundation
Contact Person:	Director Madis Einasto **Phone:** +372 7302645 **E-mail:** me@evikon.ee

6.5. Literature and web-links
Research and Development Council of Estonia: http://www.tan.ee/
Estonian Science Foundation: http://www.etf.ee/index.php?keel=ENG
Estonian Academy of Sciences: http://www.akadeemia.ee/eng/index_.html
High Technology Estonia: www.hightechestonia.com
Tartes, Thomas (1999): "Science reforms in Estonia : results and experience"
Tiits, Marek; Kaarli, Rein (2001): "Research and development in Estonia 2000-2001", published by the Research and Development Council, Tallinn, http://www.tan.ee/tan/en/doc/Documents/1016043313.84/R%26D_EE_2000 01.pdf

6.6. Acknowledgement

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The following persons, Institutions and companies have, by their contribution to Nordic Nanotech, made this report possible:

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Ph.D. Senior researcher Malle Krunks, Department of Materials Science, Tallinn Technical University, and e-mail: malle@staff.ttu.ee

Director Pavel Kudensky, MikroMasch Eesti Ltd., R&D, e-mail: pavelk@MikroMasch.com

Project Manager Paul Pällin, Tartu Science Park Foundation, and e-mail: Paul @ park.tartu.ee

Andrus Tasa, Tartu Biotechnology park, e-mail: atasa@ebc.ee

7. Hungary

7.1. General information

Hungary is a central European country, with about 10 million inhabitants. Due to political changes in Hungary, funding has undergone important changes and developments during the past 10 years. Government expenditure for R&D as a percentage of GDP is still fairly low compared to most OECD countries. As a result of the substantial economic and financial challenges that accompanied the country's transition to a market economy, GERD dropped significantly during the 1990s.

Figure 13: Map of Hungary
(Source: http://forum.europa.eu.int/irc/dsis/candidate/info/data/candidatecountries/)

In 2001, Gross expenditure on R&D was 0.94% of GDP. In absolute figures, the total R&D expenditure surpassed 140 billion HUF (approx. 600 M EURO) Since then Industrial R&D expenditures have grown by 23%, while government investments have shown a 45% increase. From 2003 on, expanding R&D tax and other incentives for innovation promise further increases in business research and development spending. R&D funds for the higher education sector have also grown significantly (by 43%), whereas the funds for government institutions have also experienced a larger increase (32%), and are well over the rate of inflation. The Government's main goal is to reach the EU average by 2006.
In 2000, the government approved the launch of the National Research and Development Programs. They followed the advice of the Science Advisory Board of the Science and Technology Policy Council established in 1999. This advice included recommendations to strengthen human resources, the institutional structure, financing, infrastructure and international co-operation. There are five national research and

development programs, on improving the quality of life; information and communication technologies; environmental and materials research; research on agribusiness and biotechnology; and research on national heritage and contemporary social challenges. Nanotechnology, in particular manufacturing and analysis of materials on the molecular level, is part of program 3 on environmental and materials research. Program 2 on ICT includes application of molecular level information technologies. (Source: Research and Development, http://www. om.hu/english).

There are three major sources of funding competitive R&D programmes. The aim of the **National R&D Programmes** (NRDPs) is to support research, development and innovation projects, focusing on interdisciplinary research. Special attention is given to large integrated projects implemented by consortia comprising the higher education sector, other public R&D institutions and industry. The **National Scientific Research Fund** (NSRF) was first established in 1986 to support scientific research, to establish conditions necessary for performing these activities and to publish results. Funding concentrates on thematic programmes with a special focus on young researchers, on scientific equipment and for post-doc support (for projects in Hungary only). The **National Technology Development Fund** (NTDF) supports technological innovation, the development of R&D infrastructure and the dissemination and economic application of research results.

In connection with these objectives the government intends to bring the state and the business sectors closer to each other since they have a role in ensuring that research, development and production are closely intertwined and placed in the service of the country's economic advancement. To achieve this, an attempt has been made to establish co-ordinated education, research and innovation policies, as well as measures to stimulate R&D activities of the private sector.

The Hungarian Science and Technology Foundation is a non-profit public foundation. The Ministry of Foreign Affairs of Hungary established the foundation in 1994. The Foundation's aims and activity areas are to support scientific and R&D activities by distributing funding to a variety of national and international co-operative research efforts. Www.tetalap.hu

Hungarian R&D organisations have an increasing opportunity to participate in multilateral and bilateral scientific programmes. Recent decades have seen an increase in the opportunities available for international technology co-operation.
Hungary is a member of most European and Euro-Atlantic research organisations and programmes (e.g. EU R&D Framework Programme, COST, EUREKA, CERN, EMBL, ESA/PRODEX and the NATO Science Programme). According to the Hungarian Central Statistical Office, about 10% of total GERD in Hungary came from abroad in 2001. Most of this has come from the EC Framework Programme in which Hungary has participated as a full member. The Hungarian contribution to the Framework Programme has been about 5% of the total budget of the Ministry of Education (in most EU countries, contributions to the EC are paid by the Ministry of Finance). Until now the Hungarian contribution and total grant awarded by the EC is approximately the same.

The Centre for Microsystems design was funded under FP5 to improve links between the Centre of Microsystems Design and Technology and other centres in the European Union and NAS (Czech Republic, Poland Slovenia).

NATIONAL CONTACT POINT
NMP Thematic Programme of the EC Sixth Framework Programme (FP6)

Mrs Zsuzsa Mokry
Address: Ministry of Education, Research and Development Division, Szervita tér 8. H-1052 Budapest HUNGARY, Tel: +36-1-4842533, Fax: +36-1-3184064
URL: http://www.om.hu
Email: zsuzsa.mokry@om.hu
Programme acronym: FP6-NMP

7.2. National programmes and projects

Nanotechnology, in particular manufacturing and analysis of materials on the molecular level, is part of program 3 on environmental and materials research. It is also part of Program 2 on ICT that includes application of molecular level information technologies.

7.3. The research centres and their expertise

There are no dedicated nanotechnology research centres in Hungary. However there are a number of research centres with nanotechnology related projects. Five focus on physics, two on chemistry, two on material sciences and one on biological research.

Condensed Matter Research Centre, Budapest	
Address:	1121 Budapest Konkoly Thege út 29-33, Hungary
General Contacts:	**Phone:** 36 1 392-2222 www.kfki.hu/~cmrc
Description:	This is a Centre of Excellence recognised by the EU and funded 2000-2003. Research focuses on advanced materials with optical, magnetic and electronic properties. The materials studied include metals, alloys, semiconductors, organic materials, liquid crystals, soft condensed matter, carbon nanotubes, and biological systems. For the structure studies they use X-ray and neutron methods, high-resolution microscopy (HRTEM, STM, AFM) and nuclear methods. They also synthesise and process the materials, including thin films, nanocomposites, crystal growth, metallic melts, etc. The centre is a collaboration between four institutes of the Hungarian Academy of Sciences: the Research Institute for Solid State Physics and Optics; the Research Institute for Technical Physics and Materials Science, the Research Institute for Atomic Energy and the research Institute for Nuclear and Particle Physics.
Contact:	Prof. Á. Buka. ab@szfki.hu

Hungarian Academy of Sciences KFKI Research Institute for Particle and Nuclear Physics	
Address:	Konkoly Thege Miklós út 29-33 H-1121 Budapest
General Contacts:	**Phone:** +36 1 392-2222 **Fax:** +36 1 3959-151 http://www.rmki.kfki.hu/
Description:	The institute has research groups looking at all aspects of physics ranging from theoretical physics to plasma physics and biophysics. There are a number of research groups focused on particle physics and modelling and quantum theory of collisions. Other areas of interest include laser plasmas generated by ultrashort pulses and using lasers to manipulate atoms.
Contact:	Prof. Zoltán Szôkefalvi-Nagy, D.Sc., sznagy@rmki.kfki.hu

Hungarian Academy of Sciences Research Institute for Technical Physics and Materials Science	
Address:	Research Institute for Technical Physics & Materials Science P.O.Box 49 H-1525 Budapest Hungary
General Contacts:	**Phone:** (+36-1) 392-2681, 395-9220 **Fax:** (+36-1) 392-2226 http://www.mfa.kfki.hu/int/nano/
Description:	The institute performs interdisciplinary research on complex functional materials and structures, studies of physical, chemical principles, development of characterisation techniques, implementation into integrated micro- and nanosystems. There are several research groups active in the field of nanotechnology.
Contact:	**Director**: Prof. József Gyulai, member of the HAS gyulai@mfa.kfki.hu
Nanotechnology Laboratory	
Contact:	László P. Biró biro@mfa.kfki.hu
Description:	The Nanotechnology Laboratory investigates the structure and composition of carbon nanotubes, produced by different methods. Other areas of research include STM and AFM technology and photonics.
The Thin Film Laboratory	
Contact person:	Béla Pécz pecz@mfa.kfki.hu
Description:	The Thin Film Laboratory works in the field of wide band gap semiconductors, novel carbon based materials and has pioneering activity in TEM sample preparation.
Thin-Film Nanosystems Laboratory	
Contact person:	Gábor Petõ peto@mfa.kfki.hu www.mfa.kfki.hu
Description:	The Thin-Film Nanosystems Laboratory works on size dependent properties (electronic structure) of the systems with different dimensions (0D, 2D, and 3D), prepared by thin film technology.

Hungarian Academy of Sciences Chemical Research Center, Budapest	
Address:	H-1025 Budapest, Pusztaszeri út 59-67. Hungary
General Contacts:	Phone: (+36-1) 325-9040 Fax: (+36-1) 325-7554

Description:	The **Chemical Research Center of the Hungarian Academy of Sciences (CRC HAS)** incorporated the former Central Research Institute for Chemistry, the Institute of Isotopes, and the Research Laboratory of Inorganic Chemistry. The Hungarian Academy of Sciences established the CRC with a view to offering better potentials for conducting research with higher economic efficiency and successful scientific results. The Chemical Research Center started with its activity in 1998. The principal research interests of the Chemical Research Center are focused on the development of new functional materials, such as medicines, polymers, catalysts, nanostructured materials with specific properties and isotopes for labelling molecules with special regards of supramolecular organisation. The activities cover fundamental as well as applied research topics. There are several research sections active in the field of nanotechnology.
Contact:	General director: Prof. Gábor Pálinkás, member of the HAS palg@chemres.hu
Department of Surface Modifications and Nanostructures	
Address:	H-1025 Budapest, Pusztaszeri út 59-67. Hungary
General Contacts:	Phone: (+36-1) 325-7548 Fax: (+36-1) 325-7509
Description:	The main research interests are focused on the development of new functional materials, such as nanostructured and nanosized materials. Within the scope of the Department there are four laboratories that are involved in the surface science and corrosion research: *The Electrochemical Laboratory* investigates the effect of self-assembly in corrosion protection by EIS and EQCM techniques. *The Inhibitors Development Laboratory* studies the development of chemicals, as potential inhibitors of corrosion taking place at metal surfaces in aqueous solutions. The properties of Langmuir- and Blodgett layers and sol-gel layers are studied in *Thin Film Laboratory*. The sol-gel technology is applied in preparation of mono-and multi-component ultra-thin coatings by wet chemical methods, ZrO_2, SiO_2, SnO_2 mono-and multi-component sol-gel layers as anticorrosive coatings on metal surfaces. *The Nanolaboratory* studies the properties of the materials in nanoscale (AFM, STM, EC-AFM, EC-STM, SEM EDS, Nanoidentator). The research on nanotubes is focused on functionalisation and their application as composites.
Contact:	Prof. Erika Kálmán kale@chemres.hu

Bay Zoltán Foundation for Applied Research	
Address:	H-1116 Budapest, Fehérvári út 130. Hungary
General Contacts:	Phone: (+36-1) 463-0502 www.bzaka.hu
Description:	The National Committee for Technological development (OMFB) established the Foundation for applied research and development at different scientific fields, necessary in Hungary, in 1992.
Contact:	István Podmaniczky pdm@bzaka.hu

Institute for Materials Science and Technology of the Bay Zoltán Foundation (BAYATI)	
Address:	H-1116 Budapest, Fehérvári út 130. Hungary
General Contacts:	Phone: (+36-1) 463-0531 www.bayati.hu/
Description:	The Institute was founded in 1995 in Budapest. The Institute has the following research sections: • Department of Metal Technology and Simulation • Department of Laser Technology • Department of Polymer Composite Research • Laboratories for Nanotechnology (electrochemical and mechanical alloying) • Laboratory for Environmental Sensors and Monitoring The *Laboratories for Nanotechnology* are dealing mainly with nanostructured surface coatings. *The main fields of Nanotechnology are:* • Nanostructured layers and multilayers made by electrochemistry • Nanocomposites and nanostructured powders (fillers) made by high energy milling • Nanostructures made by rapid solidification (melt spinning and laser technology) • Polymer Nanocomposites
Contact:	Prof. E. Kálmán e.kalman@bzaka.hu

Research Institute of Solid State Physics and Optics	
Address:	29-33 Konkoly-Thege M. Street Budapest HUNGARY
General Contacts:	**Phone:** (36-1) 392 2212 **Fax:** (36-1) 392 2215 www.szfki.hu

Description:	The main profile of the institute is basic research in the fields of theoretical and experimental solid state physics and materials science including metal physics, crystal physics and liquid crystal research, theoretical and experimental optics including laser physics, quantum optics and the interaction of light with matter. The experimental research activity is connected to unique methodologies like X-ray diffraction, NMR-, Mössbauer-, and optical spectroscopy and neutron scattering experiments at the KFKI Research Reactor. Nanotechnology research is focussed on optical thin films, laser applications, crystal growing technologies, and metallurgy.
Contact:	János Kollár D.Sc jk@skfzi.hu

Biological Research Centre	
Address:	Temesvári krt 62. H-6726 Szeged, Hungary
General Contacts:	**Phone:** +36-62-432-232 **Fax:** +36-62-432-576 www.szbk.u-szeged.hu
Description:	A significant part of the efforts of this Research Centre is devoted to the principles of biological energy transduction at the molecular level. A new study area has been started in the field of single particle observation-manipulation. The nanobiotechnology studies are aimed at determining mechanical, dynamical properties of single macromolecules, single cells. The studies are based on the laser tweezers technology. The present studies are focussed at building light driven machines that are capable of mechanically manipulate single biological particles. Experiments are started for the quantitative characterisation of intermolecular forces between cell adhesion molecules governing the formation of neural cell contacts.
Contact:	Pál Ormos Pali@nucleus.szbk.u-szeged.hu

7.4. Universities

Eötvös University, Budapest	
Address:	Department of Physics of Complex Systems, nanophysics group Department of Physics of Complex Systems Eötvös University H-1117 Budapest Pázmány Péter sétány 1/A Hungary
General Contacts:	**Phone:** +36 1 3722896 **Fax:** +36 1 3722866 http://galahad.elte.hu/nanophysics.html
Description:	The nanophysics group looks at how recent technological advances in manufacturing semiconductors of a size of few nanometers coupled to a superconductor has initiated a growing interest in considering the transport and the excitation spectrum in such hybrid (normal + superconductor) nanostructures. They specialise in modelling of complex systems including hybrid nanostructures including a semiconductor and a superconductor.
Contact:	József Cserti cserti@cpmlex.elte.hu

University of Miskolc	
Address:	H3515 Miskolc-Egy
General Contacts:	**Phone:** (36) 46 565-111 www.uni-miskolc.hu
Description:	A wide range of materials research is carried out in the departments of chemical engineering and material engineering, material science, physical chemistry, applied chemistry and non-ferrous-metallurgy. A particular focus in the area of nanotechnology is Carbon Nanotubes and the manufacture of nanocrystalline materials.
Contact:	Contact Prof. György Kaptay rekdzbm@gold.uni-miskolc.hu

University of Szeged, Department of Applied & Environmental Chemistry	
Address:	Rerrich Béla tér 1, Szeged, Hungary
General Contacts:	telephone, +36-62-544-619 fax +36-62-544-619 http://www.jate.u-szeged.hu/jate/sci/chem/appchem/akkt
Description:	This department has a strong activity in the field of large-scale catalytic growth of carbon nanotubes, their purification and functionalization by chemical methods. Research activity oriented towards zeolites, nanoporous materials and computational chemistry. Catalytic and adsorption properties of the synthesised materials are investigated.
Contact:	Imre Kiricsi kiricsi@chem.u-szeged.hu

7.5. Companies

Thales Nanotechnology	
Address:	Bem rkp. 33-34 H-1027 Budapest Hungary
General Contacts:	**Phone:** +36-1-214-2306 **Fax:** +36-1-214-2310 http://www.thalesnano.com
Description:	Thales Nanotechnology, a newly formed subsidiary of ComGenex, Inc. is involved in exploring the use of continuous flow chemistry with nanotechnology in the field of drug discovery. The subsidiary has been awarded a Small Business Incentive grant from a Hungarian Government agency to finance the development of a tool that integrates continuous flow production with microfluidic processes in a single glass chip that can be used for performing chemical reactions.
Contact:	Ferenc Darvas, Ph.D, ferenc.darvas@thalesnano.com

ComGenex	
Address:	Bem rakpart 33-34, 1027 Budapest, Hungary
General Contacts:	**Phone:** +36-1-214-2306 **Fax:** +36-1-214-2310 http://www.comgenex.com
Description:	ComGenex is an integrated drug discovery chemistry provider for the pharmaceutical and biotechnology industries based in Hungary. The novel parallel discovery model requires rapid technological advancement: miniaturisation and nanotechnology can produce millions of compounds per week that can be immobilised as small molecule arrays on glass or related activated surfaces. Using ultra-thin surface microfluidic networks and related chip-based microsystems will allow synthesis, purification and high-throughput screening in the same device, providing another milestone on the way to total integration. ComGenex has developed microfluidics chips used for diverse purposes in drug discovery, like synthesis, purification, and high-throughput screening. Furthermore in a scientific collaboration, ComGenex provides special derivatized compound sets for the development of chemical microarrays
Contact:	László Ürge: info@comgenex.hu

7. 6. FP6 collaborations

Networks of Excellence Submissions to FP6

Nanomaterials for fabrication of photonic and electronic devices and their use as sensors and catalysts for environmental protection

Various methods for preparing 1D, 2D and 3D nanomaterials will be elaborated to arrive at reliable and reproducible ways of fabricating nanowires, nanostructured thin films and complex three-dimensional structures. After having appropriate preparation and characterisation methods various applications are aimed at. They include catalytic, photocatalytic, medicinal, optical, energy storing, and etc. These methods are used at the Departments of Chemistry and Physics, University of Szeged

Integrated Project Submissions to FP6

Elaboration and application of chiral recognition systems

The aim of this research is the elaboration, investigation, and application of chiral recognition systems. These chiral recognition systems are heterogeneous metal catalysts, transition metal complex catalysts, resolving agents, phase-transfer catalysts, chromatographic stationary phases and chemical sensors. This technology is in development at the Budapest University of Technology and Economics, Faculty of Chemical Engineering, Department of Chemical Technology.

Intelligent Nanostructured Polymer Systems for Safe and Healthy Environment

The project aims to utilise external signals for transforming the internal structure of materials according to the requirements of safe and healthy environment. Sensing mechanisms, to be built into the systems, will initiate adequate material-answer. The common approach to the innovation includes development of detection and control mechanisms, new additives, nanostructures, transport properties and engineered surfaces. Budapest University of Technology and Economics, Department of Organic Chemical Technology

7.7. Literature and web-links
Ministry of Education, Research and Development Division (2002): .Research and Development in Hungary., Budapest, published at the web-site www.om.hu/english
Science Advisory Board, STPC (2000): .Research and Development., published at the web-site of the ministry of Education, Hungary www.om.hu /english
National R&D Programmes www.om.hu/j6.html
University of Debrecen (www.klte.hu)
University of Western Hungary, Sopron (www.nyme.hu)
University of Pécs (www.pte.hu)
Semmelweis University, Budapest (www.sote.hu)
University of Szeged (www.u-szeged.hu)

7.8. Acknowledgements

Oonagh Loughran has written this chapter, with valuable contributions from Ineke Malsch and Dr. L. P. Biro, MTA Hungarian Academy of Sciences, MFA Research Institute for Technical Physics and Materials Science biro@mfa.kfki.hu, http://www.mfa.kfki.hu/int/nano/

Thanks to Prof. Erika Kalman who has contributed to the update of this report.

8. Latvia

8.1 General Information

Latvia is a Baltic state, with 2,3 million inhabitants. Gross expenditure on R&D was 0.44% of GDP in 1999. In July 1998 the government adopted a national concept on R&D for the period 1998-2010. This concept embraces four national priority areas, including the integration of national research potential into universities and the creation of two research centres of national significance. They are a centre of materials science and a centre of wood science and technology. The national concept on R&D also set a number of research priorities and aim to renew and upgrade the research staff. The original research priorities were organic chemistry, biomedicine and pharmacy; materials science; IT; forestry and wood science; lettonica. Following an evaluation, the government worked out some future priorities, which were more in line with the EU framework programme. These are IT and telematics; life science and biotechnology (biomedicine and drug design); new materials and associated Technologies; environmental protection (maritime research and hydro-ecology).

Figure 14: Map of Latvia
(Source: http://forum.europa.eu.int/irc/dsis/candidate/info/data/candidatecountries/)

The government also adopted a concept for the development of a National Innovation System in 1998. In this concept, they aim to develop a new legislative framework and action plan for innovation and to develop proposals to fund this from the state budget and through a new innovation fund. (See: http://www.izm.lv/ en/default.htm look under science.)

Currently there are no large enterprises interested in nanotechnology in Latvia. *The* Baltic *Scientific Instruments*, placed in Riga, reveals interest on nanostructured pixel type detectors for ionizing radiation detection, however they do not invest themselves in research.

In Latvia it is possible to get very small funding for nanotechnological research from the *Latvian Council of Sciences*.

NATIONAL CONTACT POINT
NMP Thematic Programme of the EC Sixth Framework Programme (FP6)

Dr Vismants Zauls
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Riga, LATVIA, Tel: +371-7260803, Fax: +371-7132778
URL: http://www.zinatne-5.lv
Email: vism@latnet.lv
Programme acronym: FP6-NMP

8.2. National programmes and projects

The Latvia Technology Park	
Address:	The Latvia Technology Park Kalku Street 1, #310 1658 Riga, Latvia
General Contacts:	Homepage: www.rtu.lv/www_ltp/ltp.htm
Description:	The Latvia Technology Park is a non-profit organisation, which was founded on January 1996. The aim of the Park is to promote commercialisation of science through modern technologies, by developing and supporting small and medium-size production companies. The Latvia Technology Park is member of following networks and co-operations: *IASP* - International Association of Science Parks *ICECE* - Innovation Centres in Eastern and Central Europe *SPICE* - Science Park and Innovation Centre Expert *Bastic* - Baltic Association of Science /Technology Parks and Innovation Centres **The Confederation of Latvian Industry** *LTICA* - Latvian Association of Technological Parks, Centres and Business Incubators.
Contact person:	Chairman of the Board Asoc.Prof. Dr.sc.ing. Marcis Dzenis **Phone:** +371 7210808 **Fax:** +371 7820378 **E-mail:** ltp@adm.rtu.lv

8.3. Universities

University of Latvia, Institute of Solid State Physics	
Address:	University of Latvia Institute of Solid State Physics Division of Disordered Material Physics Kengaraga Str. 8 1063 Riga Latvia
General Contacts:	Homepage: www.lza.lv/scientists/millersd.htm
Description:	The research activities at the Institute of Solid State Physics focus around four areas: • Studies of electronic and ionic processes in wide-gap materials with different degree of structural ordering. • Development of new inorganic materials for optics and microelectronics. • Design and manufacturing of devices and products. • Vision research and primary vision care. The activities of the Institute of Solid State Physics nanotechnological focus around study of size-dependent effects for the luminescence of freestanding nanocrystals. The main goal is to develop nanostructured transparent ceramics for the new generation of scintillators. Currently ten people are involved in the nanotechnological field: 4 dr. habil. phys., 2 dr. phys and 4 students Institute of Solid State Physics, Division of Disordered Materials Physics has the following equipment in stock: • Time-resolved spectroscopy : a) Under high density pulsed electron beam excitation - transient absorption and luminescence spectra and decay kinetics; b) Under nitrogen laser excitation - luminescence spectra and decay kinetics. Both equipment suitable for detection of dependence on temperature of lifetimes. • X-ray excited luminescence spectra and luminescence intensity dependence on temperature registration. • Glow curve registration techniques (80K-600K) • Luminescence excitation spectra registration, VIS-UV excitation from 2,5 eV up to 6,0 eV. Furthermore the researchers for the Materials Physics Division have accessed to a number of important equipment located in the Institute but not in the division. For example, atomic force microscopy (AFM), and X-ray structure analysis equipment. Institute of Solid State Physics, Division of Disordered

	Materials Physics is participating in the following projects and networks: The 5-th Framework Programme project Centre of Excellence *CAMART*, Interfacial *effects in nanostructured materials*, co-ordinated by Prof. W.Lojkowski, Poland, and Energy *and Charge Transfer in the Materials for Photonics*, a project of Latvian Council of Sciences. Further Institute of Solid State Physics has submitted to Eo1/ 6-th FP, and participating in preparing and submission of STREP to 6-th FP "Nanocrystalline Materials for Optoelectronics"
Contact person:	Dr. habil. phys. Donats Millers **Phone:** +371-7261305 / home: +371-7453237 **Fax:** +371-7132778 **E-mail:** dmillers@latnet.lv

Institute of Inorganic Chemistry, Riga Technical University, Riga	
Address:	Riga Technical University Institute of Inorganic Chemistry Plasma Process Laboratory Miera Str. 34, 2169 Salaspils, LV-Latvia
General Contacts:	Homepage: http://www.nki.lv
Description:	The Institute was founded in 1946 and co-operates with the Faculty of Chemistry at the University of Latvia and the Faculty of Chemical Technology at the Riga Technical University in training students and providing research opportunities for Master's and Doctoral studies. The Institute publishes the Chemistry Journal of Latvia ("Latvijas Kimijas Zurnals"). The main research areas at the Plasma Process Laboratory, Institute of Inorganic Chemistry are: • The plasma chemistry and technology of inorganic compounds, new ceramics, ceramic materials and coatings. • The Investigation of metal surfaces; electro-deposition of super-conductive, amorphous thin layers; anti-corrosion protection of metals. • Membrane processes; the electrochemistry of liquid membranes; technology for the recovery of precious and non-ferrous metals from metal-containing industrial liquids and recycled raw materials. • The structure and properties of co-ordination compounds and their use in the analysis of industrial and natural object. • Inorganic phosphorous and nitrogen compounds, synthesis,

	structure, and use in production of bio-ceramics and ion-conducting materials. The nanotechnological research focuses on the preparation of nanosized powders of nitrides, carbonitrides, oxides, metals and their composites by plasma and chemical techniques and characteristics of nanosized powders, passivation, granulation, preparation of suspensions and densification and sintering of nanosized powders. 18 people are involved in the field of nanotechnology: 1 - Dr. hab. sc. ing., 8 - Dr. sc. ing, 7 - researchers and 2 - technicians. The Plasma Process laboratory possesses the following equipments: Radio-frequency oscillator based apparatus for synthesis of powders, Apparatus for XRD and TEM analysis and vacuum furnace (1600 ºC). The Laboratory participates in the following networks: The 5-th Framework Programme project *TRANSNANOPOWDER*, IPS-2000-00098, co-ordinator Dr. M. Herrmann, Germany Home page:www.transnano powder.org/index.html, the network *Interfacial effects in nanostructural materials*, Co-ordinator Prof. W. Lojkowski, Poland and the Project Latvian Council of Science *Materials for Latvian national economy.*
Contact person:	Director Janis Grabis **Phone:** 371-7944711 **Fax:** 371-7901257 **E-mail:** grabis@nki.lv

Institute of Technical Physics, Riga Technical University, Riga	
Address:	Institute of Technical Physics, Riga Technical University LV-Latvia
General Contacts:	Contact person: Technical University Prof. M. Knite **E-mail:** knite@latnet.lv

8.4. Literature and web-links
Ministry of Education and Science: http://www.izm.lv/en/default.htm
Latvian Council of Science: http://www.lzp.lv/
Latvian Academy of Sciences, Akademijas Lauk. 1, Riga, Lv 1524, Latvia, Phone +371-722-53-61, e-mail: lza@ac.lza.lv http://www.lza.lv/
Research and development in the republic of Latvia: http://www.izm.gov.lv

8.5 Acknowledgement

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The following persons, Institutions and companies have, by their contribution to Nordic Nanotech, made this report possible:

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Director Janis Grabis, Institute of Inorganic Chemistry, Riga Technical University, email: grabis@nki.lv

9. Lithuania

9.1 General information

Lithuania is a Baltic state, with 3.5 million inhabitants. Gross expenditure on R&D was 0.6% of GDP in 2000. The Department of Science and Higher Education of the Ministry of Education and Science and the Science Council of Lithuania are responsible for science policy. The priorities in R&D funding are at the time being discussed. These may include biotechnology, materials science, nanotechnology and information technologies. (http://193.219.137.48/english /R&D/leg.htm)

Figure 15: Map of Lithuania

The government aims to reform the system of R&D, to improve the links between research and industry. Measures may include competitive funding of research through the State Research and Higher Education Fund, upgrading research infrastructure, and the installation of science parks. The Lithuanian National Scientific Priorities Program launched by the NSF in 2003 offers funding possibilities.

