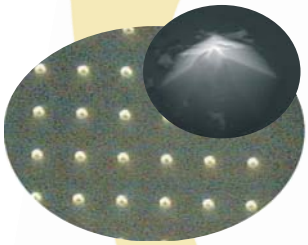
National Institute for R&D in Microtechnologies

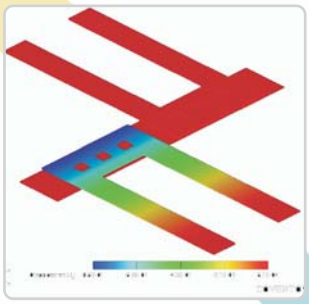
IMT -Bucharest

SCIENTIFIC REPORT 2005

NANOTECHNOLOGIES



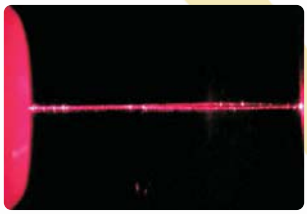
SIMULATION



From simulation to fabrication

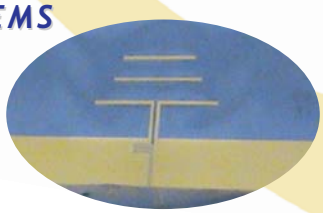
MICROSYSTEM TECHNOLOGIES

MICRO AND NANO PHOTONICS



TECHNOLOGY

RF MEMS



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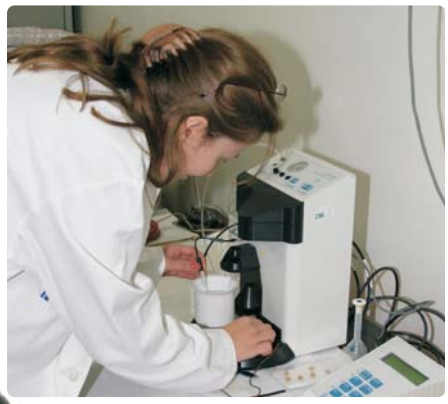

A paper about young researchers in IMT - Bucharest has been published in **Market Watch**, Romania, No. 80, November 2005 (excerpts)

Ministry of Education and Research, Romania
National Authority for Scientific Research
National Institute for Research and Development in Microtechnologies
IMT-Bucharest

SCIENTIFIC REPORT 2005

Research and technological development

Technology transfer and innovation

Education, trainig and dissemination

Networking

Edited: February 2006
Published: March 2006
Design: Elena Stanila (IMT)

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Foreword

The scientific and financial year 2005 was an exceptional one for IMT, as far as we consider the number of research projects, as well as the investments in infrastructure. IMT has now a very convincing participation in FP6, covering the whole spectrum of instruments (pp. 38-39). At the same time IMT took a decisive step in developing infrastructures for technology transfer and innovation (with the support of the national programme INFRATECH). The science and technology park for micro-and nanotechnologies MINATECH-RO, with a second clean room and new equipments (including electron beam lithography and RIE) will be officially open early spring 2006.

The money invested in 2005 exceeded the investment in the previous seven years taken altogether. With the new equipments IMT is creating two new common laboratories for two national R&T networks devoted to nanoscale structuring and characterization, as well as to nanomedicine (pp. 36-37).

In the present report, all main laboratories from IMT have the opportunity to present their work in a few pages (pp. 8-32), whereas the scientific papers and patents are covered in pages 43-48. Training, technology transfer, international cooperation are other dimensions of IMT's activity.

In the near future, two important steps in creating a "technological pole" centered on IMT will be related to the oficialization of a network of providers and in micro-and nanotechnology at the national level, as well as to the set-up of an inter-university centre for education and training.

One year before planned integration of Romania in EU, IMT seems to be well prepared to face both the opportunities and challenges related to a considerable increase in activity at the regional level.

Prof. Dan Dascalu

CEO and President of the Board

Prof. Dan Dascalu is the General Manager (CEO and President of the Board) of the National Institute for R&D in Microtechnologies (IMT-Bucharest). He founded (1993) the Institute of Microtechnology (IMT), which merged later (1996) with ICCE to create the National Institute of Microtechnologies. He is also professor at the "Politehnica" University of Bucharest (PUB), Department of Electronics and Telecommunications and full member of the Romanian Academy (of Sciences). Prof. Dascalu is the author and co-author of several books and numerous scientific papers, including four scientific monographs. He is the author of *"Transit-time Effects in Unipolar Solid-State"* and *"Electronic Processes in unipolar solid State Devices"* (both published by Abacus Press, Kent, U.K., 1974 and 1977, respectively) as well as of more than 150 technical papers published in scientific periodicals or conference proceedings. Prof. Dascalu is Senior Member of IEEE (Electron Devices).

His previous work was on semiconductor electronics and especially high-frequency devices. Prof. Dascalu is currently interested in the convergence of micro-nano-biotechnologies. He is coordinating the Romanian scientific network (RO-NANOMED) devoted to integration into the European Technological Platform of NanoMedicine (2005-2008).

As a member of the Romanian Academy, academician Dan Dascalu is the President of the Commission of *"Science and technology of microsystems"* of the Romanian Academy, Editor-en-chief of the *"Romanian Journal for Information Science and Technology"* (edited by the Romanian Academy), and coordinator of a series of books in *"Micro- and nanoengineering"* (Publishing House of the Romanian Academy), with 7 volumes already published.

Prof. Dascalu is representing Romania in the NMP FP6 Programme Committee (since 2002), in the Steering Committee of MNT ERA-NET (MNT=Micro- and NanoTechnologies), and in the "mirror group" for the European technological platform for nanomedicine. Prof. Dascalu is coordinating three SSA (support) projects (ROMNET-ERA, MINAEAST-NET and MINOS-EURONET) financed by EU and mainly devoted to networking in micro- and nanotechnologies, at the regional and pan-European scale.

Members of the IMT-Bucharest Managing Board

Prof.Dr. Dan Dascalu, *President, General Manager*, National Institute for Research and development in Microtechnologies (IMT-Bucharest);

Dr. Phys. Alexandru Muller, *Head of laboratory*, Laboratory of Microsystems and Micromachined Microwave Components, National Institute for Research and development in Microtechnologies (IMT-Bucharest);

Phys. Iulia Mihail, *Director of the Department* Management of European Integration and International Cooperations, Ministry of Education and Research, National Authority for Scientific Research;

Ec. Florentina Stefanescu, National House of Pensions and Other Social Insurance Rights;

Cons. Mioara Masariu, *Head of Department*, General Management of Sector Budgetary Programming and Social Security, Ministry of Public Finance;

Eng. Cretu Nicolae, Ministry of Environment and Waters Management;

Dr. Chem. Irina Kleps, *Head of laboratory*, Laboratory of Nanotechnology, National Institute for Research and Development in Microtechnologies (IMT-Bucharest);

National Institute for Research and Development in Microtechnologies (IMT-Bucharest)

Field of activity: *micro- and nanotechnologies*. Romania established in 1993 the Institute for Microtechnologies, or IMT (as the first institute from Eastern Europe having this profile), as well as the "microtechnologies" field of research in the National R&D plan (1993). IMT became a national R&D institute in 1996, also including nanotechnologies in its field of activity.

IMT: Brief history.

1993 - 1996. The Institute for Microtechnologies (IMT) was set up by a decision of the Romanian Government in July 1993, as a unit coordinated by the Romanian Ministry of Education and Research. The institute was hosted by Microelectronica S.A company, managing the clean room and the CAD centre. **The existing CMOS technologies have been used for developing new products (chips for MOS power devices) as well as for research activities in the domain of microsystems technologies**, following the evolution of similar organisations managing silicon technology in an attempt to construct micro-transducers and microsystems. The initial team was mainly formed by people previously working at Microelectronica S.A., the major part being represented by personnel carrying out the production activities.

1997 - 1999. The National Institute was set up at the end of 1996 by merging IMT with the former ICCE (Research Institute for Electronic Components) basically working in semiconductor electronics. In fact, IMT was taking over the building, equipments and personnel of ICCE. At the end of 1996, the total number of personnel from the merging institutes was 370 people (more than twice the personnel in 2005). Further on, starting end of March 1997, the direct activity within Microelectronica S.A. was stopped and part of the personnel involved in production was transferred back to the company. For the institute it was a new start, in a different environment! External contacts had been developed and the access to laboratories abroad was facilitated. **A remarkable success was the coordination by IMT of the European project MEMSWAVE, nominated for the Descartes prize in 2002.** The substantial decrease of national funding for research activities (starting 1998) contributed to a major "brain-drain" of researchers from different generations. The people were leaving either for studies abroad (with minimal probability of return), or for working in universities and in foreign companies.

In the time period 2000 - 2003 IMT became visible at the national level, by participating to a number of projects under the frame of "Horizon 2000" Programme (with a micro- and nanotechnologies section) and later on by coordinating various projects financed by the MATNANTECH (New Materials, Micro and Nanotechnologies) Programme (2001-2006). The multi-disciplinary characteristic of the activity was emphasized and **the activities in the micro-nanotechnologies domain** were intensified, also starting projects in collaboration with industrial companies, including Samsung (Republic of Korea).

During the next period, **starting 2004**, the investments increased, especially as part of contract funding, the clean room was upgraded at international standards (class 100), becoming functional in 2005. IMT intensified its European cooperation by participating in a number of FP6 projects. **Visiting the institute in February 2004, Mr. Philippe Busquin, the European Commissioner for Research, characterized IMT as "a pioneer of integration in ERA in Eastern Europe"**. The research thematic area was oriented towards convergent technologies, i.e. micro-nano-bio-technologies. A significant number of research projects had been won in the national Excellence Research Programme CEEX (2005). Another characteristic feature of this period is the development of technological transfer and innovation infrastructures described in detail in this report.

IMT: Main areas of interest in FP7

Aim: Development of research activities the field of micro/nano-technologies, with strong impact on the development and competitiveness of the Romanian Industry, in correlation with the the thematic priorities in FP6 and FP7.

A. Information and Communication Technologies (ICT)

A.1. Development ICT technology pillars (nano-electronics, photonics and micro/nanosytems) and of the related micro/nano technologies

- Integrating micro/nano components and devices in different materials : silicon, wide band-gap semiconductors (GaN, AlN), dielectrics, ceramics, hybrids, polymers,
- Development of mixed-technology for micro/nano systems (eg microfluidic/ICT/micro-nano, bio/chemical/ micro-nanophotonics/micro-nanoelectronics,RF MEMS/NEMS combined).
- Hybrid integration and packaging techniques, including on-chip and chip-to-chip connections
- Modelling, simulation and characterization techniques for micro/nano-structures and sytems

A.2. Applications of ICT (focus on application with societal impact)

A. 2.1. Health

- Development of innovative microstructures and systems for prevention, diagnostics and treatment processes: micro-fluidics and lab-on-a-chip; bio-photonics chips (biosensor with microphotonics components and systems); silicon biochips; controlled drug delivery systems; bioMEMS (bio microsensors, micro/nanoelectrodes, microreactors).

A.2.2. Communications

- RF circuits and MEMS/NEMS: reconfigurable millimeter wave circuits (filters, antennas) , F-BARS on compound semiconductors.
- Passive and active micro-nano-photonic structures, hybrid or monolithic integrated photonic circuits and MEMS/NEMS for optical communications.

A.2.3.Environment and Safety

- Development of microsensors, bio-sensors, bio-photonic sensors and arrays of sensors for an optimised environmental control and monitoring, for food quality control, and for home applications
- Teraherz environmental monitoring systems on a chip(SoCs)

B. Nanosciences, Nanotechnologies, Materials and new Production Technologies

B1. Nanomaterials, nanotechnologies, nanostructures

- Nanomaterials: new nanostructured semiconductor, organic, organic/anorganic hybrids materials with controlled properties, new functionalities and improved performances for industrial applications; biomaterials and hybrid materials; carbon nanotubes and fullerenes based materials.
- Integration of nanomaterials and nanostructures for microsystems;
- New advanced characterization techniques development for nanomaterials and nanostructures;

B.2. Nano-bio-tehnologies

- New approaches for interfacing biological and non- biological components;
- Self- assembley nanostructures on micro/ nanoprocessed silicon surfaces, with biomedical applications;
- Integration of the nano- bio- technologies with information technologie, social, cognitive and neurosciences in order to find to alleviate the effect of disabilities and to create new types of nanotransducers

Strategy

In the actual European context, oriented towards accomplishing the Lisbon objective and the launching of the Framework Programme 7, two main directions are present for IMT: the first one is related to micro- and nanosystems, constituting a platform for integrating different micro-nano-bio-info technologies; the second direction consists in the orientation towards nanofabrication, having micro and macro components. In parallel, the nanoelectronics direction is developed, including interfaces realized using Mirosystems technologies, so as a complex technical system could be integrated in a single component.

At national level, in Romania, the micro-nanotechnologies area is visible, representing a success, with the aid of the MATNANTECH the programme and its correlation with other European programmes through MNT-ERA NET project. The domain is well represented also in CEEX (Programme for research of excellence).

The launch of CEEX allowed a **strengthening of the IMT's role** by the number and quality of projects started with this occasion, including projects such as research networks or technological networks. Recently, IMT became a national contact point for three European technological platforms: nanoelectronics, nanomedicine and nanophotonics.

The investments in the MINATECH-RO Park lead to the inauguration in March 2006 of a new "clean room", exploitation of new equipments and in parallel offering spaces to be used by companies. The Centre for technology transfer (CTT-Baneasa) succeeded to attract into **a network** a number of **suppliers and users** of knowledge, technologies and products in the domain. The institute is involved in various activities for European cooperation, in some cases playing a special role with regard to bilateral collaboration; see the Romanian-German Centre for micro-nanotechnology and IMT as a contact point for Eastern Europe at the level of small and medium enterprises in some external projects.

The institute strategic objectives on medium term, in the time period 2006 – 2010

Redefining the IMT mission: on medium and long term, the institute intends to consolidate its role as a **technological pole in the micro-nano-biotechnologies domain**, facilitating a concentration of research efforts on national level, but also providing a direct and efficient interaction with companies and with educational activities, respectively (especially M.Sc. and Ph.D. studies). IMT intends to play a role at the regional level and become part of the system of technological centres at the European level.

The strategic objectives of the institute on medium term related to the IMT "mission" are the following:

a. The institute intends to become an **excellence centre** in research and development related to the **integration/convergence of technologies** (micro-nano-biotechnologies)

b. The institute will function as a **"technological pole"**, by using the facilities such as "clean room" spaces and the whole complex of equipments and computing technique to provide a **platform of interaction of the Romanian research with industry and education**. In Romania, IMT has a unique position through the activities carried out until now, but this role will be further developed and strengthen.

c. IMT will pursue the technology transfer and innovation, by creating a **"cluster" of organizations either providing or using the knowledge and the technologies in the domain.** The main instrument will b represented by the Science and Technology Park, whereas the Centre for technology transfer will provide some services in the park, including brokerage activities. Services will be also provided to non-residents.

Various **actions** are considered in order to achieve the above objectives:

- increasing the quality of scientific research and their utilization through publications (especially ISI) and patents
- recruiting and training of personnel, including the participation to common educational activities with universities
- promoting spin-off activities at institutes from universities and from the institute itself
- focusing and continuation of cooperation activities at European level having as the main aim participation to FP7
- establishing partnerships with a few European institutes working in the same field
- defining and constructing a regional role) for the institute, as a technological pole
- strengthening the national networks with IMT as contact point, especially with respect to the interaction with the European technological platforms of nanoelectronics, nanomedicine and nanophotonics, respectively
- increase the critical mass of the offer for knowledge, technologies and products in the domain, by developing the network of technological transfer, containing providers and users of knowledge and technologies
- installing new equipments and increasing their versatility
- structuring and expanding the scientific and technological services offered by the institute, complementary to the ones available at European level
- assuring contact points and also offices for equipments manufacturing companies
- involvement in regional development through projects for structural funding (UE)

Members of the Scientific Council of IMT

Dr. Alexandru Muller, *President*, Head of the Laboratory of Microsystems and Micromachined Microwave Components, IMT-Bucharest
Dr. Marius Bazu, *Vicepresident*, Head of the Reliability Laboratory, IMT-Bucharest
Dr. Ileana Cernica, *Scientific Secretary*, Head of the Laboratory for Prototype Development, IMT-Bucharest
Prof. Dan Dascalu, *General Manager*, IMT-Bucharest; Professor at PUB; Member of the Romanian Academy.
Dr. Dana Cristea, *Director of the Department of Multidisciplinary Research*, IMT-Bucharest
Dr. Irina Kleps, *Head of the Laboratory of Nanotechnology*, IMT-Bucharest
Dr. Carmen Aura Moldovan, *Director of the Department for Services and Microproduction* , IMT-Bucharest
Dr. Raluca Muller, *Director of the Department for Developmentt in Informatic Technologies*, IMT-Bucharest
Dr. Gheorghe Sajin, Laboratory of Microsystems and Micromachined Microwave Components, IMT-Bucharest
Prof. Adrian Rusu, *corresponding member of the Romanian Academy, Professor,* Head of department, PUB
Prof. Gheorghe Brezeanu, *Professor*, PUB
Prof. Nicolae Cupcea, *Professor*, PUB
Prof. Ovidiu Iancu, *Professor*, PUB
Dr. Maria Zaharescu, *corresponding member of the Romanian Academy*, ICF "I G Murgulescu" (Romanian Academy), Bucharest;
Prof. Ion Munteanu, *Professor*, University of Bucharest

IMT: human and financial resources (1)

Human resources Fig.1 (a, b, c) provides information about the number and distribution of researchers active in IMT in 2005 (64). Half of them are senior researchers (a). Almost 2/3 of them have the Ph.D. degree or are Ph.D. students (b). The average age is slightly above 40 (c).

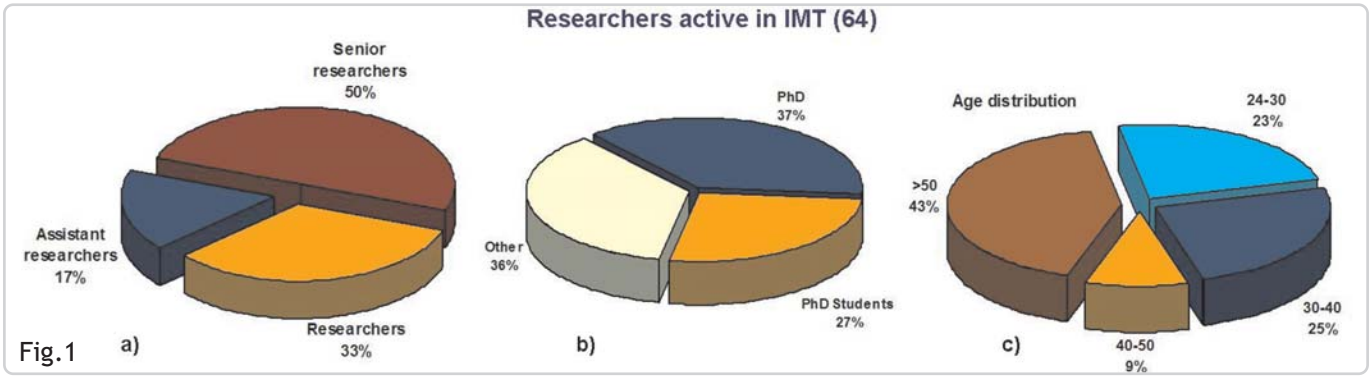


Fig.1

Fig.2 is related to **the total number of specialists active in IMT** in 2005 (82): researchers and specialists providing technical services.
Their background is shown in Fig.2.a, whereas the age distribution occurs in Fig.2.b. The female number (42) is slightly higher that the male population (40).

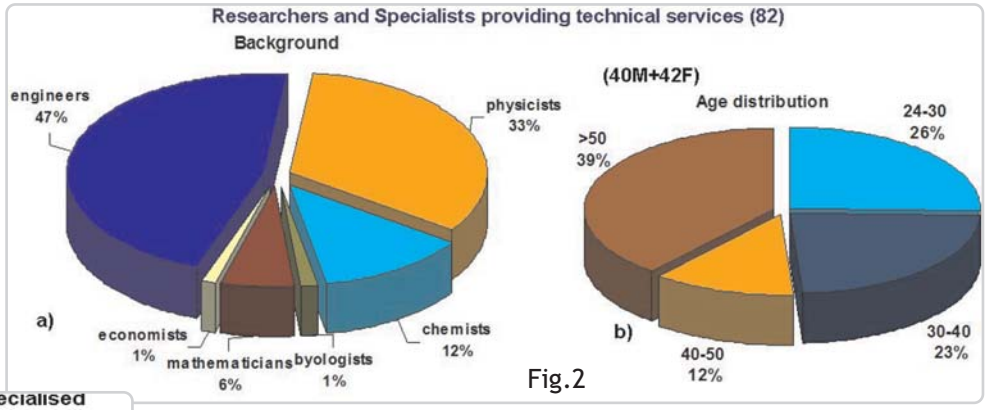


Fig.2

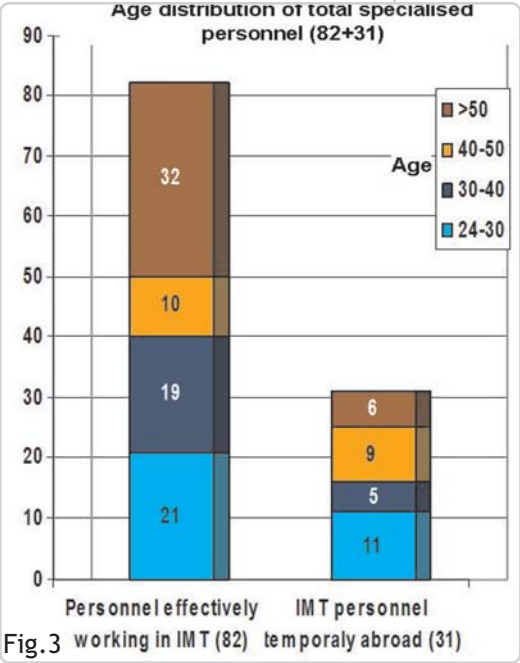


Fig.3

The number (and age distribution) of specialized IMT personnel temporarily working abroad is shown in Fig. 3.

Fig. 4 shows the **funding sources** in 2005 (a) as well as the evolution in the last five years (b). As the number of personal remained almost constant, **the substantial increase of funding** determined not only an increase in salaries brut also acquisition of new equipments.

The majority of funding (63%) comes from national R&D programmes (competitive funding, through open calls) and **only 15% is provided by core funding** (public money available to national institutes for R&D, since 2003).

The dynamics of investments during the nine years of existence of IMT as a national institute (1997-2005) is even more spectacular (fig.5). The average level of annual investments is low by international standards, with on overall increase, but with two minima (in 1999 and 2002).

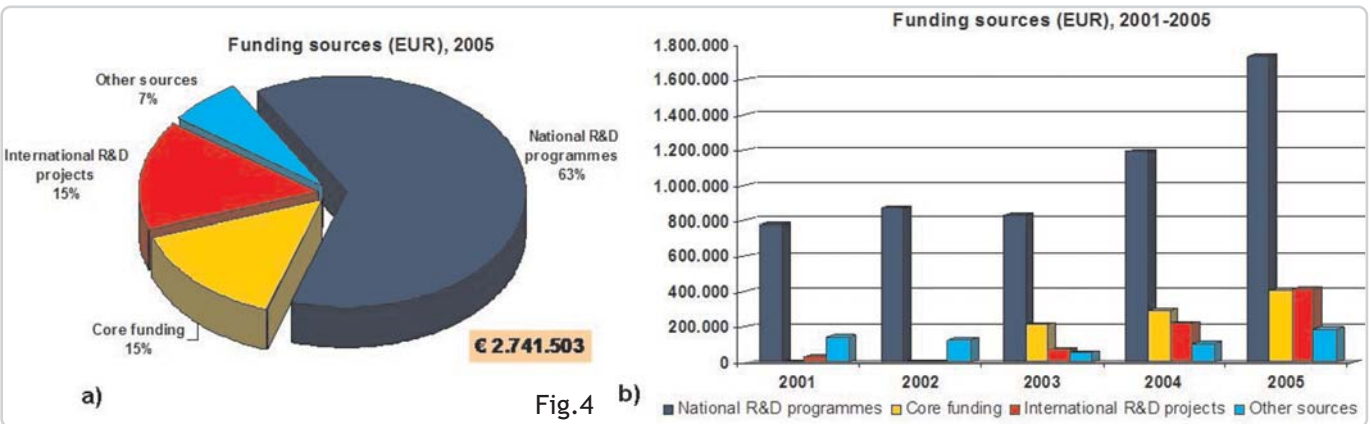


Fig.4

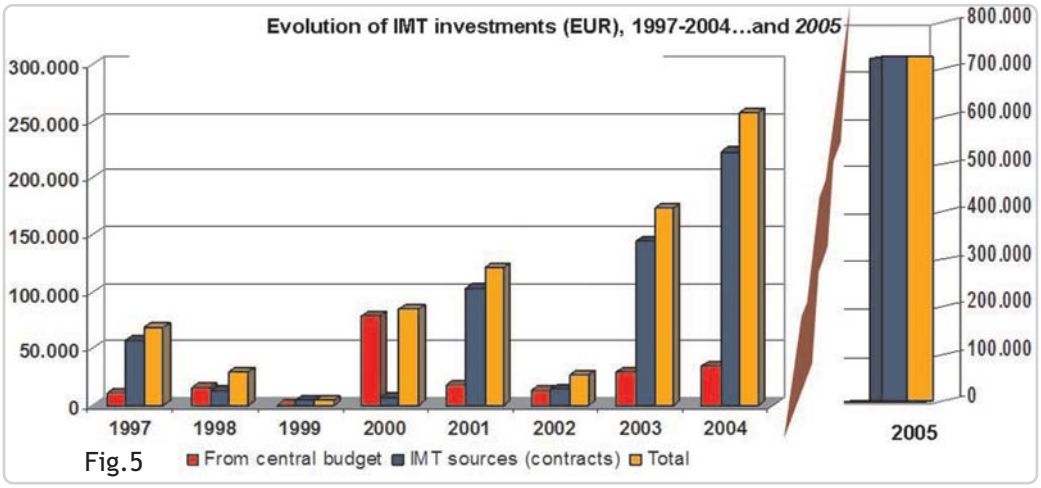


Fig.5

The investments from central funding (from the public budget) are comparatively low. The substantial increase in investments during the last three years was provided by **funding from R&D contacts financed from the national programmes.**

The increase in the last year was dramatic (**the money invested in 2005** represent 125% from the money invested in the previous four years and 94% from the total investments in the previous existence of IMT as a national institute, 1997 – 2004). This substantial increase in money spent for equipments can be explained through the access to new national programmes, namely CEEX (research of excellence) and INFRATECH (devoted to infrastructures for technology transfer and innovation).

The structure of these investments is shown in Fig.6. For the time period (1997-2000) almost all the money (94%) went into IT equipments and software (Fig. 6.a). This proportion decreased to one third during the following four year period (2001-2004), whereas the most important category became (37%) the technological equipment (Fig. 6. b).

Finally, in 2005 **more than half of the money have been invested in technological equipments** (Fig. 6. c), whereas the characterization equipments maintain a significant percentage (26%).

The use of these new equipments will be shared with many partners in R&D projects financed by national programmes. The **number of these partners in the projects coordinated by IMT** is very high, as shown in Fig. 7. The partnership with many other research institutes provides the multi-disciplinary character of research, whereas the orientation towards applications is certified by the presence of companies in these consortia.

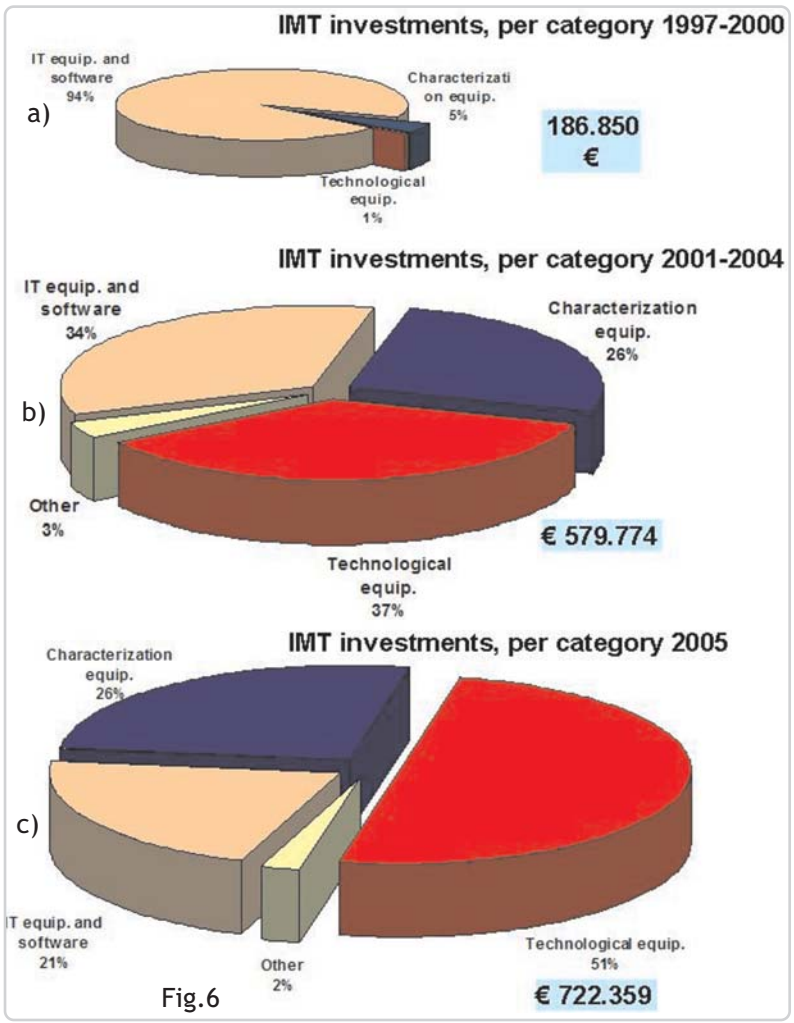


Fig.6

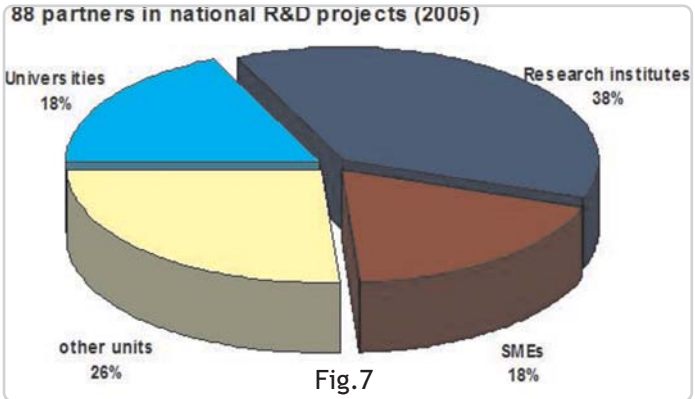


Fig.7

Two S&T networks (see pages 36, 37) are focused on common laboratories to be installed in IMT, as a "technological pole" (providing also access of companies and Ph.D. students).

It is worthwhile to note that the presence of IMT in successful FP6 research proposal (pp.38-39) was certified before the substantial upgrading of equipments accomplished in the last two years. Today, IMT has much more to offer in this respect.

L1: Laboratory of Nanotechnology

Affiliated to the Romanian Academy (of Sciences)

Laboratory of Nanotechnology is affiliated as Centre of Nanotechnology to the Romanian Academy since 2001. The Laboratory of Nanotehnology was recognized at national level, and funded between 2001 and 2004, as a Centre of Excellence in Nanotechnology.

- *Mission:* Multidisciplinary research in nanomaterials and nanostructures domain: design, modelling/simulation and technological experiments.
- *Main areas of expertise:* silicon nano-electrode arrays, porous silicon layers with electroluminescence (El), photo-luminescence (PL) and bio-active properties; field emission nanostructures; magnetic nanostructures and microsensors (modelling, computer simulation and design); biomedical applications of nanostructures: drug delivery systems, microchips for DNA analyses, bio-chips for diagnostic biological media and for pollution control, silicon microetched support for selective growth of CNT; development of new materials: silicon carbide and diamond like carbon (DLC) thin layers, nanostructured silicon, nanostructured aluminium nitride (AlN) and PZT thin layers; characterisation of nanostructured materials.

- *Research Team:* has multidisciplinary expertise and is composed by 5 senior researchers (with background in physics, chemistry, electronics), 4 PhD students (with background in physics, chemistry, computers and specialisations in pharmacy and biochemistry, 1 student (physics).

Computer room

Electrical measurement unit

- *Specific Instruments and Equipment Available:* Computers for simulation; instruments and software for electrical characterisation of nanostructures; Keithley model 6487-picoammeter/ voltage source 2004; VOLTALAB10 and Trace Master 5; AMMT: Wet etching system with software for 4' silicon wafers, potentiostat MC, silicon etching power supply; Fluorescence set-up for LEICA DMLM with images acquisition and measurement system.

VOLTALAB10 and Trace Master 5 (a);
AMMT: Wet etching system for 4' silicon wafers (b);

- *International networks:* Partner in international networks/projects: ROSTE-UNESCO-South East European Network on NANO- Science and Technologies: Nanostructured Materials and Devices) (COSENT) (2002-2006); FP6-NoE: Nanostructured and Functional Polymer-Based Materials and Nanocomposites (NANOFUN-POLY) (2004-2008); FP6-Romanian inventory and networking for Integration in ERA (ROMNET-ERA)(2004-2007); FP6- Micro- Nano- Systems European Network (MINOS) (2005-2008);

- *National networks:* Partner in national MATNANTECH networks: NANOMATFAB - Virtual Network of Centres for Research in nanotechnologies for new materials and new nanoprocesses (2003-2005) and CENOBITE - Centre of Research in Nanobiotechnologies (centre of research in nanobiotechnologies) (2002-2005); and CEEX RO-NANOMED Integrated research network devoted to Nanobiotechnology for health (Romanian Nanomedicine Network), (2004-2006).

- *AWARDS:* • Best Award Paper: Single Oriented Carbon Nanotubes Growth On Array Of Processed Microelectrodes, F. Le Normand, C.S. Cojocaru, B. Vigolo, E. Minoux, P. Legagneux, I. Kleps, F. Craciunoiu, A. Angelescu, M. Miu, M. Simion, CAS'2005. • Medaille d'argent, Technologie pour un microdispositif realize en silicium avec la function d'identification de molecules de DNA, Monica Simion, Irina Kleps, Anca Angelescu, Teodora Neghina, Mihaela Miu, Adina Bragaru, Tatiana Oana Nedelcu, Florea Craciunoiu, Eduard Condac, 54eme Salon Mondial de l'Innovation, de la Recherche et des nouvelles technologies, 19.11.2005, Brussels, Eureka 2005.

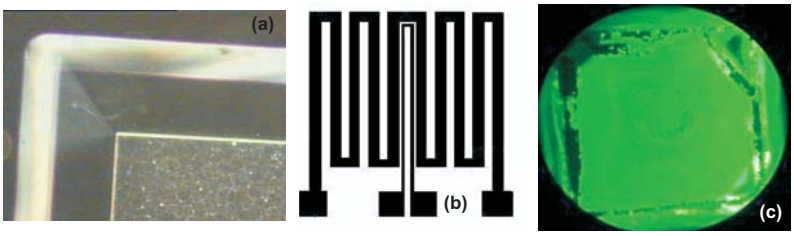
Dr. Irina Kleps, Head of the Nanotechnology Laboratory (irinak@imt.ro)

She obtained her MSc. in Chemistry Engineering, in 1973, and the PhD in chemistry in 1998 at „Politehnica" University of Bucharest. *Her competence domains are*: nanomaterials, nanostructures, nanotechnology, new materials and technological development for bio-medical devices, microchemistry.

Dr. Kleps participated in several European projects: PATCOAT (hard coatings) (1994), NATO-CNR (LPCVD-TiO_2 and SNO_2 films) (1996), INCO-COPERNICUS SBLED (1998-2001), EMERGE (guest experiments at IMM, Germany) Metallics (2000-2003), PHANTOMS (Network of Excellence on Nanoelectronics) (2001-2004), NANOFUN-POLY (2004-2008). *She was expert* for project evaluation in the EC-FP5 (IST; Growth, Improving programmes), FP6 (NMP and Marie Curie) and MATNANTECH national program.

Other activities: Golden medal (2001), Salon International des Inventions-Geneve: Chapter „Electrochemical Nanoelectrodes", in „Encyclopedia of Nanoscience and Nanotechnology"; Co-editor of the „Nanoscience and Nanoengineering" (2002) and "Advances in Micro and NanoEngineering" (2004), (Romanian Academy); More than 100 papers published in international journals/conferences, 80 technical reports, and 4 Romanian patents.

Silicon-Chip-Based Bioanalytical Microdevices



PCR microdevice 4x4 mm² chip structure: (a) microreactor; (b) temperature sensor; (c) Fluorescent primer immobilisation, 10 pmols / µl on the reservoir surface functionalized with poly (lysine)

A silicon microchip with a microreactor and a heater for oligonucleotide amplification by polymerase chain reaction - PCR and rapid analysis of the DNA samples is realized.

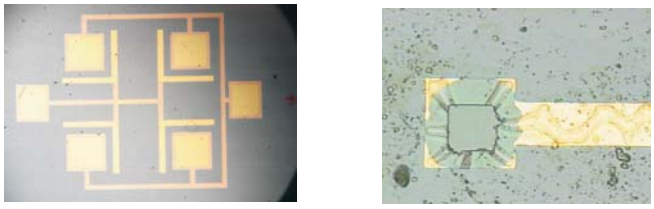
Achievements: •silicon array microfabrication; •reactor surface functionalisation and DNA immobilization;

• PCR cycling and on-chip DNA microarray hybridization.

•DNA microarray (after washing) scanned with a confocal fluorescent scanner

MATNANTECH Project (2003-2005) ***Co-ordinator :*** IMT-Bucharest, (**Project Manager**: **Monica Simion: monicas@imt.ro**); **Partners:** IMT Bucharest, Center of Nanotechnologies; Faculty of Biology, University of Bucharest, Dextercom. SRL

Microsystem for controlled drug delivery

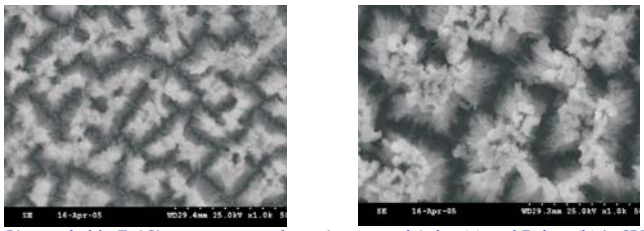


Gold electrodes (300x300 µm²,) on the back-side of the microstructure 4x4 mm² chip structure

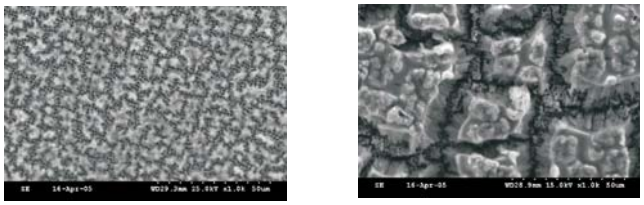
Achievements: **(i)** design and fabrication of a Si microchip with a microreservoir array; **(ii)** calibration of microchip to deliver programmed drug doses over a prolonged period, at specific time intervals. The dissolution of gold cap to release the desired drugs (encapsulated in microreservoirs) occurs by a chemical redox reaction.

MATNANTECH Project (2003-2005) ***Co-ordinator***: IMT-Bucharest, (**Project Manager: Mihaela Miu: mihaelam@imt.ro**); **Partners:** Institute for Chemical-Pharmaceutical Research; Oncological Institute "Al. I. Treistoreanu"

Nanostructurated silicon membrane technology for pharmaceutical microdevices



Bioresorbable Fe/ Si nanostructured matrix exposed 1 day (a) and 5 days (b) in SBF



Bioresorbable K/ Si nanostructured matrix exposed 5 day (a) and 15 days (b) in SBF

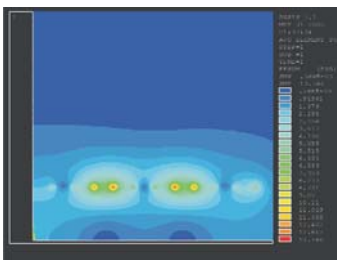
Monolith porous silicon (PS) devices as well as PS membranes are resorbable by the body, so the rate of the released substance will be related directly to the dissolved rate of the silicon material.

Achievements: •design and fabrication of pharmaceutical microdevices on silicon;•silicon nanostructured membrane impregnation with Mg, K, Fe;•study of mesoporous silicon implant for pharmaceutical substances release; •study of the surface of PS layers modifications related to different exposure times in SBF (simulated body fluids).

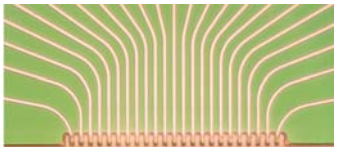
In the first day, a strong release of Fe and K was observed due to the dissolution of the iron/potassium salt from the PS pores. After that the iron release takes place in the same time with the degradation of the PS matrix in SBF solution.

MATNANTECH Project (2003-2005) ***Co-ordinator*** : IMT-Bucharest, **Project Manager Anca Angelescu: ancaa@imt.ro**); **Partners:** Institute for Chemical-Pharmaceutical Research; Center for Organic Chemistry

Microsystem for dna macromolecule separation



Simulated electric field for 6 successive gold electrodes, 3µm wide and 3µm space deposited on oxidised silicon (++-- ++).



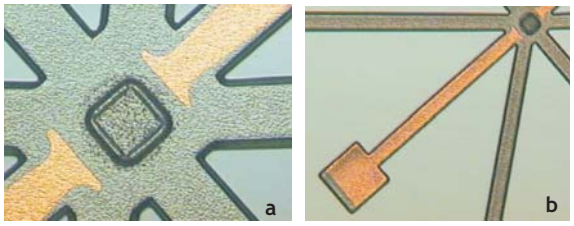
Metallic microelectrodes deposited on a glass plate

Achievements: Design and fabrication of a dielectrophoretic device for size-separation of DNA molecules. A microdevice able to separate DNA molecules in the range of tens kilo base pairs (kbp) is proposed. The DNA molecules separation is obtained using a travelling electric wave, created by a line of metallic microelectrodes, successive polarized; microelectrodes of few microns wide were realised by microlitographic techniques.