According to minister Monkevicius, of Education and Science, Nanotechnology and new materials are one of the five key areas of research for Lithuania. The other four are bioinformatics and biotechnology for health care and food, information and communication technologies, new energy and social-political sciences. (Monkevicius)

In the capital city Vilnius, the local government is investing in five high technology projects, including ”Sunrise Valley". This includes IT, Laser technology, semiconductor optical technology, nanotechnology and environmental technology. (Vilnius Municipal Government 2002) http://www.vilnius.lt/new/en/zekonomika.php?open=109&root=105&sub_cat=152

At the moment there is no government organisation related to nanotechnology in Lithuania. Relevant to the nanotechnological field is the Lithuanian Government decision NR. 1182 of July 19, 2002 *On the Approval of the Research and Technical Development Priorities of Lithuania.* Priority 1.3 is about Research *for the development of nanotechnologies*. (1.31 Nanoscience, 1.3.2 Nanotechnologies, 1.3.3 Development of multifunctional nanostructured materials). Of further interest for the field of nanotechnology is Government decision NR. 431 of April 3rd, 2003 on National Scientific priorities.

Also, the Programme of High Technologies of Lithuania -support of research and development in the field of Nanotechnology by Lithuanian State Science and Studies Foundation offer funding possibilities.

NATIONAL CONTACT POINT
NMP Thematic Programme of the EC Sixth Framework Programme (FP6)

Ms Birute Mikulskiene
Address: Agency for International Science and Technology Development Programmes, A. Gotauto 12-219, LT-2600, Vilnius, LITHUANIA, Tel: +370-5-2644713, Fax: +370-5-2312292
URL: http://www.tpa.lt
Email: b.mikulskiene@ktl.mii.lt
Programme acronym: FP6-NMP

We received quite detailed information from some of the Institutes in Lithuania. Thus very detailed information on networks and news are included in separate textboxes.

9.2 National programmes and projects

Lithuanian nanoscience and nanotechnology network	
Address:	Contact Institution: RC for Microsystems and Nanotechnology Kaunus University of Technology
General Contacts:	http://www.microsys.ktu.lt/Nanonetwork/nanonetwork1.html
Description:	The RC chairs this non-profit national research network for Microsystems and Nanotechnology at the Kaunus University of Technology. Other participants include the Physics department and the Chemistry department of Vilnius University and the Physical Chemistry department of Vytautas Magnus University. Also the State research Institutes of Physics, biochemistry and biotechnology, and the university of Agriculture take part in the network. Internationally, they collaborate with the NEXUS network of Excellence in Microsystems technology. Research topics include sensors; surface nanostructures and self assembled nanotubes.
Contact person:	Director Prof. Dr.Valentinas Snitka **Phone:** +370 37 45 15 88 **Fax:** +370 37 30 08 31 **E-mail:** vsnitka@microsys.ktu.lt

Science and Technology Park (STP)	
Address:	A.Gostauto 11 2600 Vilnius Lithuania
General Contacts:	Homepage: www.stp.lt/index_e.html
Description:	The non-profit Science and Technology Park (STP) was founded in 1993 as a joint project of the Semiconductor Physics Institute, Institute of Physics and Theoretical Physics and Astronomy. The main objectives of the STP are establishing of the firm connections between research and practice, commercialisation of the scientific ideas, products and services and the offer of the best operating environment to the companies in different phases of their development. The STP provides accommodation for the companies that are within activities of researches, technological development and technological service. The separate programme is allocated to the companies that have been established by scientists from universities and/or institutes. Business development, innovation management and support for the spin-off companies are the main goals of the STP. Start-up companies at the STP are working in a wide range of leading-edge technologies including telecommunications, data

	transmission, business management, software, lasers, instrumentation, films, electronics, sensor design, environmental pollution, services and training. There are 20 companies at the STP's 3,000 m2 premises providing jobs for more than 240 employees. Providing its services, STP communicates with a wide range of local and international consultants and organisations.
Contact person:	Director: V.Balciunas Phone: +370 5 2313763 or K.Naudzius **Phone:** +370 5 2626720 **Fax:** (+370-5) 2626720 **E-mail:** kestutis@ruta.stp.lt or info@ruta.stp.lt

The Innovation and SME Programme
Homepage: http://www.cordis.lu/innovation-smes/

The non-profit Innovation and SME Programme stands at the crossroads of the Community's policies on Research, Innovation and SMEs. It promotes Innovation at Community level and encourages SME participation under FP5.The programme supports European businesses to innovate, to develop, market and integrate new technology and to manage change more effectively. More specifically, it supports European SMEs to fully participate in FP5 actions and to optimise their advantages from such participation. It also aims at contributing to a more innovation friendly environment in Europe, improved conditions for the creation and development of new companies, the diffusion of new technologies, the emergence of new economic activities and at fostering the "innovation culture" in Europe.

9.3 The Research institutes and their expertise

Institute of Biotechnology, Vilnius	
Address:	Institute of Biotechnology Graiciuno 8 2028 Vilnius LT Lithuania
General Contacts:	Homepage: www.ibt.lt
Description:	The Institute of Biotechnology is a State Research Institute, which started its activity in 1975. It maintains the status of a State Research Institute. The Research areas are genetic and molecular studies of the DNA restriction - modification (RM) phenomenon and research and development of recombinant biomedical proteins. The Institute of Biotechnology has no research in the nanotechnological field yet.
Contact person:	Director Algimantas Pauliukonis **Phone:** +370 5 2602103 **Fax:** +370 5 2602116 **E-mail:** office@ibt.lt

Semiconductor Physics Institute, Vilnius	
Address:	Semiconductor Physics Institute, Gostauto 11, 2600 Vilnius, Lithuania
General Contacts:	Homepage: www.pfi.lt
Description:	The Semiconductor Physics Institute (SPI) is a state research institute, which was founded in 1967 as a scientific research institute of the Lithuanian Academy of Sciences. For a long time thereafter, it was very narrowly oriented towards the research of a limited number of very special fields of semiconductors and accompanying technology. Among these were experimental and theoretical investigations of hot electrons in semiconductors, optical phenomena in solids and the design and fabrication of specialised microcircuits and sensors by means of silicon planar technology. SPI concentrates on: • Material science and nanotechnology; • Ultrafast processes in semiconductors and superconductors; • Terahertz technology;

	• Information technology; • Metrology and development of National Standards. The nanotechnological activities concentrates on the following topics: Quantum nanostructures and mezoscopic systems, Nanostructured sensors, Biosensors, Semiconductor nanocrystallites, Materials for magnetoelectronics, Nanocomposites for ultrafast optoelectronics, Fullerene materials. Currently 40 researchers are involved in the nanotechnological field. The Semiconductor Institutes possesses the following equipment's: Semiconductor planar technology, Liquid phase epitaxy, Molecular beam epitaxy, Electron lithography, Multisource magnetron sputtering system, Pulsed Nd: YAG deposition system, High magnetic field facility, Microwave and terahertz facility, Hot electron fluctuation spectroscopy facility, Single time-correlated photon spectrometry facility, Scanning electron microscope, Auger electron spectroscopy, X-ray diffraction facility, X-ray photoelectron emission spectroscopy. SPI is involved in the following networks: NATO Science for Peace Projects: Project SfP 977978 *Terahertz Radiation Systems* (Optoelectronics Laboratory), Project SfP 978030 Development *of Very-Broad Frequency Band Detectors of Electromagnetic Radiation* (Non-uniform Structure Laboratory), The Center of Excellence in Processing, Research and Application of Advanced Materials (PRAMA) was established on the SPI basis in 2002, High Temperature Superconductivity Laboratory is a member of thematic network Metal *Oxide Multilayers for magnetoelectronic Microsystems and nanotechnologies* (MULTIMETOX). The Semiconductor Physics Institute is the organiser of the network of Excellence *Nanotechnology of Clusters in Oxide Matrix.*
Contact Person:	Steponas Asmontas **Phone:** +(370-5) 2 627 124 **Fax:** +(370-5) 2 627 123 **E-mail**: asmontas@uj.pfi.lt

Details on the network Nanotechnology of Clusters in Oxide Matrix:
The research activity is in the field of Nanotechnology (metal nanoclusters in oxide matrix, self-organised semiconductor nanocrystallites in porous structures, nanostructured ceramics, nanoscopic self-assembled structures) and nanoscience (physical-chemical processes in self-organising nanosystems, structure and morphology of nanomaterials, electronic excitations and magnetic interactions in nanostructures). The research and integration activities are directed to the development of fundamental knowledge on nanostructures making use of partners complementarities in scientific research work, controlled processing of multifunctional materials for heterogeneous catalysis, optoelectronic and photonic devices and spintronic technique, and efficient input of actual topics to educational process.

Institute of Biochemistry, Vilnius	
Address:	Mokslininku 12 2600 Vilnius Lithuania
General Contacts:	Homepage: www.bchi.lt
Description:	Departments active in the nano(bio)technological field: Bioanalysis, Bioelectrochemistry and Biospectroscopy, Enzyme Chemistry, and Molecular Microbiology and Biotechnology. Institute of Biochemistry
Contact Person:	Director: Prof. Valdemaras Razumas **Phone:** +370-5-2729144 **Fax:** +370-5-2729196 **E-mail:** vrazumas@bchi.lt

Institute of Biochemistry is a State Research Institute, which has specialised in:

Research into biochemical and genetic principles of cell functioning (cell biology, gene engineering, biocatalysis, bioenergetics, theoretical and practical fundamentals of the biosensors and bioanalytical systems) and synthesis of the biologically active compounds.

The nanotechnological activities at the Institute of Biochemistry are:

- Redox and/or biocatalytically active self-assembled monolayers (SAM)
- Enzymes for the SAM-based biosensors and other bioanalytical systems
- Enzyme-based electrochemical and optical biosensors
- Functionalized nanostructured amphiphilic aggregates (e. g., redact and biocatalytically active bicontinuous reversed cubic phases of lipids)

Currently 41 people are involved in the field of nanotechnology.

Spectroscopic facilities at the Institute of Biochemistry

Institute of Biochemistry possesses the following equipment:

- Spectrometers (Perkin Elmer) - systems adapted for the spectroscopic studies of self-assembled monolayers (Surface Enhanced Raman Spectroscopy) as well as of the nanostructured amphiphilic aggregates.
- Various electrochemical set-ups.
- AKTA purifier 100 (Americium Biosciences) supported with UNICORN real-time control - system for high performance purification and characterisation of proteins, peptides and nucleic acids for both laboratory and pilot-scale applications.

Figure 16: Equipment at the Institute of Biochemistry

Institute of Biochemistry is participating in a number of networks:

- EU FP5 R&TD project Intelligent signal processing of biosensor arrays using pattern recognition for characterisation of wastewater: aiming towards alarm systems
- NATO Expert Visit Grant LSTEV Electrochemical impedance spectroscopy of ordered and disordered self-assembled monolayers (SAMs').
- Grants of the Lithuanian State Science and Studies Foundation: No. T-22 Adaptation signals and self-organisation of luminous bacteria, No T-24 New redox monolayers for bioelectrocatalysis, No T-26 Enzyme wiring with redox mediators: application to nanobiotechnology, and No. T-27 Amperometric biosensor for the analysis of glycerol.

Institute of theoretical Physics and astronomy, Vilnius	
Address:	Institute of Theoretical Physics and Astronomy, group of Theoretical Molecular Electronics and Spintronics A. Gostauto 12, Vilnius 2600, Lithuania
General Contacts:	Homepage: www.itpa.lt/~tamulis/
Description:	Institute of Theoretical Physics and Astronomy (ITPA) is a University research Institute, which was established in 1990 on the basis of 5 departments, which had previously belonged to the Institute of Physics. Since 2002 the Government of the Republic of Lithuania has granted the university research

	institute status to the ITPA. It is a budgetary State research body, entitled to perform research in theoretical physics and astronomy, and aiding the Vilnius University and other higher education establishments in preparing the scientists and specialists of high qualification. The full name is Vilnius *University Research Institute of Theoretical Physics and Astronomy*. The Moletai Astronomical Observatory belongs to the institute, and the institute is the incorporator of the Planetarium in Vilnius. The headquarters of the Lithuanian Physical Society and the Lithuanian Astronomical Society are here, too. The research focuses around quantum Mechanical Investigations of Electronic Structure, Spectra, Electron Charge and Spin Density Transfer and Magnetically Features of Organic Molecules Suitable for Digital and Quantum Information Processing. The Nanotechnological activities are: Theoretical Molecular Electronics Research Group: Research are carried out in Quantum Mechanical Design of Single Supermolecule Photoactive Machines and Molecular Classical and Quantum Logic Devices.
Contact:	Contact person: Dr. Arvydas Tamulis **Phone:** +370-5-2620861, +370-69919397 **Fax:** +370-5-2125361 **E-mail:** tamulis@itpa.lt

Details on the current research activities at the Institute of Theoretical Physics and Astronomy:

Quantum Mechanical Investigations of Electronic Structure, Spectra, Electron Charge and Spin Density Transfer and Magnetically Features of Organic Molecules Suitable for Digital and Quantum Information Processing

Arvydas Tamulis, Jelena Tamuliene, Vykintas Tamulis, Aiste Ziriakoviene

Quantum mechanically designed hardware of molecular electronics digital computers and molecular NMR and ESR quantum computers are presented. Maximal lengths of these molecular electronics digital and quantum information processing logic gates are no more than four nanometers and maximal width 2.5 nm.

There are presented several two and three variable gates of molecular electronics digital computers. The results of light induced internal molecular motions in azo-dyes molecules [1-3] have been used for the design of light driven logically controlled (OR, AND, NOR, NAND) molecular machines composed from organic photoactive electron donor dithieno [3,2-b: 2', 3'-d] thiophene, tetrathiofulvalene (TTF) or ferrocene molecules and electron accepting 4,5-dinitro-9- (dicyanomethylidene)-fluorene (DN9 $(CN)_{2F}$), tetracyano-indane, and moving azo-benzene fragment. After detail investigations of various electron insulator bridges between electrondonor and electronacceptor parts occurs that non-conjugated bridge $-CH_2-CH_2-$ should be applied to join thiophene and DO3 molecules in order to design OR logical function that significantly improved quality in comparison with our previous designed devices [1-3]. Density functional theory (DFT) B3PW91/6-311G model calculations were performed for the geometry optimisation of these molecular electronics logical gates. Applied DFT time dependent (DFT-TD/B3PW91) method and our visualization

Program give absorption spectra of designed molecular gates and show from which fragments electrons are hopping in various excited states. There are designed set of single supermolecule fluorescencing devices containing OR and AND logic functions.

There are presented quantum mechanical investigations of hydrogen and nitrogen atom Nuclear Magnetic Resonance (NMR) values of Cu, Co, Zn, Mn and Fe biliverdin derivatives and their dimers and aza-fullerene C48N12 adducts using Hartree-Fock (HF). There are also DFT methods indicating that these modified derivatives should generate from one to seven and eleven, twelve, eighteen, nineteen Quantum Bits (QuBits). The chemical shifts are obtained as the difference of the values of the tetramethylsilane $(Si(CH_3)_4)$ and ammonia (NH_3) molecule Gauge-Independent Atomic Orbital (GIAO) nuclear magnetic shielding tensor on the hydrogen and nitrogen atoms and that of the magnetically active molecules. There are designed several single supermolecule and supramolecular devices containing molecular electronics digital logic gates, photoactive molecular machines and elements of molecular NMR quantum computers that allowed to design several supramolecular ControlNOT NMR quantum computing gates and induced idea of molecular quantum computing life.

Implementation of the quantum information processing based on spatially localised electronic spins in stable molecular radicals is discussed. The necessary operating conditions for such molecules are formulated in self-assembled monolayer (SAM) systems: 1) a tailoring group, to be attached to a substrate; 2) a localised unpaired electron spin; 3) a noncompensated chemical bond, responsible for an unpaired spin must be strong enough. We suggest to use the neutral radical molecules with Shift

Base, which satisfy these conditions. Using first principle quantum chemical calculations we prove that these molecules have the stable localised electron spin, which may represent a qubit in quantum information processing. Geometry of neutral radical molecules were optimised by using DFT Unrestricted B3LYP (Becke exchange and Lee-Yang-Parr correlation functionals) model with polarization 6-311G** basis functions. The spin density analysis shown that unpaired spin of radical molecules is located in the region of not-compensated valence bond. There were
Performed analysis of overlap population of chemical bonds in the region of unpaired spin density that gives evaluation and comparison of stability of various neutral radical molecules. Using optimised geometry it was calculated isotropic Fermi contact couplings constants and anisotropic spin dipole couplings. Also, it was used special EPR-II basis set in the method of UB3LYP to show that the largest hyperfine splittings (HFS) of Electron Spin Resonance (ESR) spectra are on atoms of above mentioned region of not-compensated valence bond. For the reasons of construction of logic gates of ESR molecular quantum computers were calculated electronic spectrum and electron charge and spin density transfers in various excited states of neutral radical molecules. Analysis of electron charge and spin density transfer in different excited states show that this phenomenon might be used for the construction of Control NOT logical gate for the QuBit associated with unpaired spin in the stable neutral radical molecules.

Institute of Physics, Vilnius	
Address:	Institute of Physics Savanoriu 231, LT-2053 Vilnius, Lithuania
General Contacts:	Homepage: www.fi.lt
Description:	Institute of Physics is a state scientific research institute of Lithuania. It joins scientists and laboratories for basic and applied research in chemical physics and biophysics, modern laser spectroscopy and non-linear optics, nuclear physics, Physics of atmosphere and some other related areas of physics. In addition to the scientific research, the Institute is engaged in the educational activities via tight connection links with several universities of Lithuania. The majority of the scientific staff of the Institute is engaged as lecturers, tutors and advisers of undergraduates, graduates and postgraduates in the scientific research. The nanotechnological activities are: Non-linear Optics and Spectroscopy Laboratory • Surface spectroscopy; for the analysis of surfaces and thin films • Molecular compounds physics Laboratory Photogeneration and recombination of charge carriers • Photoinduced proton and ion transfer in proteins

	• Spectral properties of molecular crystals, films and aggregates The Institute participates in several collaborative research projects, European programs, NATO projects, IAEA projects, research projects with Lund University (Sweden), and Max-Planck-Institut für Strahlenchemie in Mülheim (Germany).
Contact:	**Phone:** (3705) 266 1640, **Fax:** (3705) 260 2317, **Homepage:** http://www.fi.lt **E-mail:** romaska@ktl.mii.lt

Corrosion Research Department, Institute of Chemistry, Vilnius	
Address:	Institute of Chemistry, Vilnius (Corrosion Research Department) A.Gostauto 9, Vilnius 2600 Lithuania
General Contacts:	Homepage:http://www.chi.lt
Description:	The Institute of Chemistry is the largest institutions of chemical research in Lithuania. There are about 120 researchers at the institute. The institute has specialised in the field of electrochemistry, corrosion, nanotechnology, electroplating and related fields since 1965. Nanostructural and nanotechnological research includes: formation of new nanostructured metal alloy coatings by means of magnetron plasma sputtering; design of new nanostructural electrodes for fuel cells; formation and electrochemical study of self-assembled monolayers on the electrode surface; polymerization and electropolymerization of conducting polymers and other related substances; formation of nanostructures and polymerisation of nanostructured Particles. At the moment 120 persons are involved in the nanotechnological field. Corrosion Research Department possesses the following equipment: ***Chemical analysis*** • Light Absorbance Spectrophotometry (Perkin Elmer Lambda 35 UV/VIS) • Poliarography (PU-1) • Atomic Absorption Spectrometry (Perkin Elmer 603) • Mass Spectrometry (MX 1312A and MI-1201) • X-ray Spectromicroanalysis (JXA-50A) • X-ray Photoelectron Spectroscopy (ESCALAB-MKII) • Direct Current Plasma Emission Spectroscopy (SPECTRASPAN-IV)

	• Gas Chromatography (gas chromatography-mass spectrometer HP, library of 322000 compounds)
	• Fourier Transformation Infra-Red Spectrometry (Bomem, library of 1000 compounds)
	
	Materials science and electrochemistry
	• X-ray Diffractometry (DRON-2.0 and DRON-3M)
	• Electron Transmission and Scanning Microscopies (PEM-100, JXA-50A)
	• Scanning Probe Microscopy (Explorer Topometrix):
	  • AFM (contact/non-contact)
	  • STM
	  • Magnetic Force Microscopy
	  • Kelvin Probe
	
	Electrochemical methods
	• Electrochemical Impedance Spectroscopy (Zahner IM6)
	• Voltamperometry (VOLTSCAN)
	• Quartz Crystal Microgravimetry

Contact person:	Director: Eimutis Juzeliunas **Phone:** +370-5-2612467 **Fax:** +370-5-2617018 **E-mail:** ejuzel@ktl.mii.lt

Surface Engineering Group, Lithuanian Energy Institute	
Address:	Surface Engineering Group Lithuanian Energy Institute 16 laboratory, Breslaujos 3, 3035 Kaunas, Lithuania
General Contacts:	Homepage: www.lei.lt
Description:	Lithuanian Energy Institute was established in 1956 as the Institute of Energy and Power Engineering of the Lithuanian Academy of Sciences. Later (1967.1991) it was renamed to Institute for Physical and Engineering Problems of Energy Research and became known among the local and international scientific society involved in hydrology, fundamental research in hydrodynamics, thermal physics, material science, simulation and control of power supply systems. In January 1992 the Government of the Republic of Lithuania granted the Institute a state science institution status, which became independent from the Academy of Sciences and was renamed to Lithuanian Energy Institute (LEI, http://www.lei.lt). At present LEI is a technical research centre dealing with evaluation on influence of energy sector on water and water bodies. It also deals with energy related research in thermal

	physics fluid mechanics and hydrogen technologies, development of energy planning methods, nuclear safety issues of nuclear installations. Moreover, research of safety and reliability of other complex systems, studies of refectories and chemically resistant materials and simulation of complex energy systems are also carried out at LEI. The Institute encompasses 10 research laboratories, Energy Efficiency and Information Centre, Information Department with Library, Meteorological Service, Computer Service Group, Central Workshop and Ecological Station at the lake Druksiai. The research group aims to satisfy the increasing Requirements for high technology coating materials with improved performance characteristics in various types of environments. The scope includes thin and thick coatings to alter the mechanical, chemical and optical properties of materials. Mechanical properties include friction, wear and hardness; chemical properties include adsorption, corrosion and oxidation. Particular emphasis is placed on the emerging application of coating materials for hydrogen storage. The advanced processes such as magnetron sputter deposition, arc-deposition, activated reactive evaporation, ions plating and plasma immersion ion implantation are employed to obtain needed composition, microstructure, adhesion and internal stresses corresponding to the specific applications. The recent projects are related to the fabrication of nanostructure materials employing physical vapour deposition technologies. Of particular emphasis are the emerging advanced processes as ion beam assisted deposition, plasma enhanced low-temperature synthesis and the modification of near-surface properties of metals and alloys under high-flux, low-energy ions (nitrogen, oxygen and hydrogen) irradiation at moderate temperature, so called processes of nitridation, oxidation and hydrogenation. Furthermore the Lithuanian Energy Institute is working on an integrated project named: *The role of surface instabilities in the mass-transport of reactive gases under external irradiation*. At the moment 15 people are involved with the field of nanotechnology. The Lithuanian Energy Institute is a rather big institute. Thus the total laboratory area amount to 600 m^2.

	The institute possesses the following equipment: Experimental PVD systems for thin films deposition: BY -1 - DC magnetron sputtering system BY - 2D - Pulse DC magnetron sputtering system. Experimental atmospheric pressure plasma torch systems (4 PCs.). Scanning electron microscope (JSM 5600): Optical microscope: Optical microscope (OLYMPUS CH); Colour video camera (SONY CCD-IRIS/RGB); Macintosh computer with image analysis software NIH IMAGE 1.25 (produced by RSB). Conventional diffractometer DRON-6. Peak position identification: Crystallographica Search-Match software. Glow discharge optical spectroscope (GDOS). LECO 1000. Thin films resistivity measurements (JANDEL resistivity tester, UNIVERSAL PROBE). And samples preparation (grinding, polishing) equipment. Lithuanian Energy Institute part takes in the following networks: *Development of thin film hydrogen storage materials employing physical vapour deposition technologies.* Project partners: Sandia National Laboratories (USA). *Synthesis of new materials for new generation solid oxide fuel cells.* Project partners: Kaunas University of Technology (Lithuania), Vilnius University (Lithuania), Vytautas Magnus University (Lithuania), Oslo University (Norway) and Poitiers University (France). *Fabrication of thin film membranes for hydrogen separation and isolation.* Project partners: Oslo University (Norway) and Vytautas Magnus University (Lithuania).
Contact person:	Dr. Head of Surface Engineering Group Darius Milcius **Phone:** +370 687 80 491 **Fax:** +370 37 35 12 71 **E-mail**: milcius@isag.lei.lt

Details on the project: The role of surface instabilities in the mass-transport of reactive gases under external irradiation.

The use of low energy, high current density nitrogen, carbon, and oxygen ion beams is a new processing method for producing at moderate temperature thick modified layers with a high nitrogen or carbon or oxygen content. The objectives of this research Integrated Project are twofold:

- To investigate experimentally the process of low energy/high flux nitrogen, carbon, oxygen ions implantation at moderate temperatures of stainless steel and to understand the mechanism leading to the formation of the thick alloyed layers with high nitrogen or carbon or oxygen content (up to 20 %) using Nanotechnologies.
- To develop a model taking into account the physical effects induced by the ions in the first layers. This includes the formation of a considerable number of defects, cascade mixing, sputtering and atom relocation on the surface. The allocation is calculated by computers simulations that estimate the depth profiles of nitrogen or carbon or oxygen implanted atoms.

9.4. University research institutes

Kaunus University of Technology, Research centre for Microsystems and Nanotechnology	
Address:	Kaunas University of Technology Research Centre for Microsystems and Nanotechnology Studentu 65 3031 Kaunas Lithuania
General Contacts:	Homepage: www.microsys.ktu.lt
Description:	The Research Centre for Microsystems and Nanotechnology was established in 1997 as a research centre at Kaunas University of Technology to stimulate nanoscience research and education and to disseminate knowledge regarding nanotechnology in Lithuania. The centre is co-ordinator of *the Lithuanian nanoscience and nanotechnology network*. The research focuses around new nanofabrication methods of mesoscopic structures, new SPM methods and applications, Nanopositioning and manipulation at nanoscale. The nanotechnological activities at the Research Centre for Microsystems and Nanotechnology focus around the following subjects: • Synthesis of different shape molecular mechanisms (especially relevant to porphyrin based mesoscopic structures, like nanotubules, sieves), interaction with cell membranes • Functionalisation of nanostructures by means of ultrasound, sonochemical synthesis of nanomaterials; • New Scanning probe microscopy methods and applications • Nanopositioning and manipulation of nanoobjects • Sol-gel ferroelectric films for sensors and actuators Currently 15 people are involved in the nanotechnological field. The Research Centre for Microsystems and Nanotechnology possesses the following equipment: Atomic Force Microscope (Quesant Corp.), home built AFM, STM, SNOM (under development), optical microscopy, photolithography, vacuum deposition, sonochemistry cells. Further the Research Centre for Microsystems and Nanotechnology owns the following instruments in collaboration with others SEMs: X-ray diffraction, optical spectroscopy, times

	resolved optical spectroscopy, and Raman spectroscopy, XPS, FTIR. The Research Centre for Microsystems and Nanotechnology is taking part in a number of research projects and networks: • Nanostructured thin films: properties and applications. In partnership with Kiel Technical University • Synthesis and investigation of Spatial structure of Self-assembled nanotubes. • Investigation and formation of complex surface micro/nano structures. • Functional nanostructures and molecular mechanisms (submitted to Lithuanian NSF) • Lithuanian Nanoscience and Nanotechnology network (Co-ordinator). • Targeted Drug Delivery Devices (submitted to FP6).
Contact person:	Director Prof. Dr.Valentinas Snitka **Phone:** +370 37 45 15 88 **Fax**: +370 37 30 08 31 **E-mail:** vsnitka@microsys.ktu.lt

Details on Kaunas University of Technology, FP6 Collaboration:
Faculty of Chemical Technology, Department of Organic Technology

Project Proposal: Multifunctional materials based on high-substituted polysaccharides Synthesis, Characterisation and application (nanotechnology, biotechnology, renewable energy technologies, environmental protection, processing of intelligent materials and other, unforeseen fields) of the high-substituted cationic polysaccharides. Examination of their biodegradability, obsolescence and compatibility with low-molecular compounds, other bio- and synthetic polymers. Mastering and processing of self-assembling structures with defined physical, chemical and biological characteristics.

Head of the research group: ZEMAITAITIS, Algirdas
E-mail: alzem@ctf.ktu.lt
Address:
Radvilenu 19,
Kaunas 3028
Lithuania
Phone: +370-37-456081
Fax: +370-37-456081

Institute of Physical Electronics, Kaunas University of Technology	
Address:	Institute of Physical Electronics, Kaunas University, Savanoriu 271, 3009 Kaunas, Lithuania
General Contacts:	Homepage: www.fei.ktu.lt/en/
Description:	Institute of Physical Electronics consist of four departments: Department of Microlithography, Department of Vacuum processes, Department of Physical and chemical analysis and Department of research of thin films and surfaces. The research activities at the Institute of Physical Electronics can be divided into two main areas: • Surface nanometric structures: Thin films and surface engineering (physics and applications), Application of ion and plasma methods for formation of nanostructures and nanomaterials, • Optical document security: Microoptical elements, interference filters, Development of new materials and structures Nanotechnological activities at the Institute of Physical Electronics emphases: Carbon nanotubes, Chemical methods for formation of nanostructured thin films and Nanoimprint lithography. Currently 10 people are involved in the nanotechnological field. The equipment consists of: Vacuum evaporation, magnetron sputtering, electrochemical deposition, ion beam etching and eposition, RIE, CVD, plasma enhanced CVD, microlithography, X-ray photoelectron spectroscopy, IR and UV-VIS spectrophotometry, SEM, AFM, X-ray diffractometry, BET analysis, fluorescence spectrometry, gas chromatography, I-V and C-V characterisation, Langmuir-Blodgett trough Institute of Physical Electronics is participating in a number of networks: • *INCAF* Eureka project • *Nordic Energy Research Programme* • *Replication of periodic structures in polymeric materials* (project funded by Lithuanian State Science and Studies Foundation) • Giliber project *Mechanical properties of thin films*

Contact person:	Prof. Sigitas Tamulevicius **Phone:** +370 37 314423, **Phone/Fax:** +370 37 314423 **E-mail:** Sigitas.Tamulevicius@ktu.lt
Physics Department, Vytautas Magnus University, Kaunus	
Address:	Physics Department, Vytautas Magnus University Donelaicio 58, 3000 Kaunas, Lithuania
General Contacts:	Homepage: www.vdu.lt
Description:	The nanotechnological activities at the Physics Department, Vytautas Magnus University consists of Nanocrystalline thin film and coating materials fabricated by employing physical vapour deposition technologies. There is also plasma enhanced reactive synthesis of chemical compounds (hydrides, oxides and nitrides). At the time being 8 people are involved in the Nanotechnological field, those are 1 professor, 1 associate professor, 3 doctoral students, 1-magistrate students, and 2 technical staff. The research infrastructure consists of technological Processes-characterisation of microstructure and properties analysis. The Physics Department possesses the following equipment: Different modifications of vapour deposition technique, XRD analysis, SEM, Glow discharge optical emission spectroscopy, four probe resistivity measurement, mechanical and optical properties. The Physics Department part takes in the following networks: • Plasma nitridation of stainless steel • YSZ coatings • Plasma hydrogenation of thin film materials • Surface technologies (Nextst),
Contact person:	Prof. Pranevicius Liudvikas **Phone:** (3703 37) 203775 (3707 37) 203858 **E-mail:** Liudvikas_Pranevicius@fc.vdu.lt

Details on the *network of excellence Surface Technologies*:
This Network aims to integration expertise and knowledge of leading research centers in the area of Nanotechnology and surface treatment technologies, such as plasma treatment, ion sputtering, ion implantation and plasma assisted physical and chemical vapour deposition technologies for tribological, surface erosion protection and barrier coating applications. Its aim is also spreading of excellence through the training researchers, students, engineers and industrial representatives in support of technological innovations, including hydriding, nitrating, oxidation and carbonisation under high-flux, low-energy ion/plasma irradiation. Members of this network are EU States (United Kingdom, France Greece), Associated Baltic Candidate countries (Estonia, Latvia, Lithuania) with participation of research centres neighbouring countries (Byelorussia, Russia and the Ukraine).

Laser Research Center, Biophotonics group, Vilnius University	
Address:	Laser Research Center Vilnius University Sauletekio ave. 9, c.3, 2040 Vilnius, Lithuania
General Contacts:	**Phone:** 370 2 366022 **Fax:** 370 2 366006 **Homepage:** Http://www.ff.vu.lt/biophotonics/riro.html
Description:	The Biophotonics group was established in 1985 as a scientific unit of Vilnius University Laser Research Center to stimulate research and education and to disseminate knowledge regarding lasers application in life sciences, steady state and time resolved spectroscopy, photophysics and photochemistry of biological objects and biomolecules.
Contact:	Ricardas Rotomskis, Prof. Habil.dr. **Phone:** 370 2 366022 **E-mail:** ricardas.rotomskis@ff.vu.lt

Nanotechnology activities
The nanotechnological activities at the Biophotonics group of Laser Research Center start from 1997 and focus around the following subjects:

- Spectroscopy of self assembled nano-structures (especially relevant to porphyrin based J-aggregates).

  Due to their unique and specific properties nanostructures formed from J-aggregates recently become the subject of high scientific interest. Meso- (sulphonatophenyl) porphines in acidic solutions form specific structures, the so-called J-aggregates, where molecules are organised in nanostructures, which is endowed with interesting properties important for technological future applications.

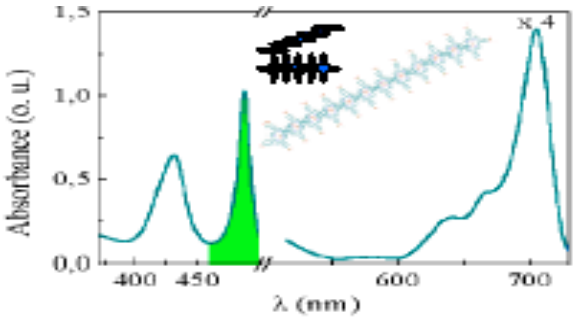

Figure 17: Sample of Nanotehcnology in Lithuania

- Investigation of principles of spatial organisation of J-aggregates and determination of the size and shape of these nano-structures by non-linear spectroscopic methods and atomic force microscopy (AFM).

  The energy relaxation kinetics and structure of the J-aggregates formed by water-soluble $TPPS_4$ molecules were investigated in aqueous media by means of steady state and time-resolved fluorescence and absorption spectroscopy. The spatial structure of J-aggregates and deposited on silicon and several glass substrates can be analysed by atomic force microscopy (AFM) and modelled theoretically.

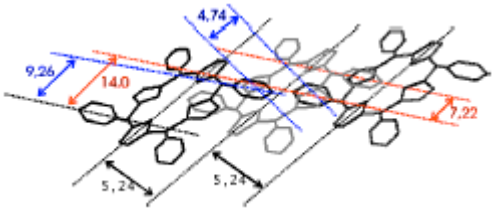

Figure 18: Sample of J-aggregated nano-structures

- Investigation of modification of nano-structures under the influence of optical irradiation, interaction with biologically active molecules, deposition on different substrates and incorporation to the polymer matrix.

  J-aggregates being deposited on the hard substrate retain their structure. The AFM experiments indicated the presence of stick-like J-aggregate structures on all surfaces. The size of the sticks ranged from 0,05-3 nm in length, 25-45 nm in width (depending on substrate), and 4-5 nm in thickness (cross-sectional profiles). Investigation of spectroscopic properties of J-aggregates incorporated in thin layers of organic polymers has revealed that $TPPS_4$ does self-associate in polyvinyl alcohol at acidic pH forming molecular nano-structures with slightly different spectroscopic features in comparison with aqueous media.

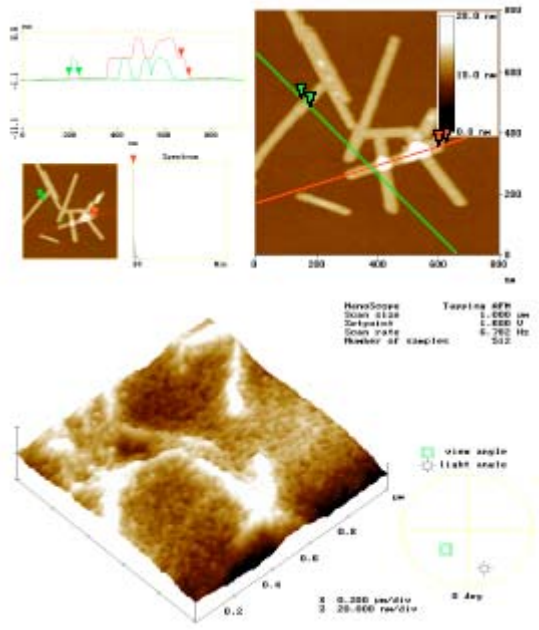

Figure 19: Sample of modification of nano-structures

In collaboration with:

Laser Research Center, Institute of Optics and Quantum Electronics, Jena University, Jena, Germany,
Department of Physics and Measurement technology, Linkoping University, Linkoping, Sweden,
Institute for Biochemistry, Johan Wolfgang Goethe University, Frankfurt, Germany,

Ultrafast Laser and Spectroscopy Laboratory, Materials Science Center, University of Groningen, Groningen, The Netherlands,
Institute of Chemistry, Vilnius, Lithuania
Theoretical Molecular Electronics Research Group, Institute of Theoretical Physics and Astronomy, Vilnius, Lithuania.

Current projects:

- *Investigation of spatial structure of self assembled nanostructures* (funded by Lithuanian State Foundation for science and education, project leader Prof. R.Rotomskis, 2002.04-2004.12).

At the moment 5 persons are involved in the field of nanotechnology: 1 professor, 1 doctor, 2 master students and 2 bachelor students. Laser Research center is taking part in the Lithuanian Nanoscience and Nanotechnology network.

Chemistry Department, Vilnius University, Vilnius	
Address:	Chemistry Department, Vilnius University Naugarduko Str. 24, Vilnius 2006, Lithuania
Contact person:	Ricardas Rotomskis **E-mail:** ricardas.rotomskis@ff.vu.lt **Phone/fax:** 330987

Research at the Chemistry Department at Vilnius University focus around:
Electrochemical processes at the interface solid electrode/electrolyte, creation of analytical methods and instruments for analysis of environmental and industrial objects and syntheses and investigation of inorganic, organic and polymer compounds materials.

Figure 20: Equipment for Electrochemical processes in Lithuania

The nanotechnological activities at the department are:

- **Dept. of Polymer Chemistry**: Research in polymers, polymer coating, plastics and coatings.
- **Metal Organic Chemical Vapour Deposition (MOCVD) group**: Preparation of various oxide layers and multilayered nanostructures
- **Sol-Gel Chemistry group**: Development of new sol-gel chemistry synthetic approaches for the preparation of advanced nanoceramic oxide materials.

The department possesses the following equipment's:

Multimode Scanning Probe Microscopes, Electron microscope with electron microprobe analysator CAMEBAX SX50

The department is involved in the following networks:

CERMOX: FP5 Growth Programme - RTD *Advanced Ultra-Thin Ceramic Membranes for Efficient Industrial Processes* (Project Reference: G5RD-2000-00351).

EU COPERNICUS PROGRAMME: *Functional Thin Films Obtained By New MOCVD Techniques (*Project reference: IC15-CT96-0735).

MULTIMETOX FP5 Growth Programme - RTD: *Metal Oxide Multilayers obtained by Cost-Effective New CVD Technologies for Magnetoelectronic Microsystems and Nanotechnologies* (Project Reference: G5RT-CT-1999-05001).

CoE CEBIOLA, Vilnius University, ENESCO Associated Centre of Excellence for Research and Training in Basic Sciences, Vilnius 2006, Lithuania

Abstract of the project:
The investigation of principles of cell functioning will be a ground of new approaches to biotechnology and biomedicine. Going from cell through sub cellular structures to biomolecules, the minimal systems will be selected to apply to biotechnology. Cell response to treatment will be investigated, cell forces enhancing resistance to treatment will be revealed. Rapid and cost-effective methods for environmental pollution sampling with semi-permeable membrane devices will be developed, and short-term bioassays will be developed. Laser research relevant to new technologies concerned with development of laser instruments for photodynamic tumour therapy and diagnostics, hyperspectral imaging of biological structures and visualisation of tumour tissue, monitoring of environmental pollutants will be carried out. Ultrafast energy transfer processes in objects from simple molecules to biological tissue will be investigated by pico- and femtosecond laser technique.
Visits of researchers, real and virtual conferences, existing and newly established networks will be used to strengthen international links and to create wide and dense network.
Education and training activities involve lectures and practical courses by invited experts, experimental research at the other centres, workshops and conferences.

Authorised contact person:
Dr. Habil., Prof. Algis Piskarskas
E-mail: algis.piskarskas@ff.vu.lt
Phone: +370 5 2366050

9.5. Companies

AB Rapsolis	
Address:	UAB Rapsolis Dovilu sen Klaipedos Raj. 5841 Dovilai Lithuania
General Contacts:	Homepage: www.takas.lt
Description:	Rapsolis is a SME, which manufactures biodiesel. Rapsolis engages in production of demonstration gear, using critical environment (carbon dioxide or water), for production or waste cleaning, seeking sustainable development, reducing production technologies extensions, using nanotechnologies. 2 persons are involved in the nanotechnological field. At the moment Rapsolis main activity is a FP6 project. The general aim of the project is to receive cheap biodegradable polymers. The task is divided into three stages. The end of a stage provides creation of industrial technology. The research works of the first stage provide creation of processes of whole chemical complex on creation of cheap biodegradable polymers in SCFs (supercritical fluids) on a basic of PTA (purified terephthalic acid), BDO (1.4-butanediol) and Adipic Acid. The SCwater technology allows to receive highly effective nano-catalyst, therefore the Project includes research and creation of nano-catalyst for oxidation processes, hydration processes, polymerisation processes and synthesis processes in SCFs. The project provides creation of new principles of effective chemical manufacture. Advantages of chemical manufacture on a basic of SCFs are ecological cleanliness of chemical processes in SCFs and Simplicity of technological process. Absence of the solvents for allocation of the received products from reactor; Reduction of the sizes of reactors and all manufacture at the expense of the large speeds of reactions in SCFs; An opportunity of creating flowing reactor; Reduction of the cost of production (raw materials for manufacturing biodegradable polymers). It will ensure an opportunity of replacing PE packing with biodegradable packing, Universality of SCFs reactor. An opportunity of using of the equipment and reactor for various reactions and processes. Fast change of a direction of manufacture.

	The project represents basic research and applied research of processes in SCFs, which are oxidation, hydration, synthesis, polymerisation and creation of nano-catalyst. The Project provides: Development of technology of Manufacturing PTA; the designing of pilot installation of manufacturing PTA in SCFs; tests and preparation of the initial data for designing the plant; development of technical and economic substantiation of the plant project by capacity of 120-200 thousand tons PTA per one year.
Contact person:	Asta Lapinskiene **Phone:** +370-61-275124 **Fax:** +370-46-397901 asta@rapsolis.lt

9.6. Literature and web-links
Ministry of Education and Science: http://www.smm.lt/smm_english/index.htm
Vilnius Municipality Knowledge Economy web-site: http://www.vilnius.lt/new/en/zekonomika.php
Monkevicius, Algirdas (...): "Lithuania should join common European research and development area creation", published on:http://www.smm.lt/smm_english/Gen_info/Speaches_Present /sp021009_1.pdf
Snirpunas, Antanas (2001): "The present and the future of microelectronics in Lithuania", in "Introduction to Microelectronics", TU Delft, the Netherlands, http://www.elen.ktu.lt/~santana/projects/microelec_in_lithuania.pdf
Vilnius Municipal Government (2002): "Doing Business in Lithuania", published on http://www.lpvp.lt/data/publications/government.php
Lithuanian Development Agency for Small and Medium - Sized Enterprises **Address** : Gedimino ave. 38/2, Vilnius LT - 2600, Lithuania **Phone**: + 370 5 261 92 27 **Fax**.: + 370 5 261 92 07 **E-mail** address : info@svv.lt

9.7 Acknowledgement

Authors: Morten Bøgedal and Signe Holm Pedersen, Nordic Nanotech Denmark E-mail: morten.boegedal@nanotech.dk and signe.holm.pedersen @nanotech.dk

The following persons, Institutions and companies have, by their contribution to Nordic Nanotech, made this report possible:

Director Prof. Dr.Valentinas Snitka, Research Centre for Microsystems and Nanotechnology, Kaunas University of Technology, E-mail: vsnitka@ microsys.ktu.lt

Prof. Sigitas Tamulevicius, Institute of Physical Electronics, Kaunas University of Technology, and E-mail: Sigitas.Tamulevicius@ktu.lt

Dalius Jucius, Institute of Physical Electronics, Kaunas University of Technology, E-mail: Dalius.Jucius@ktu.Lt

Prof. Pranevicius Liudvikas, Physics Department, Vytautas Magnus University, E-mail: Liudvikas_Pranevicius@fc.vdu.lt

Prof. and head of department, Gintautas P. Kamuntavicius, Physics Department, Vytautas Magnus University, E-mail: g.kamuntavicius @gmf.vdu.lt

Prof. Habil.dr. Ricardas Rotomskis, Laser Research center, Vilnius University, E-mail: ricarda.totomskis@ff.vu.lt

Director Algimantas Pauliukonis, Institute of Biotechnology; E-mail: office@ibt.lt

Doctor Irena Simkiene, Semiconductor Physics Institute; E-mail: irena@uj.pfi.lt

Steponas Asmontas, Semiconductor Physics Institute; E-mail: asmontas@uj.pfi.lt

Director Prof. Valdemaras Razumas, Institute of Biochemistry; E-mail: vrazumas @bchi.lt

Dr. Arvydas Tamulis, Institute of theoretical Physics and astronomy, group of Theoretical Molecular Electronics and spintronics, Vilnius, E-mail: tamulis@itpa.lt

Dr. Darius Milcius, Surface Engineering Group, Lithuanian Energy Institute E-mail: milcius@isag.lei.lt

Asta Lapinskiene, UAB Rapsolis
E-mail:asta@rapsolis.lt

10. Malta

10.1. General information

Malta is an archipelago consisting of three inhabited islands, Malta, Gozo and Comino and two other uninhabited islands, Cominotto and Filfla. The Maltese Islands are situated in the middle of the Mediterranean Sea, with Malta lying 93 km south of Sicily and 230 km north of North Africa. The total area of the islands is 316 sq. km (Malta 246, Gozo 67, Comino 2.7) and their total population in 2000 was 382,525 (89 % urban).
The GDP reached 3.9 billions of euros in 2000 and the GDP per capita was 12 600 €.

Figure 21: Map of Malta

The country economy is based on tertiary industries and on industries linked to the activities of its ports.
Although Malta is a small country with a relatively young local manufacturing base, it has developed this sector at a remarkably fast pace. Important traditional sectors (shipbuilding, processed food and beverages, textiles and clothing, plastics and metal products, building materials, furniture and fixtures, giftware and home accessories, cosmetics, etc) are offset by the growth of lucrative, high-tech sectors such as electronic parts, microchips and components and electrical equipment. Malta is scheduled to join the EU in 2004.

Malta assigns top priority to the role of science and technology on the National Agenda. For this reason, in August 1988, the Government set up the **Malta Council for Science and Technology (MCST) as** an advisory body to assist in the formulation of a National Science and Technology Policy. The MCST is responsible for identifying and addressing major science and technology challenges and issues of strategic importance for Malta thereby contributing to the development of coherent and sustainable policy visions and initiatives.

In 1994, the **Foundation for Science and Technology** was established as a public Foundation, to work on the implementation and co-ordination of national science and technology policies under the direction of the MCST. 1994 also saw the adoption by Government of a **National Science and Technology Policy**, which outlines the direction of Maltese future activity in developing effective science and technology policies. Nowadays, the national network of institutions responsible for science and technology policy in Malta is the following :

- **Ministry for Transport, Communications and Technology**
  The Ministry brings under one portfolio a number of agencies which promote S&T or S&T-related activity, namely the Malta Council for Science and Technology, the Telemalta Corporation, the Civil Aviation Department and the Malta Maritime Authority. The Ministry has the key responsibility for implementing the national science and technology policy and for promoting bilateral agreements in science and technology with various countries.
- **Ministry of Education and Human Resources**
  The Ministry's mission is to oversee and plan an ongoing process of reform of the Maltese educational system. One of the key projects of the Ministry is the "I.T. (Information Technology) in Education Project" which is aimed at raising the level of I.T. expertise in Malta to that of the more advanced countries.
- **Ministry for the Environment**
  The Ministry is responsible for the infrastructure, planning, environmental protection, energy and water.
- **Ministry for Food, Agricultural and Fisheries**
  This Ministry focuses on implementing the measures needed to improve farmers' conditions, safeguarding public health and animal health through the veterinary service and securing an economically viable and sustainable development of fisheries and aquaculture. The Ministry's research activity is carried out through the Department of Agriculture's Research and Development branch, the Fisheries and Aquaculture Department, the Animal Health Surveillance Department and the National Aquaculture Centre.
- **Ministry for Economic Services**
  The Ministry's mission is to encourage the strengthening and development of the manufacturing, commercial and services sectors in the light of Malta's application for EU membership. The Ministry plays an important role in attracting direct investment in export oriented and advanced technology manufacturing sector. Through the Malta Development Corporation, concerted efforts are being made to promote the participation of Maltese local companies in the European Community Investment Partnership Scheme.
- **Ministry for Social Development**
  The overall mission of this Ministry is to promote and provide for the health care needs of the Maltese people and to develop and deliver appropriate services for those with special needs. Training and research activities in this sector are carried out at the Ministry's Agency for Drug and Alcohol Abuse (SEDQA), the Medical School, the University of Malta's Faculty of Medicine and Surgery and the Institute of Health Care, and at the United Nations International Institute on Aging (INIA).

- **Foundation for Science and Technology / Malta Council for Science and Technology (MCST)**
  The MCST, which is linked to the Ministry for Transport, Communications and Technology, brings together leading experts and personalities from academia and the public and private sectors through a number of policy-oriented, multisectoral networks focusing on national priorities including the water, energy and marine sectors. The MCST is also responsible for providing an overall focus and strategy for Malta's international relations in science and technology, in close co-operation with the Ministry of Foreign Affairs.

The general national policy objectives in relation to science and technology are "substainable development" and "integrated resource management" and the specific sectoral S&T priorities defined are the following:

- Establishment and implementation of a National Information Technology Strategy covering at least three main concerns: the telecommunications infrastructure, the human resources requirements and the possible identification of niche markets.
- Co-ordination of sea- and land-related activities (ranging from freeport and ship repair activities to fishing and aquaculture and recreational activities including tourism).
- Exploration of alternative, economically feasible, energy-saving and renewable energy applications in order to reduce Malta's dependence on foreign fuel supplies as well as negative environmental impacts. These may range from direct solar heating to photovoltaics, from wind energy to energy-saving buildings.
- Improvement of water production and water use through updated scientific study and technological innovation.
- Setting up of a Remote Sensing Centre to develop scientific capabilities in support of local and regional environmental decision-making, through natural resources management, (land and marine) environmental management, risk and environmental impact assessments.
- Development of the application of biotechnology for instance in the area of medicinal technologies, human and comparative genomes, medicinal and aromatic plants, as well as in the food industry and the production of speciality biochemicals, including biofuels.

But the research priorities do not include nanotechnology (*National Contact Point (NCP) Malta - BORG Jonathan C*).

10.2. National programmes and projects

Malta has neither technology parks nor networks relevant to innovation. But, MCIST and IPSE are creating the Innovation Relay Centre (IRC).

Industrial R&D, Technology transfer & consulting structures:

- Malta University Services Ltd
  Address: University Campus, Msida - Malta
  Phone: +356 331734, 343572, 3290 2324
  Fax: +356 344879
  Website : http://www.cis.um.edu.mt/~mus/welcome.htm
  Malta University Services Ltd. is a limited liability company owned by the University of Malta. Its main objectives are to make the facilities and expertise of the University available on commercial terms to the community at large and to initiate and to promote technology transfer.
  The Company's activities can be grouped into the following divisions:
  - technology transfer & special projects
  - consultancy
  - education and training
  - testing
  - publications
  - environment consultancy unit
  - architectural model making studio
  - market research

Contacts:

Prof. R. Ellul Micallef, Rector of the University and Chairman of the company (Phone : 2340 2202; E-Mail : rector@um.edu.mt)
Prof. Daniel Darmanin Executive Vice-Chairman (Phone: 21333997; e-mail: daniel.darmanin@um.edu.mt)

- Institute for Promotion of Small Enterprises (IPSE)
  Address: Small Enterprise Centre, Marsa Industrial Estate, Marsa LQA 06, and MALTA
  Phone: 2123 3838
  Fax: 2123 4045
  Email: info@ipse.org.mt
  Website : http://www.ipse.org.mt/page.asp?p=5&l=1
  The Institute for the Promotion of Small Enterprise (IPSE) was officially set up in 1998 through a venture involving the Chamber of Commerce, the Federation of Industry and the central Government. IPSE was initially established to assist enterprises restructure their operations in the context of the removal of levies and the impact of a liberalised market. In addition, IPSE was also earmarked to assist enterprises to become compliant with various directives and practices as advocated by the European Union through the Acquis

Communitaire. Now, the Institute also encourages and assists in the formation of new start-up ventures particularly those nurturing innovative concepts to the island. The products and services offered by IPSE are the following :

- Programmes of Assistance,
- Grants and subsidies,
- Diagnostic services,
- Credit Guarantees and High-Risk Capital to facilitate Access to Finance.

The Kordin Business Incubation Centre (KBIC) is another tool operated by IPSE that seeks to promote the growth and success rate of new start-ups. The incubator targets industries that operate in information technology, renewable energy resources and biotech projects. The Centre is located at the Kordin Industrial Estate, Kordin, and Malta
Email Address: info@kbic.com.mt

NATIONAL CONTACT POINT
NMP Thematic Programme of the EC Sixth Framework Programme (FP6)

Dr Jonathan Borg
Address: Department of Manufacturing Engineering, Faculty of Engineering, University of Malta, Tal .Qroqq, MSD 06 Msida/Malta MALTA, Phone : +356-2134 6761, Fax : +356-21343577
URL: http://www.eng.um.edu.mt/~jjborg/jcb.html
Email: jjborg@eng.um.edu.mt
Programme acronym: FP6-NMP

10.3 Universities

The main national centre of scientific and technological research has been and will remain the **University of Malta**. There are a number of fields, which the University has identified as priority areas: engineering, information technology, computer science and artificial intelligence (*National Contact Point (NCP) Malta - BORG Jonathan C*)

Faculty of Engineering / University of Malta	
Address:	Address : Faculty of Engineering / University of Malta Msida MSD 06 MALTA
General Contacts:	**Phone :** +356 2340-2440 **E-mail** : foe@eng.um.edu.mt **Website** : http://www.eng.um.edu.mt
Description:	The Faculty runs a number of laboratories including electrical power and machines, telecommunications, control, electronics and IC design, metallurgy and materials, CAD, manufacturing, industrial automation, industrial metrology, fluids, mechanics, and thermodynamics. The academic staff members of the Faculty are divided into six departments : • Mechanical Engineering, • ***Manufacturing Engineering***, • ***Metallurgy and Materials Engineering***, • Electrical Power and Control Engineering, • ***Microelectronics,*** • Communications and Computer Engineering. The Faculty Members are active in research as well as in engineering consulting and some hold key positions in several industries and institutions around the country. Here are some examples of subjects: cryptography, mechatronics, intelligent systems, finite element stress analysis, ion implantation, laser materials processing, heat treatment, processing and application of polymers, ceramics and composites, quantum well structures, signal processing, neural networks.
Contact:	*Ms. Yvette Attard, Faculty Officer* **Phone:** 3290-2440 **E-Mail:** yyatta@eng.um.edu.mt)

Faculty of Science / University of Malta	
Address:	Faculty of Science / University of Malta Msida MSD 06 MALTA
General Contacts:	**Phone:** (+356) 3290 2362/2450 **Fax:** (+356) 312110 **E-mail:** science@um.edu.mt **Website:** http://home.um.edu.mt/science
Description:	The Faculty of Science includes the following departments: • Biology, • ***Chemistry*** : analytical chemistry, inorganic chemistry, organic photochemistry, modelling of auxetic materials, polymers, colloids and interfaces, environmental geochemistry. • Computer Information Systems, • Computer Science & Artificial Intelligence, • Mathematics, • Physics, • Statistic & Operations Research. In particular, the Department of Chemistry works on ***Physical Chemistry of Gelatin With Respect to Nanoparticle Production and Production of Nanoparticles in Surfactant Media*.**
Contact:	*Ms May Lawrence, Faculty Officer* **Phone:** (+356) 2530 **E-mail:** mlaw2@um.edu.mt *Other Faculty Officer Staff : Ms. Rose Williams* **Phone:** (+356) 3290 2362 **E-mail:** rwil1@um.edu.mt

10.4. Companies

Until some forty years ago, agriculture was widespread and Malta's main industrial activity was based upon ship repair. Today, the country has an industrial sector comprising 23 % of GDP. Malta has welcomed many companies from a wide range of sectors including light and heavy engineering, electronic components and assembly, plastics, pharmaceuticals, software and textiles but it seems to have no companies with activities wholly or partly dedicated to nanotechnologies.