MATNANTECH Project (2004-2006) ***Co-ordinator***: IMT-Bucharest, (**Project Manager Florea Craciunoiu: floreac@imt.ro**) **Partners:** Academy Biochemistry Institute; ROMES SA.

Lab-on-a-chip: Silicon multifunctional test structures with biomedical applications

Achievements: Design of a test bio-chip structure containing a two-steps microreactor, many microreservoires and micro-channels between them, and a cap with micro-pipes was proposed. All these structures were realized by silicon micromachining. The central reservoir was porosified in order to obtain a porous membrane. This membrane is bio-compatible with human tissue/biological cells and can be impregnated with drugs or can be immersed in a drug solution; the influence of the drug on the ill cells can be investigated.



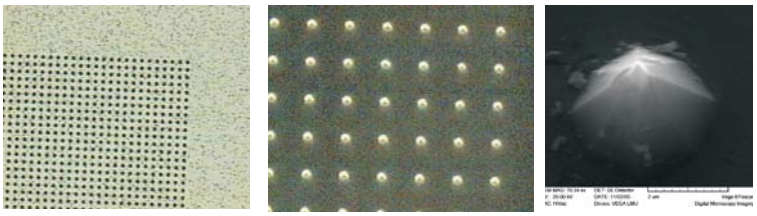
Microfluidic Biochip for Biomedical Application (a - x20; b - x10)

MINASIST project (2004-2005); **(contact person: Anca Angelescu)**

Increase of the microprocessed silicon tips field emission efficiency, by localized deposition of the nano-structured materials in vacuum thermoionic arc

Achievements:

- technological processes for localized deposition of the carbonic nanostructured materials in vacuum thermoionic arc;
- design and fabrication of microelectronic vacuum device based on microprocessed silicon tips field emission; new knowledge on field emission microdevices.


SEM image of a silicon microprocessed matrix (tips partial covered by localised deposition)

MATNANTECH Project (2004-2006) **Co-ordinator : IMT-Bucharest, Project Manager Florea Craciunoiu: (floreac@imt.ro)**; Partners: National Institute of Materials Physics; ROMES SA.

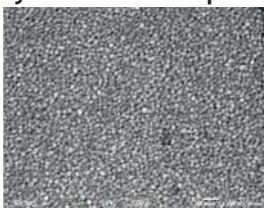
Technologies for nanostructured materials preparation using physico-chemical processes

Achievements:

Gold films deposited on porous silicon substrates and thermal treated at temperature higher than 500^{0}C become (111) textured.

The crystallite size significantly increases with thermal annealing with 5-8 nm from 500^{0}C to 900^{0}C, reaching the same size, 25-28 nm, excepting the (220) and (311) crystallites which disappear.

The nanocrystalline gold, (111) textured deposited on PS layers were successfully used in biomedical applications, such as PCR membrane functionalisation.

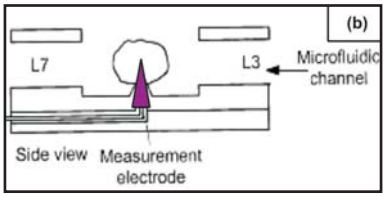

Au/PS (Si p+ (100), 0.005Ωcm, 3mA/cm^2, 25%HF, 30min, Au=1000Å)


Immobilisation of a fluorescent oligonucleotide on Au/Ps (A-20X, B- 40x, Nikon fluorescence microscope)

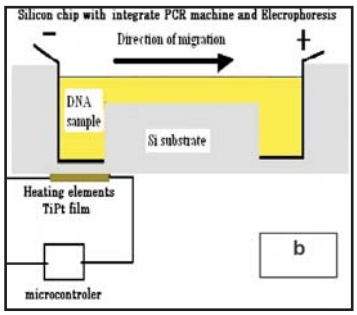
MINASIST project (2004-2005); **Contact person: Irina Kleps (irinak@imt.ro)**

Silicon Carbide Devices for High Power and High Temperature Applications

TOOPROLAB project is related to a very exciting and novel domain BioLab-on-a-chip based on the electrical biochip technology. Research includes interfacing nano-to-nano, nano-to-micro-to-macro components and connecting nano and micro devices to biological materials like organic molecules or living cells. *The proposed project envisaged two important health applications:* **(i)** CELL-Lab-on-a-chip for in-vitro drug testing and **(ii)** DNA- Lab-on-a-chip for genetic diagnosis.



CELL-Lab-on-a-chip for in-vitro drug testing (schematic representation)

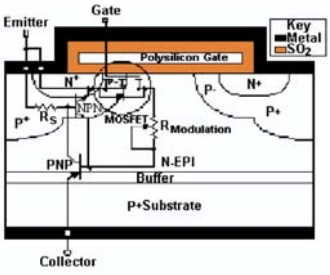


DNA- Lab-on-a-chip for genetic diagnosis (schematic representation)

CEEX Project (2005-2007), **Co-ordinator : IMT-Bucharest, Project Manager: Irina Kleps (irinak@imt.ro);**
Partners: InterNET SRL, DEXTER Com SRL, Faculty of Medicine, Faculty of Biology, METAV SA, Faculty of Chemistry, Faculty of Physics, INCDFLPR, LABOR&SOFT, ROMES SA

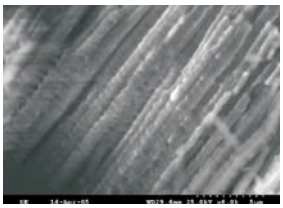
Isolated gate bipolar transistor (igbt) fabrication technology for high power and high temperature applications

Achievements: The basic properties of the IGBT as a switch to achieve higher switch, the lower gate drive current and the ability to block both polarity voltages. The static model for the IGBT is a diode in series with a power MOSFET to better explain: forward voltage behavior, low gate current and reverse blocking ability. The IGBT is a voltage-controlled device with high impedance gate.

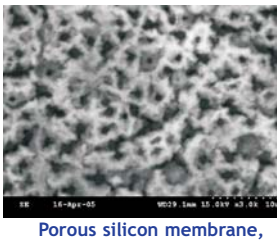


The IGBT equivalent circuit consisting of a MOSFET and a bipolar transistor in a Darlington configuration

RELANSIN project (2004-2006); **Co-ordinator : IMT Bucharest, (Project Manager: Marioara Avram: marioaraa@imt.ro);** Partners: Politehnica University of Bucharest; ROMES SA



Macroporous silicon with uniform pores, perpendicularly to the surface, 0.5 - 1 μm diameter



Porous silicon membrane, pore size 1-3μm

Service offer: micro- and nanostructured silicon fabrication

Achievements:

• Fabrication of porous silicon (PS) layers (2-500 mm thickness) on n+ or p+ Si, 4inch diameter.

• Fabrication of meso- and macroporous silicon membrane (thickness 500 mm) on n+ or p+ Si, 4inch diameter.

Contact person : Mihaela Miu (mihaelam@imt.ro)

INTERNATIONAL RESEARCH GRANTS

• **Marie Curie Host Fellowships programme:** a young researcher from our group, Teodora Ignat, is involved in the project: Nanoelectrochemistry: from the synthesis of nanomaterials to functionality; job title: Functionalization of silicon surfaces for bioelectronics; Host Laboratory: PMC CNRS - Ecole Polytechnique France, 2005-2006.

• **NATO Collaborative Linkage Grant:** 'Novel optical nanosensors on the basis of organic nanofibers', 2005 -2006, coordinated by Prof. Dr. Horst-Günter Rubahn from Physics Institute, Syddansk Universitet, Odense, Denmark.

L1: Participation to a NoE in FP6

NANOSTRUCTURED AND FUNCTIONAL POLYMER-BASED MATERIALS AND NANOCOMPOSITES

Acronym: **NANOFUN-POLY**; Priority: 3 - **NMP**; Instrument: **NETWORK OF EXCELLENCE (NOE)**; 2004-2008

Coordinator: Prof. José M. Kenny; Italian Consortium for Science and Technology of Materials (INSTM);
e-mail: kenny@unipg.it; **www.nanofun-poly.com**
Fax: 39 0744 492925, Tel: 39 0744 492939/39 3292332268

Areas of excellence:

• **Area 1.** Polymer Chemistry: new monomers; new precursors (copolymers, dendrimers, hyperbranched polymers, microgels, nanoclusters); polymerization routes - chain polymerisation, polycondensation, free radical and radical polymerisation, sol-gel, etc.; and formulation.

• **Area 2.** Polymer Processing: intelligent and integrated processing; environmentally friendly processing techniques; processing nanocomposites; coatings; patterning of polymer surfaces.

• **Area 3.** Nanostructure-Property Relationships: new techniques of nanoscale characterization; rheology at different scales; molecular modeling and related simulation techniques.

• **Area 4.** Applications: mechanical systems; functional coatings; membranes; optical and electrical devices; bioactivity.

The Romanian participation in NANOFUN-POLY

The Romanian participation in NANOFUN-POLY network is realized by a Romanian Consortium for Nanostructured Polymers - RCNP; the president of the RCNP is Prof. Dan Dascalu.

The two partners from the Romanian Consortium for Nanostructured Polymers are:

• National Institute for Research and Development in Microtechnologies IMT-Bucharest, General Manager: **Prof. Dan Dascalu (dascalu@imt.ro)**, Project coordinator: **Dr. Irina Kleps (irinak@imt.ro);**

• National Institute for Research and Development for Isotopic and Molecular Technologies (Group of the Conductive polymers), Cluj-Napoca; General Manager: **Dr. Mircea Bogdan**; Project, coordinator: **Dr. Rodica Turcu (turcu@s3.itim-cj.ro).**

IMT-Bucharest group is involved in NANOFUN-POLY NOE activities: such as: Polymer processing and Applications.

RESEARCH ACTIVITIES RELATED TO NANOFUN-POLY IN IMT LABORATORY OF NANOTECHNOLOGY (2005)

WP8.1: Functional and nanostructured branched polymers: synthesis and structural characterization

- Surface functionalization of a silicon device using different polymers, like the photoresist SU8, poly-lysine and poly (styrene-co-maleic anhydride)- PMMA, in order to attach DNA oligonucleotides; - Characterization of the obtained structures by optical methods (SEM, AFM) and electrical measurements;

WP8.2: Production and Functionalization of carbon-nanotubes; preparation, structure and physical properties of their polymer-based nano-composites.

- Carbon nanotubes production by localized deposition of the carbonic materials in vacuum arc thermoionic; we made studies regarding deposition process in order to obtain carbon nanotubes on micro processing silicon surfaces.

RESEARCH PROPOSAL WITHIN NANOFUN-POLY

NANOBIO ROADMAP: Nanostructured and functional polymer-based materials and nanocomposites in the field of health and medical systems inside the Network of Excellent (2005-2006)

OBJECTIVE: The objective of this project is to establish a science and technological roadmap of NANOFUN-POLY partner's expertise, to set the basis for discussion and selection of two or three out of these identified topics, in the nanocomposites and polymers fields of medical and health systems, which will be developed in the following years inside the NoE.

INFORMATION ON MOBILITIES

• Workshop on Functional & Nanostructured materials from Chemistry + Nanostructured polymers from Processing; Dresden Germany, January 27-29, 2005; Adina Bragaru and Teodora Ignat.

• First Short Course "Polymer Chemistry and Processing of Nanostructured Polymer Materials"; Dresden, Germany, January 27-29, 2005; Adina Bragaru and Teodora Ignat.

• Second Short Course on "Nanostructured Polymer Materials: Characterization and Applications", Prague, Czech Republic, November 9-10, 2005; Adina Bragaru.

• 3rd Workshop on "Chemistry, Processing, Structure, Properties and Applications of Nanostructured Polymers and Nanocomposites; Life-Cycle Engineering, Gender Issues", Prague Czech Republic, November 11-12, 2005; Adina Bragaru.

• Workshop "Responsive Gels and Networks. Characterization of their Structure, Properties and Applications." and "Structure and Properties of Functional Coatings. Characterization of their Surfaces" March, 14-15, 2005 in Madrid, Spain. Florea Craciunoiu.

L2: Laboratory for Microsystems in biomedical and environmental applications

- ***Mission:*** The **Mission** of the laboratory for microsystems in biomedical and environmental applications is research, focused on the development of microsensors (chemo - resistive and resonant gas sensors), electrodes for biological sensors, microprobes for recording of electrical activity of cells and tissues, education in the field of micro chemo and biosensors (in cooperation with University "Politehnica" of Bucharest), and services in design, simulation and technology for bio- and chemo-applications.

- ***Main expertise:*** development of a large area of microsensors (chemoresistive, resonant gas sensors, accelerometers, microarrays, ISFET (Ion Sensitive Field Effect Transistors) sensors, electrodes for biological sensors, microprobes for recording of electrical activity of cells and tissues), in terms of software simulations modelling, using MEMS-specific CAD software (CoventorWare, CADENCE), technological development and electrical characterisation. Our team was working in 20 national projects during the last 5 years, and is currently involved in 10 FP6 projects (Networks of Excellence, Integrated Projects, Concerted Actions and Specific Support Actions).

- ***Research Team:***
Our team is including 9 people, both senior and young researchers. They have multidisciplinary expertise (micro-electronics, physics, chemistry, biology).

- ***International networks:*** The international networks are: **4M** (Multi-Material Micro Manufacture: Technologies and Applications) – FP6 NMP NoE, 2004 – 2008.

- ***National networks:*** Our lab is the coordinator for **NANOMATFAB** (Nanotechnology research centre for new materials and fabrication processes) – MATNANTECH Network, 2002 – 2005 and a partner in **CENOBITE** (Centre of Research in Nanobiotechnologies) – MATNANTECH, NoE, 2002-2005.

Dr. Carmen Moldovan, Head of the Laboratory for Microsystems in biomedical and environmental applications (cmoldovan@imt.ro)

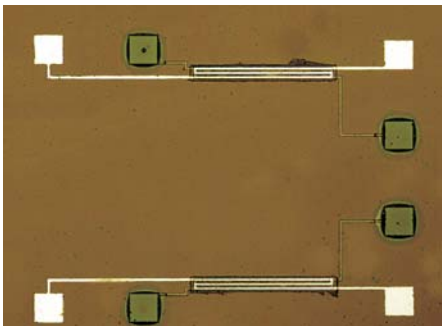
Dr. Carmen MOLDOVAN, the head of the laboratory, is also the Head of the Microtechnology Department within the National Institute for R&D in Microtechnologies and Associated Professor at the Faculty of Electronics and Telecommunications, University "Politehnica" of Bucharest.

She graduated on Electronics and Telecommunications and has a PhD in Microsensors. She is the *Leader of the Virtual Network of Centres for Research in nanotechnologies for new materials and new nano-processes coordinated by IMT*, **Contact person for IMT in MST Design Consortium** (EUROPRACTICE Provider, FP5 project) and **REASON FP V project**. Dr. Moldovan is the vice-coordinator of the FP 6 SSA "Micro and Nanotechnologies going to Eastern Europe through Networking (MINAEAST-NET)" and "ROManian Inventory and NETworking for Integration in ERA (ROMNET-ERA)". She is involved in the NoE 4M (NMP), working on demonstrators, in Ceramic cluster, having the goal to integrate a non-standard micromachining processes to a ceramic substrate and in the Sensors and Actuators cluster, in the PATENT-DfMM (Design for Micro & Nano Manufacture) NoE, in INTEGRAMplus (FP6 IP – IST), dealing with technology convergence and integration and virtual design and manufacturing, and TOXICHIP (FP6 STREP – IST), as responsible for the development of temperature and pH sensors.

She is involved in the **NoE 4M (NMP)**, working on demonstrators, in Ceramic cluster, having the goal to integrate a non-standard micromachining processes to a ceramic substrate and in the Sensors and Actuators cluster, and in the **PATENT-DfMM NoE**. She is a member of: **IEEE and Science and Technology Commission of the Romanian Academy and NEXUSPLUS and BRIDGE subcontractor** (and also a *member of the NEXUSPLUS Steering Committee*).

The scientific activity is published in more than 53 papers in journals, books and communications in Proceedings.

Micropellistor for methane detection



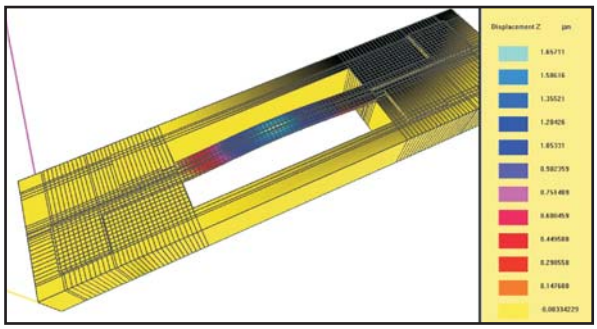
Optical photography of the micropellistor

Achievements: Using micromachining techniques we manufactured a miniaturized pellistor that has several advantages over the standard design:

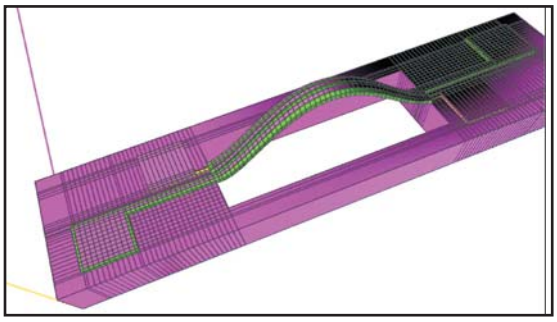
- possibility of integrating an area of sensing devices and the electronics on the same chip;
- reduced power consumption;
- possibility of making portable devices.

The device consists of a polysilicon heater and a platinum temperature sensor built on top of a suspended silicon nitride bridge (500x50 microns). The doped ceramic is deposited using sol gel technique before releasing the bridge. Building the sensor on a suspended membrane or bridge reduces heat loss in the substrate thus minimizing power consumption.

Device simulation: Three types of results were obtained from electro thermal simulations run on the full device: z-axis displacement, deformation and temperature distribution. The device needs higher voltages to heat at temperatures higher than $300^{o}C$, because of heat dissipation in the above layers. An unwanted effect of the heating of the sensor is the displacement of the suspended bridge due to the temperature.



Thermal distribution at 10.5 Volts

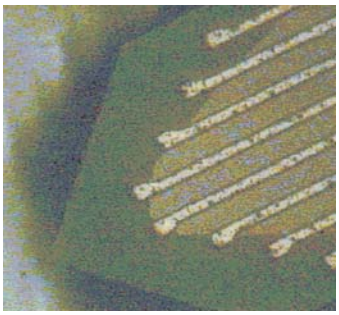


Deformation at 10.5 Volts (10 times exaggerated)

That effect can cause the breaking of the bridge or can affect the functionality of the sensor. For that reason that effect must be carefully monitored during the reliability tests.
The purpose of these simulations was to determine if the device would operate with low power (low voltage) consumption and also if this design could work at the temperatures higher than $300^{0}C$ for the catalytic reaction to take place. From the simulation we were also able to determine the weak points of the device (deformation of the membrane).

Results obtained within the **MATNANTECH project** "Micropellistors array for combustive gas detection" – AMIC.
Project manager: Dr. Carmen Moldovan, IMT-Bucharest

Diamond-like carbon based biomedical MEMS

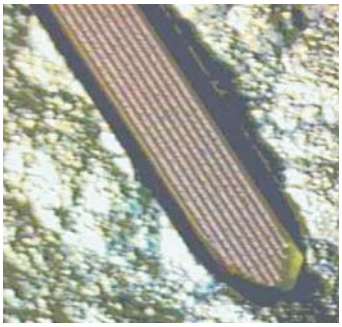


Optical photography of recording area (x1500)

Achievements: Toxins effect on cells can be evaluated through impedance and pH measurements. For impedance measurements, a microprobe described below was used:

- 3¸ 10mm length (3mm for human cells; 10 mm for rat cells);
- 30 mm thickness on 4 channels and 60mm on 8 channels;
- thickness: 10 –100 mm depending on investigated cells.

The microprobe has a 4x4 mm^2 enlarged aria serving as a support for electronic circuits. The compatibility between materials used in semiconductor fabrication and human body has been analyzed. The extracellular potential recording (through 8 channels displayed on the tip of the microprobe) permits the investigation of the central nervous activity.



Optical photography of the body of integrated microprobe (x300)

Stimulating probes for many prosthetic applications should be able to deliver constant current pulses into the tissue through multiple sites precisely spaced on a substrate.

The microprobe has a thin tip of 3-10mm length, and a 3x4mm^2 surface which serves as support for the electronic circuits. The microprobe tests were realized by in vivo impedance measurements of mice wet tissues: (stomach, intestine) and dried tissues (heart, brain, muscles, liver).