10.5. FP6 collaborations

In 1995, Malta was given the possibility of participating in all the specific programmes of the EU 4th Framework for Research and Technological Development with the exception of the part of the Training and Mobility Programme related to "Training through Research". Then, Malta was associated to the 5th Framework Programme and is also currently participating in FP6.
But, there are no research projects dealing with nanotechnologies, neither for the previous FPs nor for FP6 (EoI and partners).
Nevertheless, we can mention the project "eFORESEE" (Exchange of Foresight Relevant Experiences for Small European and Enlargement Countries (start date January 2002) :
eFORESEE is a two-year EU funded project aimed at anticipating and responding to the needs of policy makers, involved in the formulation and implementation of foresight activities in EU15+ smaller economies and regions. It will define and highlight the strategic role of foresight in the accession process, and in the integration of accession states into a European Research Area. eFORESEE will address decision-making processes involved in setting up foresight activities, as well as the challenge of managing and implementing specific foresight actions. It will look at the Knowledge Management needs of foresight and explore the possibility of applying benchmarking techniques to improve the efficiency of foresight over time. The project will carry out six pilot foresight actions in three countries: Malta, Cyprus and Estonia.
It will focus its effort on the following domains : Nanotechnology and material sciences, environmental sciences, biotechnologies in agriculture, aquaculture and medicine, as well as tourism and cultural heritage.

10.6. Literature and web-links
Government of Malta www.gov.mt
Malta Council for Science and Technology http://www.mcst.org.mt/
National Strategy for Science and Technology Policy www.mcst.org.mt/aboutmcst/strategy.pdf
National Statistics Office of Malta http://www.nso.gov.mt/
Malta Federation of Industry http://www.foi.org.mt
University of Malta www.um.edu.mt
Enterprises Directorate-General of the European Commission, "Innovation Policy in Seven Candidate Countries: the Challenges", Summary of main findings of first interim report, May, 2002. ftp://ftp.cordis.lu/pub/innovation-policy/studies/studies_seven_candidate_countries_interim_report.pdf

10.7. Acknowledgement

Sandrine Locatelli and Carole Nicollet have written this Chapter.

11. Poland

11.1. General information

Poland is a Central European country with 39 million inhabitants. GERD is 0.47% of GDP. The Polish share in world publication output has for many years amounted to 1 percent, occupying 21th place in the world as regards scientific publications output.

Figure 22: Map of Poland
(Source: http://forum.europa.eu.int/irc/dsis/candidate/info/data /candidate countries/)

Since 1991 the State Committee for Scientific Research KBN has been responsible for research policy and distribution of research funding. KBN is divided in 12 disciplinary units. (website www.kbn.gov.pl) According to Professor Michal Kleiber, Minister of Science and Chairman of KBN, the policy of the Polish Government is to develop a more efficient Polish research system by 2006, and to substantially increase funding for R&D to 3% of GDP. Funding is available for statutory research tasks of scientific institutions; infrastructure; competitive peer reviewed projects; co-funded applied research projects together with users; international collaborations and supporting research activities. (KBN, 2001)

In view of the poor financial means at the Polish research institution's disposal, discussing any priorities in scientific research is difficult. Nevertheless the government's new Economic Strategy defines clearly the preferred fields of scientific research and development. In accordance with the Strategy's plan the following are to be treated as priority fields:

- biotechnology including genetic engineering
- informatics and telecommunication

- microelectronics and nanotechnologies
- robotization and automation
- new material technologies
- alternative and renewable sources of energy
- health and environment protection

The financial policy of the State Committee for Scientific Research connects these priorities with four special sections of research - ***INFO, BIO, TECHNO, EDU***. The intention is that these sections are to cover special areas of Polish science and have to be extended in future. In part these priorities have been selected with reference to the FP6 framework priorities and participation in the EU Framework programmes is a preferred way of developing the national scientific research infrastructure. Poland manages to receive more European funding than they pay for. (Kleiber, 2002)

Poland co-operates with over 50 countries in the area of science and technology and is involved in ca 1100 projects. In 1999, Poland became a associated country to the 5th Framework Programme of the European Union for Research, Technological Development and Demonstration Activities. Furthermore, Poland is a partner to such international programmes as EUREKA, COST, NATO scientific projects.

NATIONAL CONTACT POINT
NMP Thematic Programme of the EC Sixth Framework Programme (FP6)

Mr Zbigniew Turek
Address: IFTR PAS, Institute of Fundamental Technological Research, Polish Academy of Sciences, Swietokrzyska 21, PL-00-490, Warsaw, POLAND, Tel: +48-22-8287481, Fax: +48-22-8285370
URL: http://www.npk.gov.pl
Email: zturek@ippt.gov.pl
Programme acronym: FP6-NMP

11.2. Nanotechnology Research Networks

Poland hosts two specialised nanotechnology research networks. These networks work in tandem with the Centres of Excellence and competence to link Polish researchers and overseas researchers.

FAMA unites 21 Polish partners in research in advanced functional materials. http://sp.itme.edu.pl/fama/fama_ang.htm

The "**Interfacial Effects of Nanostructured Materials"** network led by The High Pressure Research Centre of the Polish Academy of Sciences involves 18 partners from Poland, Russia and Ukraine. The network is funded by the European Commission and the Polish government (KBN). Focus of the research is metallic, ceramic and organic nanomaterials. The network is subdivided in four working groups:

- nanostructured materials produced by severe plastic deformation;
- synthesis and sintering of nanocrystalline powders for optoelectronic applications;
- polymer nanoparticles composites;
- magnetic nanomaterials (being formed).
- Source: Lojkowski, 2002 , http://www.unipress.waw.pl/CE/

Wroclaw Group on Sol-Gel and Nanotechnology, Wroclaw

Research focuses on fabrication and study of ceramic, metallic and organic nanocomposites using sol-gel techniques. Includes: CELTAM, Institute of Low Temperatures and Structure Research, PAS, Wroclaw (Strek) and CoE MAREC, Wroclaw Institute of Technology, Wroclaw (Maruszewski), http://www.unipress.waw.pl/CE/Network/08/main.html

11.3. National programmes and projects

There is a national programme of centres of excellence and competence, which funds innovative research in many areas including nanotechnology.

Centres of Excellence and Centres of Competence in Nanotechnology
http://www.npk.gov.pl/centra_dosk/index_en.html & http://www.6pr.pl/coe/i.html These centres serve as a hub for teams of scientists with outstanding achievements who cooperate in the areas of common interest and of large significance for national economies. This role supports the innovative activity of the centre and boosts the promotion of research, technology and products at home and abroad

Micro- and Nano-Technology Applied Research Centre
Institute of Electron Technology (ITE)
32/46 Lotników Al., 02-668 Warszawa, Poland
(48-22) 548-78-80; (48-22) 548-78-82
The MANTARC centre focuses on applied research in the field of integrated microelectronic, micromechanical and optoelectronic systems and devices. The Centre aims at becoming a national resource for applications of MEMS/MOEMS microtechnologies in order to meet scientific and technical challenges of the industry.
The most important topics of the research and development activities include:

- development of new electrical, photoelectrical and SEM/TEM methods
- photodetectors including silicon avalanche photodiodes,
- silicon sensors for physical and chemical quantities,
- micro- and nano-probes for 3D surface analysis with scanning atomic force microscopy,
- analogue and digital specialised integrated circuits and systems, including Application Specific Integrated Circuits (ASIC's) and Systems on Chip (SoC),

Contact: Piotr Dumania, Ph.D pdumania@ite.waw.pl

High Pressure Methods in Optoelectronics, Nanotechnology and Biotechnology
High Pressure Research Center
Polish Academy of Sciences
29/37 Sokołowska Str., 01-142 Warszawa, Poland
(48-22) 632-50-10; (48-22) 632-42-18
The largest high-pressure research center in West and Central Europe combines basic research and applications. The main fields of research are solid state physics, materials science and biotechnology. Within the Center of Excellence project areas or research include

- development of nitride-semiconductor blue- and UV-light emitters,
- synthesis of nanocrystalline powders and sintering of nanocrystalline ceramics
- development of high pressure equipment.

Contact: Witold Łojkowski wl@unipress.waw.pl

Centre for Knowledge Based Materials and Technologies
Technical University of Szczecin
17 Piastów Alee, 70-310 Szczecin, Poland
(48-91) 4494730; (48-91) 4496886
Technology of nanostructural forms of carbon is the main focus of the centre.
Advanced functional materials including superconductors, ferroelectric, polymeric and magnetic materials s for use in electronics and in optoelectronics new membrane technologies in applications leading to pure technologies, limited energy consumption.
Contact: Prof. Dr. Ryszard J. Kaleńczuk rk@mailbox.ps.pl

NanoCentre
Warsaw University of Technology
Faculty of Materials Science and Engineering
141 Wołoska Str., 02-507 Warszawa, Poland
(48-22) 849-99-29 / 660-85-14
The research in the Centre is organised around three areas: processing, modelling and characterisation of structure and properties of nanomaterials. The research in processing is carried out in the areas of permanent magnet materials, soft magnetic materials, intermetallics, aluminium-based structural materials, nanocomposites, very hard coatings etc. The applied processing techniques are, e.g., mechanical alloying, rapid solidification, severe plastic deformation, CVD, PVD, impulse plasma deposition. Modelling is the growing area of interest, and the recent developments here are: modelling of texture formation in nanocrystalline permanent magnets, modelling of crystallographic structure of nanocrystalline materials
Contact: Prof. Tadeusz Kulik wim@inmat.pw.edu.pl

NANODIAM - New Technologies for Medical Applications: Studying and Production of Carbon Surfaces Allowing for Controllable Bioactivity
Technical University of Łódź
1 Stefanowskiego Str., 90-924 Łódź, Poland
48-42) 631-22-77; (48-42) 631-22-79
The research interest of the Centre focuses on study and production of new materials with intentionally modified surfaces, exhibiting variety of properties designed for controllable bioactivity.
Contact: Prof. Stanisław Mitura mitura@ck-sg.p.lodz.pl

Nanometer-scale Science and Advanced Materials
Jagiellonian University
4 Reymonta Str., 30-059 Kraków, Poland
(48-12) 632-48-88; (48-12) 633-70-86
The NANOSAM Centre is concerned with

- Electronic and atomic properties of nanoscopic systems.
- Nano-scale modification of surfaces.
- Biological materials at nanoscale.

- New liquid crystalline materials.
- Polymer materials, especially polymer mixtures.
- Magnetic properties, including magnetic and electronic structure of rare-earth RmTnXp intermetallics (R - rare-earth atom, T - transition d-electron atom, X - p-electron atom).
- pin reorientation phenomena in R2Fe14B - type intermetallic compounds. Superconductivity.

Contact: Prof. Marek Szymoński szymon@castor.if.uj.edu.pl

CEPHONA Physics and Technology of Photonic Nanostructures
Institute of Electron Technology
32/46 Lotników Al., 02-668 Warszawa, Poland
(48-22) 548-79-32; (48-22) 847-06-31
The main research focus of the Center concentrates on the subject of Physics and Technology of Photonic Nanostructures in three main fields:

- Microcavity physics, technology and applications;
- High power semiconductor lasers;
- Development of new technologies for photonic devices and systems and increase of the level of applied research.

Contact: Prof. Maciej Bugajski, Ph.D. bugajski@ite.waw.pl

MMMFE Centre of Excellence for Magnetic and Molecular Materials for Future Electronics
Institute of Molecular Physics
17 Smoluchowskiego Str., 60-179 Poznań, Poland
(48-61) 869-51-52; (48-61) 868-45-24
The main goal of the Centre is to intensify the research in magnetic, molecular and dielectric materials for future applications in novel electronics.
Contact: Bogdan.Bulka@ifmpan.poznan.pl

Sol-Gel Materials and Nanotechnology
Technical University of Wrocław
25 Smoluchowskiego Str., 50-370 Wrocław, Poland
(48-71) 320-21-18; (48-71) 321-12-35
The following technology themes are under current development in the Center of Excellence: fabrication of porous monolithic and thin film glasses, fabrication of glasses doped with transition metal and rare earth ions, fabrication of optical sensors (optodes) of various physical and chemical parameters, fabrication of nanometric crystallites, fabrication of pure and doped submicron spherical particles
Contact: Prof. Krzysztof Maruszewski marusz@immt.pwr.wroc.pl

Thermodynamic Laboratory for Environmental Purposes
Institute of Physical Chemistry
44/52 Kasprzaka Str., 01-224 Warszawa, Poland
(48-22) 632-32-21
TALES main area of research comprises theoretical chemistry, physical chemistry

and chemical engineering as well as applications of new methods in industrial technology.
Contact: M.A. Magdalena Wawrzyniaktales@ichf.edu.pl

CoE AMAS, Institute of Fundamental Technological Research, PAS, Warsaw
Institute of Fundamental Technological Research
21 Świętokrzyska str., 00-049 Warszawa
(48-22) 8287479; (48-22) 8287480
www.ippt.gov.pl/amas
The research focuses on theoretical and experimental studies of the development of polymer structures on nanoscale, and other modelling and characterisation of crystalline and other nanostructures.
Contact: Andrzej Jarzebowski, ajarzeb@ippt.gov.pl

11.4. The Research institutes and their expertise

Institute of Molecular Physics, Polish Academy of Sciences, Poznan	
Address:	ul. Mariana Smoluchowskiego 17 60-179 Poznan, Poland
General Contacts:	**Phone:** +(48 61) 8695100 **Fax:** +(48 61) 8684524 http://www.ifmpan.poznan.pl/
Description:	Here research is carried on the physics of Dielectrics, Magnetism and Magnetic Materials and Radiospectroscopy. The Centre of Excellence for "Magnetic and Molecular Materials for Future Electronics" was established at the Institute, which operates from December 2002 to December 2005 within the 6th Framework Program of the European Commission.
Contact:	Prof. Bogdan Bulka, centre@ifmpan.poznan.pl

Polish Academy of Sciences (PAS), Lodz	
Address:	Sienkiewicza 112 90-363 Lodz, Poland
General Contacts:	**Phone:** (+042) 6815832
Description:	There are two research centres of the PAS in Lodz.
Centre of Molecular and Macromolecular Studies	
Contact:	www.cbmm.lodz.pl Professor Marian Mikołajczyk, marmikol@bilbo.cbmm .lodz.pl
Description:	The centre employs about 150 researchers focusing on structural studies of materials on molecular, macro-molecular and supra-molecular levels. In 2000, the European Commission selected the Centre of Molecular and Macromolecular Studies as one of the European Centres of Excellence based on their proposal entitled: "Designed Molecules and Macromolecules; Their Assemblies and Biological Functions" (DESMOL)
Centre for Physics and Fabrication of Low-dimensional structures	
Contact E- mail:	http://info.ifpan.edu.pl, Professor Marian Mikołajczyk director@ifpan.edu.pl
Description:	This centre, CELDIS for short, consists of 15 of the IoP's 25 laboratories, which focus on education and research in solid state physics, mainly semiconductors and magnetic materials. The research is targeted to low-dimensional nanometre structures, including quantum dots, wires and wells. Applications are foreseen in spintronics, and among the centre's key aims are networking inside Poland and internationally and educating the nano-workforce.

High Pressure Research centre UNIPRESS, PAS, Warsaw.	
Address:	Sokolowska 29, 01-142 Warsaw, Poland
General Contacts:	http://www.unipress.waw.pl/~nano/
Description:	This institute has world-class high-pressure equipment for multidisciplinary research, including nanomaterials. The laboratory of nanomaterials work on synthesis, characterisation and sintering of *bulk* nanometric materials. They also work on structural characterisation of polycrystalline nanomaterials from X-ray diffraction and, in co-operation with other research groups, investigate their basic crystallite size-dependant properties.
Contact:	Witold Lojkowski, wl@unipress.waw.pl

Smart tech, Institute of Fundamental Technological Research, PAS, Warsaw	
Address:	ul. Świętokrzyska 21; 00-049 Warszawa; Poland
General Contacts:	**Phone:** (48-22) 826 12 81 **Fax:** (48-22) 826 98 15, 826 73 80 http://www.ippt.gov.pl/
Description:	The centre specialises in design and modelling of smart materials and mechatronics, including nanomaterials. The Institute plays an increasingly important role in the development of new technologies, in the construction of research equipment and development of modern methods of measurement.
Contact:	Prof. M. Kleiber jknabel@ippt.gov.pl

Institute of Materials Science and Applied Mechanics, Wroclaw	
Address:	Mechanical Faculty Wroclaw University of Technology Wybrzeże Wyspiańskiego 27 50-370 Wrocław
General Contacts:	Institute Director Dr. Jerzy Kaleta kaleta@immt.pwr .wroc.pl **Phone:** +48 (71) 320-27-65 **Fax:** +48 (71) 321-12-35 http://www.immt.pwr.wroc.pl/eng/
Description:	Institute research activity include Dimensional analysis and theory of similarity, structural studies, biomechanics, dynamics of mechanical systems, strength hypotheses, elasticity and plasticity theory, materials technology (nano-materials, new plastics and their technology, reinforced composite structures, changes in microstructure and material properties, sol-gel technology), fracture mechanics and the fatigue of materials, methods of experimental mechanics, modelling of processes in mechanics, rheology, strength of materials, recycling of plastics. The institute houses two Centers of Excellence for: • Sol Gel Materials and Nanotechnology (SGM&N) • Materials Recycling (MARECEX)

	Institute equipment: hydraulic pulsators MTS 810, optical and electron microscopes, X-ray diffractometers, vibration analyser of structures and all kind of equipment recording and processing signals of mechanical, thermal, magnetic and acoustic quantities which accompany the failure of materials and structures.
Contact:	Marek Rybaczuk, marek.rybaczuk@immt.pwr.wroc.pl
Description:	The group of Rybaczuk specialises in computer modelling of complex systems including damage processes in smart and composite materials. http://smartsite.immt.pwr.wroc.pl/index/multimod
Contact:	Dr. Krysztof Widanka, widanka@immt.pwr.wroc.pl
Description:	The group of Widanka investigates the microstructure of sintered iron and steel. http://www.immt.pwr.wroc.pl/eng/
Contact	Krzysztof Maruszewksi maruszewski@immt.pwr.wroc.pl
Description:	The group of Professor Krzysztof Maruszewksi applies sol-gel materials to a broad range of applications. http://smartsite.immt.pwr.wroc.pl/index/sgmn
Centre for Physics and Fabrication of Low-dimensional structures	
Contact:	Dr Maciej Kulisiewicz M.Kulisiewicz@immt.pwr.wroc.pl
Description:	The group of Dr Maciej Kulisiewicz models non-linear dynamic systems including nanocomposites. http://smartsite.immt.pwr.wroc.pl/index/eassma/

ITME, Institute of Electronic Materials Technology, Warsaw	
Address:	133, Wolczynska Street 01-919 Warsaw, POLAND
General Contacts:	**Phone:** (48) (22) 835 30 41 **Fax:** 48) 39 12 07 64 http://www.itme.edu.pl/
Description:	The institute specialises in technology of advanced materials including nanoelectronics materials, ceramics, optical materials and composites.
Contact:	Dr inź. Selim Achmatowicz itme@sp.itme.edu.pl

IMN, Institute of Non-Ferrous Metals, Gliwice	
Address:	ul. Sowińskiego 5, 44-100 Gliwice, POLSKA
General Contacts:	**Phone:** (48-32)2380-200 **Fax:** (48-32)2316-933 http://www.imn.gliwice.pl/

Description:	Research focuses on non-ferrous metals, including nanostructured hard metals, composites, magnetic materials.
Contact:	Krystyna Anyszkiewicz :krystynaa@imn.gliwice.pl

11.5. Universities

University of Technology, Warsaw Faculty of Materials Science and Engineering	
Address:	Wołoska 141, 02-507 Warszawa
General Contacts:	**Phone:** (+48 22) 849-99-29 **Fax:** (+48 22) 660-85-14 http://www.inmat.pw.edu.pl/
Description:	The Faculty is a leading centre in both fundamental and applied sciences with research programmes in • Fundamentals of Materials Science • Materials Design • Structural and Functional Materials • Surface Engineering The main areas of scientific research include: impulse-plasma synthesis of nanocrystalline powders and intermetallics, amorphous and nanocrystalline materials, advanced ceramic materials, polymer and composite materials, intermetallics, biomaterials, magnetic materials, materials for catalysis
Contact:	Professor T. Kulik Ph.D., D. Sc.tkulik@inmat.pw.edu.pl

Technical University of Lodz, Department of Chemistry, Lodz	
Address:	Technical University of Łódź 1 Stefanowskiego Str., 90-924 Łódź, Poland
General Contacts:	**Phone:** 48-42) 631-22-77 **Fax:** (48-42) 631-22-79 http://www.p.lodz.pl/
Description:	The principal research theme is polymer nanocomposites with research work on the synthesis of nanofillers and organic-inorganic hybrids, the characteristic of nanofillers, preparation of nanocomposites, studies of their rheological properties, morphology and structure, Phenomena occurring in the systems: adsorption, migration, phase separation, surface segregation, crosslinking, degradation, crystallisation.
Contact:	Ludomir Slusarski sludpolp@ck-sg.p.lodz.pl http://www.unipress.waw.pl/CE/Network/09/main.html

Krakow Academy of Mining and Metallurgy, Krakow	
Address:	AGH University of Science and Technology,Mickiewicz Avenue 3030-059 Krakow
General Contacts:	(48 12) 633 49 98; (48 12) 633 46 72 http://www.uci.agh.edu.pl/

Description:	The research focuses on synthesis and characterisation of nanopowders, including ceramics, carbon and carbon-plastic biomaterials.
Contact:	Krzysztof Haberko, : haberko@uci.agh.edu.pl

Wroclaw University of Technology, Physics Department, Wroclaw	
Address:	Wybrzeże Wyspiańskiego 27 50-370 Wrocław, Poland
General Contacts:	**Phone:** 48 (71) 320 25 79 **Fax:** +48 (71) 328 36 96 http://www.if.pwr.wroc.pl/en/index.html
Description:	The group specialises in theoretical studies of the application of quantum dots for nanotechnology.
Contact:	Lucjan Jacak, jacak@if.pwr.wroc.pl

11.6. Companies

"Independent" PIAST SNT	
Address:	PIAST-SNT 30-837 KRAKÓWul. Aleksandry 5/125
General Contacts:	**Phone:** 12 638-33-78
Description:	This is a small Consultancy/Research SME, which develops and prototypes sensors. A main area of interest is in electrotribological friction composites
Contact:	Habdank Wojewodski, piastsnt@poczta.onet.pl

11.7. FP6 collaborations

Polish research organisations were involved in expressions of interest in 75 nanotechnology related integrated proposals and 45 nanotechnology related networks of excellence.(http://eoi.cordis.lu/search_form.cfm).

The company independent PIAST SNT wants to collaborate in electrotribological friction composites (7/3/2003) (www.cordis.lu).

Wroclaw University of Technology, Wroclawis seeking partners to apply quantum dots in nanotechnology (20/1/2003). The institute of materials science and applied mechanics at the same university has published 5 partner search items: to model damage processes in smart and composite materials; on sintered iron and steel; on sol-gel materials and nanotechnology; on mechanical properties of advanced materials; on smart magnetic materials and applications; and on natural gas vehicles. www.cordis.lu

11.8. Literature and web-links
The State Committee for Scientific Research KBN: http://www.kbn.gov.pl/en/index.html
Central web-site on Poland in English http://www.poland.pl/index.htm
Central web-site on science in Poland: http://main.amu.edu.pl/~zbzw/ph/sci/naupol.htm
Polish RTD Potential: http://www.6pr.pl/coe/
KBN (2001): .Science in Poland., published online on www.kbn.gov.pl/en/science/kbn.htm
Kleiber, M. (2002): "Polish Research System - evolution towards better efficiency", published online on www.kbn.gov.pl/en/research.html
Lojkowski, W (2002): "Network of Centres of Excellence -Interfacial Effects, Novel Properties and Technologies of Nanostructured Materials", paper presented at EMRS fall meeting 2002, http://www.unipress.waw.pl/CE/Network/network.pdf

11.9. Acknowledgements:

This chapter has been written by Oonagh Loughran, with valuable contributions from Ineke Malsch, Dr. Antonio Correia, Prof. Bogdan Bulka and Prof. Witold Lojkowski Head of laboratory of nanocrystalline materials, High Pressure Research Center of the Polish Academy of Sciences, Sokolowska 29, 01-142 Warsaw, Poland (wl@unipress.waw.pl)

12. Romania

12.1. General information

Romania is a southeast European country with about 22.3 million inhabitants (Pop2002). Gross expenditure on R&D (GERD) was 0.37% in 2000, which has decreased from 0.80% in 1998 (Statistic2003). Responsible for Research is the ministry of Education and Research. The government programme 2001-2004 sets out a strategy including for Scientific Research. They intend to develop a National Research and Development System. This system includes defining the strategic fields and priority funding, diversifying funding sources and evaluation of results. The system will be adapted to integration in the European Research Area. Labs will be equipped with ICT, and the government facilitates co-operation projects and centres of excellence for international collaborations as well as regional and national industrial development. (Government programme, 2001) This strategy development is well underway, and explicitly includes nanotechnology.
The IMT Research Institute in Bucharest is the nucleus for the nanotechnology networks and programmes in the country. It also acts as a "bridgehead" to integrate Romanian nanotechnology research into the European Research Area ERA.

Figure 23: Map of Romania
(Source: http://forum.europa.eu.int/irc/dsis/candidate/info/data/candidate countries/)

NATIONAL CONTACT POINT
NMP Thematic Programme of the Sixth Framework Programme (FP6)

Ms. Letitia Stanila and **Mr. Serban Panaitescu**
Address: Ministry of Education and Research
str.Mendeleev 21-25, RO-70168, Bucharest, ROMANIA
URL: http://www.mct.ro
E-mail: claras@mct.ro
Programme acronym: FP6-NMP

12.2. National programmes and projects

In Romania co-ordinated activities in nanotechnologies started in February 2000. Funding from national sources for multidisciplinary projects in the "nano" field were provided starting late spring 2000. The nano-activities started with the MICRONANOTECH network at The National Institute for Research and Development in Microtechnologies (IMT) in Bucharest.

Today, there are six research networks in the micro-nano domain; four of them registered as "nano" networks in the database of the European Commission. The networks started their activities in 2001; four of them are financing multidisciplinary training. The other two are distributed virtual centres of excellence, co-ordinated by IMT (Ref:1st NanoForum Workshop: Nanomaterials and Applications).

After a national call for proposals in 2001, 108 collaborative projects, 3 single beneficiary projects and 7 priority projects have been selected. Of the 134 partners, 49% are research organisations, 13% large companies and 38% SMEs.

There is currently one national research programme in nanotechnology, called **MATNANTECH** (New Materials, Micro and Nanotechnologies) that provides funding for both research and infrastructure projects. It started in 2001 and has a total budget of 6.53 Million Euros. MATNANTECH consists of 10 programmes

MATNANTECH Programmes		
	Programme	**Percentage of budget (%)**
1	Composite materials	15
2	Intelligent materials	5
3	Biosubstances and biomaterials	5
4	Advanced materials with electrical, optical, magnetic and thermomechanical properties	10
5	Materials for process engineering, chemical and environmental applications	10
6	Powder synthesis and optoelectronics	10
7	Micro and nanoelectronics and optoelectronics	15
8	Micro and nanotechnologies for interfaces, transducers and microsystems	10
9	Nanostructured materials, micro and nanostructures	10
10	Development of facilities and R&D and innovation services in the field new materials, micro and nanotechnologies	10

MATNANTECH funds several dedicated research networks including:
(Sources: Bazu & Dascalu, 2003, and http://www.imt.ro/MNT/V2N23/ Page_4.pdf)

- MINAMAT-NET: Characterisation of materials and structures for micro and nanoengineering - Research Laboratories Network (http://www.imt.ro/MINAMAT-NET/Defaultenglish.htm,
  contact: Dr. Raluca Muller, ralucam@imt.ro)
- BIONANONET: Bionanotechnology Network aims to bring together research, medical professionals and SMEs interested in biomedical nanotechnology. (http://www.imt.ro/BIONANONET/Defaultengleza.htm, contact: Roxana Vasilco, IMT Bucharest, roxanav@imt.ro)
- NANOTECHNET: Romanian Network on Nanotechnology. This network runs from 2001 to 2004, and has 18 partners. The focus is on multidisciplinary education and training. (http://www.imt.ro/NANO TECHNET_PUB/En/default.asp,
  Contact: Dr Marius Bazu, mbazu@imt.ro)
- 3N: consulting centre in Nanomaterials, Nanostructures and Nanotechnology,
  Contact: Dr. Irina Kleps, irinak@imt.ro
- CENOBITE: Network of Centres of Excellence in Nanobiotechnology. This network started in 2002, and funds equipment, and promotes international research collaborations. This network is grouping research labs from physics, chemistry, biology, medicine, pharmacology and engineering.
  Contact Dr Marius Bazu, mbazu@imt.ro.

The MATNANTECH also finance NANOMATFAB, NaNOtechnology for new MATerials and FABrication processes. NANOMATFAB is a consortium of the Romanian research institutes that are partners in the nano-projects to be financed as “new instruments” after the first call of FP6 (http://www.nanoforum.org/events/workshop/Dascalu.pdf).

Furthermore MATNANTECH provides funds to project SINEMA (2001-2004): Porous silicon matrix for biomedical applications. The project is co-ordinated by Centre of Nanotechnologies; National Institute for Research and Development in Microtechnologies (IMT-Bucharest) and the partners in the project are the National Institute for Research and Development in Material Physics and the Institute of Biochemistry, Bucharest.

12.3. The Romanian Consortium for Nanoscience and Nanotechnology

The “Romanian Consortium for Nanoscience and Nanotechnology” (RCNN) is emerging rapidly as a “coalition” of the most motivated members from the institutes and research centres, nowadays involved in networks and research projects in nanotechnology. The RCNN may evolve as an association, which will continue the activity of the existing research networks that are financed up to 2004 or 2005. Also RCNN will be dedicated to a better management of knowledge required for the interaction of research with both education and industry..

The RCNN activities are summarised as:

- Dissemination, training and networking at the national level, using the national networks
- Co-ordinate the participation in the FP 6
- Perspective to provide dissemination, training and networking in ACC countries (Eastern Europe).
- Development of the International Centre for Innovation and Education in Nanotechnologies (INCENTIVE: NANO).

12.4. The research institutes and their expertise

Institute of Physics and Nuclear Engineering Magurele-Bucharest			
Address:	St. Atomistilor no. 407, P.O.Box MG-6, R.O.-76900 Bucharest - Magurele, Romania		
Institute General Contacts:	**Tel:** +40 1 78 07 040, **Fax:** +40 1 42 31 701 **E-mail:** secretar@ifin.nipne.ro **Website:** http://www.nipne.ro		
Description:	Research focuses on interface effects in metal-C60 nanocomposites, metallic nanostructures and catalytic systems. http://www.unipress.waw.pl/CE/Network/05/main.html		
Contact Persons, Field & E-mail:	M. Mirea	CE IDRANAP	mirea@ifin.nipne.ro
	D. Pantelica	Thin Films, Rutherford Backscattering	pantelica@ifin.nipne.ro
	Paduraru	Clusters in Molten Metals, Neutron Scattering	paduraru@ifin.nipne.ro
	M. Apostol	Nanostructures	apoma@theory.nipne.ro

National Institute of Materials Physics Bucharest-Magurele			
Address:	Atomistilor St., 1, sector 5, Bucharest-Magurele P.O. Box: MG-7, Ro 76900, Romania		
Institute General Contacts:	**Tel:** +40 1 780 4375, **Fax:** +40 1 423 1700 **Website:** www.alpha2.infim.ro or http://www.imt.ro/Nexus/Members/IFTM.htm Radu Ionescu, e-mail: rionescu@alpha2.infim.ro Ana Vancu, e-mail: anina@alpha2.infim.ro Magdalena Lidia Ciuream, e-mail: ciurea@alpha1.infim.ro		
Group: Lab of Low Dimensional Systems	The Laboratory of Low Dimensional Systems studies surfaces and interfaces, nanocrystals, magnetism and electronic effects, etc.		
Contact Persons, Field & E-mail:	Dr. Magdalena Ciurea; Head of the lab	Nano-Holes, Electroluminiscence	mciurea@alpha1.infim.ro
	Dr Christian-Mihail Teodorescu,		teodorescu@alpha2.infim.ro

Other researchers:	S. Frunza	Nanoclusters in alkali ha lides, Optical, IR, raman, etc	frunza@alpha1.infim.ro
	M. Nedelcu	Pulsed Electrochemistry	nedelcu@alpha1.infim.ro
	M. Sima	Cd-S nanowires, electrochemistry	sima@alpha1.infim.ro
	S. Nistor	Induced Nano-Clusters, Spectrometry, TEM, EXAFS	snistor@alpha1.infim.ro
	D. Macovei	Fullerene-Metal Contacts, X-rays	macovei@alpha1.infim.ro

National Institute of Lasers, Plasma and Radiation **Magurele-Bucharest**	
Address:	Atomistilor 1, P.O. Box MG-36, Magurele-Bucharest R-76911, Romania
Institute General Contacts:	**Phone:** +40 1 42 31 226; **Fax:** +40 1 42 31 791 **Website:** http://alpha2.infim.ro/~ltpd/
Group: Laser Photochemistry Laboratory:	The Laser Photochemistry Laboratory (LPL) applies laser pyrolysis techniques to nanopowder and thin film synthesis. Due to the versatility of the laser pyrolysis method, the LPL could develop several research directions in the field of nanomaterials: • iron carbides • filamentary iron/iron oxide nanoparticles • nanocarbons • iron/carbon composites (core-shell structures) • gamma iron oxide nanopowders • titanium-doped gamma iron oxide • carbon fibres and nanotubes • metal-polymer nanocomposites
Expertise:	The application of the laser pyrolysis technique in the gas phase for the synthesis of different nanopowders and composites has given the following results: Soot containing different carbon nanoparticles were obtained by the laser pyrolysis of different hydrocarbons • Nanometric size γ-Fe2O3 particles were obtained from gas-phase reactants (iron pentacarbonyl (vapors) and air as oxygen donor) • Different titanium-based iron oxide nanocomposite

	powder prepared from TiCl4/Fe(CO)5/ air/ C2H4 precursors show different degrees of titanium incorporation, mainly by simply penetrating the iron oxide network (mean sized between 1.5 and 8 nm) • Filamentary iron nanostructures were obtained from laser-induced pyrolysis of iron pentacarbonyl and ethylene mixtures • Single-step experiment was leading to the synthesis of Fe-C nanocomposite formed of iron nanoparticles (4.5-6 nm mean diameters) with a low degree of agglomeration, which are covered by carbon layers • Preliminary CVD experiments demonstrate the catalytic properties for growing fibers/nanotubes of the as-prepared Fe-C nanocomposite See additional information on: http://www.nanoforum.org/events/workshop/orals/Morjan1NewTrends.pdf		
Contact Person, Field & E-mail:	Dr. Ion Morjan		morjan@ifin.nipne.ro
Group: Laser Surface Plasma Interactions Laboratory:	The Laser Surface Plasma Interactions Laboratory synthesises and deposits bioactive and other thin films on surfaces.		
Expertise:	• Nanostructured materials • Thin films depositions and characterisation • Laser processing • Biomedical applications • Optical materials • Laser enhanced and conducted chemical reactions		
Contact Persons, Fields & E-mails:	Prof. Ioan N. Mihailescu		mihailes@ifin.nipne.ro
	D. Dumitras	Bio-clusters	dumitras@ifin.nipne.ro
	Morjan	Nanotube, Laser Deposition	morjan@ifin.nipne.ro
	C. Grigoriu	Nano- AlO, Laser deposition	grigoriu@ifin.nipne.ro

National Institute for Materials Physics (NIMP)	
Address:	Strada Atomistilor 105 bis , P. O. Box MG-7, 76900 Bucuresti-Magurele, Romania
Institute General Contacts:	**Phone:** + 40 21 49 30 195, **Fax:** + 40 21 49 30 267 **E-mail:** frunza@alpha1.infim.ro **Website:** http://www.infim.ro/
General Description:	The National Institute for Materials Physics is one of the physics institutes belonging to Institute of Atomic Physics (IFA-Bucharest-Magurele), one major research

	centre in Romania.
Group: Laboratory of Optics and Spectroscopy	**Website:** http://www.infim.ro/lab160/lab160.html
Expertise:	• Optical and electrical properties of organic crystals • Electrochemical studies on metals and conducting polymers. • Photoluminescence studies. • Metallic nanoclusters in alkali halides. • SERS studies on thin films. • Lyotropic liquid crystals. • Nematic liquid crystals confined to nanoporous systems.
Contact Person & E-mail:	Monica Enculescu — mdatcu@alpha1.infim.ro

National Institute for Research and Development in Microtechnologies (IMT-Bucharest)	
Address:	Erou Iancu Nicolae 32 B, Bucharest, Romania
Institute General Contacts:	**Phone:** +40 21 49 08 12, **Fax:** +40 21 49 08 238 **Website:** http://www.imt.ro/
General Manager:	Prof. Dan Dascalu, e-mail: dascalu@imt.ro
General Description:	Main activities include the theoretical studies and experimental technologies in nanomaterials and nanostructures. Main areas of expertise: silicon nanoelectrode arrays, low-frequency noise in nanostructured materials; porous silicon layers; field emission nanostructures; biofunctional nanostructures and interfaces. One of the project of the institute is on Variable-Range Hopping in Platinum Nanoparticle films. The project is carried out with the collaboration of the Department of Physics, Transilvania University and the National Institute for Laser, Plasma and Radiation Physics.
Group: Microphysical Characterization and Microphotonics	
Contact Person & E-mail:	Raluca Muller, ralucam@imt.ro
Expertise:	• Organisation of scientific conferences • Education (specific courses and student laboratories) and training by research • Charge and interface states characterisation in the Si/SiO2 system • Electrical characterisation of materials and devices

	• x-ray diffraction studies of materials • Surface morphology imaging and quantitative measurements in all three dimensions (x, y, z) for a large variety of materials • Si micromachining for optical MEMS • Sol-gel technology for photonic structures and sensors • Design, fabrication and characterisation of OEICs and optical MEMS for communications and sensors (chemo and bio) • Modelling and simulation of micro and nano optoelectronic and photonic devices • Advanced materials for micro and nano photonic structures (nano-crystalyne Si, Si alloys, composite polymers
Group: Centre of Nanotechnology (Nanotechnology Laboratory)	
General Contact:	http://www.imt.ro/PublicInfo/Departments-Labs/D1/L15/l15.htm)
Contact Person & E-mail:	Alexandra Irina Kleps, irinak@imt.ro
Expertise:	• Field emission pressure sensors • Field emission magnetic sensors • Vacuum field emission (theory and experimental) • Porous silicon • Thin films • Nanoelectrodes for pollution control by cyclic voltammetry • Chemical Vapor Deposition (CVD) • Diamond-Like Carbon (DLC) and a-Silicon Carbide (a-SiC) • Low frequency noise and phonon noise spectroscopy In 2003, Laboratory of nanotechnologies from IMT-Bucharest, participated in the national MATNANTECH competition and gained other new projects, as follows: o Microchip for DNA identification (DNA-PCR) o Integrated system on silicon for controlled drug delivery (DESIRE) o Technologies for nanostructured silicon membranes fabrication for a pharmaceutical micro-laboratory (FARMEC) Furthermore, this centre participates as coordinator in the national project SINEMA: Porous silicon matrix for

	biomedical applications. The project received financial support from MATNANTECH programme for the period 2001-2004. The Responsabilities of the centre and the partners in this project are: Centre of Nanotechnology • realisation of a porous silicon matrix as a test-support for cell growth; • technologies for porous silicon surface modification in order to ensure its biocompatibility; Partners: • National Institute for Research and Development in Material Physics, Bucharest; Responsability: porous silicon characterisation. • Institute of Biochemistry, Bucharest, Responsibility: study the cell culture growth on the surface of the micro/mezo porous silicon. The Center of nanotechnology is partner in the following international projects: • Brancusi Romanian-French Project (2003-2004): Selective growth of carbon nanotubes on silicon nanoelectrode array; French; Partner: Institut de Physique et Chimie des Matériaux (IPCMS) • Research Infrastructure for Microelectronics Development, Analysis and Characterisation RIMDAC-Porous silicon matrix for biomedical applications, NMRC Cork (2003-2004) • European FP5 Network PHANTOMS, CMP Científica, Madrid, Spain (2001-2004); • European FP6 Network Nanostructured and Functional Polymer-Based Materials and Nano-composites • NanofunPOLY, Coordinator: Prof. José M. Kenny Italian Consortium for Science and Technology of Materials (INSTM) (2003-2006); • Nato Science Programme: Collaborative Linkage Grant, Nano-structured functional coatings for optical and lubricating applications, (2003-2004); Coordinator: Institute of New Materials, CVD Division, Saarland University Saarbrücken, Germany

National Institute for R&D of Isotopic and Molecular Technologies Cluj-Napoca	
Address:	P.O.Box 700, R3400 Cluj-Napoca, Romania
Institute General Contacts:	**Fax:** +40 264 42 00 42 **Website**:www.itim-cj.ro

Description:	The research focuses on metallic and semiconducting nanomaterials, and on carbon nanotubes production by CVD The Institute is working on experiments in low volume sample cell, with "in-situ" activation treatment at 300 ^{O}C in Helium flow.
Contact Person & E-mail:	Dr. Mircea Bogdan, e-mail: mircea@L30.itim-cj.ro

The National Institute for R&D of Technical Physics, Iasi	
Address:	Mangeron ave. 47, Iasi, RO-6600, Romania
Institute General Contacts:	**Fax:** +40 32 23 11 32 **Website:** http://www.phys-iasi.ro/
Description:	This institute specialises in development and study of amorphous and nanocrystalline silicon materials, magnetic materials, and the development of new research and testing equipment. The institute also specialises on the preparation and magnetic characterisation of nanostructured magnetic materials in 1-D and 3-D.
Contact Person & E-mail:	Dr. Raimond Grimberg, grimberg@phys-iasi.ro

The Romanian Academy -Timisoara Section and University Politehnica Timisoara	
Address:	Pta. Victoriei No. 2, 1900 Timisoara, Romania
Institute General Contacts:	**Tel:** +40 25 64 03 000 / 011/ 034 **Fax:** +40 25 64 03 021 **E-mail:** rectorat@utt.ro **Website:** http://www.utt.ro/english/indexeng.shtml
Group: The Centre for Fundamental and Advanced Technical Research-Laboratory of Magnetic Fluids	
Group: National Centre for Engineering of Systems with Complex Fluids	
Description:	These groups specialise in magnetic nanoparticles. They activities consist of synthesis of magnetic nanoparticles and preparation of magnetic nanofluids or ferrofluids, magnetostatic characteristics of the magnetic nanofluids, small angle neutron scattering structural investigations, flow behaviour under the influence of magnetic field and development of applications for magnetic nanofluids. Applications developed include • Magnetofluidic leakage-free rotating seals • Magnetogravimetric separations, low noise MF bearings • Acceleration/inclinations sensors • Aerodynamic sensors: differential pressure, volumic flow • Magnetic nanofluids for polymeric nanocomposites

	• Nano/micro-structured magnetorheological fluids for semiactive vibration dampers • Biomedical applications in plant genetics (e.g. biostimulators) and veterinary medicine(e.g. radioprotecting and antiinflammatory composites, magnetically driven drugs(citostatics)) See additional information at http://www.nanoforum.org /events/workshop/ orals/Vekas.pdf
Group Details:	B-dul. Mihai Viteazul 1, RO-1900 Timisoara, Romania **Phone/Fax:** 004-056-221547 **E-mail**: cnisfc@mh.mec.utt.ro **Website:** http://mh.mec.utt.ro/cnisfc
Contact Persons & E-mails:	Romanian Academy, Dr Ladislau Vékás vekas@flumag2.mec.utt.ro
	UPT: Prof. Floriana D. Stoian, dstoian@mec.utt.ro

Research and Development Institute for Electrical Engineering, Bucarest	
Address:	Advanced Research Center Spaiul Unirii 313, 74204 Bucharest, Romania
Institute General Contacts:	**Tel:** +40 1 322 28 13, **Fax:** +40 1 321 37 69 **Website:** www.icpie.ro
Description:	The department applies magnetic and ceramic materials including micro and nanostructured materials.
Contact Person & E-mail:	Prof. Wilhelm Kappel, kappel@icpe.ro

Timisoara Condensed Matter Research Institute	
Institute General Contacts:	**Website:** http://www.icmct.uvt.ro/
Description:	Department of the National Research Institute for Electrochemistry and Condensed Matter. The research focuses on nanocrystalline thin films for optical, photonic and optoelectronic applications.
Contact Person & E-mail:	Dr. Ioan Grozescu, grozescu@icmct.uvt.ro

Research Centre for Macromolecular Materials and Membranes *Commercial Society, Bucarest*	
Institute General Contacts:	**Website:** www.membrane.rnc.ro
Description:	The basic and applied research focuses on membranes and membrane processes including nano-filtration.
Contact Person & E-mail:	macromol@rnc.ro

"Petru Poni" Institute of Macromolecular Chemistry, Iasi	
Institute General Contacts:	**Website:** www.icmpp.tuiasi.ro
Description:	The polymer physics and structure department fabricates photoactive polymer thin films and studies opto-electric properties. The institute is working on the development of polymer materials for medical purposes having a wide variety of functions: • Micro- and nanofunctional particles based on poly (N-acyliminoethylene) for biocompatible polymers and (bio) catalytic systems • Dextran ion-exchange microsheres included in cellulose acetate butyrate microspheres for porous microsheres loaded with different drugs • Poly (dimenthylsiloxane-b-ε-caprolactone) copolymers for nanospheres loaded with Vitamin E or indomethacin • Rotaxane supramolecular architectures for membranes, partially cristalines and functional materials
Contact Person & E-mail:	Dr. Daniel Timpu, dtimpu@icmpp.tuiasi.ro

Institute of Biochemistry of the Romanian Academy, Molecular Glycobiology Lab, Bucharest	
Institute General Contacts:	Splaiul Independentei 296, Bucharest, Romania **Website:** www.biochim.ro
Description:	The research focuses on cultivation of living cells on nanoporous silicon and hydroxyapatite - titanium. One of the projects has focus on the cultivation of Mammalian Cells on Biocompatible Carbon Nanostructured Films.
Contact Person & E-mail:	Dr. Stefana Petrescu, Stefana.Petrescu@biochim.ro

Institute of Biology of the Romanian Academy *Centre of Microbiology, Bucharest*	
Institute General Contacts:	**Website:** www.ibiol.ro
Description:	The expertise is in biochips and biomolecules.
Contact Person & E-mail:	Dr. Ioan Ardelean, ioan.ardelean@ibiol.ro

National Institute for Chemical Pharmaceutical Research and Development, Pharmacology Department Centre for Cellular and Molecular Pharmacology, Bucharest	
Institute General Contacts:	**Website:** www.ncpri.ro
Description:	The research includes cell cultures and biomaterials development for tissue engineering and interactions of cells with nanostructured materials.
Contact Person & E-mail:	Dr. Mihaela Albulescu, mihaela@ncpri.ro

Institute of Physical Chemistry "I.G. Murgulescu" Romanian Academy, Bucharest	
Institute General Contacts:	**Website:** www.icf.ro
Description:	The institute specialises in production, characterisation and modelling of nanomaterials including inorganic-organic composites and carbon nanotubes. One of the research project of the Institute on Nanostructures refers to the possibilities offered by the sol-gel method to obtain oxide and hybrid inorganic-organic sol-gel films, with special optical and electrical properties. http://www.nanoforum.org /events/workshop/zaharescu2_rezumat_sinaia.pdf. Results obtained in this project are summarised as follows: • The films obtained by alcoholic route presents a more homogeneous morphology on the structure of $LiCo0_2$ compound films; • The films deposited on the Si monocrystal supports are better crystallised than the films deposited on the glass; • The support influenced the structure and morphology of the sol-gel films more than the preparation route; • Studies are underway using other precursors and other supports, like ceramics.
Contact Person & E-mail:	Dr. Maria Zaharescu, mzaharescu@icf.ro

National Institute for Electrical Engineering, Bucharest	
Address:	Advanced Research Centre Spaiul Unirii 313, 74204 Bucharest, Romania
Institute General Contacts:	**Tel:** +40 1 322 28 13, **Fax:** +40 1 321 37 69 **Website:** www.icpie.ro
Dept.: Micro and	In the Department for Micro and Nanostructured Materials

Nanostructured Materials	and their Applications, research focuses on magnetic nanostructured materials and materials for gas sensors.
Contact Person & E-mail:	Dr. Jenica Neamtu, jenica_neamtu@icpe-ca.ro
Dept.: Magnetic Materials and Electrical Engineering Applications	In the Magnetic Materials and Electrical Engineering Applications department, research focuses on nanostructured materials development for permanent magnets. Also, the department applies magnetic and ceramic materials including micro and nanostructured materials.
Contact Person & E-mail:	Eng. Ion Ivan, magnet@icpe-ca.ro
	Prof. Wilhelm Kappel, kappel@icpe.ro
Dept.: Ceramics	In the Ceramic department, research focuses on nanomaterials and nanoceramics based on alumina and composites.
Contact Person & E-mail:	Dr. Gheorghe Gavriliu, gavriliu@icpe-ca.ro
Dept.: Carbon Materials	In the Carbon Materials Department, research focuses on carbon nanocomposites.
Contact Person & E-mail:	Dr. Ana Maria Bondar, abondar@icpe-ca.ro

Institute for Non-ferrous and Rare Metals, Research Group for Nanoceramic Materials Ilfov	
Institute General Contacts:	**Website:** www.imnr.ro
Description:	The research focuses on deposition of powders and thin films of nanoceramics.
Contact Person & E-mail:	Dr. Roxana Mioara Piticescu, roxana@imnr.ro

12.5. Universities

Faculty of Physics, Chemistry and Petroleum Technology, University Ovidius, Constanta	
Institute General Contacts:	**Website:** www.univ-ovidius.ro
Description:	In the interdisciplinary research centre on micro and nanostructures; research focuses on condensed matter including nanostructured materials. One project in this interdisciplinary research refers to the preparation of nano-sized TiO_2 particles by the laser pyrolysis of a precursor mixture containing titanium (IV) chloride and air/N_2O. http://www.nanoforum.org /events/workshop/orals/Morjan2MixedPhases.pdf
Contact:	Associate Prof. Victor Ciupina, vciupina@univ-ovidius.ro

Alexandru Ioan Cuza University / Faculty of Physics, Iasi	
Address:	Universitatea "Alexandru Ioan Cuza" Blvd. Carol I, Nr. 11, Iasi, 6600 - Iasi, Romania
Institute General Contacts:	**Tel:** +40 232 20 10 00 **Fax:** +40 232 20 12 01 **Website:** http://www.uaic.ro/
Laboratory for Physics of thin films:	
Group: Semiconductor systems with low dimension	
Contact:	Prof. Nicolae Sulitanu
	Felicia Dacia Iacomi, iacomi@uaic.ro
Expertise:	• Low Dimension Systems • Other research domain: nanostructured magnetic materials
Project:	Semiconductor Clusters in Zeolite Matrices In this research the focus is on: • synthesis of semiconductor nanoclusters in zeolites • xrd, sem and tem studies of composite samples • optical properties of semiconductor nanoclusters in zeolites Details at http://www.nanoforum.org/events/workshop/orals /IacomiFelicia.pdf

The Babes-Bolyai University **Department of Optics and Spectroscopy, Cluj**	
Institute General Contacts:	**Website:** http://phys.ubbcluj.ro/english/index_e.html
Description:	The research focus on the fabrication of nanostructures for manipulating light fields on the nanoscale that will be used for photonics and ultrasensitive spectroscopic analysis.

	One of the project refers to the structural and optical properties of regular arrays of metallic nanostructures with the goal to control the spectroscopic signature, especially the fluorescence decay and surface-enhanced Raman scattering of embedded dye molecules and semiconductor nanocrystales.
Contact:	Prof. S. Simion, simons@phys.ubbcluj.ro

University of Bucharest, Bucharest	
Group: Thermal Physics	At the Thermal Physics Department, Faculty of Physics, theoretical research focuses on electron field emissions from solid and composite surfaces.
Contact:	Associate Prof. Valeriu Filip, filip@digitalnet.ro
Group: Laboratory of Atoms & Molecules	At the Laboratory of Atoms and Molecules, Faculty of Physics, they model and characterise atomic clusters and atom and molecule-surface interactions.
Contact:	Associated Prof. Mircea Bercu, mbercu@Olimp.fiz.infim.ro
Group: Applied and Theoretical Physical Chemistry	At the Research centre for Applied and Theoretical Physical Chemistry, Physical Chemistry Department, Faculty of Chemistry, they focus on nanobiotechnology for medical applications, nanobiomaterials.
Contact:	Prof. Mihaela Olteanu, oltmi@gw-chimie. math.unibuc.ro
Group: Molecular Biology Centre	At the Molecular Biology Centre of the Faculty of Biology, research includes nanobiotechnology. Website: www.bio.bio.unibuc.ro
Contact:	Associate Prof. Marieta Costache costache@bio.bio.unibuc.ro

12.6. Companies

Samsung Electronics, Bucharest	
News:	Samsung Electronics, Co Ltd (Korea) and IMT Bucharest are collaborating in a Joint Laboratory in Microsystems research, 2003-2006. Website:http://www.imt.ro/INTERNET_IMT/News_Events/Samsung&IMT.htm
	

Yarc Design, Magurele-Bucharest	
Address:	St. 1, Jud. Ilfov. 76920, Magurele Bucharest, Romania
Institute General Contacts:	**Website:** http://www.yarc-design.ro/ **E-mail:** contact@www.yarc-design.ro
Description:	Nanoelectronics

12.7. FP6 collaborations

EC SIXTH FRAMEWORK COLLABORATIONS *(Source: Cordis website, enlargement section)*
The **Babes-Bolyai University, Cluj** is interested in a collaboration in "controlling the optical response of nanostructures for ultrasensitive spectroscopic analysis and relevant photonic applications" (18/3/2003).
The **National Institute of Research and Development for Technical Physics NIRDTP**, is looking for partners for .Non-destructive evaluation of nano and smart materials. (17/2/2003).
The **Romanian Academy - Timisoara** section and university Politehnica Timisoara, propose "Magnetic nanoparticles and magnetizable complex fluids, engineering and biomedical applications" (6/2/2003)
ICPE-Advanced Research, ... looks for partners in "Permanent magnetic materials system for diminishing of the solid layer sediments in extracted oil pipes" and "Ceramic materials technology for the manufacturing of the electrical insulators" (31/7/2002)

12.8. Literature and Web-Links
Marius Bazu, & Dan Dascalu (2003): "Nanotechnology in Romania", published by IMT Bucharest; www.imt.ro/RomanianNanotechnology
National Institute for Physics and Nuclear Engineering; http://www.nipne.ro
Dan Dascalu, "Romanian Consortium for Nanoscience and Nanotechnology (RCNN) and its role in Dissemination, Training and Networking", 1st Nanoforum Workshop Nanomaterials and Applications, October 5-7, 2003, Sinaia, Romania; http://www.nanoforum.org/events/workshop/Dascalu.pdf
H. Chiriac, "Magnetic Nanostructures in 1-D and 3-D Materials", 1st Nanoforum Workshop Nanomaterials and Applications, October 5-7, 2003, Sinaia, Romania; http://www.nanoforum.org/events/workshop/chiriac2_sinaia.pdf
F. Iacomi, "Semiconductor Clusters in Zeolite Matrices", 1st Nanoforum Workshop Nanomaterials and Applications, October 5-7, 2003, Sinaia, Romania; http://www.nanoforum.org/events/workshop/orals/IacomiFelicia.pdf
I. Morgan, "New Trends in the Synthesis of Nanomaterials by Laser Pyrolysis", 1st Nanoforum Workshop Nanomaterials and Applications, October 5-7, 2003, Sinaia, Romania; http://www.nanoforum.org/events/ workshop/orals/Morjan1NewTrends.pdf
L. Vekas, "Magnetic Nanofluids: Preparation, Properties and Some Applications", 1st Nanoforum Workshop Nanomaterials and Applications, October 5-7, 2003, Sinaia, Romania; http://www.nanoforum.org/events /workshop/orals/Vekas.pdf

References:

(Pop2002), Source: CIA The World Fact Book, website:
http://www.cia.gov/cia/publications/factbook/geos/ro.html
(Statistic2003), Source: Eurostat, Statistics in Focus 1/2003, website:
http://europa.eu.int/comm/eurostat/

12.9. Acknowledgements

CMP Cientifica as a NanoForum member has written this chapter in collaboration with the following people: Ineke Malsch, Dan Dascalu and Marian Apostol.