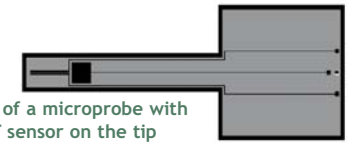
Results obtained within the **MATNANTECH project** "Advanced technologies for MEMS devices with biomedical applications, based on Diamond-Like Carbon layers" – BIOMEMS-DLC.
Project manager: Dr. Carmen Moldovan, IMT-Bucharest

Technology for obtaining biosensors for bioterrorism toxin detection

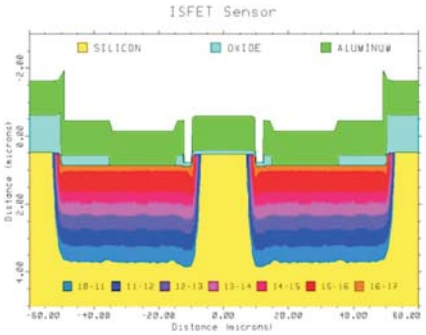
Achievements: The project aims to develop the technology for manufacturing a microsystem to monitor and detect toxins from natural environments (water, air, food). The integrated microsystem will include the biosensor that permits electrical measurements of several toxins and electronic circuits for signal processing.

Field effect gas sensors are based on metal-insulator-semiconductor structures in which the enzyme deposited on the gate is detecting the toxins presence. ISFET sensors use the field effect transistors to detect very small quantities (10-3 g). Examples are biological and medical applications. The ISFET is essentially an extended gate field effect transistor with the surface of the transistor and the reference electrode.

Results obtained within the **SECURITY project** "Technology for obtaining biosensors for bioterrorism toxins detection" – TOXISISTEM.
Project manager: Dr. Carmen Moldovan, IMT-Bucharest



Layout of a microprobe with FET sensor on the tip

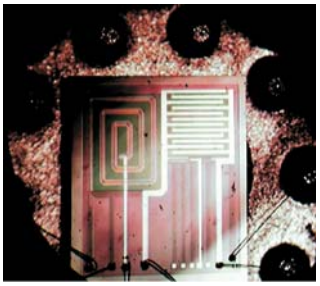


Simulation of the ISFET sensor

Biosensors for neurotoxic substances detection

Achievements: The biosensors for neurotoxic substances will be developed as ISFET-type biosensors. The ISFET structure is represented by a concentration-potential transducer, with a biosensitive layer deposited on the gate (acetylcholinesterases, immobilised on chitosane), which generates an interface potential on the gate. The enzymatic ISFET structure is developed in CMOS technology and the sensor's response characteristics depend mainly on the AChE enzyme immobilisation mode.

Results obtained within the **MATNANTECH project** "Biosensors for food neurotoxic substances detection" – SENBIONET. **Project manager: Chem. Rodica Iosub, IMT-Bucharest**



Optical photography of the sensor chip

L2: Participation to a NoE in FP6

MULTI-MATERIAL MICRO MANUFACTURE: Technologies and Applications

http://www.4m-net.org/

Acronym: **4M**; Priority: 3- **NMP**; Instrument: Network of excellence **NoE**; 2004-2008

Coordinator: Dr. Stefan Dimov; Cardiff University; **e-mail: dimov@cardiff.ak.uk**;

Mixed technologies for gas sensors microfabrication

The main goal was developing a novel class of chemoresistive gas sensors, miniaturized, low cost and with low power consumption, by using mixed techniques such as: laser milling techniques, conductive ceramic technology, thin film technology, bulk micromachining techniques (proceedings of the 4M Conference, 2005, published by Elsevier Ltd., pp.211-217).

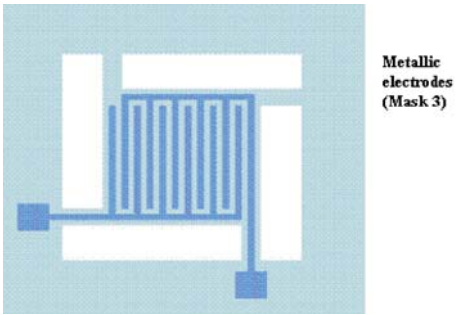
The sensor's operating principle is Change in conductivity due to the chemisorption of gas molecules at the sensitive layer surface. Small quantities of gas can be detected by measuring the resistance of an interdigitated capacitor with a sensitive film deposited on top.

Simulations of the thermal behaviour of the integrated heater on the ceramic membrane were performed using CoventorWare.

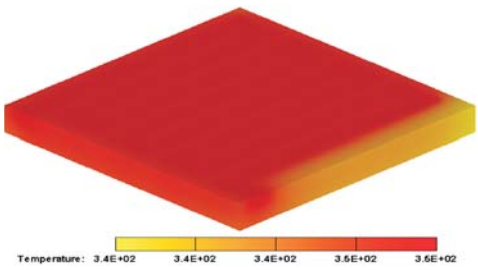
The best results are achieved with Al2O3/TiN (ATN). It has been shown that the heaters can be operated up to 1000°C. Due to the linear temperature versus electrical resistance correlation they can also be used as temperature monitoring units. The thickness and properties of screen printed layers can be controlled by powder content in the paste and mesh size.

The work was developed under the 4M (Multi-Material Micro Manufacture: Technologies and Applications) – FP6 Network of Excellence frame. It was a partnership between:

- National Institute for R&D in Microtechnologies, Romania;
- Forschungszentrum Karlsruhe, Institut für Materialforschung III, Germany;
- Manufacturing Engineering and Multidisciplinary Technology Centre, Cardiff University;
- Nanotechnology Group, Cranfield University, UK;
- IMEGO, Sweden;
- Fundacion Tekniker;
- IVF- Industrial Research and Development Corporation, Sweden.



Metallic interdigitated capacitor



Thermal distribution after 0.2s at 550°C

L3:Laboratory of micro/nano photonics

The Laboratory of Micro/Nano Photonics is recognized at national level, and funded between 2001 and 2004, as a **Centre of Excellence in Micro and Nano - Photonics.**

- ***Mission:*** Research and development activities in the field of micro/nano- photonics and optical MEMS focused on the development of micro/ nano structures based on new materials and processes and photonic integrated circuits based on heterogeneous integration technology; development of materials, technologies and components for optical MEMS.

- ***Main areas of expertise:***
  - modeling and simulation of *micro and nano photonic structures* ;
  - new *materials* for *micro/nano opto- electro-mechanical systems integration* (e.g. compound semiconductors, functional polymer, hybrid organic-inorganic nano-compozites and glasses), and related *fabrication processes* (including mixed technologies);
  - *passive and active micro-nano-photonic structures;*
  - *hybrid or monolithic integrated photonic circuits* and MOEMS (including heterogeneous platforms) for *optical communications, interconnects and optical signal processing;*
  - MOEMS for *bio-medical and environment applications.*
  - Optical and electrical characterization of materials and devices

- ***International co-operation***
  - Partner in **international networks: ASSEMIC** - Advanced Handling and Assembly in Microtechnology (2004-2008), EC FP6 - Marie Curie Research Training Network; 4M - Multi-Material Micro Manufacture: Technologies and Applications , NoE FP6 – priority 3, NMP; PATENT - Design for Micro & Nano Manufacture (Packaging, Test and Reliability Engineering in Micro & Nanosystem Technologies), NoE FP 6 - priority 2, IST
  - **Bilateral co-operation** with LAAS-CNRS Toulouse, France, and with University of Athens- Department for Optical Communications, Athens, Greece
  - **European Projects**: Waferbonding and Active Passive Integration Technology and Implementation in Photonics (**WAPITI**), STREP- FP6, *Priority 2 (IST)*, Thematic area: Optical, opto-electronic, photonic functional components.

- ***Research Team:*** has *multidisciplinary expertise* and is composed of 6 senior researchers (5 with PhD in optoelectronics, materials for optoelectronics, microsytems, physics, chemistry), 2 PhD students (with background both in physics and photonics), 1 romanian early stage researcher and an early stage researcher from Moldavia (trained in the frame of ASSEMIC network).

- ***Specific facilities:***

Modeling and simulation: computers, software for design and simulation of advanced passive and nonlinear photonic components (***Opti FDTD 6.0***) and of active devices based on semiconductor heterostructures (***Opti-HS***); CAD software tool for design of complex optical waveguides, which perform guiding, coupling, switching, splitting, multiplexing and demultiplexing of optical signals in photonic devices (***OptiBPM***); design software for modelling integrated and fiber optical devices that incorporate optical gratings (***OptiGrating***);
Characterization: *spectrophotometers* for UV-VIS-NIR and IR spectral range; *spectroscopic ellipsometer* for materials characterization; experimental set-up for *optoelectric characterization* in UV-VIS-IR spectral range of opto-electronic and photonic components, circuits.

Laboratory Head — Dr. Dana Cristea (danac@imt.ro)

Dr. Dana CRISTEA obtained the MSc in Electronics (1982) and PhD in Optoelectronics and Materials for Electronics from "Politehnica" University, Bucharest, Romania.

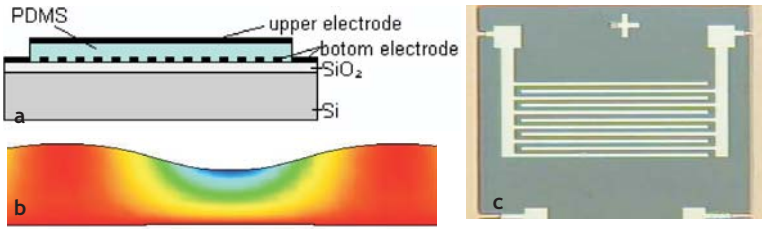
From 1982 until 1994 she was a research scientist in the Department of Optoelectronics and Sensors from the Research & Development Institute for Electronic Components, Bucharest, Romania. Since 1994 she has been a senior researcher in the National Institute for R&D in Microtechnologies (IMT- Bucharest), Romania, head of Laboratory of Micro/Nanophotonics since 1997 and head of Department for Multidisciplinary Research since 2002; since 1990 she has also Associate Professor at "Politehnica" University, Bucharest, Faculty of Electronics.

Her main **research activities** are in the fields of optoelectronics and photonic integrated circuits, optical MEMS for communications, chemo and bio-sensors with optical read-out. She has been more than 75 publications in international scientific journals *(Sensors and Actuators, Optical Materials, Materials Science for Semiconductor Processing, Materials Science and Engineering B, Journal of Micro System Technology, Journal Sol-Gel Science and Technology)* and conference proceedings.

She is a reviewer in Romanian and international scientific journals *(Optical Materials, IEEE Trans. on Electron Dev., Journal of Sol-Gel Science and Technology, Journal of Optoelectronics and Advanced Materials, Romanian Journal of Information Science and Technology)* and evaluator of European projects *(FP6 – Priority 2 IST and 3-NMP).*

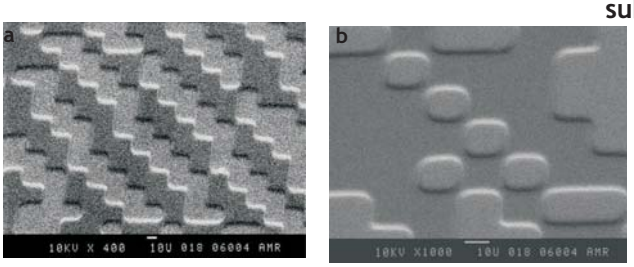
Silicone polymer based optical modulator – design and fabrication process

Silicone polymers are among the most suitable materials for optical communications devices due to their optical properties, thermo-mechanical and environmental stability, low cost processes. The required properties (optical, mechanical, thermo-optical, electro-mechanical) are adjustable through controlled synthesis. We have simulated, designed and experimented a spatial optical modulator. The device consists of an interdigitated bottom electrode, a compliant silicone layer (PDMS), and a top electrode. The substrate can be glass or oxidized silicon. The devices operation is based on the deformation of the polymer surface due to the Maxwell stress effect produced by the applied voltage between the electrodes



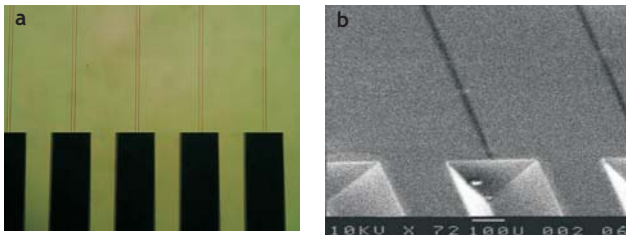
a) Cross section of the optical modulator structure; b) Simulation of the surface deformation due to the applied voltage (Maxwell effect); c) layout of the bottom electrode.

Diffractive optical elements (DOES)



SEM images of DOEs configurated in thermal grown SiO_2 on silicon wafer: a) 400x; b) 1000x

Optical interconnect fiber to polymer wave-guides on silicon substrate for hybrid integrated photonic circuits and moems

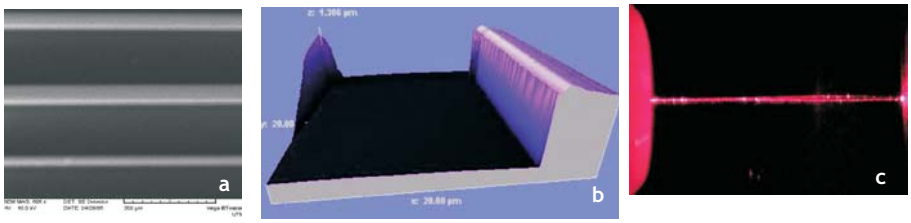


a) Optical image of waveguides from SU-8 and V-grooves for fiber positioning; b) SEM image.

MATNANTECH Project (2003-2005), Microphotonic structures and integrated circuits for optical data processing and transmission, **Coordinator: IMT Bucharest, Project manager: Dana Cristea (danac@imt.ro).**

Optical biosensor based on integrated interferometer using polymeric waveguides

The biosensor consists of SU-8 polymer waveguides integrated on silicon substrate and is based on the evanescent interaction of light with an immobilized bio-sample on a waveguide. Changing the specimen causes a variation of the refractive index of the cladding layer, which can be observed through the phase shift between light of both interferometer branches. The interferometer comprises of two branches: a reference and a sensing waveguide. The latter of which is in direct contact with a bio-sensitive layer and can bind biological specimens. This layer serves as cladding for the sensing waveguide. Changing the specimen causes a variation of the refractive index of the cladding layer, which can be observed through the phase shift between light of both interferometer branches.

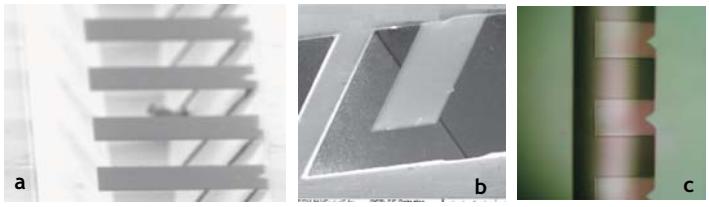


Images of SU-8 waveguide profiles: a - SEM image of several waveguides with different width; b - AFM image o the edge of a single waveguide; c- light propagation in a single MZ interferometer coupled to a fibered light source.

MATNANTECH Project (2004-2005), Integrated photonic microstructures for chemical and biological analyses **Coordinator: IMT Bucharest, Project manager: Raluca Muller (ralucam@imt.ro);**

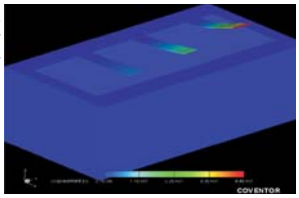
Cantilever arrays used as biosensor in biochemical applications

Microcantilevers are highly sensitive to mechanical stress, which is largely caused by surface tension of layers deposited onto a cantilever. A thin bio-molecular layer, with the potential to bind biochemical samples to the cantilever surface, will change the deflection of the cantilever in the presence of a biochemical specimen. The cantilever arrays where obtained in 1.5 μm thick SiO_2 by wet anisotropic etching of <100> Si wafers.



Array of cantilever beams, obtained by wet anisotropic etching: a) SEM image of the entire area; b) SEM image of a single beam; c) Optical microphotograph of a set of beams.

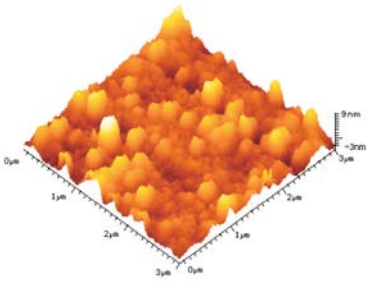
Simulations using COVENTORWARE 2004 were carried out systematically in order to investigate cantilever deflection. Using the numerical calculations the cantilever parameters were optimised in order to increase its sensitivity.



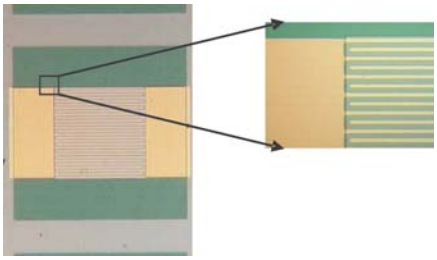
Simulation results for different modes for the designed cantilever beam arrays:- Cross talk in water based medium;

MATNANTECH Project (2004-2006), Microtechnologies for multifunctional cantilevers , integrable on silicon substrate for microsensors and microactuators, **Coordinator: IMT Bucharest, Project manager: Raluca Muller (ralucam@imt.ro).**

Silicon metal-semiconductor-metal photodetector with transparent conductive (TC) electrodes.



AFM 3D image of Al doped ZnO



Layout of the MSM structure

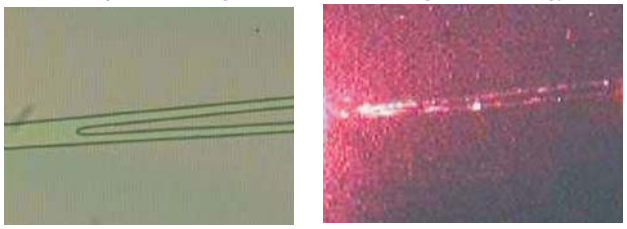
Metal-Semiconductor-Metal (MSM) photodetector is a high speed photodiode which consists of two Schottky diodes with interdigitated electrodes on the top surface of a light absorption layer. We improved the responsivity using as Schottky electrodes a TC thin layers (doped ZnO thin layer) in order to eliminate the photo-response limitation due to shadowing of the active layer by opaque metallic electrodes. The high transparent ZnO (T >80 %) thin layers doped with Al have been prepared by sol-gel method using organo-metallic precursors.

MATNANTECH Project (2004-2006), Development of new processes and microphotonic structures based on transparent and conductive thin films on Si and $A^{III}B^{V}$ compounds substrates, **Coordinator: IMT Bucharest, Project manager: Elena Budianu (elenab@imt.ro).**

Microphotonic components based on new materials and processes.

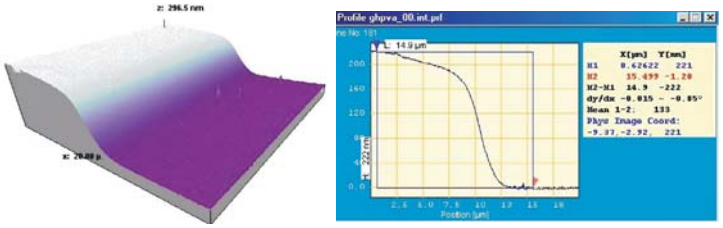
Microphotonic components such as optical waveguides, Y optical splitters, optical couplers, movable micromirrors, are key passive components in photonic integrated circuits for optical signal processing. We have obtained some types of microphotonic components based on various materials: (SiO_2, SiO_2+TiO_2, SiO_2+ZrO_2), polymeric and hybrids materials using mixed technologies compatibilized with silicon processing.

Optical waveguides based on sol-gel technology



Images Y shaped based on doped PVA: a) lay-out; b) light propagation.

Optical waveguides based on polymer technology

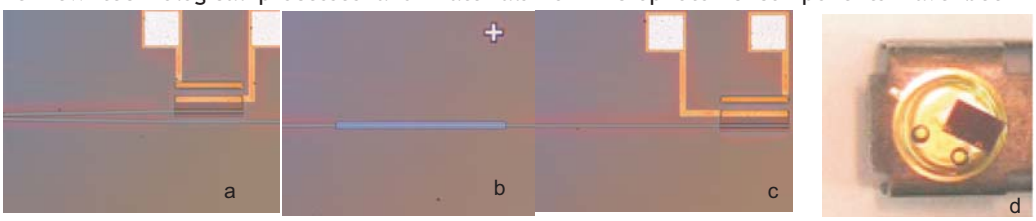


AFM image of the waveguide profile prepared from thin polyvinyl alcohol (PVA) doped with CuO and CrO_3.

MATNANTECH Project (2004-2006), Technologies for microstructures based on polymeric and hybrid composites, **Coordinator: IMT Bucharest, Project manager: Paula Obreja (paulao@imt.ro)**

Photonic integrated circuits with photodetectors and waveguides for sensing applications

The new technological processes and materials for microphotonic components have been compatibilized with silicon integrated technology and a photodetector integrated with an optical waveguide from epoxy polymer (SU-8) have been performed.

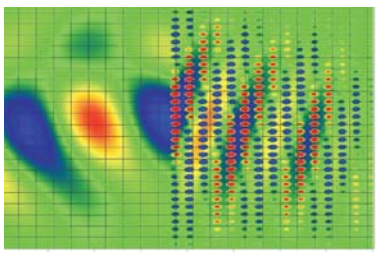


The image of the photodetector integrated with an optical waveguide: a) splitter and reference photodiode region; b) bio-sensitive layer region; c) measuring waveguide coupled with photodiode; d) final device.