13. Slovakia

13.1. General information

Introduction of the country

The Slovak Republic is a Central European country with about 5.5 million inhabitants. Gross Expenditure on R&D was 0.68% of GDP in 2000. Main industries include brown coal mining, chemical, metalworking, consumer appliances, fertilisers, plastics, armaments.

Figure 24: Map of Slovakia
(Source: http://forum.europa.eu.int/irc/dsis/candidate/info/data/candidate countries/)

The government is adapting its policies including R&D policy to prepare for accession to the European Union.

The ministry of economic affairs then wants to focus Slovakian R&D on two main goals:

- "Improving competitiveness and quality of existing products"
- "Support for such research and development as will help Slovak industrial companies to develop new products which are in demand on the world market"

To achieve these goals the ministry has been developing a new industrial policy in discussions with experts from all relevant institutions. Further to modernise the R&D support, the government is developing measures including diversification of support, clear selection criteria, an integrated approach to funding, and monitoring of the use of the money. The government also has favoured repayable loans to grants. In fact, it wants to use the Innovation Fund and introduces competition in the funding for industrial research. Hence, it has proposed to improve institutional co-ordination

and to make the independent Agency for Support of Research and Development in Industry. This agency is responsible for the revolving Innovation Fund and strengthens the financial and personnel basis of the fund. (Ministry of Economic Affairs, 2000)

In 2001, the government announced new policy measures on science and research, including a new policy conception in the area of science and technology and a new act on the Slovak Academy of Sciences (SAS). This act should allow researchers in the SAS institutes to participate in higher education. The same year, the government also announced a new *Scientific and Technological Information Centre*, responsible for international scientific collaborations; foresight studies and dissemination of results. (Slovakian government, 2001).

The acts on Science and Technology, on the Slovak Academy of Sciences and on University Education were adopted in February 2002. "The act on University Education foresees the transformation of State universities into public institutions, the introduction of higher education establishments other than universities, the transformation of the system of disciplines, the across the board introduction of a credit study system, the transition to multi-source financing for universities and the introduction of a new system of social support for students" (European Commission, progress report 2002).

Finally, we can notice that there is an *Association of Industrial Research Institutes* in the Slovak Republic. Here are some key figures about R&D in this country (Source: NATO Science and Society Newsletter (March 2003)):

- Structure of R&D expenditure
  - Ministry of Education 39.6%
  - Slovak Academy of Sciences 19%
  - Other Ministries or and Departments of State 41.4%
- Universities and Research Institutes
  - 19 Universities
  - State-funded Research Institutes
- National Priorities and Programmes
  - Building of Information Society
  - Quality of Life - Health, Nutrition, Education
  - Development of Progressive Technologies (for the Efficient Economy)
  - Utilisation of Domestic Raw Materials and Sources
  - Application of Principles for Progressive Energy Production and Energy Alternation
  - Participation of Social Sciences at the Development of Society

At present, there are six European Centres of Excellence in Slovakia, including four in Bratislava, one in Zilina and one in Nitra. (source Ivan Horvath, NCP for the NMP programme in FP6).

NATIONAL CONTACT POINT
NMP Thematic Programme of the EC Sixth Framework Programme (FP6)

Dr Ivan Horvath
Address: Praesidium of the Slovak Academy of Sciences,
Stefanikova 49 SK-814 38, Bratislava, SLOVAKIA
Tel: +421-2-52492751, Fax: +421-2-52496849
URL: http://www.savba.sk
Email: horvath@up.upsav.sk
Programme acronym: FP6-NMP

13.2. National programmes and projects

The *Slovak Academy of Sciences* (SAS) is Slovakia's foremost institution for the promotion and support of basic, strategic and applied research. The Academy's primary mission is the advance of knowledge and understanding of the nature and social sciences. In fact, the Academy provides support to the demands of the scientific community in Slovakia.

Since the scientific community in Slovakia only represents a small fraction of the world community, scientific endeavours of the SAS are undertaken in close collaboration with current scientific activities abroad. The SAS principally supports those scientific and scholarly disciplines which attain international levels and which are deemed necessary for the advancement of Slovakia and its international aspiration.

There are results of this support. The SAS has concluded co-operative contracts with partner institutions abroad supported by 53 inter-academic agreements. The SAS also has recently installed the **NANOSMART Centre of Excellence** in **Nanomaterials**. Around 60 researchers, from the SAS institutes on Materials Research, Inorganic Chemistry, Experimental Physics, Geotechnics, Materials and Machine Mechanics, Physics, and Electrical Engineering, collaborate in it. Research topics are mainly dedicated to **ceramic nanocomposites** and metallic materials, and mechanical, magnetic, superconducting, semiconducting, electric properties and water treatment.

The main activities on nano are the following:

- Multifunctional ceramic nanocomposites based on $Si_3 N_4$ powders exhibiting a self-diagnostics of defects and improved properties at room and higher temperatures.
- Nanostructural materials for construction applications having ultrahigh strength combined with a lightweight (aluminium alloys), excellent thermal conductivity (copper alloys), or biocompatibility (titanium alloys).
- Unique magnetic nanomaterials based on Fe, Ni, Co with magnetic nanoparticles in metallic or insulating matrix, exhibiting very low coercivity, high saturation magnetisation, low losses, high magneto-resistance, as well as self-assembled media for magnetic data recording, materials for sensoring, etc.
- Superconducting nanomaterials (e.g. Y2 BaCuO3 nanoparticles embedded in Yba2 Cu3 O7 single crystals, or Nb, NbN nanoparticles embedded in metallic matrix).
- Non-magnetic semiconducting nanoparticles in insulating matrix showing electron Confinement.
- Model metallic (Cu, Pb, Gd, Dy) and ferritic nanoparticles, and sulfitic nanoparticles used for absorption of toxic metals from wastewater.

- Nanostructured metallic systems with extraordinary electric, magnetic and mechanical properties based on unique interatomic bonding leading to special distribution of electron density.

The list of the techniques mainly used for preparation of the nanomaterials includes:

mechano-chemical methods, spark discharge technique, rapid solidification, equal channel angular pressing, vacuum deposition by sequential sputtering or codeposition, self-assembling deposition of magnetic nanoparticles from colloidal solution, etc (http://csnmt.fme.vutbr.cz/nano02/abstract/34058581.pdf).

Further, Slovakia is involved in ***national projects***, such as:

Metallic and silicide multilayers, supported by the Grant Agency of Slovak republic (GAS) (2/1148/94)

13.3. National research networks

In Slovakia, there is a National research network, Innovating Relay Centres (IRC).

Innovating Relay Centres

Established in 1997 by the European Union as FEMIRC Slovakia (Fellow Member to the IRCs) and from July 2000 full member of the Innovation Relay Centres Network, which associates the IRCs from Member and Associated States of EU.

- **Coordinator** : Business and Innovation Centre - BIC Bratislava - host organization for IRC Slovakia :

  BIC Bratislava
  Address : Zochova 5, SK . SK . 811 03 Bratislava
  Contact: Stefan Vratny
  Phone : +421 2 5441 7515
  Fax: +421 2 5441 7522
  E-mail: vratny@bicba.sk
  Organisation URL: http://www.bicba.sk/femircsk.htm

  BIC Bratislava is investigating the creation of a Science & Technology Park (to make easier the technology transfer).

- **Partner organisations:** BIC Group, s.r.o. and Slovak Chamber of Commerce and Industry :

  BIC Group
  Address: Zochova 5, SK . SK. 811 03 Bratislava
  Contact: Jan Strelecky
  Phone: +421 2 5441 1192
  Fax: +421 2 5441 7522
  E-mail: bicgroup@bicba.sk
  Organisation URL: http://www.bicba.sk/bicgroup.htm

In Slovakia, there is also a chamber of commerce and industry that supports the creation of innovatieve companies.

Slovak Chamber of Commerce and Industry
Address: Gorkeho 9, SK. 81603 Bratislava
Contact : Jitka Repkova
Phone : +421 2 5413 1136
Fax : +421 2 5443 0754
E-mail : sopkurad@scci.sk
Organisation URL : www.sopk.sk

13.4. The research institutes and their expertise

The Slovak Academy of Sciences consists of institutes of technology whose activities are regulated by the acts on Science and Technology adopted in February 2002. One of these activities is the organisation of conferences on Nanotechnology.

Tot 2003, this organisation has organised the following conferences:

2003: Fraktografia - Fractography 2003 (9.-12.11.2003, Stara Lesna, Slovak Republic)
2002: International Conference Deformation and Fracture in Structural PM Materials (15.-18.9.2002, Stara Lesna, Slovak Republic)
2001: Fractography of Advanced Ceramics 2001 (13.-16.5.2001, Stara Lesna, Slovak Republic)
LECO seminar (2.-4.5.2001, Stara Lesna, Slovak Republic (in Slovak only)
2000: Fraktografia - Fractography 2000 (15.-18.10.2000, Stara Lesna, Slovak Republic)

Other activity is the execution of projects of the FP5 and FP6 programs. For e***xample, a project of the FP6*** *is Development and Characterisation of Advanced Ceramic Nanocomposites (cf. details in section 13.6 FP5 and FP6 collaborations). Further, t*he whole list of the SAS' projects for FP6, is available on the Internet website: http://www.agri.gov.il/Units/RA/FP6SAS1-3.pdf .

The institutes that are involved with nano activities are as follows:

The Institute of Inorganic Chemistry, Slovak Academy of Sciences, Bratislava	
Address:	Dubravska cesta 9, SK-845 36 Bratislava
Institute General Contacts:	**Phone :** +421 2 59410 410 **Fax :** +421 2 59410 444 http://www.uach.sav.sk/
Description:	This Institute of Inorganic Chemistry is one of 70 institutions covering the research activities of the Slovak academy of Sciences. It focuses on the production of **nano Si-N-C powders and nano-composites** by the CVD method. The Institute is included in the Section II - The Life and Chemical Sciences. The Section of the Life and Chemical Sciences co-ordinates the activities of 22 scientific research institutes which may be subdivided into 3 scientific areas, namely : medical; biological and chemical; and agricultural and veterinary sciences. The scientific activity of the Institute is currently focused to the research of the inorganic and bioinorganic systems suitable for design of new materials and/or

	technologies. This research is ultimately associated with the development of new theoretical and experimental methods. The Organising Scheme of the Institute reflects the current management structure consisting of four research departments: • Department of ceramics : Development of advanced functional ceramic materials at the atomic (**nano**) level • Department of hydrosilicates: Catalytic and structural properties of layered silicates • Department of molten systems • Department of theoretical chemistry : Development and application of theoretical methods for characterisation of structure and properties of matter
Contacts:	Pavol Šajgalík **E-mail :** uachsajg@savba.sk

This Institute has organised international conferences such as:

- **Structure Solution from Powder Diffraction Data, 14.-19.09, 2003, Stará Lesná (**www.sspd-03.sav.sk)
- Engineering Ceramics 2003; 11-15.05.2002, Smolenice (www.engcer03.sav.sk)
- **Solid State Chemistry'02; 11-17.07.2002, Bratislava** (www.ssc2002.savba.sk)

It also has proposed to the FP6 program the project : Multifunctional Ceramic Nano-Composites with Self-Diagnostic Ability . See more details of this project at: http://www.fp6-eu.sav.sk/113.html

The Institute of Experimental Physics, SAS, Kosice	
Address:	Watsonova 47, 043 53 Košice, Slovak Republic
Institute General Contacts:	**Phone :** +421 55 633 63 20 (633 8115-6) **Fax :** +421 55 633 62 92 **E-mail:** sekr@saske.sk http://www.saske.sk/UEF/en/index.php
Description:	The Institute of Experimental Physics employs about 120 people. It consists of seven scientific departments. They are : • *The Department of Space Physics:* Transport of Energetic Cosmic Particles. (doc. Ing. Karel Kudela,DrSc., Phone:421 55 6224554, E-mail: kkudela@kosice.upjs.sk) • *The Department of Subnuclear Physics:* Study of new forms and plasma phases. (doc.RNDr.Du.an

	Bruncko,CSc., Phone: +421 55 6338115 kl.183, E-mail: bruncko@ saske.sk) • *The Department of Magnetism:* Biotechnological and biomedical applications of magnetic fluids, **Nanocrystalline** Alloys, magnetic fluids. (RNDr.Milan Timko,CSc., Phone: +421 55 6338115 kl.155, E-mail: timko@saske.sk) • *The Department of Low Temperature :* **Nanostructures** in superconductors, quantum liquids. (RNDr.Peter Samuely,DrSc., Phone: +421 55 6221138 kl. 37, E-mail: samuely@saske.sk) • *The Department of Metal Physics :* **Nanocrystallization**, deformation and failure of amorphous metals, powder diffraction. (RNDr.Kornel Csach,CSc., Phone: +421 55 6331816 kl.132, E-mail: csach@saske.sk) • *The Department of Biophysics :* Study of the physical properties of materials, study of deformations. (doc.Ing.Marián Antalík,CSc., Phone:+421 55 762240, E-mail: antalik @saske.sk) • *The Department of Theoretical Physics :* (doc.RNDr.Michal Hnatiè,CSc., Phone:+421 55 6338115 kl.186, E-mail: hnatic@saske.sk)
Contacts:	doc.RNDr.Peter Kopčanský,CSc. **Phone :** +421 55 6336320 **Fax :** +421 55 6336292 **E-mail :** kopcan@saske.sk

It is possible to find *Biennial Reports* of this Institute at: http://www.saske.sk/UEF/en/index.php?id=bienial&code=

***One of the projects proposed to the FP6 program is**: Advanced nanostructured magnetic materials with improved functional properties (cf. details in Section* 13.6. FP5 and FP6 collaborations*)*

The Institute of Geotechnics, SAS Kosice	
Address:	Watsonova 45, 043 53 Kosice, Slovakia
Institute General Contacts:	**Phone / Fax :** +421 / 95 / 632 34 02 **E-mail :** ugtsekr@saske.sk http://www.saske.sk/UGT/page2.html
Description:	The research is focused on the geotechnics, mineralogy, mechanical-chemistry, mineral biotechnology, ecological technologies, technologies for preparation of complementary materials, development of new technologies for construction of underground workings, ecological objectives and minimalization of unfavourable impacts of the activities

	connected with getting raw materials and energy. The Institute of Geotechnics of the SAS Kosice is a contributory organisation. This institute is composed of seven departments : • *Department of the extractive metallurgy* : extraction of the utility metals from ores, concentrates and wastes of various origin, using the principles of mechanical/chemical leaching, reduction, crushing and synthesis are being developed • *Department of the destruction and construction geotechnics* : study of the issues of monitoring, optimising and disintegrating rocks during rotary drilling, cutting and full-profile tunnelling in connection with determining the physical, mechanical and solid phase characteristics of rocks. • *Department of the environmental technologies* : study of the physical and chemical principles of treating desulfurizing and beneficiating coal with the aim of using it in a more environmentally acceptable system • *Department of the mechanochemistry* : mechanical-chemistry modification of the structure and properties of solid materials (simple oxides, insoluble salts.), **studying the principles of mechanical-chemistry synthesis (at the nanoscale)** • *Department of the mineral biotechnology*: study of the issues of monitoring, optimising and disintegrating rocks during rotary drilling, cutting and full-profile tunnelling in connection with determining the physical, mechanical and solid phase characteristics of rocks. • *Department of physical treatment methods* : study of the basic physical, physico-chemical and chemical properties of ores, non-ore materials and metal-bearing wastes of the metallurgic industry origin • *Department of the environment and hygiene in mining engineering* : study of mining aerosols
Contacts:	Dr. Vit'azoslav KRUPA, Ph D. **Phone:** +421 / 95 / 6334049 **Fax:** +421 / 95 / 6323402 E-mail : krupa@saske.sk

The Institute regularly organises **professional seminars and conferences** home as well as internationally.

Example of project proposed in FP6 *: Preparation of bulk nanocrystalline materials by milling (cf. details in Section* 13.6. FP5 and FP6 collaborations)

The Institute of Materials and Machine Mechanics, SAS Bratislava	
Address:	Raèianska 75, SK - 831 02, BRATISLAVA 3, SLOVAKIA
Institute General Contacts:	**Phone:** + 421 - 2 - 44 25 47 51 **Fax:** + 421 - 2 - 44 25 33 01 http://www.umms.sav.sk/uk_full/index.html
Description:	The research topics of this Institute are the following: • **Advanced materials** (metal matrix composites, metallic foams, intermetallics, **coatings**, **nanocomposites**.) • **Technologies** (**vacuum deposition**, thermal spraying (**plasma, gas**).) • **Structural analysis** (**electronic microscopy** (SEM, TEM), X-ray analysis, diffraction, mass spectroscopy.) • **Testing of properties** (thermal and electrical conductivity, resistance against oxidation at higher temperatures, acoustic emission.) • **Mechanics** (computer simulation and **modelling** (CAD, CAM, FEM), dynamics of machine aggregates, mechatronics.)
Contacts:	Ing. Vladimír GIBA, PhD **E-mail:** ummsgiba@savba.sk

The Institute also co-organises following **scientific conferences**:

- 2003 : Advanced Metallic Materials - Smolenice, 5th - 7th November, 2003
- 2002 : 7th International Acoustic Conference - Koèovce, June 3rd and 4th, 2002
- 2001 : 6th International Acoustic Conference - Koèovce, June 4th and 5th, 2001

Further, the Institute deals with **national and international projects**:

- National projects :
  - Service strength of materials under multiaxial loading *(Project leader: Ass. Prof. Jozef Èaèko - ummscac@savba.sk; Project duration: 01/2002 to 12/2004; VEGA agency code: 2/2029/22)*

    This project answers problems of service strength and structural integrity of mechanical systems under complex dynamical loading conditions.

Acquired results will enrich knowledge in various branches of technical sciences. Application of scientific results of the project will make possible an increase of endurance, safety and reliability of machine aggregates and simultaneous reduction of economical, material and energy expenses.

- Optimisation of properties and joining of metal matrix composites (Project leader: Pavel .ebo, PhD - ummssebo@savba.sk; Project duration: 01/2001 to 12/2003; VEGA agency code: 2/1046/21

  Description: Composite material consisting of the components (matrix and reinforcing component) may posses the properties, which no any of the components possess. One of them can be limited on the account of another one. The aim of the project is to optimise the properties of such material by that way to fulfil the given requirements. Solution is to understand the relationship between the structure of composite and its properties, to understand the parameters and the way to control them to increase the effectivity of composites. The subject of optimisation will be the physical properties (thermal conductivity, thermal expansion), mechanical properties (strength, Young modulus), tribological properties and properties of composite-ceramic joint.

It is possible to find the complete list of the national research projects at: http://www.umms.sav.sk/uk_full/index.html

- European projects :

Example of project proposed in FP6 *: Transmission electron microscopy studies of the microstructure of powders, interfaces, thin layers and bulk nanomaterials (cf. details in Section* 13.6. FP5 and FP6 collaborations*)*

The Institute of Physics, SAS Bratislava	
Address:	Dubravska 9 SK-842 28 Bratislava, Slovak Republic
Institute General Contacts:	http://www.fu.sav.sk/
Description:	The research in solid state physics is concentrated mainly on : • *Metallic glasses and nanocrystalline materials* : prepared by rapid solidification from the melt using a high-tech equipment designed at the Institute. Research is targeted to thermodynamics and structure evolution in metastable amorphous and nanocrystalline systems, to the investigation of exceptional magnetic and mechanical properties of these solids. • *Thin film multilayers*: fabrication of thin films and multilayers, in X-ray reflectometry and X-ray

	diffractometry. • *Interfaces in semiconductor structures*: research is oriented on structural, optical and electrical properties on various semiconducting thin film structures. • *Solid state diagnostic methods* : deep-level transient spectroscopy, scanning probe microscopy, transient method of measurements of thermophysical properties, positron annihilation techniques, atomic absorption and emission spectroscopy and X-ray reflectometry and diffractometry. • *Theoretical quantum optics* : nonclassical properties of optical fields (such as a reduction of quantum fluctuations, quantum entanglement, creation and destruction of quantum coherence, etc.) in non-linear quantum-optical parametric processes are investigated. The Institute co-operates with numerous universities and institutions around the world including CERN Geneva, ICTP Trieste and JINR Dubna. At present, it is involved in the projects of the ***5th Framework Programme*** of European Community, NATO Science for Peace program, Access to Large Facilities scheme and other bilateral projects.
Contacts:	Director Eva Majkova **E-mail :** majkova@savba.sk

Example of project proposed in FP6: Nanoparticles and subnanometric multilayered systems (*cf. details in Section* 13.6. FP5 and FP6 collaborations)

Further, a list of institute's publications is mentioned on the website: (http://www.fu.sav.sk /MLpage.htm#_Selected_Publications)

The Institute of Electrical Engineering, Bratislava	
Address:	Institute of Electrical Engineering, Slovak Academy of Sciences, Dúbravská cesta 9, 84104 Bratislava, Slovak Republic
Institute General Contacts:	**Phone :** +421-2-5477 5820 **Fax :** +421-2-5477 5816 http://www.elu.sav.sk/
Description:	The Institute is focused on the research and development of : • **Semiconductors** : focuses on films and heterostructures prepared on planar and patterned

	GaAs- and InP- structures. • **Superconductors**: covers the fields of weak superconductivity, preparation of superconducting materials and large-scale applications. • **Oxides and magnetic materials and devices**, including theoretical and experimental study of their structural, optical, and transport properties : Structural characteristics of the films and multilayers are studied using standard methods, such as X-ray diffraction and transition electron microscopy. The morphology of the samples is studied by scanning electron microscopy and atomic force microscopy. It also uses nanostructured materials.
Contacts:	Ing. Karol FRÖHLICH, DrSc. **Phone :** +421-2-5477 5826 ext. 2363 **Fax :** +421-2-5477 5816 **E-mail :** Karol.Frohlich@savba.sk

This Institute also runs some **projects** for different organisations such as the EU, NATO, COST (P. Lobotka: « Nanostructured materials »), APVT, VEGA.

Example of project proposed in FP6 *: Nanostructures for sensors, nanometrology and cryoelectronic devices (cf. details in Section* 13.6. FP5 and FP6 collaborations*)*

A list of ***citations and publications*** is mentioned on the Internet website: (http://www.elu.sav.sk/)

Polymer Institute (SAS)	
Address:	Polymer Institute, Slovak Academy of Sciences, Dúbravská cesta 9, 842 36 Bratislava, Slovakia
Institute General Contacts:	**Phone:** +421-2-5477 3448 **Fax:** +421-2-5477 5923
Description:	The principal objective of this Institute is to carry out the fundamental research in the field of polymers and macromolecular systems. The scientific program of the Institute is focused on the synthesis of polymeric materials and on the studies of the relationship between the structure and properties of macromolecular compounds. A substantial part of the research is directed to the preparation and study of the properties of modified polymers, polymeric blends and composites. The Institute consists of **Departments** where the scientific and administrative activities are concentrated: • Department of Polymerisation Reactions: study of the synthesis of polymers and copolymers. • Department of Polymer Reactions: polar properties

	of polymers, investigation of the mechanisms and kinetics of polymer reactions. • Department of Composite Thermoplastics: characterisation of polymers, small-scale manufacturing of composites (**nano scale**). • Department of Photochemistry of Polymers: photodegradation of polymers and model compounds. • Department of Thermooxidation Degradation of Polymers: interpretation of chemiluminescence from organic materials and on its relation with the rate of thermal oxidation of polymers, crystallisation of polymers and biopolymers. • Department of Liquid Chromatography: New methods for liquid chromatography of multi-component polymer systems. • Department of Molecular Thermodynamics • Department of Special Polymers and Biopolymers: macromolecular chemistry and technology, study of kinetics of free radical polymerisation of predominantly water-soluble monomers, characterisation of the properties of synthetic and natural oligomers. • Department of Synthesis and Polymer Additives: Low molecular compounds, photochemical sensitivity, non-linear optical activity
Contacts:	Jozef Rychlý upoljory@savba.sk **Phone:** +421-2-5477 1626

Example of project proposed in FP6 *: New functionalized polymer nano-materials, their preparation, processing and exploitation (cf. details in Section* 13.6. FP5 and FP6 collaborations*)*

VÚZ-PI (Welding Research Institute – Industrial Institute of Slovak Republic)	
Address:	Račianska 71, 832 59 BRATISLAVA 3, Slovakia
Institute General Contacts:	**Phone:** +421 2 4924 6111 **Fax:** +421 2 4924 6341 **E-mail:** vuz@vuz.sk
Description:	*Activities of the centre:* • Research and development of technological and physical-metallurgical processes of welding and allied technologies (welding and surfacing with arc methods, plasma arc welding, projection welding, surfacing and re-melting, electron beam, laser, flame welding in vacuum and deposition brazing, spraying and

	deposition of surface coatings by flame, weld overlays and sprayed coatings including determination of tribological characteristics, **nanomaterials**.) • Research of environmental, hygienic and risk aspects and factors of welding and allied technologies
Contacts:	Ing. Peter Klamo **Phone:** +421/2/4425 3500, +421/2/4924 6200 **Mobile:** +421/905/846 732 **Fax:** +421/2/4924 6211 **E-mail:** riaditel@vuz.sk, vuz@vuz.sk Director : Anton Buben **Mobile:** +421/905/540 216 **E-mail:** buben.anton@vuz.sk

13.5. Universities

Technical University Košice, Faculty of Metallurgy, Department of Material Research	
Address:	040 01 Košice, Park Komenského 11, Slovak Republic
Institute General Contacts:	Contact person: Doc. Ing. Ladislav Pe.ek, CSc. **E-mail:** ladislav.pesek@tuke.sk
Description:	**Nanometrology** (Instrumental indentation for mechanical testing in nanoscale)

Slovak Technical University, Faculty of Chemical and Food Technology, Department of Polymer Chemistry	
Address:	Radlinského 9, 801 00 Bratislava, Slovak Republic
Institute General Contacts:	Contact person: Ing. Viera Khunová, CSc. **E-mail:** khunova@chtf.stuba.sk
Description:	**Nanocomposites** (intercalated nanocomposites, preparation from melts)

Slovak Technical University, Faculty of Electrical Engineering and Information Technology, Microelectronics Department	
Address:	812 19 Bratislava, Ilkovičova 3, Slovak Republic
Institute General Contacts:	Contact person: Ing. R. Srnánek, CSc. **E-mail:** srnanek@elf.stuaba.sk
Description:	**Characterisation of semiconductor nanodimensional structures** (bevel preparation by chemical etching, Si and Si-Ge structures, secondary ion mass spectrometry, Auger electron spectrometry)

Slovak Technical University, Faculty of Electrical Engineering and Information Technology, Microelectronics Department	
Address:	812 19 Bratislava, Ilkovičova 3, Slovak Republic
Institute General Contacts:	Contact person: Prof. Marcel Miglierini, DrSc. **E-mail:**bruno@elf.stuba.sk; www.nuc.elf.stuba.sk/bruno
Description:	**Nanocrystalline alloys** (characterization by Mossbauer spectroscopy)

Comenius University, Faculty of Mathematics. Physics and Computer Science, Department of Biophysics	
Address:	842 48 Bratislava, Mlynská dolina F1, Slovak Republic
Institute General Contacts:	Contact person: Prof. RNDr. Tibor Hianik, DrSc. **Phone:** +421 2 65426774
Description:	**Biomimetic and dendimer films** (application in biosensing for biomedical and environmental purposes, structure and physical properties of biomimetic amphiphilic films, dendrimers as biosensors)

International Laser Centre	
Address:	Ilkovičova 3, 812 19 Bratislava, Slovak Republic
Institute General Contacts:	Contact person: František Uherek **E-mail:** uherek@ilc.sk; www.ilc.sk
Description:	**Diagnostic methods for nanostructures and nanomaterials** (parameters and experimental possibilities of pulse laser deposition system, high resolution optical microspoy, low-T and time resolution photoluminiscency)

P.J. Safarik University, Faculty of Science, Institute of Physics	
Address:	Park Angelinum 9, 041 54 Košice, Slovak Republic
Institute General Contacts:	Contact person: P. Vojtaník **E-mail:** vojtanik@kosice.upjs.sk
Description:	**FeNi based soft magnetic nanomaterials** (nanocrystallization of industrially produced amorphous alloys, study of magnetic properties)

13.6. FP5 and FP6 collaborations

Concerning FP5 **collaboration**
Many projects have been accepted in FP5 for Slovak Republic. It is possible to find a complete list of these projects on **the Minanet website** :
http://www.minanet.com/search4a.asp

- An Example of accepted project in FP5 is the following:

Correlation of structure and magnetism in novel nanoscale magnetic particles
Principal investigator (IP SAS) : E. Majková, RNDr., DrSc.
Project Nr. : HPRN-CT - 00150
Co-ordinator: Prof.. M. Farle, TU Braunschweig, Germany
http://ups.savba.sk/mnp/main.html

General description of the project : In this network, consisting of 10 European laboratories a novel interdisciplinary approach to the fabrication and characterisation of **nanoscale magnetic particles** (5-15 nm) is taken. They propose an innovative approach to a cost-efficient fabrication of **nanoscale particles**, which have offer long-term magnetic stability and minimum domain size for magnetic storage or magnetoresistive application.