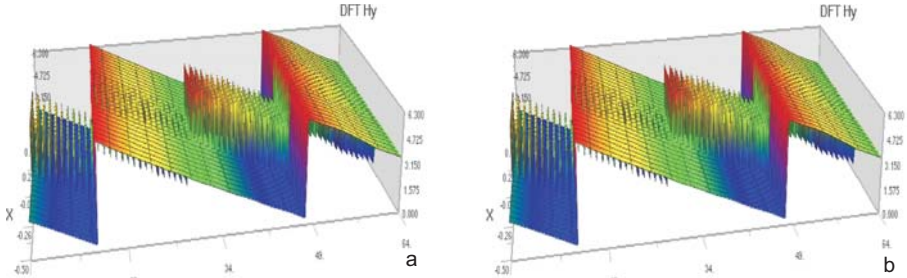
MINASIST Project (2003-2005), **Contact person: Dana Cristea (danac@imt.ro).**

Numerical investigations of left-handed metamaterials (LHM)

Metamaterials are artificially structured systems of magnetic and electric resonators patterned on a scale much smaller than the operating wavelength. This makes the effective medium theory valid and, in certain conditions, the system can mimic an effective negative permittivity or magnetic permeability. These systems have been theoretically and experimentally demonstrated at the microwave wavelengths and an intensive investigation effort is to increase the spectral range up to infrared or even optical domain. We have performed finite difference time domain FDTD computations of various LHM structures. Several typical results below:



Negative refraction in a structure presenting LHM properties.



a) Negative phase advance in a two dimensional LHM structure computed by FDTD method in contrast to b) positive phase advance in an ordinary structure.

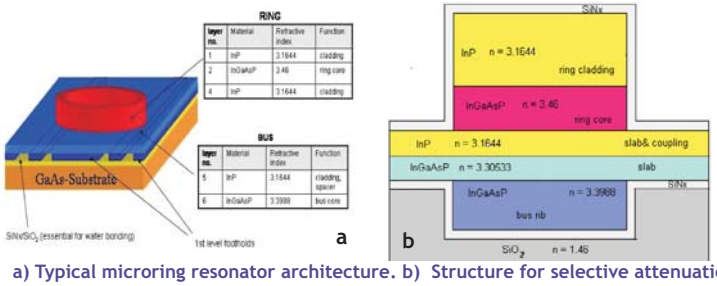
MINASIST Project (2004-2005), **Contact person: Cristian Kusko (cristiank@imt.ro).**

WAFERBONDING AND ACTIVE PASSIVE INTEGRATION TECHNOLOGY AND IMPLEMENTATION

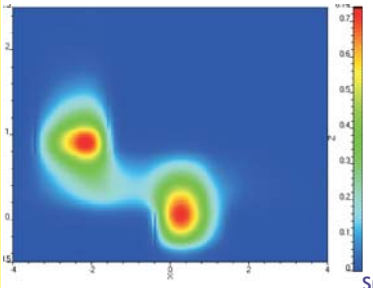
Acronym: **(WAPITI)** Instrument: **STREP FP 6**, Priority 2, IST

Coordinator - Fraunhofer Institute for Telecommunications, Heinrich Hertz-Institut, Berlin, Germany; **Dr. Helmut Heidrich (Helmut.Heidrich@hhi.fraunhofer.de). Partners:** National Kapodestrian Univ. of Athens (GREECE); Cambridge Univ., Engineering Depart. (UNITED KINGDOM); EV Group, E. Thallner GmbH, Scharding (AUSTRIA); Max Planck Institute of Microstructure Physics, Halle (GERMANY); **National Institute for R&D in Microtechnologies, Bucharest (ROMANIA)**

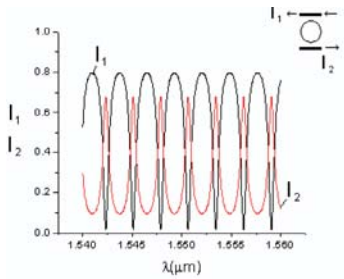
Waveguiding properties and spectral characteristic of a microring resonator obtained by wafer-bonding technology



a) Typical microring resonator architecture. b) Structure for selective attenuation of the higher order ring modes.



Radiation coupling from bus to ring.



Spectral characteristics for the structure with R = 40 μ m and offset = 0.5μ m.

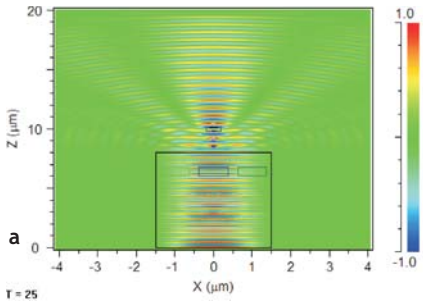
Microring resonators will be one of the most important components of the next generation of optical communications. In WAPITI project, we have analyzed from theoretical perspective a new proposed microring resonator structure based on the wafer-bonding technique. This technique consists in the vertical coupling between the passive bus waveguide and the active ring resonator. We have investigated the possibility to obtain the single mode operation of the active ring waveguide for certain ring radius values by the selective attenuations of the higher order modes and the obtaining of the desired coupling efficiency by varying the technological parameters like the layers thickness, etching depth, bus waveguide width and the offset (misalignment between the ring and the bus waveguide). We have numerically calculated the coupling coefficients and we used their values as input quantities in the scattering matrix formalism, obtaining in this way the spectral characteristics for various architectures and configurations. Our theoretical and numerical results were confirmed by the experiments done upon the passive ring resonators realized by WAPITI consortium.

Contact person: Dana Cristea (danac@imt.ro), National Institute for R&D in Microtechnologies, Bucharest (ROMANIA).

ADVANCED HANDLING AND ASSEMBLY IN MICROTECHNOLOGY

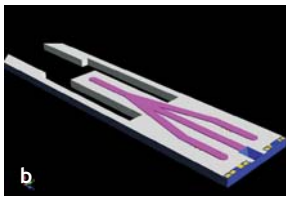
Acronym: **ASEMIC,** *Instrument:* EC FP6 - **Marie Curie Research Training Network,** 2004-2008

Coordinator: Institute of Sensor and Actuator Systems - ISAS, **Prof. Dr. Werner Brenner.** *Consortium*: 14 parners from 10 countries



IMT Bucharest - laboratory of micro/nano photonics in 2005was involved in research activities related to WP.1 (High resolution positioning systems, micromotors and micro robots.**), WP2, WP5:**

Design and fabrication of optical sensors for micropositioning



The proximity/position optical sensor (PPOS) was specially designed to work with 2 arms gripper. PPOS can detect a position in the range of 0 to 300 microns as position sensor and with high precision in the range of 0 to twice the wave-length as proximity sensor.

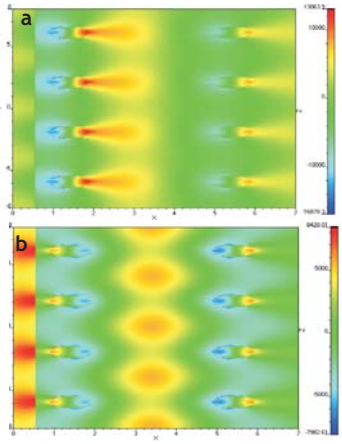
a) Simulation results for field distribution in the working area of the OPS in case of presence of a small detectable object; b) 3D layout of the designed integrated position/proximity sensor.

Contact person Raluca Muller (ralucam@imt.ro), National Institute for R&D in Microtechnologies, Bucharest, Romania

DESIGN FOR MICRO & NANO MANUFACTURE

Acronym: **PATENT-DfMM,** NoE-FP6, Priority 2 **IST,** Contract No. 507255,
Coordinator - University of Lancaster, UK; **Dr. Andrew Richardson**

Investigation of the interaction of the electromagnetic waves with micro and nanostructures



a) The bonding configuration in a photonic crystal leading to an attractive interaction. b) The antibonding configuration in a photonic crystal leading to an repulsive interaction.

The main goal was investigation of the interaction of the electromagnetic waves with various periodic and nonperiodic micro and nanostructures (focused on the forces that appear in micro and nanostructures as a result of their interaction with radiation). We have numerically investigated a case that has been theoretically addressed in the literature, namely the photoinduced forces that appear in photonic crystals. Using the FDTD method and considering realistic two-dimensional and three-dimensional periodic systems, we have identified the resonant states of the systems, we have identified the bonding and the antibonding states and we have estimated the forces between the photonic crystal constituents. Using the flexibility of the FDTD method we have started a preliminary investigation of the dynamics of a colloidal system subjected to the interaction with a radiation field. We have identified an iterative method to combine FDTD method (OptiFDTD) with the FEM method (ANSYS) in order to take into account the other forces (gravitational, Van der Walls, etc) that contribute to the dynamic of a colloidal system. Detailed simulations of the interaction of the electromagnetic radiation with colloidal systems can show if light can be used to obtain self assembled photonic crystals.

Contact person: Cristian Kusko (cristiank@imt.ro), National Institute for R&D in Microtechnologies, Bucharest, Romania.

L4: Laboratory of micromachined structures, microwave circuits and devices

The laboratory has coordinated one of the first European projects in **RF MEMS "MEMSWAVE" (1998-2001).** The project was nominated, in 2002 between the first ten European projects for the **Descartes Prize** (awarded for the best European co-operative research projects). The laboratory is one of the promoters of membrane supported microwave and millimeter wave circuits in Europe and is partner in the FP6 European network of excellence in RF-MEMS, **"AMICOM"** (2004-2007). The laboratory was recognized at national level as RF-MEMS Center of Excellence, financed by the National Programme MATNANTECH (2002-2005).

- ***Mission:*** scientific research and technological development of micromachined microwave and millimeter wave devices and circuits. These new technologies represent a solution to manufacture high performance microwave and millimeter wave devices and circuits devoted to the emerging communication systems.

- ***Main areas of expertise:*** • Design, modelling and manufacturing of microwave and millimeter wave components and circuits based on silicon, GaAs and GaN micromachining and nanoprocessing;
• Design and manufacturing of micromachined, passive circuit elements: inductors, capacitors, filters, and antennae (endfire and broadside);
• Design and manufacturing of monolithically and hybrid integrated receiver modules based on silicon and GaAs micromachining;
• Design, modelling and manufacturing of reconfigurable millimeter wave circuits for wireless communication systems;
• Electromagnetic modelling of RF switches;
• Studies on magnetostatic wave resonators in microstrip and CPW configurations;
• Design, modelling and manufacturing F-BAR resonators on GaN membranes;
• MEMS and NEMS technologies development;

- ***Research Team:*** the research team has multidisciplinary expertise in physics and electronics of microsystems and is composed of 7 senior researchers (5 of them with PhD in physics, electronics, microwave and chemistry), 1 early stage researcher (PhD in electronics), two PhD students in physics and one Master Student.

- ***Specific facilities:*** Computers and software for microwave electromagnetic simulations (IE3D and Fidelity from ZELAND software packages); Vector network analyzer Hewlett Packard 0.1-18 GHz; Süss MicroTech EP 4 prober; Access (by international cooperation) to millimeter wave on wafer measurements.

- ***International Networks:*** Partner in international network - FP6 Network of Excellence "Advanced MEMS for RF and Millimeter Wave Communications" coordinated LAAS-CNRS Toulouse

- ***International bilateral cooperations:*** The laboratory has bilateral governmental cooperation with ITC-irst Trento, Tor Vergata University Rome, CNR Rome, FORTH Heraklion, KERI Changwon Koreea.

- ***National networks:*** The national projects contributes **to the development of a new generation of circuits based on MEMS and NEMS technologies, devoted to the millimeter wave communications.** The laboratory had 4 projects in the MATNANTECH Programme, one in the MINASIST progamme and just started two CEEX projects. National partners in these projects are: Polytechnica Univ Bucharest, Nat. Inst in Mat. Physics, Military Tech. Academy, IMC P. Poni, Valahia Univ. Targoviste.

- ***AWARDS:*** **Finalist at the EC Descartes Prize competition 2002** for the coordination of the MEMSWAVE FP4 Project.
Romanian Academy Prize "Tudor Tanasescu" for "Micromachined circuits for microwave and millimeter wave applications - MEMSWAVE" (2001);Second prize for the MATNANTECH project, SIRMEMS (CONRO 2003).

Laboratory Head — Dr. Alexandru Muller (alexm@imt.ro)

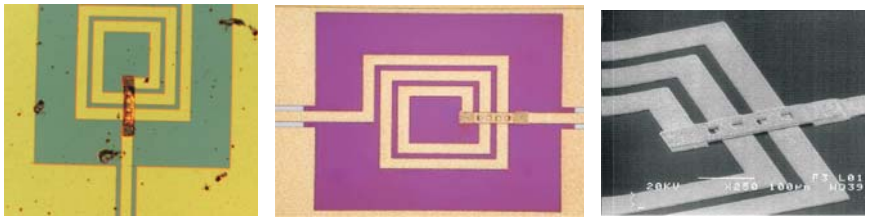
He obtained M.Sc. in Physics at Bucharest University (1972) and PhD in physics at Bucharest University in 1990;
Competences: Silicon, GaAs and GaN micromachining and nanomachining: manufacturing of RF MEMS components and circuits, technological process in GaAs MMICs, design, modeling and manufacturing of microwave passive supported on circuits on membranes (1997-European priority), micromachined inductors, filters and antennas, monolithically as well as hybrid integrated receiver front end modules.

Dr. Müller has coordinated the ***European Project FP 4 MEMSWAVE (1998-2001)***, and ***is the leader of the Romanian team in the FP6 NoE AMICOM and member of the "Board of directors" of this project***. He is member of Micromechanics Europe Workshop and MEMSWAVE Workshop steering committees. He is an expert in project evaluation in the national program Research for Excellence (started in 2005). He is member of IEEE and EuMA. Dr Muller is member of PhD Jury in Politechnica Univ. Bucharest and Univ. Paul Sabatier/LAAS Toulouse. Co-editor of the Micro and Nanoengineering Series (Romanian Academy). He had invited papers at important European conferences.

Dr. Müller was finalist of the Descartes Prize competition 2002 of the European Comunity with the MEMSWAVE Project, Romanian Academy Prize "Tudor Tanasescu" for "Micromachined circuits for microwave and millimeter wave applications" project); second prize for the MATNANTECH project, SIRMEMS (at CONRO 2003). He has more than 150 contributions in books and international journals and conferences.

Passive elements based on RF MEMS technologies for mobile communication applications

New topologies for L-C type low pass and high pass filters based on interdigitated capacitors and membrane suspended inductors obtained by silicon and gallium arsenide micromachining are developed. These lumped elements are used in design and manufacturing of low pass and high pass filter. L-C type filters using MEMS technology, are key elements in microwave and millimeter wave applications such as mobile communication systems.



Membrane supported inductor (two levels of micromachining) on silicon substrate (center and right) and GaAs membrane supported inductor air bridge (left) (Proc. of MEMSWAVE Workshop, 2005, pp 169-172)

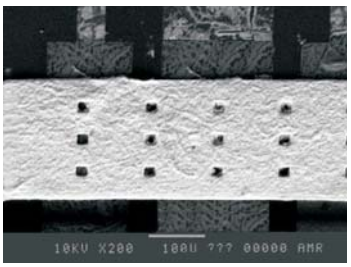
Achievements: Two level of micromachining for manufacturing membrane suspended inductors; 1 – 5 GHz frequency range low pass and high pass filters

MINASIST project "Development of RF-MEMS technologies for passive components to be integrated in mobile communication systems" (2003-2005) **Contact person and project manager Dr. A Müller-alexm@imt.ro,**

Reconfigurable filters for mobile communication

New reconfigurable micromachined filters for millimeter wave applications are designed and manufactured on silicon substrate or on dielectric membrane on silicon. For the second version, two levels of micromachining are studied. MEMS varactors are used in reconfigurable filter tuning.

Achievements: Design for cantilever type switch; design, modelling and simulation for stop band and band pass reconfigurable filters for 38 GHz.

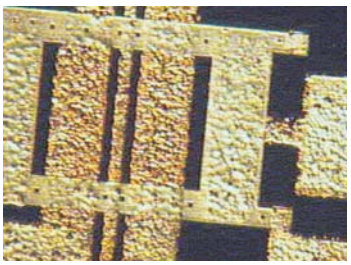


SEM image of varactor test structure

MATNANTECH Project "Silicon based reconfigurable filters for millimeter wave applications"-FIREMEMS, (2004-2006), **Contact person and project manager: Dr. A Müller-alexm@imt.ro);**

Switch structures for millimeter wave communications

Micromachined MEMS switches for 40 GHz and 60 GHz frequency range were developed. Actuation voltage less then 25 V have been obtained. Transmission losses lower then 2dB and isolation higher then 20dB were obtained.



Switch structure-detail

MATNANTECH Project "Micromachined switch structures for millimeter waves communications"-SECOM (2003-2005).
Project manager and contact person: Dr. M. Dragoman mircead@imt.ro;

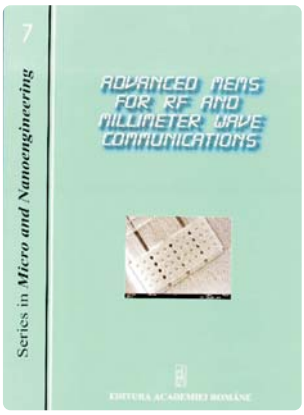
Acoustic wave devices - SAW-BAW

Manufacturing of a micromixer using SAW type resonators as mixing element for use in bio-medical applications, mainly in DNA in situ hybridization is in progress. Also, a FBAR resonator as detecting element for environmental pollutants will be manufactured.

Achievements: Obtaining of SAW and FBAR resonators and preliminary electrical characterization of these structures; experiments concerning biological compatibility of the used materials (piezoelectric ceramics used in SAW fabrication); experiments for obtaining the piezoelectric polyimides in collaboration with ICM "Petru Poni" Iasi

SAW resonator structure mounted on TO39 package

MATNANTECH Project: "Surface and bulk acoustic waves devices for biomedical applications and environment pollution monitoring", (2004 – 2006).
Co-ordinator, IMT-Bucharest, Project Manager, Dr. Gheorghe Ioan Sajin.
Partners: INCD ICPE CA Bucharest; "Carol Davila" Medical University, Bucharest; Institute of the Macromolecular Chemistry "Petru Poni", ICM, Iasi.



The volume "Advanced MEMS for RF and Millimeter Wave Communications" (editors A Müller, A Rydberg and R Plana) was launched at Lausanne in June 2005, during the **5-th edition of the international Workshop on RF MEMS "MEMSWAVE"**. The volume was printed in the **Micro and Nanoengineering Series** coordinated by **Prof Dan Dascalu** and was edited by the Romanian Academy Press. The volume contains the extended papers of the 4-th MEMSWAVE Workshop, Uppsala, 2004.
The international MEMSWAVE workshop was generated by IMT Bucharest in 1999, in the frame of the MEMSWAVE project.

International cooperations

Results obtained by the Laboratory team in the FP6 Network of Excellence *"Advanced MEMS for RF and Millimeter Wave Communications" (AMICOM; 2004-2006)* - *www.amicom.info*, *coordinator LAAS-CNRS, Toulouse, France*, IMT contact person for AMICOM: Dr. Alexandru Müller, member of the governing board (alexm@imt.ro)

The research work in AMICOM in 2005-2006, was performed in the second year via two "North Star" Projects: "MMID – Millimeter Wave Identification" and "ReRaFE – Reconfigurable Radio Front-End". The technological research is developed together with partners from FORTH Heraklion, TU Darmstadt, LAAS Toulouse, VTT Helsinki, IMEC Leuven and ITC-irst Trento.

Achievements: • Design, modelling and manufacturing of a membrane supported Yagi-Uda antenna for 45 and 77 GHz,
• Monolithically integrated receiver front end with a membrane supported Yagi Uda antennae;

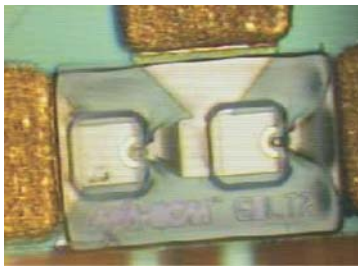
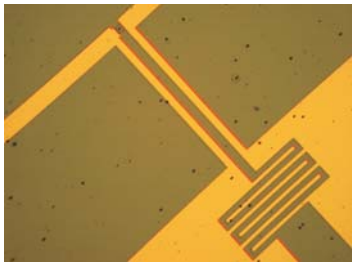
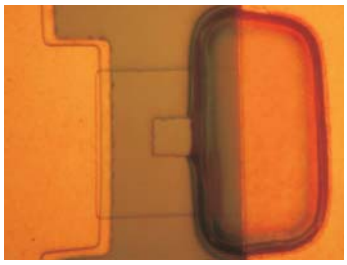
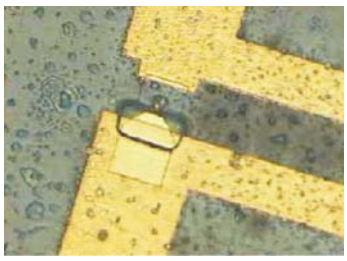
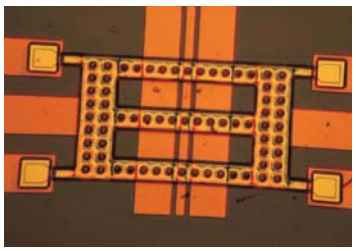
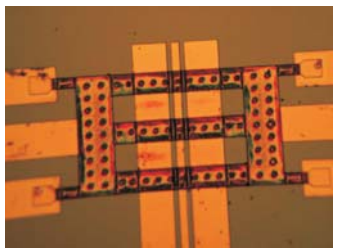
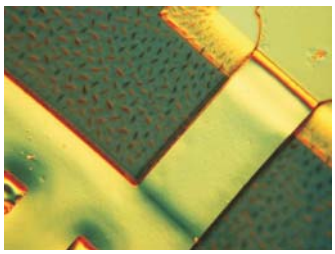



Image of receiver structure with membrane supported Yagi Uda antennae, hybrid integrated with an antiparalel GaAs Schottky diode pair - IMT, LAAS (Proc. IEEE Int. Workshop on Antenna Technology - IWAT 2005, pp. 113-116)

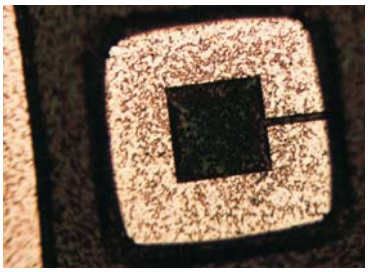
• Design, modelling and manufacturing of advanced F-BAR test structures;
• Switches for 60 GHz on GaAs substrate;
• Lumped elements filter structure manufactured by bulk and surface of micromachining;
• Architecture for the 60 GHz membrane supported reconfigurable filter;
• Diplexer filters based on FBAR resonators;
• Design of tunable bandpass and bandstop reconfigurable filter for MMID applications;
• Millimeter wave tag;

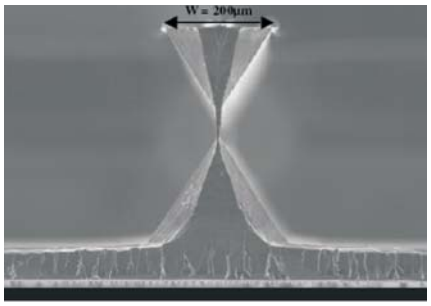
Integrated receiver structure using GaAs micromachined Yagi antenna- IMT, FORTH, (A Müller invited paper at WSGAAS-Worshop on Advanced Microsystem for RF and Millimeterwave Communications, European Microwave Week 2005)

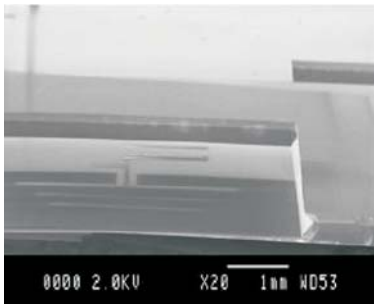




A test switch structure on GaAs substrate, for 60 GHz - IMT, FORTH, TUD

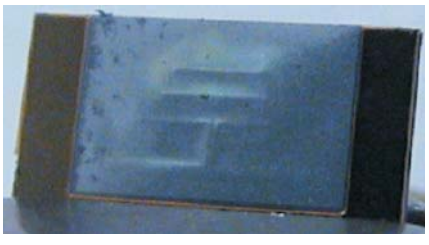


A test F-BAR structure on GaN membrane, IMT, TUD, FORTH (Proc. of MEMSWAVE 2005 Workshop, Lausanne, pp. 63-66)





SEM images of the silicon wall shape after DRIE etching (left) and Yagi Uda antenna supported on three edges membrane - IMT, LAAS, (Journal of Micromech. Microeng., vol.15, No7, pp. S65-S71, 2005)

Photos of the 45 GHz membrane supported Yagi Uda atenna, top view (left) and bottom view (right) - IMT, FORTH, (Journal of Micromech. Microeng., vol.15, No. 7, pp. S53-S59, 2005)

The laboratory team has organized in September 2005 in Sinaia the second **AMICOM Summer School**: *19 tutorials on RF MEMS design, modeling, technological processes, packaging, have been presented by well-known European researchers.*

L5: Simulation, Modelling and Computer Aided Design Laboratory

● ***Mission:*** research, education and training in simulation, modeling and CAD for micro- nano structures and materials, microsystems, microfluidics.

● ***Main areas of expertise:*** structural analysis, mechanical, thermal analysis, electric and magnetic field analysis, coupled field analysis of MEMS and MOEMS; design development and optimization of MEMS components and devices, such as RF MEMS switches and tunable Fabry-Perot optical filters, electrostatically and piezo-electrically actuated; modelling of optoelectronic devices, simulation and design of microfluidic components for biomedical applications, neural networks, cellular automata, nanostructures.

● ***Research Team:*** The team has a multidisciplinary expertise in: mathematics, physics, electronic and mechanics (4 senior researchers: 2 PhD, one physicist and one mechanical engineer, 3 PhD students and 2 MS Students.

● ***Specific facilities:***
• Finite element method software COVENTORWARE 2005
• Finite element method software ANSYS 5.4
• Programming tool MatLab 7.0
• Multiprocessor workstation
• Training room equipped with a computer network, used also for design and simulation with specific software packages.

● ***Research interest:*** • modelling and simulation of contact phenomena in MEMS microdevices; • determination of material parameters using FEM simulation for micro and nano materials, modelling and simulation of hard biological tissues, development of new simulation techniques, simulation and optimization of specific technological processes, evelopment and modelling of structures and assemblies for optical computers, modelling, simulation and realization of elastomer based microstructures; • application of simulation techniques to the Design for Manufacturing concept (DfM) in the field of microsystems; • diffusion of mixed fluids in microchannels and study of separation effect, modelling, simulation and characterization of microfluidic structures as micropumps, microvalves, microchanels; • microliquid handling by electrokinetics; developing nanofluid structures for cooling microsystems obtained by plasma and laser technologies; developing silicon microchips for ADN identification; • modelling, simulation of microfluidic components for lab-on-chip structures; parameter optimization of microsystems design by genetic algorithms analysis;

● ***International networks and projects:*** the laboratory is involved in international projects as: FP6: PATENT(NoE/IST) - 3 grants in WP2-Modelling and Simulation, ASSEMIC (RTN)- WP 2- Microhandling (Computational fluid dynamics): MI-Lab-on-chip – STREP project (modelling and simulation) and is involved in trainning activities and technical support for for Design and simulation of MEMS and microfluidic structures with CAD Techniques.

The *laboratory carries out activities for modelling and simulation* as support for the research activities of the other laboratories of IMT Bucharest. The lab offer simulation services using COVENTOR and ANSYS software tools.

Laboratory Head – Dr.Raluca Muller (ralucam@imt.ro)

Raluca Müller received the M.Sc and PhD in Electronics and Telecommunications from "Polytehnica" University of Bucharest. From 1978-1994 she was research scientist with ICCE Bucharest; since 1994 she is with IMT Bucharest.

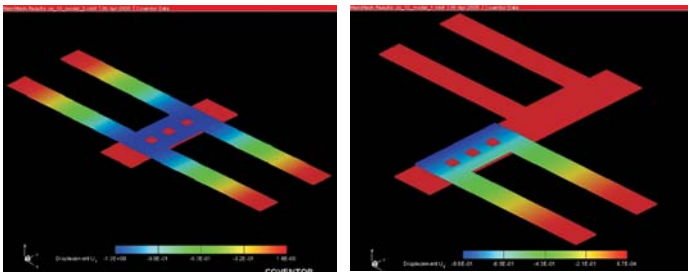
Currently she is Head of Development in Information Technologies Department and Coordinator of the **Simulation, Modelling and Computer Aided Design Laboratory.**

Her main scientific interests include design, modelling and technological processes for microelectronic devices, integrated optics, microsensors and microsystems. She was involved in teaching activities as associated professor at University "Valahia Targoviste".

She is leader of national research projects and scientist in charge from IMT in international projects as: *IMPACT Project* (FP5) with CNRS – LAAS Toulouse (2003-2004), FP 6: *ASSEMIC- Marie Curie Training Network* (2004-2007)- FP6- *PATENT (Modelling and Simulation cluster)* and *Leonardo da Vinci - Microteaching Project*. She is author of more than 55 scientific papers presented at conferences and published in journals (Sensor&Actuators, J. of Micromechanics and Microengineering, Optical Materials, J. of Microsystem Technologies, etc).

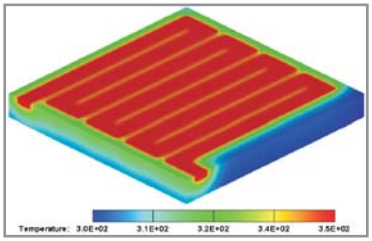
Results of National Projects coordinated by the team

1. "Design And Simulation Of Microdosing Components For Biomedical Applications" Contact Oana Nedelcu, oanan@imt.ro
Results: Different microfluidic components were designed and characterized by simulation (Coventorware 2005): piezoelectric actuator, actuating membrane, micropump with diffuser nozzle valves, microchannels array for dosing and chemical reactions. Mechanical, piezoelectric, modal, harmonic and microfluidic simulations were performed.
2. "Algorithms For Elastic Material Properties Determination Using Reverse Engineering Methods And Finite Element Method" 2004-2005; Coordinator: V. Moagar-Poladian, victorm@imt.ro
3. CEEX Project : "Nonconventional Materials for Microtechnology - Research and Experimentation of Elastomer-Based Microstructures for applications in theField of Microsystems" - (CEEX Project no. 15/ 2005, 2005-2008 - **Leader: IMT, coordinator Dr. Gabriel Moagar-Poladian, gabim@imt.ro.**
Main objectives: • setting up the technology for elastomer based microsystem manufacturing; designing new types of sensors based on elastomer material; • designing of new types of optimized elastomer based microsystems, which will be transferred to potential customers (delivered turn-key know-how and design solution);
Results: conceive of new type of sensors based on elastomers.



Simulation of RF MEMS switches (double cantilever and bridge type) with COVENTORWARE 2005 for Micromachined Structures, Microwave Circuits and Devices Laboratory

Simulations carried out for different groups of IMT



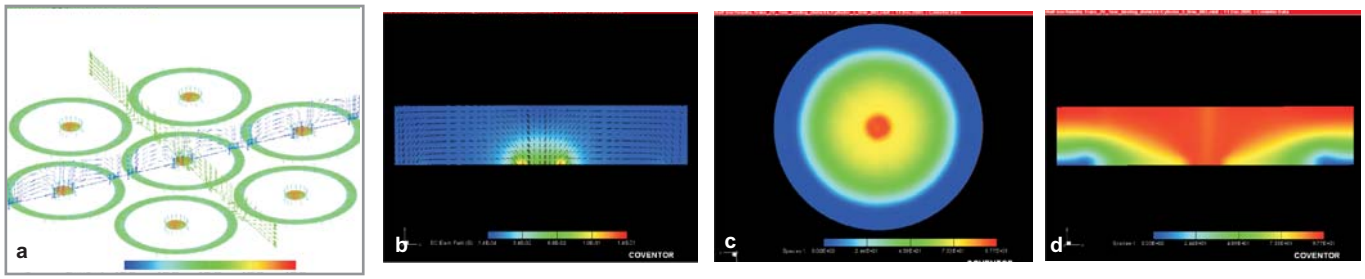
Transient thermal simulation with COVENTORWARE 2005 (Substrate: alumina; Heater: Au+Pt) for Centre for Microstructures and Microsystems for Bio-medical and Environmental applications

PATENT APPLICATIONS (***submitted to Romanian State Office for Inventions and Trademarks***):
1) G.Moagăr-Poladian, V. Moagăr-Poladian: Structure for the thermal management of integrated circuits and microsystems (*Won Silver medal at the 33rd International Exhibition of Inventions, New Techniques and Products, Geneva, Switzerland, April 2005*)
2) G.Moagăr-Poladian, V.Moagăr-Poladian- Structure for microsystems and integrated circuits bonding.

MI-lab on chip - Lab-On-A-Chip Implementation of Production Processes for New Molecular Imaging Agents

Acronym: **MI-lab-on-chip,** STREP-FP6, Priority 3 **NMP,** 2005-2007, Contract No. 221105

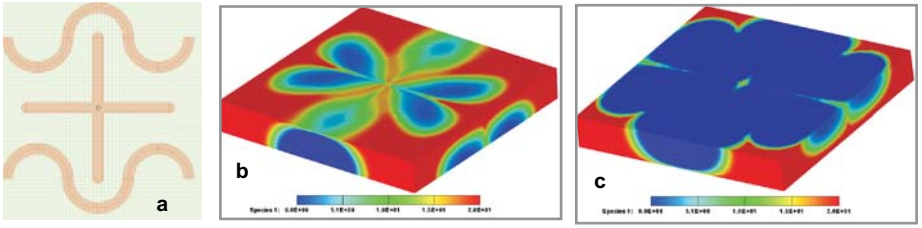
Partners: ***Liege University, Belgium - Leader***; Trasis S.A., Belgium; Bartels Microtechnik GmbH, Germany; ***IMT-Bucharest*** **(Contact: Oana Nedelcu, oanan@imt.ro), Romania**; University Henry Poincare - Nancy I, France
Objective: Developing multiple steps radio-pharmaceutical chemistry processes at the micro molar scale
Results: Design and simulations for ions cell separation (Coventorware 2005)



Electrostatic and electrokinetic simulation results: a) Electric field distribution; b)-c)-d): Distribution of ions concentration in elementar cell

IMT Team is carrying out the simulation for Lab-on chip components: mecanical, electrostatic, microfluidic, thermal, electrokinetic, fluid-structure interaction analysis.

The results are used to find the appropriate working parameter set as function of desired outputs and performances.



a) Masks design b)Top view c) Bottom view

Design and electrokinetic simulation for the second elementar cell

Oana Tatiana Nedelcu is mathematician and work in Modelling and Simulation Laboratory as Scientific Researcher. She is also PhD student at "Polytechnica" University of Bucharest. Her scientific expertise refers to computer aided design and simulation for microfluidic structures. She is involved in training activities and technical support in this area.

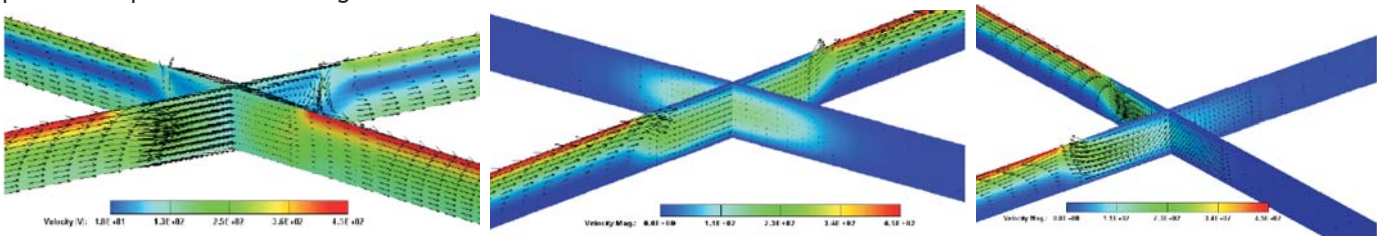
Design for Micro & Nano Manufacture

Acronym: **PATENT-DfMM,** NoE-FP6, Priority 2 **IST,** Contract No. 507255,
Coordinator – University of Lancaster, UK; **Dr. Andrew Richardson (A.Richardson@Lancaster.ac.uk)**
WP2: Modeling and Simulation

1. Fault Modelling and System Simulation of Flow FET-Based MEF Arrays

Partners: MESA+ Institute for Nanotechnology/University of Twente - Leader, Centre for Microfluidics and Microsystems Modelling (CCLRC) Daresbury, *IMT Bucharest* **(Contact: Oana Nedelcu oanan@imt.ro)**

Objective: To investigate the electroosmotic flow in cross-shaped microchannels and to study the influence on the transport of fluids in the case of closely-spaced electrodes.
Results: Fluid flow in channel cross points, described as function of input parameters (flow control by mean of zeta-potential on gates), with regard to the cross-sections of FlowFETs as they appear in FlowFET MEF arrays, using Coventorware 2005 software. The FlowFET operates by applying a voltage field from a gate electrode in the insulated side wall of a microchannel to control the ζ-potential along the wall. The change in æ-potential can be used to manipulate the magnitude and direction of the electroosmotic flow (EOF). Recently, an improved FlowFET has been designed, fabricated and tested by project partners as part of Work-Package 2 of the PATENT DfMM Network of Excellence.

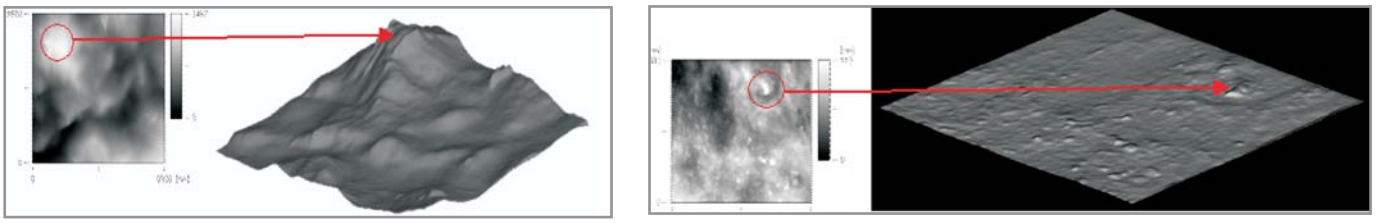


Electroosmotic analysis for fluid flow in cross-shape microchannels (Coventor 2005)

2. Simulation of the Stiction effect in the Metal-to Metal Resistive Contact Occurring in MEMS Switches

Partners: IMT Bucharest - Project Leader (Contact: Catalin Tibeica catalint@imt.ro and Victor Moagar Poladian victorm@imt.ro, *HWU - Edinburgh, Tyndall - Cork, WUT – Warsaw*

Objective: Simulation studies on the physical phenomena related to the stiction effect in MEMS devices.
Results: Modeling the rough surfaces by using AFM images and roughness parameters; Mechanical contact simulation; Study of the Casimir and Van Der Waals forces contribution to the stiction; Study the effect of damping on stiction.

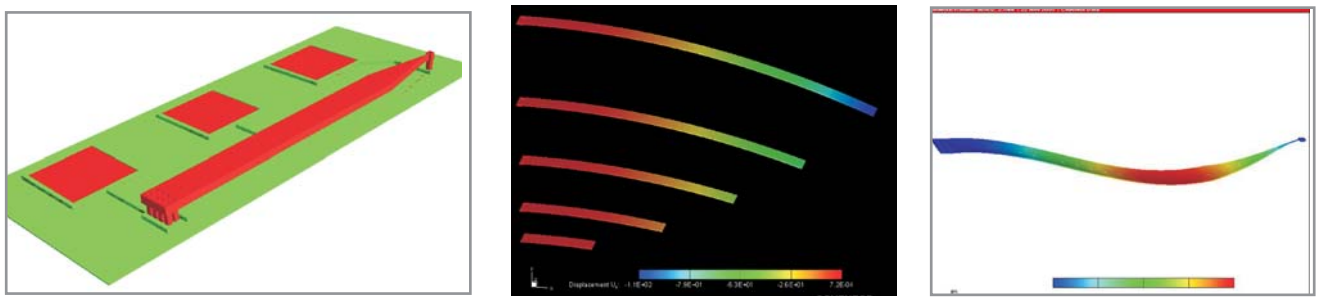


CAD modeling of the rough surfaces (ANSYS)

3. Round-Robin Modeling Study (still in progress)

Partners: Tyndall, QinetiQ -Leader, *IZM - Berlin, POLIMI - Milano,* **IMT - Bucharest (Contact Catalin Tibeica, catalint@imt.ro),** *HWU - Edinburgh, Lancaster University, CSL - Liege*

Objective: Fabrication, test and characterization of three micromechanical test structures (cantilever, fixed-fixed beam, and capacitive microphone); FE modelling of structures; Comparison of simulation results across a range of tools; Identification of parameters required in establishing common data formats; Simulation of the effects of packaging on MEMS; Investigation of suitability / limitations of modeling tools with regard to packaging of MEMS devices.
Results: Modeling the structures; Simulation of the residual stress effect on the test structures (static deflection due to stress gradient and the pull-in voltage).



Test structures; effects of residual stress relaxation (Coventor2005)

L6: Microphysical characterization laboratory

- ***Mission:*** Research and development in the field of characterization methods for materials and processes at micro and nanometric scale. Application of high resolution surface investigation techniques to solve engineering problems at these scales, especially investigation of correlations between technological process parameters structure and structure-properties order to obtain materials for specific applications.

- ***Main areas of expertise:*** Atomic Force Microscopy (AFM), Scanning Electron Microscopy (SEM), Electron Beam Lithography, Optical Microscopy, Electrical characterization of materials and devices.

- ***Research Team:*** is composed of 4 senior researchers with background in Physics, Chemistry, Pharmacy.

- ***Specific facilities:*** home-built, non-commercial Atomic Force Microscope (maximum scan area: 20μmx20μm, vertical resolution: 2 nm, lateral resolution: 20 nm). Professional software for advanced image processing SPIPTM - Image Metrology (contains specialized tools for analysing and correcting AFM data: visualization, including a 3D visualization studio, measure and analysis (roughness analysis, grain and particle analysis), reduce noise and enhance features (correlation averaging, filtering and extended Fourier filtering), calibration, tip characterization), on-wafer electro-thermal characterization equipment for micro and nanostructures.