Partners:
CNRS-UPR5031, Laboratoire de Cristallographie, France
- Aristoteleio Panepistimio Thessalonikis, department of Physics, Greece
- Uppsala university, department of Physics, Sweden
- Freie universitaet Berlin, Institut of experimental physics, Germany
- Université Louis Pasteur, Institut de Physique et Chimie des Matériaux, France
- Hahn-meitner-Institut berlin GMBh, Abteilung grenzflachen-Bereich physikalische
- chemie, Germany
- Technische universitaet braunschweig, Institut fur halbleiterphysik und optik, Germany
- Slovak academy of sciences, electron beam lithography and microstructuring, Slovakia
- Academy of sciences of the Czech republic, Institute of physic-group of surface magnetism, Czech republic

Concerning the FP6 **Collaboration**

Many projects have been proposed to FP6 for Slovak Republic. You could find a list of Slovak projects dealing with the thematic 3 "***Nanotechnologies and nanosciences***, *knowledge-based multifunctional* ***materials and new production processes and devices"*** at: *http://www.fp6-eu.sav.sk/113.html*. Some of these projects are as follows:

Production and characterisation of nanostructured and multifunctional materials

Address: Technical University of Kosice, Metallurgical Faculty
Contact : LONGAUER, Svätoboj (Dr, Associate Professor)
Organisation URL: http://www.tuke.sk
E-mail address: slong@tuke.sk
Phone : +42-55-6022770
Fax: +42-55-6022243

50 years old university situated in East Slovakia with experiences in international research and educational projects.

Department of Materials Science of Technical University in Kosice has 31 teachers, research workers and technicians. They have experience in mechanical testing, heat treatment, corrosion of metals and alloys, physical metallurgy of iron, steels, Ni superalloys, Al, Cu and Ti alloys, Cu based shape memory alloys, production of Fe oxides free spheroidal **nanoparticles**, Fe and Sn **nanowires**, **nanoidentation** techniques.

Development and Characterisation of Advanced Ceramic Nanocomposites

Address: Slovak Academy of Sciences, Institute of Materials Research, Watsonova 47, 043 53 Kosice Slovak Republic
Contact: Assoc. Prof. Dr. Jan DUSZA, DrSc.,
Phone: +421 55 6338115
E-mail: dusza@imrnov.saske.sk

***Research subject for a potential FP6 project**:*

- Microstructure analysis of **nanocomposites** prepared by different processing
- route, having a .designed microstructure., with **nanoparticles** located
- predominantly intergranularly or intragranularly according to the physical
- properties of the matrix and nanoparticles.
- Statistical evaluation of the grain size of matrix grains and nanoparticles and the location of nanoparticles.
- **Characterisation** of the chemical composition and geometry of intergranular phase.
- Analysis of residual stresses.
- Testing of mechanical properties as bending strength, fracture toughness, static/cyclic fatigue, creep, etc. and the oxidation behaviour of the materials.
- Fractographic failure analysis.
- Optimalization of the technological process based on the results of the microstructure analysis and the measured fracture - mechanical properties.

Multifunctional Ceramic Nano-Composites with Self-Diagnostic Ability

Address: Slovak Academy of Sciences, Institute of Inorganic Chemistry, Dubravska cesta 9, 84236 Bratislava, Slovak Republic
Contact: Pavol SAJGALIK, Doc. RNDr., DrSc.
Phone: +421 2 59410 400
E-mail: sajgalik@savba.sk

Research subject for a potential FP6 project:

- Proposed research deals with the design of ceramic nano-composites with layered structure, which are characterised by decreased sensitivity to the structural defects. Advantageous properties of these ceramic materials are combined through layered design: combination of high strength, fracture toughness and oxidation resistance of one type of nano-ceramic layers with adjustable thermal and electrical conductivity of other layers. The potential of this kind of multifunctional nano-composites is mainly as components of special engineering applications such as structural parts of combustion engines, cutting tools, nozzles, etc.

- Self-detection ability of the multifunctional nano-composite is based on the monitoring of electrical conductivity of the tensile-under-surface layer. Measured decrease of the electrical conductivity sensitively reflects the starting point of crack formation and thus, directly signalises the necessity of pre-cracked/damaged part replacement.

Advanced nanostructured magnetic materials with improved functional properties

Address: Slovak Academy of Sciences, Institute of Experimental Physics, Watsonova 47, O43 53 Kosice, Slovak Republic
Contact: Dr. Ivan SKORVANEK
Phone: +421 55 6338115
E-mail: skorvi@saske.sk

Research subject for a potential FP6 project:

The research objectives of the project focus on the better understanding of the composition structure-property relationships in advanced Nano-phased magnetic materials, where the nanosized building blocks are arranged into different topological order. The materials of our interest include:

i) the soft magnetic materials with bcc-Fe, Fe(Si) and FeCo **nanoparticles** embedded in a residual amorphous matrix either in the form of ribbons and/or in the form of densely arranged and compacted powder
ii) **nano-composite materials** based on Fe, Co, Ni and RE-elements

where the building units are formed by chemically identical nanoparticles and/or **nanocapsules** having core/shell structure. Of particular interest is to better understand the effects of the variation of grain sizes and the intergranular distances as well as the chemistry of the constituent phases on the magnetic behaviour in a wide range of applied fields and temperatures.

The aims of a potential FP6 project can be outlined in the following way:

- Optimisation of the alloys composition and the preparation methods in order to obtain **nanostructured magnetic materials** with improved functional properties
- Study the effects of residual amorphous matrix as well as the grain sizes and intergranular distances on the character and intensity of magnetic coupling between grains and on the magnetic behaviour versus temperature in investigated **nanocrystalline magnetic materials**
- Study the magnetocaloric behaviour in selected nano-composite materials
- Better understand the influence of interfaces on the magnetic properties of investigated **nanostructured materials**

Preparation of bulk nanocrystalline materials by milling

Address: Slovak Academy of Sciences, Institute of Geotechnics, Watsonova 45, 043 53 Kosice, Slovak Republic
Contact: Prof. Dr. Peter BALAZ
Phone: +421 55 63 307 90
E-mail: balaz@saske.sk

Research subject for a potential FP6 project:

Nanocrystalline materials are single-phase or multi-phase materials, the crystal size of which is of the order of a few (typically 1-100) **nanometers** in at least one dimension. Nanocrystalline materials have been synthesised by a number of techniques starting from the vapour phase (e.g.inert gas condensation), liquid phase (e.g. rapid solidification), and solid state (e.g. mechanical alloying). Mechanical alloying is a solid-state powder processing technique involving repeated welding, fracturing, and rewelding of powder particles in a high-energy mill. Grain sizes with nanometer dimensions have been prepared in form of amorphous alloys, **nanostructured metal** nitrides, metal hydrides, metal carbides, metastable materials and **nanocomposite materials**.
The possibilities of solid-state mechanochemical reductions (displacement reactions) as well as solidstate mechanochemical reactions in order to prepare novel nanocrystalline materials are currently studied in our Department. The mechanochemical reduction of copper sulphides with iron was induced in a planetary mill. The transformation of copper sulphides, the synthesis of cubic FeS and its transformation to the hexagonal form are

associated with the primary mechanochemical reduction. Platelets of Cu/FeS nanoparticles are formed with the average grain size of the freshly formed copper are between 10-25 nanometers. The novel processes of nanocrystalline sulphides synthesis that is stimulated by their extensive use in infrared optoelectronics for manufacturing IR lasers and detectors are now strongly focused in our Department.

Transmission electron microscopy studies of the microstructure of powders, interfaces, thin layer and bulk nanomaterials

Address: Slovak Academy of Sciences, Institute of Materials and Machine Mechanics, Racianska 75, 83102 Bratislava, Slovak Republic
Contact: Dr. Karol IZDINSKY
Phone: +421 2 49 268 226
E-mail: ummsizd@savba.sk

Research subject for a potential FP6 project :

As the extensive progress within the Sixth Framework Programme of the European Community for research, technological development and demonstration activities is expected in the field of **nanomaterials** large effort is to be paid to structural studies performed before, during and after the applied technological operations leading to the desired **nano-structures**. Here, the transmission electron microscopy (TEM) will play a significant role providing large portion of fundamental information. We have gathered at the IMMM much of experience in preparing samples for TEM observations within the last 20 years. Our preparation techniques based on ion thinning process enable us to prepare TEM samples from various kinds of powders used in powder metallurgy or thermal spraying processes.

The technique for TEM cross sectional sample preparation makes us the study of various **thin coatings** and their interfaces on different substrates possible. Finally microstructure and interfaces in metal matrix composites reinforced with metallic and **non-metallic fibers** and particles were extensively studied and their structures were revealed. We believe that this know-how and experience can be well integrated in many kinds of projects directed to the development and optimisation of nano-structures within the FP6 thematic area.

Nanoparticles and subnanometric multilayered systems

Address: Slovak Academy of Sciences, Institute of Physics, Dubravska cesta 9, 842 28 Bratislava, Slovak Republic *Contact***:** Dr. Eva MAJKOVA, D.Sc.
Phone: +421 2 59410500
E-mail: majkova@savba.sk

***Research subject for a potential FP6 project** :*

The project will focus on multidisciplinary research of mesoscopic scale systems (**nanoparticles**, subnanometric multilayers) prepared by physical and chemical methods. The main research areas are: **magnetic nanoparticles**, **surface modified**

nanoparticles, **advanced techniques for nanoscale manufacture**, **self-assembling**.
The goal of the project will be to develop new complex materials with defined physical properties. Here, also the patterning of substrates or prepared structures can bring new effects.
Our research team has a long-term expertise in **preparation and characterisation of thin film multilayers**. Recently we extended our research to nanoparticles. The physical **vapour deposition** and laser processing has been used for preparation of multilayer structures, the submicron patterning is performed by **electron beam lithography** and **dry etching**. For characterisation the X-ray scattering methods (specula reflectivity, diffuse scattering at grazing incidence and X-ray diffraction are the most important experimental techniques. Recently the methods using the synchrotron radiation (GISAXS, EXAFS) have been applied. The main research area is to study the structure, the role of surfaces and interfaces on the physical properties of nanoparticles and **Nanometric** layered systems and to study the self-assembling of **nanoparticles** deposited onto the substrate under various conditions.
International projects: Project of the 5FP of EC HPRN-CT-00150 Correlation of Structure and Magnetism in Novel Nanoscale Magnetic Particles, co-ordinator Prof. M.. Farle, TU Braunschweig, Germany (10 members); NATO project PST.CLG 978058, Laser assisted formation of magnetic nanoparticles for information storage.

Nanostructures for sensors, nanometrology and cryoelectronic devices

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Contact: Doc.RNDr. Andrej PLECENIK, DrSc.
Phone: +421 2 54775820
E-mail: plecenik@savba.sk

Research subject for a potential FP6 project *:*

The group of the Cryoelectronic Department has the experience in the preparation of superconducting (MgB2, YBa2Cu3O7-x) and dielectric thin films (Al2O3, CeO2, SrTiO3), as well as tunnel junctions (including Josephson junctions) and cryoelectronic devices (SQUIDs) prepared on them. The group have at his disposal of vacuum equipment for preparation of metallic, dielectric and **superconducting thin film**, equipments for physical (in Ar ion beam) and plasma **chemical etching** of thin films, optical **and electron lithography** (in co-operation with the Institute of Informatics SAS). The group also does experiments with measurements of transport properties of these materials to 1.3 K, as well as down to 50 mK (in co-operation with the Institute of Experimental Physics SAS), and with measurement in magnetic field up to 14 T from the temperature 2.2K to 300 K. A **nanolitography** by means of Scanning Probe Microscope is available in last time. For **characterisation** of thin film and Josephson junctions' quality, as well as interfaces in tunnel junctions, the microwave measurements in the range from 10 GHz to 100 GHz and tunnelling spectroscopy are used.

On the base of the above mentioned possibilities the group of the Cryoelectronic Department can participate on the research programs oriented on the preparation and characterisation of structures in micrometers and sub-micrometers dimensions.

The main interest of the group is structures for detectors (single photon detector), **nanometrology** (current standard) and cryoelectronic devices based on the high Tc (YBa2Cu3O7-x) and medium Tc (MgB2) superconductors.

New functionalized polymer nano-materials, their preparation, processing and exploitation

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Research subject for a potential FP6 project *:*

The volume of materials based on polymers is steadily increasing. The traditional way of preparation of new polymeric materials through new or conventional monomers is still open but seems to be rather limited. The open and promising way for preparation of new polymeric materials such as functionalised nano-structure polymer materials, fine and coarse polymer dispersions, percolationlike (conductive) polymer matrices etc. is to polymerise common or new monomers in a nonconventional way to produce nano-particles with controlled size and distribution in any type of heterogeneous polymerisation. The **nanoparticles** besides using them as fillers or micro-reactors can carry various functions e.g. catalytic, conductive, thermo-responsive, pH-responsive, etc.
These materials are of great interest because of their surface-active properties and therefore they can serve as the stabilisers of dispersions or compatibilizers of polymers and carrier of drugs and sensors of different types. New properties are expected from polymeric materials based on both conventional and new monomers and polymers and the blends of synthetic and natural polymers.
These materials will have a complex structure with a unique morphology and phase behaviour. The morphology will be dominated by domains is in the **nano-region**. The development of new processes will be needed to prepare these micro-domains in situ of the conventional polymers.
These new materials will have unique optical, mechanical, electrical properties. The morphology and properties will vary with the size of domains and the interface area between the continuous and dispersed phases within the integral complex approach to advanced polymer materials development computer modelling based on molecular simulations (Monte Carlo method) will be included. This will help to elucidate the behaviour of macromolecules on micro- and nano-scale and provides one of few routes for the transition from trial and error approach in macromolecular applications to a knowledge-based approach.

13.7. Literature and web-links
A central web-site with information in English on Slovakia and many links: http://www.slovakia.org/
English web-pages of the ministry of Economic Affairs: http://www.economy.gov.sk/angl/angl.htm
The Slovak Academy of Sciences: http://www.sav.sk/
Ministry of Economic Affairs (2000): .Elaboration of the principles of the European Union's industrial policy for conditions of the Slovak Republic (Strategy for Slovak Industrial Development for the 21st Century)., published on www.economy.gov.sk/angl/sekciastrategie/ppangl.htm
Slovakian Government (2001): "Slovakian Government Declaration", published on www.economy.gov.sk/angl/declarat.htm
Škorvánek, Ivan; Švec, Peter; Šajgalík, Pavel; Majková, Eva; Vávra, Ivo; Lobotka, Peter (2002): "Nanomaterials and nanotechnologies in Slovakia", in "Nano '02", organised by Czech Society for New Materials, Nanoscience and Nanotechnology section and Brno University of Technology Faculty of Mechanical Engineering, Brno, 19-21 November 2002, Czech Republic, ISBN 80-7204-258-0.
Urad vlady Slovenskej republiky, Address nam. Slobody 1, 813 70 Bratislava; *Phone*: (421-2) 5729 5111; *Fax:* (421-2) 5249 7595; *Organisation URL*: www.government.gov.sk
Economical mission ; Address : Hlavne namestie 7, P.O. Box 132, 814 99 Bratislava *Phone* : (421.2) 59 34 74 44; *Fax* : (421.2) 59 34 74 99; *E-mail* : bratislava@dree.org *Organisation URL* : www.dree.org/slovaquie
The SAS proposals for participation in FP6 projects: http://www.fp6-eu.sav.sk/113.html

13.8. Acknowledgements

This chapter has been written by Sandrine Locatelli and Carole Nicollet, with valuable contributions from Dr Ivan Horvath, National Contact Point for the NMP programme in FP6. horvath@up.upsav.sk

14. Slovenia

14.1. General information

The Republic of Slovenia is a central European country with 2 million inhabitants. Its capital is Ljubljana. Main strengths of Slovenian research and development are a relatively high share of GDP invested in R&D (1.51% in 1999 and 1.57% in 2001), well established international scientific co-operation and a relatively high number of researchers. Since 2001, the Ministry of Education, Science and Sport is responsible for the science policy, while the Ministry of Economy is responsible for the technology policy. The Slovenian Science policy is actively involved in the creation of the European Research Area.
As in most technologically oriented countries the Slovenian economy is aiming at being based on knowledge and new technologies (Science in Slovenia, 2001). Slovenian national research programme is therefore an integral part of the national development strategy. It sets some long, medium and short term policy goals, regarding organisation of research, and identification of priorities in the funding of scientific research. The goals include research activities; postgraduate education of R&D personnel; application of research results, transfer of knowledge and building up a research infrastructure. International S&T collaboration, networking and education are therefore part of the programme. Up to now, nanoscience or nanotechnology are not explicitly mentioned among the priority research fields. Slovenia is currently preparing a new National Research Programme.

Figure 25: Map of Slovenia
(Source: http://forum.europa.eu.int/irc/dsis/candidate/info/data/candidate countries/slovenia.html)

Slovenia co-operates in science and technology with more than 75 countries world-wide. It has joined the FP5 formally in August 1999 and has average success rate 30% regarding participation. Most frequent partners are United Kingdom and Germany, followed by Italy and France. Slovenia has signed formal intergovernmental agreements in S&T with 22 countries (Science in Slovenia, 2002).

Besides, it was signed more than 40 intergovernmental agreements on S&T, culture and education and approximately 40 intergovernmental agreements on the field of economy including S&T. The activity "International co-operation in research and development" as part of the programme "Knowledge for Development" aims for strengthening international co-operation in R&D. The objective is to stimulate projects, which could evolve into multilateral or regional projects. Slovenia wants to increase the involvement of Slovenian researchers and institutions in European programmes and tries to speed up the transfer of research results into marketable applications. However, the co-operation between companies and public research institutions is still not satisfactory.

Research is carried out in five types of organisations:

- 18 national research institutes and
- about 32 other public sector research institutes;
- the two Universities in Ljubljana and Maribor;
- private non-profit research institutes and
- industrial research departments.

The Slovenian Academy of Sciences and Arts - SAZU is a supreme national institution of sciences and arts. It cultivates and promotes the development of scientific thought and creativity in the arts, and is the founder of the SAZU Scientific Research Centre.

NATIONAL CONTACT POINT
NMP Thematic Programme of the EC Sixth Framework Programme (FP6)

Dr. Bojan Jenko
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SI-1000 Ljubljana, SLOVENIA,
Tel: +386-1-4784633, Fax: +386-1-4784719
URL: http://www.mszs.si
Email: bojan.jenko@gov.si
Programme acronym: FP6-NMP

14.2. National programmes and projects

National research programmes:
The SICRIS online database (http://sicris.izum.si) includes one national research programme related to nanotechnology. This programme on "Physics of surfaces, modulated structures and nanostructures" runs from January 1999 until December 2003 and is led by Prof. Dr. Igor Muševič of the Institute Josef Stefan. http://sicris.izum.si

National Projects:
Since 1996, there have been 16 projects related to nanotechnology, including 9 that are still ongoing. These are:

- a project on transition metals dichalcogenide nanostructures (2001-2004);
- a project on a photoelectrochromic system and a photovoltaic self-charging battery (2001-2004);
- a project on sol-gel processing and characterisation of nanomaterials (2001-2004);
- a project on nanocrystalinic materials for soft magnetic applications (2002-2004);
- a project on a synthesis and characterisation nanopowders for magnetic materials (2002-2005);
- a project on a synthesis of new nanosized materials and adsorption of various gases (2002-2004);
- a project on development of nanocomposite polymers (2001-2004);
- a project on properties and stability of solutions of charged nanoparticles (2001-2004), and
- a project on nanometer scale resolution plotter (2002-2005).

See http://sicris.izum.si

Networks:
SINANO: Slovenian network on nanotechnology. Details on this network were published in the Survey of European Networks in Nanotechnology:
http://www.cordis.lu/nanotechnology/src/networks.htm under No.154.
The network comprises tasks related to nanomaterials, sensor applications, and chemical processing technologies, equipment and also long term research parts.
Leader of the network is

Prof. Marija Kosec
Jozef Stefan Institute
Jamova 39
SI-1000-Ljubljana
E-mail: marija.kosec@ijs.si
Phone: +38-614773368 / **Fax:** +38-614263126

14.3. The research institutes and their expertise

Josef Stefan Institute	
Address:	Jamova 39, 1000 Ljubljana
Institute General Contacts:	**Phone:** +386 1 477-3900 (operator) **Fax:** +386 1 2519-385www: http://www.ijs.si Director: Prof. Dr. Vito Turk **Phone:** +3861 4773-365 **E-mail:** vito.turk@ijs.si
Description:	Most of the nanotechnology research work in Slovenia is performed in several departments at the Institute Jozef Stefan (IJS). The Institute is named after the distinguished 19th century physicist Jozef Stefan, and is the leading Slovene research organisation. It is responsible for a broad spectrum of basic and applied research in the fields of natural sciences and technology. The staff, of around 700 people, specialises in research in physics, chemistry and biochemistry, electronics and information science, nuclear technology, energy utilisation and environmental science.
Condensed Matter Physics:	
Contact:	Prof. Dr. Igor Muševič **Phone:** +3861 4773-900 **E-mail:** igor.musevic@ijs.si **WEB:** http://titan.ijs.si/f5/nanophysics_surfaces.html
Expertise:	Nanophysics and surfaces play a dominant role in the condensed matter physics department. Their, the atomic force and soft matter laboratory and the lab for electron and tunnelling microscopy work on tasks on nanotechnological problems.
Complex Matter:	
Contact:	Prof. Dr. Dragan Mihailovic **Phone:** +3861 4773-900 **E-mail:** dragan.mihailovic@ijs.si **Web:** http://complex.ijs.si/
Expertise:	Real-time dynamics of self-organised nanoscale inhomogeneities in oxides and transition metal chalcogenides that are confined 1D and 2D systems Collective behaviour of nanoscale quantum, systems such as spin an charge ordering in nanotubes and other 1D systems Functional properties of transition metal chalcogenide nanotubes and nanostructures ranging from field emission sources to electrochemistry (batteries). Electron dynamics in bio-nano-systems relating to functional properties thereof.

Electronic Ceramics:	
Contact:	Prof. Dr. Marija Kosec **Phone:** +38-614773368 **Fax:** +38-614263126 **E-mail:** marija.kosec@ijs.si **WEB:** http://www.ijs.si/ijs-dept-k5.html
Expertise:	Ceramic powder synthesis: solid state reactions, sol-gel and hydrothermal synthesis Powder processing: solid liquid interfaces, stability of ceramic suspensions Ceramic processing: tape casting, low pressure injection moulding, slip casting, pressing, HIP-ing Thin and thick film processing Sintering and microstructure design Microstructure-property relationships of functional and structural ceramics Powder metallurgy for application in intermetallic magnet processing Glass research Defect chemistry and crystal structure determination High temperature phase equilibria determination
Nanostructured Materials:	
Contact:	Prof. Dr. Spomenka Kobe **Phone:** +3861 4773-251 **E-mail:** spomenka.kobe@ijs.si **WEB:** http://nano.ijs.si/
Expertise:	The Department for Nanostructured Materials consists of two research groups: - Magnetic Materials Group - Electron Microscopy Group The basic research in the Department for Nanostructured Materials focuses on inorganic materials with specific physical properties that are a consequence of their structural and chemical phenomena at the nanostructural and atomic levels. The fields of research involve natural and manufactured ceramic materials as well as metals and intermetallic compounds. The basis of the research is to find relationships between the physical properties of a material and its structural and chemical properties by using electron microscopy techniques to reveal phenomena on the nanoscale. Macroscopic phenomena, for example, phase transformations, phase equilibria, polytypisim, polymorphism, crystal growth and the development of the microstructure are areas of particular interest.

National Institute of Chemistry	
Address:	Hajdrihova 19, 1001 Ljubljana
Institute General Contacts:	**Phone:** +3861/476 02 00 **Fax:** +3861/476 03 00 Director: Dr. Peter Venturini http://www.ki.si **E-mail:** info@ki.si

Description:	The most Nanotechnology related part of the National Institute of Chemistry is the Laboratory for Spectroscopy of Materials. The Laboratory for Spectroscopy of Materials performs research on photoelectrochromic systems and photovoltaically self-charging batteries, and on sol-gel processing and characterisation of nanomaterials.
Contacts:	Dr. Boris Orel **Phone:** +3861 476 0276 **E-mail:** boris.orel@ki.si http://www.ki.si/lab/l02/index.html

Institute of Metals and Technology	
Address:	Lepi pot 11, SI-1001 Ljubljana
Institute General Contacts:	**Phone:** +386 1 4701 900 **Fax:** +386 1 4701 939 Director: Dr. Monika Jenko http://www.imt.si/ **E-mail:** imt@imt.si
Description:	The Institute of Metals and Technology (IMT) is a public research institute for fundamental and applied research in natural, technical and environmental sciences. It has experience in nanotechnological characterisation and processing of metals. Laboratory for the Surface Characterisation of Materials Research and characterisation of solid surfaces, boundaries, surfaces of grains and phases, the analysis of microstructures and submicron features; research into physical-chemical phenomena on the free surfaces of metallic and inorganic materials: adsorption, segregation of surface-active elements, oxidation, corrosion, recrystallization, wear, catalysis and analysis of thin and ultra-thin films.
Contacts:	Dr. Monika Jenko **Phone:** (+386 1) 4701 950 **Fax:** (+386 1) 4701 939 **E-mail:** monika.jenko@imt.si http://www.imt.si/index.php?id1=2&id2=3&id3=1&lang=en

Nova Gorica Polytechnic:	
Address:	Vipavska 13 POB 301 SI-5001 Nova Gorica
Institute General Contacts:	Director: Prof. Danilo Zavrtanik **Phone:** +386 5 3315 223 **Fax:** +386 5 3315 224 **E-mail:** danilo.zavrtanik@p-ng.si http://www.p-ng.si

Description:	Nova Gorica Polytechnic is the youngest institution of higher education in Slovenia. It was established in 1995 as the School of Environmental Sciences Nova Gorica. In just three years it developed a rich research and educational activity and reorganised itself into the Nova Gorica Politechnic. Nanotechnology related work is performed in the Laboratory for Epitaxy and Nanostructures: • Ellipsometry of thin organic layers • Metal-organic semiconductor contacts • Electronic energy band structure of organic semiconductors.

14.4. Universities

University of Ljubljana	
Faculty of Chemistry and Chemical Technology	
Contact Person & E-mail:	Aškerčeva 5 SI-1000 Ljubljana, Head: Prof. Dr. Primoz Segedin **Phone:** +386 61 1760 531 **Fax:** +386 61 1258 220 **E-mail:** primoz.segedin@uni-lj.si http://rcul.uni-lj.si/kem/fkkt.html
Expertise:	The department of inorganic chemistry in the faculty of chemistry and biochemistry is specialised in nano-catalysis.
Faculty of electrical engineering:	
Contact Person & E-mail:	Dean: Prof. Dr. Tadej Bajd Trzaska 25, 1000 Ljubljana, Slovenia **Phone:**: +386-1-4768-411 **Fax:** +386-1-4264-630 **E-mail:** Tadej.Bajd@fe.uni-lj.si http://www.fe.uni-lj.si/welcome-E.html
Expertise:	Nanotechnology relations exist in the fields of semiconductor electronics, metrology and characterisation, and electroenergetic systems.