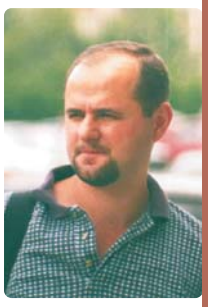
Atomic Force Microscope

Electro-thermal characterisation unit

- ***National networks:*** Network of scientific services for nanoscale structuring and characterization, with applications in the development of convergent technologies **NANOSCALE-CONV** Romania - Scientific Network of Services, CEEX Programme starting 2005

- ***AWARDS:*** Best Paper Award: A. Dinescu, G. Conache, R. Gavrila, CORRUGATED MICROSTRUCTURES FOR SILICON PHOTODETECTORS, International Semiconductor Conference - CAS 2005, Sinaia Romania

Acting Laboratory Head – Phys. Adrian Dinescu (adriand@imt.ro)



He received the M. Sc. (1993) degree in Physics from University of Bucharest. From 1993 -1997 he was Research Scientist at Research Institute for Electronic Components, ICCE Bucharest in the Optoelectronics Laboratory, from 1997 he is Senior Researcher at the National Institute for R&D in Microtechnologies (IMT Bucharest) in the Microphysical Characterization and Simulation Laboratory. Currently he is Head of Microphysical Characterisation Group.

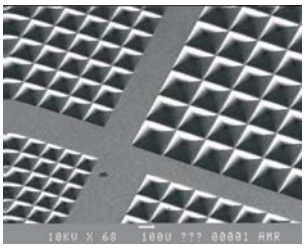
His main scientific interests include: Scanning Probe Microscopy (mainly AFM Surface morphology imaging and characterization), force sensors for Atomic Force Microscopy , Scanning Electron Microscopy and Electron Beam Lithography.

He was the leader of some national research projects (Matnantech, Ceres, Orizont 2000) and partner in international projects (IMPACT, ASSEMIC- Marie Curie Training Network, PATENT-DfMM) and the author more than 15 scientific papers presented at conferences and published in journals (Sensor & Actuators, J. of Micromechanic and Microeng., Balkan Phys. Letters, Optical Materials, etc).

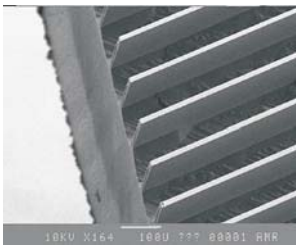
Antireflective microstructures for silicon photodetectors

- Areas of inverted pyramids and V-shaped grooves obtained on Si (100) and deep vertical-wall grooves of different dimensions on (110)-oriented single - crystal silicon wafers
- Corrugated microstructures obtained on (100)-oriented single-crystal silicon wafers

Corrugated microstructure in cross section - optical micrograph



SEM micrograph of inverted pyramid pattern on Si(100)



SEM micrograph of deep vertical-wall grooves on Si(110)

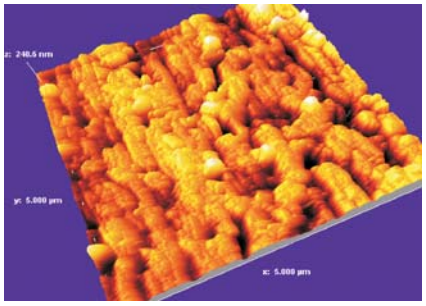
MATNANTECH Project (2003-2005) ; Coordinator : IMT-Bucharest; Partners : ROMES S.A., Bucharest University, Faculty of Physics.

Acquisition of a state-of-the art SEM (TESCAN VEGA 5136 LM) and ELPHY Plus - nanolithography equipment, for research at nanometer scale.

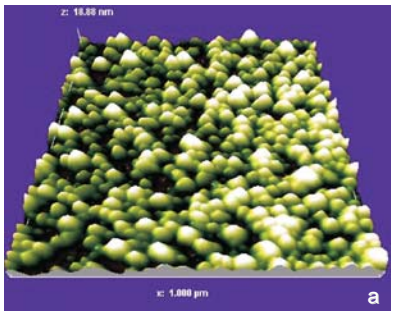
- The equipment will be located in the clean room of IMT Bucharest, all partners of the network **NANOSCALE-CONV** having access to it.

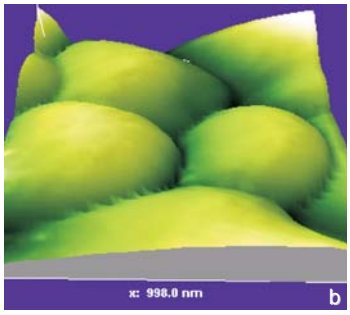
CEEX Programme starting 2005, "Network of scientific services for nano-scale structuring and characterization, with applications in the development of convergent technologies" - **NANOSCALE-CONV, Coordinator: IMT-Bucharest, Project manager Dr. Raluca Muller**

Surface morphology studies of a large variety of materials (semiconductors, dielectric coatings, thin films, polymers, biocompatible materials)

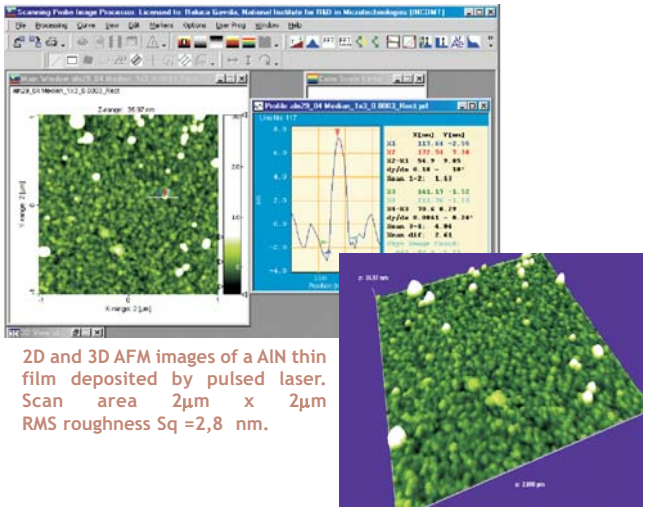


2μm x 2μm area of a wood sample (alder tree). National PNCDI project FINAMAT

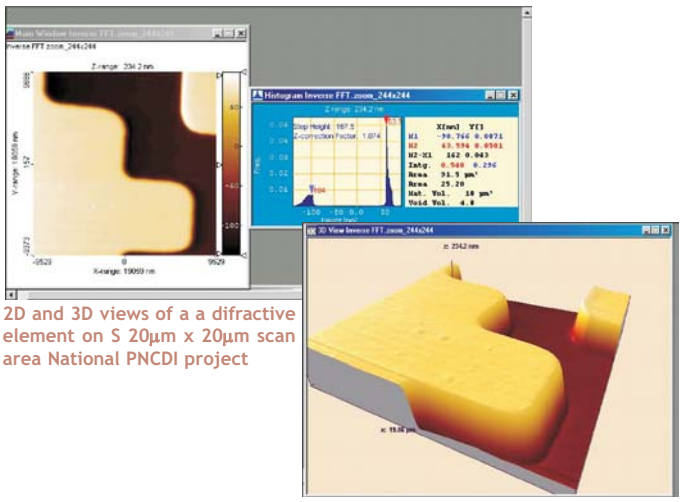




Morphology of a 1μm x 1μm area of a thin evaporated Au film (a) and the same sample after electrochemical thickening (b)



2D and 3D AFM images of a AlN thin film deposited by pulsed laser. Scan area 2μm x 2μm RMS roughness Sq =2,8 nm.



2D and 3D views of a a difractive element on S 20μm x 20μm scan area National PNCDI project

Services:

- 3D surface topography recording and measurement (waviness, roughness, step heights, grains, particles etc)
- x, y resolution: typical 20nm; z resolution: 2 nm
- compatible with nearly all solid samples, both conductive and nonconductive
- operates in ambient air, with no sample preparation needed
- maximum scan area: 20μm x 20μm sample: area min. 2x3 mm, max. unlimited; thickness max: 2.5 mm, max roughness 5 μm.

Options: 2D and 3D surface visualization, Inspection of image details by interactive rotation and scaling, Line-by line cross-section profile analysis, Roughness statistical analysis, Histogram, Fourier analysis

Contact person: Raluca Gavrila (ralucag@imt.ro), IMT-Bucharest

L7: Reliability Laboratory

- ***Mission:*** Providing tools to improve the design & technology of sensors, actuators, microsystems and micro-electronic components by assessing and building the quality & reliability in a Concurrent Engineering approach.

- ***Main areas of expertise:*** *Reliability building:* Design for reliability and testability - design for manufacture (see Results), Reliability monitoring & screening, Burn-in and accelerated testing, Reliability of components used in harsh environment (nuclear, geology, automotive, aeronautics, etc.);
Reliability assessing: Failure analysis & physics (see Results), Data processing & Reliability prediction, Behaviour of electronic components in harsh environment, Virtual prototyping (see Results);
Standardization: Certification, Qualification and periodic tests, Standards and other specifications.

- ***Research Team:*** The research team is formed by three senior engineers with background in microelectronics and one physicist.

- ***Specific facilities:*** *Environmental testing:* Rapid change of temperature, Low air pressure, Damp heat, Temperature storage Mechanical acceleration, Vibrations, Salt mist, Sealing with bomb pressure test, Electrical endurance with thermal stress, etc.; Accelerated testing: Bias & temp., Screening the reliable chips by laser acceleration of the recombination.

The Reliability Laboratory is co-operating with the Centre for Microscopy- Microanalysis and Information Processing of the University "Politehnica" Bucharest on: *Atomic force microscopy (AFM), Confocal microscopy with laser scanning - analyses of stresses between various layer, Microscopy with laser scanning based on the analysis of the induced photocurrents, High resolution characterizations by laser beam and holographic interferometry.*


AFM - Quesant 350

- ***International Networks:*** Network of Excellence "Design for Micro and Manufacture PATENT-DfMM" - cluster "Reliability & Characterisation" (2004-2007), with 24 partners (universities, research centres, companies) from 18 European countries. The NoE contains four scientific workpackages: WP1 - "Testing", WP2 - "Modelling & Simulation", WP3 "Reliability & Characterization", WP4 - "Packaging". Dr.M.Bazu is member of the Management Board and WP3 leader. The Reliability Laboratory is co-ordinator of three WP3 projects: "Reliability of MEMS basic moveable structures" (10 partners), „MEMS test structures for material, process and reliability characterization" (10 partners), „Methodology for accelerated testing and reliability analysis of MEMS" (9 partners) and *Inventory of standardization activities on MEMS.*

- ***National networks:*** Contractor of the "Centre of research in nanobiotechnologies - CENOBITE", project (2002-2005) in the National Research Programme "New Materials, Micro and Nanotechnologies - MATNANTECH", with 10 partners (laboratories from national research institutes & universities);
Member of the "Interdisciplinary network for synthesis and studying semiconductor and conductor nanostructures for obtaining photonic and optoelectronic devices usable in biology and medicine - NANOCRYSTALNET", project (2005-2008) in the National research Programme „Excellence in Research - CEEX", 8 partners (co-ordinated by the University Politehnica Bucharest).

Laboratory Head — Dr. Marius Bazu (mbazu@imt.ro)

He received the B.E. (1971) and PhD. (1994) degrees from the University "Politehnica" Bucharest, Romania. He was involved in device design and semiconductor physics. Now, his recent research interests include methods for building, assessing & predicting reliability.

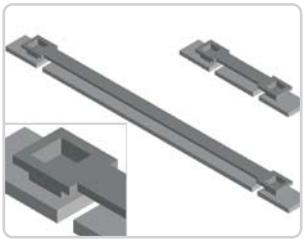
He developed in Romania the accelerated reliability tests, building-in reliability and concurrent engineering approaches. Leader of a European project (Phare/TTQM) on a building in reliability technology (1997-1999), Leader of the Reliability & Characterisation Cluster and Member of the Management Board of the NoE "Patent-DfMM", FP6/IST (2004-2007).

He is referent of the journals IEEE Transactions on Reliability, IEEE Transactions on Components and Packaging and IEEE Electron Device Letters. Recipient of the AGIR (General Association of Romanian Engineers) Award for the year 2000. Chairman and lecturer to international conferences: CIMCA'99 (Vienna, Austria), CAS 1991 (Sinaia, Romania), MIEL 2004 (Nis, Serbia and Montenegro). Author or co-author of more than 100 scientific papers (IEEE Trans. on Reliability, J. of Electrochem. Soc) and contributions to conferences (Annual Reliability and Maintainability Symp., Probabilistic Safety Assessment and Management, European Safety and Reliability Conference). Co-author of a book ("Reliability of electronic components") published at Springer Verlag, in 1999.

The research projects run in 2005 by the Reliability Laboratory were intended to develop the laboratory offer for industry and research. Consequently, in presenting the scientific results, after indicating the subject of the research (in capitals), the service to be developed is mentioned.

Design for Micro & Nano Manufacture
Acronym: **PATENT-DfMM,** NoE-FP6**,** Priority 2 **IST,** Contract No. 507255,
Coordinator – University of Lancaster, UK; **Dr. Andrew Richardson**
WP3 Design for Reliability & Characterisation

MEMS FAILURE MECHANISMS - Reliability assessing: Failure analysis & physics



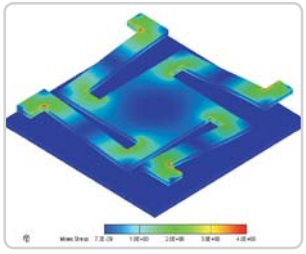
3D models and cup-shaped anchor detail of the analyzed micro-bridges, created in CoventorWare

Basic moveable structures of MEMS (e.g. membranes and cantilevers) were studied, by using modelling & simulation tools, in order to assess the failure modes / mechanisms and to elaborate corrective actions.

Achievements: IMT performed simulations and electrical characterisation of gold micro-bridges manufactured by LAAS-Toulouse. The pull-in voltage was predicted by analytical (the electro-mechanical model) and two computational models of the bridge (ideally clamped conditions on the bridge ends and the model with boundary conditions, respectively). The estimations were verified by experimental measurements.

Project: Reliability of MEMS basic moveable structures, grant of the IST Network of Excellence (2004-2007) "Design for Micro and Nano Manufacture" **(PATENT-DfMM), WP3 Design for Reliability & Characterisation. Co-ordinator: IMT-Bucharest (Contact person: Marius Bazu, mbazu@imt.ro).** Partners: 10 European research institutions members of **NoE Patent-DfMM.**

VIRTUAL PROTOTYPING - Reliability assessing



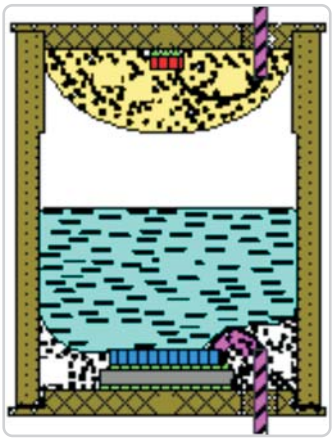
3D model of the tuneable Fabry-Perrot micro-cavity. Distribution of induced von Misses stress, used for simulating the main failure mechanism: fatigue damage.

Virtual Prototyping means to simulate (by using appropriate models) the behaviour of a future prototype even at the design phase. Based on the Concurrent Engineering approach, virtual prototyping requires extensive knowledge about the involved failure mechanisms and their dependence on technological and stress factors.

Achievements: For a resonant micro cavity composed by two flat, parallel, high quality mirrors, separated by a variable gap, the fatigue damage of the movable membrane was analysed. The results demonstrate that the reliability of the device may be monitored even at the design phase by appropriately choosing the structure parameters.

Project: Reliability improvement in a concurrent engineering environment, **Core Financing Programme (2003-2005), Contact person: Marius Bazu (mbazu@imt.ro)**

BIOSENSOR FOR ENVIRONMENT MONITORING - Reliability building - Design for reliability and testability (design for manufacture)



Electrochemical micro-cell with illumination, transverse section

Biosensors detecting the environmental pollutant concentrations, offering the possibility to generate information continuously were developed. The design for manufacture approach was used, in order to develop a general methodology. Research was directed on: obtaining a biologic process/ element having a good reactivity; using the microelectronics technologies for miniaturization; using conducting polymers for interfacing the transducer microelectrodes with the biological element.

Achievements: An electrochemical micro-cell for building micro-biosensors based on detecting photosynthesis inhibition was executed. The constructive solution ensures: the possibility to introduce and to remove the electrolyte which contacts only the micro-electrodes area; the illumination of the working electrode; the electrical connection of the micro- electrodes; the biocompatibility and the reliability for the fixation of the biological element, together with a good electrons transfer and conductivity.

A cluster formed by two projects was focused on designing and manufacturing the biosensors for environment protection: ***Biosensor for detecting and monitoring of xenobiotics in the effluents of the installations for biological purging of worn-out waters*****,** MATNANTECH Project (2004-2006), Co-ordinator: IMT-Bucharest. Partners: Institute of Biology Bucharest, "Petru Poni" Institute of Macromolecular Chemistry, Institute of Industrial Ecology Bucharest (ECOIND) and ***Method for electrical investigation of the cyanobacteria reaction at pollutants for developing new microstructures used for environment protection*****,** **Core Financing Programme** (2004-2005), **Contact person Lucian Galateanu (luciang@imt.ro).**

A4: Prototype development laboratory

● ***Mission:*** Developing new technologies in the areas of Microsystems technologies: design, technological development up to the prototype level. Technological services: technological assistance in order to obtain prototypes starting from the experimental models (technological flows design, control gates, technological compatibilities) and defect analysis on technological flow.

● ***Main areas of expertise:*** individual technological processes as ion implantation, annealing treatments, as gate oxides, surface cleanings, ICs CMOS technologies, nuclear detectors technologies, piezoelectric integrated microsensors, high speed photodetectors and white LED micromatrix , MCM technologies, sol-gel technique, technology for non-standards LED devices assembly, technological compatibilities for integrated M(O)EMS.

Our team (from left to right): Veronica Schiopu, Ileana Cernica, Florian Pistritu, Maria Cimpoca, Alina Ciuciumis

● ***Research Team:*** The team is represented by a senior researcher (PhD), a senior technological development engineer, 2 PhD students (with background in chemistry) and a young engineer specialized in electronic applications field. The seniors of the team have industrial experience and company RD activity in CMOS technologies (IC dice manufacturing and IC assembly techniques).

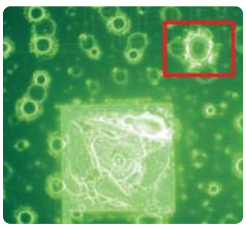
● ***Services Offer:***

• Technological assistance for technological flow design, control gates and technological compatibilities

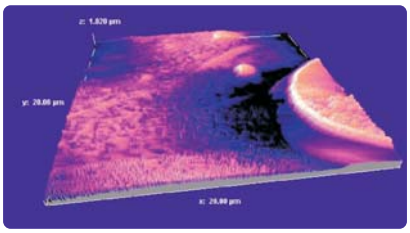
• Defect analysis on technological flow

Example: Process failure: In a pressure microsensor technology a three multilayer thin film deposition of SiO_2 from TEOS by sol-gel method was used as final protection thin film. The process failed due to the inadequate treatment between the deposition of the second and the third film- the multilayer film is not functional as protection layer and the device failed electrically too (over sintering time)

Contact person: Ileana Cernica (**ileanac@imt.ro**)



Optical microscopy (X160)



AFM 3D Detail

● ***Awards:***

• "Advanced Manufacturing Technologies for Specific Nanomaterials Dedicated to Lingo-Cellulose Composite Used in Furniture Industry Finishing Processes Applications" **6th National Symposium MATNANTECH**, 7-11 June 2005, Jupiter, Romania – third prize – Session Student Paper

• "Preparation Of Yttrium Aluminum Garnet Doped With Cerium For Application In Optoelectronics" –V.Schiopu, M. Macrin, I.Cernica, Proc. CAS, vol. I, p.149-152 [2005] – Annual **International Semiconductor Conference CAS 2005**, Sinaia, oct. 2005 - Best Paper Award- Session: Student Paper

• "PIN Photodetector Micromatrix for Optical cable Communication Manufacturing Technology" , **Salon International des Inventions – Geneve 2005** – Silver Medal

Laboratory Head — Dr. Ileana Cernica (ileanac@imt.ro)

She received MSc on Electronics and Telecommunication (1981) and PhD in Microelectronics (1998) both from University "Politehnica" of Bucharest. She worked as senior integration engineer in CMOS ICs technologies, CMOS RD activities and as AQ responsible in a semiconductor industrial company for 10 years.

Now she is senior research scientist, currently coordinate 5 national R&D projects and is responsible person in EUREKA umbrella project MINATUSE and project manager of Romanian – German Centre for micro and nanotechnology Project. She also is involved in technology transfer activities being former executive director of Centre for Technological Transfer in Microengineering (CTT-Baneasa).