University of Maribor:	
Address:	Smetanova 17, SI-2000 Maribor
Institute General Contacts:	**Phone :** +421 2 4924 6111 **Fax:** +421 2 4924 6341 **E-mail :** vuz@vuz.sk
Description:	The Centre for interdisciplinary and multidisciplinary research and studies (CIMRS) was founded in 1994 by University of Maribor and is a public, non-profit self-supporting scientific research institution. With establishment of CIMRS the basic conditions for collaboration between scientific research social sphere and macroeconomics environment were set up, which is in agreement with the new scientific-technological European research policy. At the Institute for Materials Development at the University of Maribor (IRMAT) as part of the CIMRS research work is orientated towards the development of polymers and polymers nanocomposites
Contacts:	Head: Dr. Manica Ulčnik-Krump, Smetanova 17

	SI-2000 Maribor **Phone:** +386 (2) 229 44 01 **Fax:** +386 (2) 252 77 74 **E-mail:** manica.ulcnik@fs.uni-lj.si http://www.unib.si/povezave/izpis_povezave.asp?pov_id=193&langID=1033

14.5. Companies

Metal Ravne d.o.o, SEM-EDS laboratory, Ravne	
Address:	Laboratory Address SEM - EDS Laboratory Metal Ravne d.o.o. Koroska c.14 SI - 2390 Ravne
Institute General Contacts:	Phone: +386 2 870 7076 **GSM Phone:** +386 031 380 875 **Fax:** +386 2 870 7022 **E-mail:** sem-eds@sz-metal.si http://www2.arnes.si/guest/sgszmera1/index.html
Description:	The laboratory specialises in Scanning Electron Microscopy and Energy Dispersive Spectrometer analyses of steel samples, including thin films and microstructure analyses. One researcher is employed. The laboratory offers these services also to external customers.

14.6. Literature and web-links
The Ministry of Education, Science and Sport: http://www.mszs.si/eng/
Information on the Ministry of Economic Affairs in English: www.sigov.si/vrs/ang/government/ministry-of-economic-affairs.html
Slovenian Current Research Information System SICRIS: http://sicris.izum.si
Slovenian Trade and Investment Promotion Agency: http://www. investslovenia.org/
Ministry of Education, Science and Sport (2001): "Science in Slovenia 2001", published online at www.mszs.si/eng/ministry/publications/science/mzteng/ pub/science-dec01/pog2_1.htm
Ministry of Education, Science and Sport (2002): .National Research Plan., published online at www.mszs.si/eng/science/activity/nrp.asp
Nanoscience at the Josef Stefan Institute at http://optlab.ijs.si /nano/nanoscience.htm and http://nano.ijs.si/

14.7. Acknowledgements

This chapter has been written by Gerd Bachmann, with valuable contributions from Antonio Correia, Ineke Malsch, and Holger Hoffschulz

15. Turkey

15.1. General information

Turkey is an EU candidate country of around 65 million inhabitants. Important advances have been made in Turkey in recent years as to the productivity of science and technology. This is based on the increase in the number of publications originating from Turkey in the Science Citation Index from 361 in 1981 to 6,066 in 1999 bringing Turkeys ranking from 42nd in the world to 25th place in 1999 (latest available figures).

Figure 26: Map of Turkey
(Source: http://forum.europa.eu.int/irc/dsis/candidate/info/data/candidate countries/)

The Turkish Science and Technology Policy 1993-2003 aimed to increase the number of researchers and the investment in science to improve the quality of Turkish science and to increase the share of the private sector in R&D. Currently the higher education sector has the largest commitment to research and development expenditure, at 57.2 percent, followed by the commercial sector at 32.3 percent and the public sector at 10.5 percent. While there is no explicit mention of nanotechnology, technological priorities include establishing a national information network; new production technologies; aerospace technologies, genetic engineering and biotechnology; as well as regional development initiatives and environmental technologies. (Source: Turkiye 2000, www.tbb.gen.tr/english/education/policy.html)

NATIONAL CONTACT POINT
NMP Thematic Programme of the EC Sixth Framework Programme (FP6)

Professor Sahir Arikan
Address: METU, TUBITAK, Ataturk Bulvari, 221, Kavaklidere
TR-06100, Ankara, TURKEY,
Tel: +90-312-4272302, **Fax:** +90-312-4277483
URL: http://www.tedib.tubitak.gov.tr
Email: ncpnano@tubitak.gov.tr
Programme acronym: FP6-NMP

15.2. National programmes and projects

The Scientific and Technical Research Council of Turkey (TÜBİTAK)
TÜBİTAK Atatürk Bulvarı No:221, Kavaklıdere, 06100 Ankara
telephone, (+90 312) 4685300
Fax: (+90 312) 4272672
www.tubitak.gov.tr

The objective of this institution, which was established in 1963, is to develop, encourage, organise and co-ordinate research and development activities in the fields of basic and applied sciences. TÜBİTAK is an institution , which has administrative and financial autonomy, provides consultancy to the government for the determination of policies on science and technology and provides financial support for research and development activities undertaken by the universities, public and private sectors. Further, the institution has the function of carrying out secretariat services of the Supreme Council of Science and Technology. Also it gives scholarships and awards with the objective of supporting researchers, provides information services and publishes scientific publications. The research committees evaluate submitted projects and choosing those eligible for financial support. While nanotechnology is not explicitly mentioned it may be evaluated in a number of these committees:

Basic Sciences (TBAG)
Electric, Electronics and Informatics (EEEAG)
Mechanical Engineering, Chemical Technologies, Material Science and Manufacturing Systems (MİSAG)
Construction and Environmental Technologies (İÇTAG)
Marine, Terrestrial and Atmospheric Sciences (YDABAG)
Health Sciences (SBAG)
Agriculture, Forestry and Food Technologies (TOGTAG)
Veterinary and Animal Husbandry Sciences (VHAG)
Contact: npak@tubitak.gov.tr

The Turkish Academy of Sciences (TÜBA)
BAŞKANLIK **Atatürk Bulvarı No: 221 06100 Kavaklıdere ANKARA**
Telephone: (312) 467 67 89
Fax (312) 467 32 13
www.tuba.gov.tr

The establishment of the Turkish Academy of Sciences (TÜBA) was one of the important developments in the 1990s. This institution, which has provided great services for the development of scientific research, is also engaged in activities for orienting youth towards scientific research and awards those who expend efforts in these fields.

The Young Scientist Award Programme (GEBİP) which covers all scientific areas,

aims to support young, distinguished scientists to set up independent research groups. With this programme, TÜBA tries to develop a new generation of competent researchers from all disciplines. Since 2001, 75 young scientists have been supported within the framework of this Programme.
Contact tuba@tuba.gov.tr

International Co-operation

The Scientific and Technical Research Council of Turkey (TÜBİTAK)
Turkey has many activities on the subjects of bilateral, multilateral and regional co-operation in the scientific and technological fields. Bilateral co-operations are carried out within the framework of agreements and protocols signed between the governments, or between TÜBİTAK on behalf of the Turkish Government and its equivalent foreign organisations. There are bilateral agreements signed between the Government of Turkey and the governments of the USA, the Russian Federation and Hungary. Furthermore, there are many agreements signed between TÜBİTAK and foreign organisations such as CNR of Italy, CNRS of France, CSIR of India, NSF of USA and OFMB of Hungary. Within the framework of regional co-operation activities, TÜBİTAK also participates in the activities of the Economic Co-operation Organisation (ECO), Euro-Mediterranean Partnership (EURO-MED) and the Black Sea Economic Co-operation (BSEC) Organisation.
Turkey also actively participates in activities in the field of science and technology with numerous international organisations such as UN, NATO, OECD, the Organisation for Islamic Conference (OIC), the European Science Foundation (ESF) and the International Council of Scientific Unions (ICSU). Turkey is a member of the Co-operation in Scientific and Technological Research in Europe (COST) and the European Research Co-ordination Agency (EUREKA) programs and has duties in some of the programs of the EU.

The Turkish Academy of Sciences (TÜBA)
TÜBA has established bilateral agreements with the Albanian Academies of Sciences; the Austrian Academy of Sciences; Bulgarian Academy of Sciences; the Bulgarian National Academy of Medicine; the French Academy of Sciences; the Hungarian Academy of Sciences, the Israel Academy of Sciences and Humanities; the Korean Academy of Science and Technology; and the Romanian Academy.

TÜBA is a member of All European Academies (ALLEA), InterAcademy Panel (IAP) and its Executive Committee, Network of the Academies of Mediterranean Countries, Third World Academy of Sciences (TWAS), International Human Rights Network of Academies and Scholarly Societies, Association of Academies of Sciences in Asia (AASA), Co-operation between Academies of Black Sea Economic Co-operation (BSEC) Countries and International Social Science Council (ISSC).

15.3. The Research Institutes and their expertise

There are several national research centres subordinated to TUBITAK. The main research centre is the Marmara research Centre. Besides these, TÜBİTAK also provides some technological facilities. The main units providing these facilities are the National Metrology Institute, TÜBİTAK National Observatory, the National Academic Network and Data Centre and the Instrumental Analysis Laboratory in Ankara. Among the organisations for research, development and application activities in the nuclear field are the Ankara Nuclear Research and Education Centre (ANAEM), the Çekmece Nuclear Research and Education Centre (ÇNAEM) and the Lalahan Animal Health Nuclear Research Institute, which are units connected to the Turkish Atomic Energy Commission.

Marmara Research Centre (MAM)	
Address:	P.O. Box 21 41470 Gebze / Kocaeli . TURKEY
Institute General Contacts:	**Phone:** 90 (262) 6412300 **Fax:** 90 (262) 6412309 http://www.mam.gov.tr/english/about.html
Description:	The TUBITAK Marmara Research Centre (TUBİTAK-MRC) was established in 1972 as the first research and development unit of TÜBİTAK. It undertakes a very broad spectrum of research and development activities, including geological sciences, genetic engineering and biotechnology, electronics and cryptology, information technologies, space sciences and technologies, materials and chemical technologies, food science and technologies, environment and energy systems. Contact: baskan@posta.mam.gov.tr The Marmara Research Centre consists of five institutes including • Information Technologies Research, Contact Details: pk@btae.mam.gov.tr • Energy Systems and Environmental Research, Contact Details: escae@posta.mam.gov.tr • Materials and Chemical Technologies Research, Contact Details: Onur.Baran@posta.mam.gov.tr Interests "Polymeric nanoparticles and nanocomposites". • Food Science and Technologies Research, Contact Details: gbtae@posta.mam.gov.tr • Earth and Marine Sciences Research. Contact Details: ydbae@posta.mam.gov.tr • The Marmara research centre also has an incubator. Contact Details: tekseb@posta.mam.gov.tr

Basic Sciences Research Institute (TBAE)	
Address:	Feza Gürsey Insitute Emek Mah. No:68, 81220 Çengelköy, Istanbul, TURKEY
Institute General Contacts:	**Phone:**+90-216-308 94 32 **Fax:** +90-216-308 94 27 http://www.tubitak.gov.tr/english/tbae.html
Description:	The main purpose of TBAE is to increase Turkey's contribution to universal science in the fields of theoretical physics and mathematics. The mission of the Institute is to raise the level of Turkish scientific research, especially in Physics and Mathematics, to international standards. Ongoing research projects are mainly concentrated in the fields of integrable systems, classical and quantum gravity, quantum groups, and statistical physics on the one hand and low dimensional topology, algebraic number theory, representation theory, non-linear partial differential equations and control theory on the other. The modelling carried out at the institute has applications at the nanoscale.
Contacts:	HAJI AHMEDOV hagi@gursey.gov.tr

15.4. Universities

Middle East Technical University, METU, in Ankara Department of Physics	
Address:	Middle East Technical University 06531 Ankara TURKEY
Institute General Contacts:	**Phone:** + 90 312 210 20 00 http://www.physics.metu.edu.tr/research/
Description:	The department has no separate nanotechnology research programme. However the programme includes research on solid state physics and atom and molecule physics including: • Laser-atomic beam spectroscopy. • Analysis of quadrupole moment of Cr isotope using beam-laser interaction. • Structural stability and energetics of small clusters, empirical potential energy function for microclusters. • Computer simulation of thin films
Contacts:	Gulay Dereli gdereli@metu.edu.tr

Research Centre in Microelectronic Technologies	
Address:	Middle East Technical University 06531 Ankara, Turkey
Institute General Contacts:	**Phone:** + 90 312 210 20 00 **Fax:** + 90 312 210 11 05 http://www.microsystems.metu.edu.tr/
Description:	The METU-MET research centre in Microelectronic Technologies is a high volume plant for production of microelectronics and MEMS. Their research does not explicitly cover nanoelectronics. METU-MET Facilities include a microelectronics fabrication facility for 4" and 3" wafer processing. It has 1000 sq. meters of class 100 and class 1000 clean room area for fabrication and 300 sq. meters of class 10000 clean room area for electrical testing of IC's and active discrete components. The facilities are currently being used to develop a number of MEMS products for commercial applications, including piezoresistive pressure sensors, capacitive pressure sensors, humidity sensors, and surface and bulk micromachined gyroscopes and accelerometers. The design team in EEE Department is working to implement various sensors using post-CMOS process, including CMOS thermopiles and uncooled infrared detector arrays.
Contacts:	Assoc. Prof. Tayfun Akin tayfun-akin@metu.edu.tr

BILKENT University	
Address:	Department of Physics Fizik Bölümü, Bilkent Universitesi, Bilkent, Ankara, 06533
Institute General Contacts:	**Phone:** +90 (312) 290 1579 **Fax:** +90 (312) 266 4579 http://www.fen.bilkent.edu.tr/~aydinli/
Description:	The Advanced Research Laboratories (ARL) of the Department of Physics at Bilkent University consists of an STM laboratory and a clean room facility with • a 55 m2 class-100 lithography and process area and • A 100 m2 class-10, 000 characterisation area. http://www.fen.bilkent.edu.tr/%7Erecai/arl/arl.html Nanotechnology Projects include: a) Scanning hall probe microscopy of superconductors funded by the Turkish scientific and Technical Research Council (TUBITAK) and Nanomagnetics Instruments Ltd. b) Non contact atomic force microscopy, funded by BILKENT UNIVERSITY AND Nanomagnetics Instruments Ltd. c) Near field scanning optical microscopy. Funded by (TUBITAK)
Contacts:	Atilla AYDINLI, aydinli@fen.bilkent.edu.tr

Bogazici University,	
Address:	Bebek 80815, Istanbul, Turkey
Institute General Contacts:	**Phone:** +90-212-358 15 40 **Fax:** +90-212-257 50 30 http://www.bme.boun.edu.tr/
Description:	Institute of Biomedical Engineering Here researchers are looking at how to produce high technology medical equipment and biological instrumentation, and devising new and efficient methods for physiological measurements, medical data processing and analysis, and developing prosthetic materials and artificial organs, and for introducing the suitable technological developments to the health care system. Research projects focus on Robotics and Biocybernetics, Biomedical Signal and Image Processing, Astrophysics, Solid State Physics and Microelectronics.
Contacts:	atilgan@prc.bme.boun.edut.tr

Izmir Institute of Technology **The Centre for Materials Research**	
Address:	Gulbahce - URLA, IZMIR, 35437 Turkey
Institute General Contacts:	**Phone:** 90 (232) 498 7513 **Fax:** 90 (232) 498 7509 http://www.iyte.edu.tr/
Description:	The Centre for Materials Research (CMR) is a multi-disciplinary research and development organisation. Established in 2002 at IZTECH, CMR provides an environment that fosters significant advances in the fields of materials science and engineering. CMR provides research facilities, an equipment base and a support infrastructure that enables faculty members, students and industry professionals to conduct successful, team-oriented research and development projects. More than 20 faculty members and 100 graduate students throughout the campus use the centre resources for research The centre was established in 2001, and specialises in microscopic and crystallographic characterisation and mechanical testing of materials, including nanomaterials.
Contacts:	Dr Mustafa Guden, mustafaguden@iyte.edu.tr

Department of Chemical Engineering	
Address:	not found
Institute General Contacts:	http://www.iyte.edu.tr/cheweb/indexeng.html Semra ÜLKÜ, semraulku@iyte.edu.tr
Description:	There are a wide range of nanotechnology related projects being carried out. The main research topics include • Catalysis • Microporous and Mesoporous Materials, Implants • Composite Materials, • Polymers, • Sol-Gel Processing, • Ceramics

15.5. FP6 collaborations

Networks of Excellence Submissions to FP6

Industrial Applications of Microwave Energy

A network excellence to carry out research activities on microwave energy to better understand the phenomena, to cope up with present challenges of microwave applications, to master the process and to develop relevance research tools.

Contact: Tunc.Savasci@posta.mam.gov.tr

http://www.mam.gov.tr/english/6fp/noe34.html

Synthesis and Characterisation of Nano Particle Zeolites and Their Industrial Applications

Synthesis, characterisation and applications of nano zeolites have been of great interest recently, mostly because of the challenges involved and versatility of the application areas. Materials and devices of superior performance such as improved property catalysts, membranes, membrane reactors, sensors and composite polymeric materials, and their production and utilisation technologies will be developed. The uptake of the outcomes in existing sectors will be promoted and competitive advantages for European Industry will be created via nano technology applications. http://www.mam.gov.tr/english/6fp/ noe35.html

Contact: Tunc.Savasci@posta.mam.gov.tr

Bio-Ceramics, Bio-Glass and Glass-Ceramics

TUBITAK-MRC, as a largest and most equipped research centre in Turkey, has a dedication to be a part of the joint effort in Europe in the area of Bioceramics research. With a multidisciplinary research team and state of the art facilities combining the experiences in advanced ceramics research, TUBITAK-MRC intends to be one of the centre in the area of bioceramics activities. http://www.mam.gov.tr/english/6fp/noe36.html

Contact: Volkan.Gunay@posta.mam.gov.tr

Inorganic Membranes: Preparation, Characterisation and Application

Most of the membranes used in industry are made of polymeric materials that have considerable disadvantages when compared with inorganic membranes. The aim in this project will be to prepare and characterise inorganic membranes for different application purposes and adopt them to their usage areas. http://www.mam.gov.tr/english/6fp/noe37.html

Contact: Volkan.Gunay@posta.mam.gov.tr

Engineered Surfaces by Sol-Gel Coatings

The aim in this project is to carry out a detailed research work on antireflective, reflective, self cleaning coatings by photocatalytic Titanium dioxide on glasses; easy cleaning, photocatalytic, corrosion and scratch resistance coatings on metals and scratch and chemical resistant coatings on polymers.

http://www.mam.gov.tr/english/6fp/noe38.html

Contact: Volkan.Gunay@posta.mam.gov.tr

Synthesis and Processing of Boron Nitride Nanotubes
Boron nitride BN nanotubes are predicted to be semiconductors with a nearly constant energy band ~5.5 eV regardless of diameter, chirality, or the number of walls of the tube. This contrasts markedly with the heterogeneity of electronic properties of carbon nanotubes and also makes pure BN nanotubes particularly useful for potential device applications. Beside this the BN nanotubes have an exceptional elastic modulus, using them as reinforcement fibres is a possible way to obtain ultra resistant materials. In addition to that BN nanotubes is well known for its inertness to chemicals or to oxygen. It is inert in atmosphere conditions to 1000 °C. http://www.mam.gov.tr/english/6fp/noe45.html
Contact: Mehmet.Gunes@posta.mam.gov.tr

Polymer-Clay-Nanocomposites
Clays as the reinforcement phase in selected polymer matrices provide this new family of materials. Only at very low filler levels the properties of the nanocomposite like stiffness, toughness, tensile, thermal stability and gas barrier properties are increased. As a side effect the flame retardance is perfect. A few weight percent loading of organoclay in nylon-6 boots the heat distortion temperature by 80 °C, making possible structural applications where the pristine polymer would normally fail. http://www. mam.gov.tr /english/6fp/noe49.html
Contact: Emel.Yildiz@posta.mam.gov.tr

Electronic Ceramics by Nano-sized Powders and Sol-gel Technology
Properties of electronic ceramics namely varistors and titanates depend on the strict control of the microstructural and grain boundaries of the systems. Tailoring of the microstructure requires the fine control on the powder characteristics, preparation techniques and sintering. Together with our experience in conventional powder processing of electronic ceramics, the aim of this proposed project is; to study the effects of nano-sized sol-gel derived powders, coatings and bulk ceramics on the sintering and grain growth kinetics in varistors and titanates. Especially the effects of minor additives on microstructural tailoring, electrical properties will be studied.
http://www.mam.gov.tr/english/6fp/noe91.html
Contact: Volkan.Gunay@posta.mam.gov.tr

Polymeric Nanoparticles and Nanocomposites
The rapidly promising areas of nanoscale science and technology are focused on the design, production, and description of functional objects having dimensions at the nanometer length scale. An extremely active and prolific field in modern colloid chemistry is finding ways to control size and morphology of colloids at the nanometer level. Commercial applications of all these different nanoparticles, however, call for a high degree of control over the processibility as well as the structure and composition of the produced materials. http://www.mam.gov.tr/english/6fp/noe33.html
Contact: Tahsin.Bahar@posta.mam.gov.tr

Integrated Project Submissions to FP6

Thin Film Preparation for Various Applications,
Organic thin films and the surface modification of materials have been subject of various applications at multidisciplinary technological area including microsensors, separations media, biomaterials. We are aiming at the synthesis and characterisation polymers and copolymers to use in surface modification of polymers and metals for creating biocompatible-biodegradable surfaces.
http://www.mam.gov.tr/english/6fp/ip29.html
Contact: Mehmet.Eroglu@posta.mam.gov.tr

Preparation of New Organic Multi-Functional Materials
General structures of such materials are based on thiophene, pyrrole and bis(ethylenedithio)tetrathiafulvalene (BEDT-TTF) backbone. These electron rich compounds are electrically conducting, redox electroactive, electrochromic and light-emitting materials, which are at the forefront of technological importance, having broad range of application fields such as electrostatic, active electronics (diodes, transistors), molecular electronics, electrical displays, sensors, rechargeable batteries, optical computers, smart structures, magnetic resonance (MR), switches, aircraft structures, etc.
http://www.mam.gov.tr/english/6fp/ip30.html
Contact: Mehmet.Eroglu@posta.mam.gov.tr

Bioceramic Materials
Advanced ceramic materials used for the reconstruction of diseased or damaged parts of the musculo-skeletal system are termed bioceramics. These bioceramic materials may be bioinert, resorbable, bioactive or porous for tissue ingrowth. Applications include replacements for hips, knees, teeth, tendons, and ligaments and repair for periodontal disease, augmentation and stabilisation of the jaw bone, and bone repair after tumour surgery.
http://www.mam.gov.tr/english/6fp/ip48.html
Contact: Sibel.Tarar@posta.mam.gov.tr

Processing and Properties of Nanocrystalline Materials
Nanocrystalline materials offer possibilities for improved and new properties compared to conventional microstructured ones. Over the past decade, there has been a gradual shift from nanopowder synthesis (particle size<100nm) to processing, properties and application-related issues. A major challenging area is the consolidation of nanopowders using industrially applicable processing techniques such as powder injection molding, extrusion, tape casting, slurry coating. The objective of the proposal is to develop methodologies to obtain dense or porous nanocrystalline materials with improved and new properties for applications such as light-emitting devices, displays, security systems, varistors, wear parts, structural alloys. http://www.mam.gov.tr/english/6fp/ip97.html
Contact: Serafettin.Eroglu@posta.mam.gov.tr

15.6. Literature and web-links
A list of internet sites on research and science in Turkey: http://ariadne.iief.de/index.php3/Research+&+Science/Turkey
Science in Turkey http://www.bilimfeneri.org.tr/ http://www.fizikmuhoda.org.tr/ , http://www.biltek.tubitak.gov.tr/
Ministry of National Education: http://www.meb.gov.tr
Ministry of Industry and Trade: http://www.sanayi.gov.tr
Patent Institute : http://www.turkpatent.gov.tr
Turkish Counsel of Higher Education: http://www.yok.gov.tr
The Scientific and Technical Research Council: http://www.tubitak.gov.tr
Turkish Academy of Science : http://www.tuba.gov.tr
Universities : http://www.yok.gov.tr/univbil/oku22.html
Ministry of National Education : http://www.meb.gov.tr
Marmara Research Center : http://www.mam.gov.tr
Turkish Atomic Energy Authority : http://www.taek.gov.tr

15.7. Acknowledgements

This chapter has been written by Oonagh Loughran with valuable contributions from Ineke Malsch.

16. Concluding Summary

The European Union (EU) is preparing for enlargement by at least 10 candidate countries in 2004. It is believed that research is one of the fields in which enlargement can offer the greatest potential benefits - both to the Member States and to the candidate countries. European Commissioner Philippe Busquin and the responsible ministers from the EU´s candidate countries had signed an association agreement for the Sixth Framework Programme (FP6) on 29 October 2002. As a result, at the end of October 2003 from a total of 106.000 participants in FP6 proposals, there was 40 % of proposals that involves acceding/candidate countries. The highest participation of the acceding/candidate countries was found in Nanotechnologies (21.8%). For the first time the candidate countries get the same entitlements as Member States.

Nanotechnology plays a prominent role in strengthening the R&D collaborations between established EU member states and the candidate countries, which will join the Union in 2004 or later. Governments and the research communities in these countries themselves also emphasise the strategic importance of nanotechnology for their national economy and RTD scene. Therefore, most countries include nanotechnology or nanostructured materials among their national research priorities.
Examples are:

- In the Czech Republic the foresight exercise recommended to include nanotechnologies and nanomaterials research in the emerging technologies sub programme of the Thematic Programme on "competitiveness and sustainable development".

- The Estonian Research and Development Strategy 2001-2006 "Knowledge Based Estonia" implies focusing R&D on three strategic areas: information society technologies, biomedicine, materials and nanotechnologies. Speciality of Estonian Nanotechnology is scanning probe techniques.

- There are seven preferred fields of Research and Innovation in Poland, including “Microelectronics and Nanotechnologies”. Participation in the EU Framework programmes is a preferred way of developing the national scientific research infrastructure. Poland hosts two specialised nanotechnology research networks. FAMA unites 21 Polish partners in research in advanced functional materials. The High Pressure Research Centre of the Polish Academy of Sciences leads the international network in “Interfacial Effects of Nanostructured Materials”, involving 18 partners from Poland, Russia and Ukraine.

- In Lithuania, Nanotechnology and new materials are one of the five key areas of research.

Some other countries do not mention Nanotechnology as own thematic in their

national research programmes. Nevertheless Nanotechnology is part of other priorities:

- In Hungary there are five national research and development programs, on improving the quality of life; information and communication technologies; environmental and materials research; research on agribusiness and biotechnology; and research on national heritage and contemporary social challenges. Nanotechnology, in particular manufacturing and analysis of materials on the molecular level, is part of program 3 on environmental and materials research. Program 2 on ICT includes application of molecular level information technologies.

- Nanoscience or nanotechnology is not explicitly mentioned in the national research programme of Slovenia. Nevertheless, there is one national research programme related to nanotechnology on “Physics of surfaces, modulated structures and nanostructures”. Since 1996, there have also been 13 projects related to nanotechnology, including 3 which are still ongoing on Transition metals dichalcogenide nanostructures; on a photoelectrochromic system and a photovoltaic self-charging battery; and on sol-gel processing and characterisation of nanomaterials.

Other countries have installed national nuclei for Nanotechnology:

- The IMT research institute in Bucarest is the nucleus for the nanotechnology networks and programmes in Romania. It also acts as a “bridgehead” to integrate Romanian nanotechnology research into the European Research Area ERA.

- The Slovakian Academy of Sciences has recently installed the NanoSMART Centre of Excellence in nanomaterials. Around 60 researchers from the SAS institutes on Materials Research, Inorganic Chemistry, Experimental Physics, Geotechnics, Materials and Machine Mechanics, Physics, and Electrical Engineering collaborate in it. Research topics are mainly dedicated to ceramic nanocomposites and metallic materials, and mechanical, magnetic, superconducting, semiconducting, electric properties and water treatment

- In Bulgaria, there is a national research program to cover Nanotechnology. The researchers, working in the field of nanotechnology, organised a network, which became the basis of the National Centre on Nanotechnology (NCNT) established in 1999 under the auspices of the Bulgarian Academy of Sciences. The NCNT organised 5 workshops on nanotechnology. The research in the field of nanotechnology is very wide. The thematic groups present of this community are: Clusters, nanoparticles, complexes and composites; Ultra thin films and multilayer nanosystems; Submicron regions and inhomogenities in bulk materials; Molecular and atomic design;

Nanometrology and applications; and Finance and Strategy of Research.

Smaller countries have often no own Nanotechnology programme, but concentrate on special fields:

> Cyprus, for example, has no national programme dedicated to nanotechnology but has some noteworthy activities on nanotube research.

In countries like Turkey or Malta, Nanotechnology is not explicitly mentioned in the Science and Technology Policy.

In summary, there are very different models how the candidate countries deal with Nanotechnology. This report gives an overview about the national policies and the specialised Nanotechnology institutions in these countries.

16.1 Acknowledgements

This chapter has been written by Holger Hoffschulz.