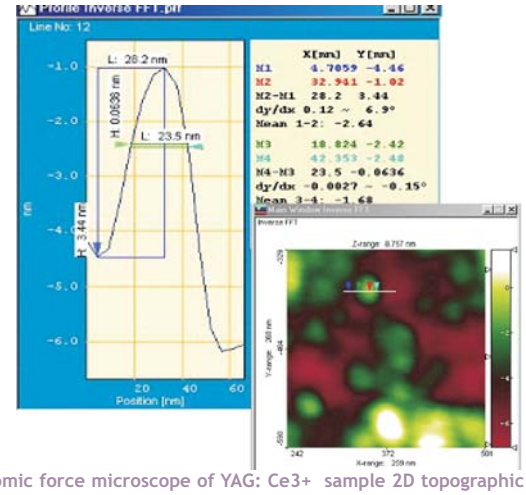
She is member of Scientific Committee of IMT. Other activities: is project evaluator in national RD programs (MENER, MATNANTECH, CERES, CEEX) IEEE member and associate professor at University "Politehnica" of Bucharest (Faculty of Electronic, telecommunication and information technology and Faculty of Mechanics) The scientific activity is published in more than 50 papers in international journals/conferences, 94 technical reports and is author or co-author of 8 Romanian patents (2 of them won silver and 1 gold medals at International Inventions Exhibition in Bruxelles and Geneve) and 2 books.

Micromatrix with white light emission for indoor illumination systems applications

A white lighting micromatrix for indoor illumination systems will be design and realize. The applications: in hospitals for night surveillance or in cars for indoor illumination during driving.

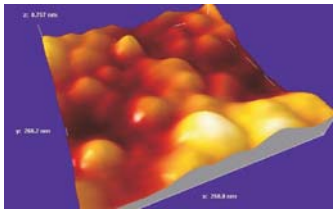
Achievements: • Technological experiments were done in order to obtain the phosphorous for white light emission. Nanocrystalline YAG powders doped with Ce3+ were synthesized by a sol-gel process, using an a hydroxide-nitrate- glycolate intermediate Synthesis at 1100 °C produced fully crystallized single-phase Ce-$Y_3Al_5O_{12}$ with a well pronounced garnet crystal structure. The results are also in a good agreement with the reference data for $Y_3Al_5O_{12}$. The most intensive line is at (420) – 100 %. Therefore, it can be concluded that the sol-gel synthesis gave well-developed rare-earth doped YAG at 1100 °C and no formation of crystalline dopant phase was observed. The formation of a single mixed-metal Ce-$Y_3Al_5O_{12}$ phase with a homogeneous distribution of the dopant element already at 1100°C emphasizes that this synthesis temperature is rather low for such kinds of materials.

• Microphysical characterization of the obtained material.

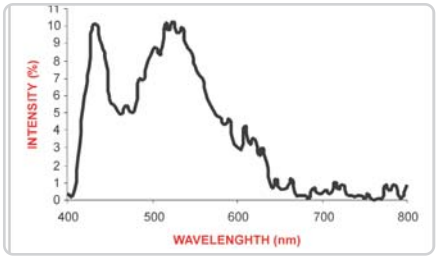


Atomic force microscope of YAG: Ce3+ sample 2D topographic imagine, and calculation of grain diameters

MATNANTECH Project : New manufacturing technologies for micromatrix with white light emission for indoor illuminate systems applications **MATRIX-LA** (2004-2006);
Co-ordinator IMT-Bucharest, Project manager: Ileana Cernica (ileanac@imt.ro)
Partners: Romes S.A. – SME; Valahia University of Targoviste ; Gh.Asachi Technical University of Iasi



Atomic force microscope of YAG: Ce3+ sample 3D



Emission spectra of the white LED

The data obtained by AFM measurements show phosphors with average grain size of 24 nm.

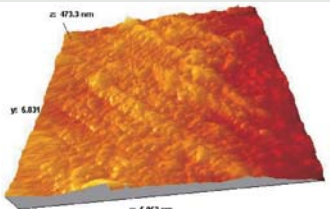
Nanomaterials dedicated to ligno-cellulose composite used in furniture industry finishing processes

We start to develop new technologies for ligno-cellulose composites finishing processes using nanostructured materials with controlled properties(hydrophobic and antistatic)in order to improve the quality of products in furniture industry. Another important aspect is that the standard finishing technologies are using volatile organic compounds but, starting with 2007, the European direction no. 13/1999(imposing the minimization of the volatile organic compounds (VOC) emissions) will be obligatory applied. So, we propose new technologies that eliminate the use of VOC.

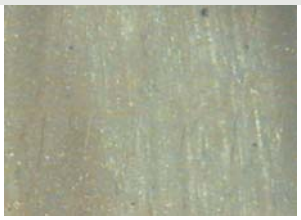
Achievements: The technological experiments were three folded:

• we choose the materials which can be processed in application without using COV; • we develop a sol-gel technology in order to obtain the materials; • we try to identify the compatibilities problems between the lingo-cellulose plates and the finishing materials- the intermediary results reveal that the adsorption of the finishing products are strongly dependent by the proportion between alburnum and heartwood (more than the influence of the wood type)

Beech tree substrate



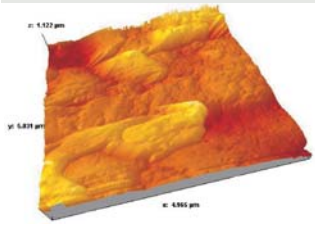
3D topographic AFM image substrate



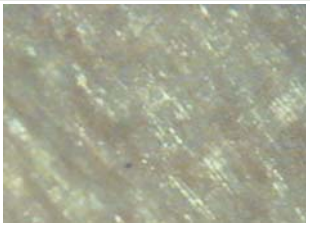
Optical microscopy after CeO2 film covering

Optical microscopy after ITO film covering

Birch tree



3D topographic AFM image substrate



Optical microscopy after CeO2 film covering

Optical microscopy after ITO film covering

MATNANTECH Project: Advanced manufacturing technologies for specific nanomaterials dedicated to lingo-cellulose composite used in furniture industry finishing processes applications **FINAMAT**(2004-2006), **Co-ordinator IMT-Bucharest, Project manager: Ileana Cernica (ileana@imt.ro) Partners:** National Institute of Woods Bucharest, R&D Institute for Non ferrous and Rare Metals Bucharest, Valahia University of Targoviste

A2: Technology Laboratory for Microstructures

● ***Mission:*** The Technology Laboratory for Microstructures provides technical support for the research activity developed in the institute.

● ***Main areas of expertise:*** The Laboratory covers a broad range of technological processes in order to fulfil the requirements for implementation of semiconductor devices, sensors, micromechanical and microoptical structures, microstructures for bio-chemical devices, metallic and dielectric lattices.

The versatility and the adaptability to the various needs of microsystems realization are the major characteristics of the technologic processes offered by the Technology Laboratory for Microstructures. Besides silicon wafers, other materials as gallium arsenide can be also processed.

● ***Research Team:*** The team is represented by three senior researchers, 1 chemist and 2 physicists. The laboratory has also auxiliary personal specialised in technological processes.

● ***Services:***

• Thermal processes (oxidation, dopant deposition/diffusion, annealing) for wafers up to 4";
• Vacuum deposition (thermal and e-beam evaporation techniques) of dielectric and conductive materials. Materials available: Al, Cr, Ti, Au, Mo, Ag, W, Ni, Pt, Ni-Cr, permalloy, Cu, Pd, Si, SiO_2;
• Ion implantation for energies up to 150 keV;
• CVD from liquid sources for silicon dioxide and carbonitride thin film realisation;
• Photolithography (UV, double side aligners, lift-off techniques);
• Chemical processes; surface cleaning, wet/dry etching, isotropic/anisotropic etching, metal electroplatting or chemical plattings, anodic oxidation, sol gel techniques.

Equipments for photolithography

Equipments for chemical processes

● ***Awards:***

• **Medaille d'argent**, Technologie pour obtenir des micromatrices photodetectrices "PIN", Ileana Cernica, Elena Manea & Ioana Dinoiu, 33eme Salon International des Inventions Geneve, 8 avril 2005, Geneva 2005
• **Medaille d'or**, Microconcentrateurs pour cellules solaires basees sur microstructuration de surface du substrat, Manea Elena, Cernica Ileana Viorica, Dumbravescu Nicolae, 54eme Salon Mondial de l'Innovation de la Recherche et des nouvelles technologies, 19.11.2005, Brussels, Eureka' 2005
• **Special award** from the Governor of Ivanova region of Russian Federation "In the field of high technologies", Elena Manea & I.V. Cernica, participant of the 54th Warld Exhibition of Inovation, Research and New Technologies in Brussels, 16-20 of November 2005

Laboratory Head — Dr. Elena Manea (elenam@imt.ro)

She received Ph.D. in Solid State Physics, University of Bucharest, Faculty of Physics", 1998.

Research in the field of microsystems and microsensors technologies and new materials and processes for microstructured glass for biomedical application. 20 years experience in silicon planar technology including: photolithography and diffusion processes for MOS-CI, thin film deposition (e-beam and sputtering) for wafer up to 4"; elaboration of processes and vehicles for testing the performances of the photolithography and diffusion processes; optimized of technological process to obtain new devices: for CMOS Al gate IC, polysilicon CMOS for gate array, thin films silicon solar cells; anisotropic etching of crystalline silicon in alkaline solutions; define the thickness of the silicon membrane by boron diffusion processes for MOMS.

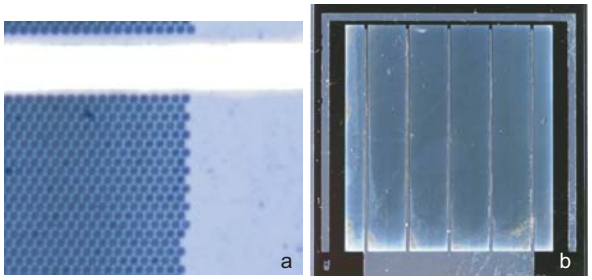
Patent: 5-TCI /09.05.2005-31.12.2015 "Optical microconcentrators for solar cells based on substrate surface micro-structuration", Manea Elena, Cernica Ileana Viorica, Dumbrăvescu Nicolae

Advanced technology for solar cells realization based on monocrystalline silicon surface microstructuring

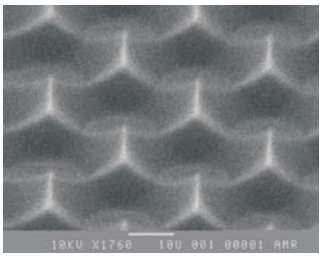
Substrates texturization was realized by surface etching using a mask layer and the "honneycomb" topography to obtain hemispherical walls. At the moment when the neighbouring hemispherical walls are in touch, "honneycomb" structures/geometries will be formed.

Optical microconcentrators for solar cells were realized to enhance the PV solar cell efficiency by substrate surface microstructuring. The topography consists of windows uniformly distributed in the vertexes of an equilateral triangle.

• Development of technologies for the realization of PV solar cells;
• Design and fabrication of PV solar cells;



Optical image of the structure through oxide of theSolar cells with the micromachined surface, (a)-detail

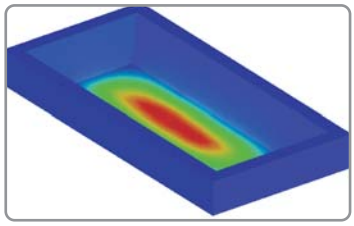


SEM image of the surface of the Solar cells with the microfabricated surface

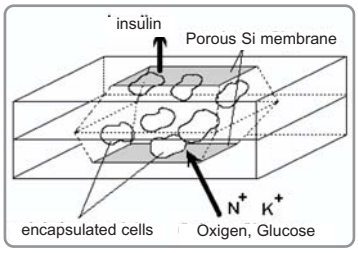
MATNANTECH: project (2003-2005) Co-ordinator: IMT-Bucharest, Project Manager: Elena Manea (elenam@imt.ro); Parteners: University "VALAHIA TARGOVISTE", ROMES SA, INCDO-INOE 2000 Cluj

Biomicrocaps fabricated on silicon

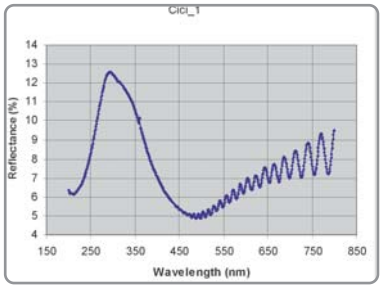
Microprocessed microcavities having porous silicon membrane used in drug delivery by a new implant technique.
Achievements: • Porous nanostructured membrane microfabrication by auto-stop etching on p+ silicon;
• Coventor ware device simulation;
• Microdevice design;
• Porous silicon membrane mechanical simulation.



Conventor Ware simulation on the whole device.



Schematic representation of the nanoporous silicon membrane biocap.

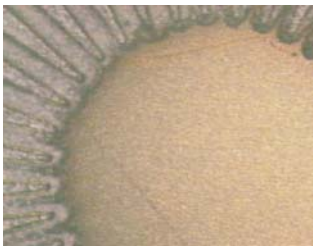


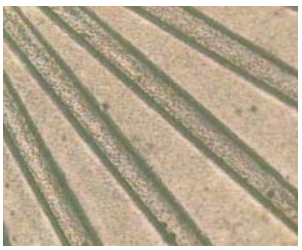
Reflectance variation of the porous silicon versus wavelength.

PN. Project (2003 - 2005) Co-ordinator IMT - Bucharest (Manager Cecilia Podaru: ceciliap@imt.ro). Technology to obtain microfluidic devices by silicon microprocessing having applications in thermal transfer and biology.

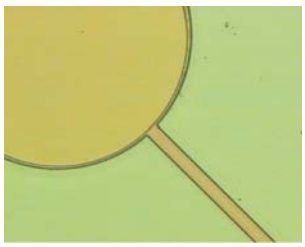
Technology to obtain microfluidic devices by silicon microprocessing having applications in thermal transfer and biology.

The project aims to realize a silicon surface, or other substrates microprocessing to obtain microfluidic devices based on microchannels, having applications in thermal transfer and biology. The resist is used as a sacrificial layer.





Micro-heat sink based on silicon surface microprocessed Au microchannels.



Surface microprocessed silicon monoxide structure realized on glass substrate having a microchannel and a microcavity.

Achievements: • Technology for microfluidic devices microprocessing;
• Non - standard lithography onto various substrates;
• Thermal and mass transfer modelling and simulation in microfluidic devices;
• Measurement and characterization techniques of the device, the microprocessed micro-heat sink.

MATNANTECH Project (2004 - 2006). Co - ordinator IMT - Bucharest, (Project Manager: Antonie Coraci: antoniec@imt.ro). Partners: UVT - Targoviste, and ROMES SA - Bucharest.

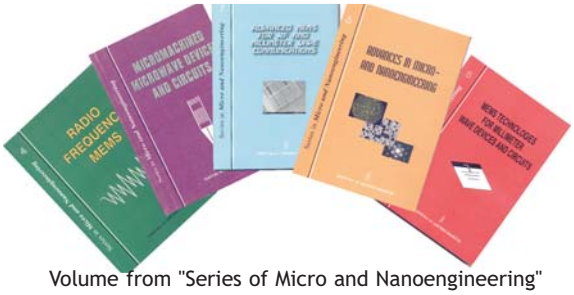
PROJECTS AND SPECIFIC RESEARCH AREAS: The Technology Laboratory for Microstructures has his own projects focused on developing technological processes for MEMS applications, as well as a large participation to the other projects developed in the Institute. *During the last years, the work was focused on:* • Design and implementation of the technology for the realization of physical sensors; technology for pressure sensors and accelerometers; • Special metallization systems suitable for gas sensors and manufacturing of such structures; • Realization of thin films used as sensitive layers (Al_2O_3 thin layer for humidity detector, TiO_2 thin layer for oxygen detector, SnO_2 based thin films detectors); • Design, simulation and technology implementation of cold electron emission microdiodes; • Technology development for LPCVD thin films realization; • Development of structures used for implementation of biosensors (e.g. glucose sensor); • Development of technologies for the realization of PV solar cells; • Technologies for surface microchannels microfabrication;

Also, our laboratory acts as a technological support for institute projects belonging to other laboratories. The projects in which the working group was involved merge the following disciplines: semiconductors technology, semiconductors physics, materials physics, optics and chemistry.

Department for training and international cooperation

Centre for international cooperation

Mission: The mission of the International Cooperation Center is: communication with partners; dissemination of information about institute and institute partners, research activities, national and international projects; to develop and maintain the internet "interface" regarding all activities carried on by the institute; administration and maintenance of specially designed E-ROOM communication platform for networking. The team is involved in organizing of the International conferences: *CAS Conference* (IEEE annual event) and other international events. Also take part in activities of editing International publications in English: **Micro and Nanotechnologies (MNT) Bulletin**; Romanian Journal for Information Science and Technology (Romanian Academy), **Volume from "Series of Micro and Nanoengineering"** (Romanian Academy).



Volume from "Series of Micro and Nanoengineering"

Micro and NanoTechnology Bulletin is published quarterly by IMT-Bucharest, Romania. This Bulletin, originally intended to publicize **results of Romanian researchers in the micro and nanotechnology (MNT) field**, extended its coverage since 2004 to Eastern Europe. The purpose is to contribute to a better communication of MNT scientific communities from Eastern Europe to the rest of the world. All research organizations from Eastern and Western European Countries are invited to contribute (free of charge) with articles to our publication (contact **mnt@imt.ro**). MNT Bulletin is distributed free of charge to interested organisations and individuals. *Editor-in-Chief*: **Dan Dascalu** (IMT-Bucharest). The Bulletin is also available on the web page: **www.imt.ro/mnt**.

Team expertise: dissemination and communication activities; organizing events (conference, workshops, seminaries); web design: **www.imt.ro**, **www.minos-euro.net**, **www.romnet.net**, **www.minaeast.net**, **www.nano-link.net**; design of dynamic web pages in PHP; database design using MySQl, PostgresSQL; image creation and editing for web and publication (CorelDRAW, Adobe Photoshop); editing publications (QuarkXPress) (**www.imt.ro/mnt**); editing and printing: flyers, posters (A0-A4); etc

IT services:

- INTERNET & INTRANET applications design;
- Interactive database application design;
- Web sites design and maintenance;
- Soft and hard integration of designed system;
- IT maintenance, system development;
- Creation and maintenance of electronic databases;
- Consulting in IT problems and development;
- Equipment up-grade, maintenance and PC network internal organization;
- Administration of E-ROOM communication platform for networking (web-based application that allows gradual access to a virtual space, reducing costs for project management and enhancing transparency of communication. General functionalities: offers a user rights system and a file management policy and capabilities to describe projects by publishing web media content.)

Enewsletter web page (common issue MINAEAST-NET and MINOS-EURONET)

ROMNET-ERA project web page

Team:

Elena Stanila - partners communication; internal activity advisor; responsible for editing and publishing activities; responsible with dissemination activities; web designer; administrator of web based application; data base application design;

Iorga Ionica - partners communication; internal activity advisor; responsible with dissemination activities; administrator of web based application; web designer;

Pompiliu Munteanu - network administrator; network maintenance; application programmer; database application design (database maintenance); web based applications programmer and maintenance;

George Boldeiu - web designer; data base application design; applications documentation;

Dragos Varsescu - web designer; applications programmer; 3D designer;

This Department also contains a Centre of training in Micro- and Nanotechnologies (cooperation with PUB)

Computer and Communication Infrastructure

Computer Network: Ethernet star configuration type (Windows 2000 Server - IBM eServer xSeries 232 /); Data transfer rate: 100 Mbps (full duplex); *Two internet connection: optical fibre and radio connection*; Ethernet Network- microsegmentation principle (each computer is connected to a switch port - result package collision almost null); Router Cisco 2600 ; Switches in "Stack" AT-8324SX/72P; Unshielded twisted pair cable (UTP); The Network can be divided in virtual network (VLAN) for isolation of computers group witch contains confidential data: INTRANET, INTERNET and Electronic mail-(Linux, Q-mail); Network can provide VIDEOCONFFERENCE technical support; Network: *100 computers* (Athlon XP 1700-3000+; Pentium IV)

Key people: **Serban Dunare**: network administrator, network maintenance;

Ioana Dinoiu: software support for PC and Sparc stations (SUN-Unix), elaborating test and service procedures, management information system in the company;

CENTRE FOR TECHNOLOGICAL TRANSFER IN MICROENGINEERING (CTT-Baneasa)

CTT-Baneasa is a **distinct, autonomous entity of the** National Institute for R&D in Microtechnologies (IMT-Bucharest), with financial autonomy. The Centre was initiated in 2003 and finally audited for accreditation in October 2005. The presentation below corresponds to the reorganization of this Centre in the second half of 2005.

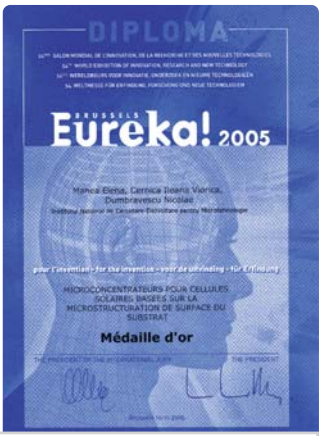
The main mission of the Centre is to contribute at the micro- and nanotechnologies development by stimulating the technological transfer and innovation at national level, with collaborations at regional or European level.

CTT-Baneasa will assure the obtaining of a critical mass for transfer of **knowledge and technologies in the micro- and nano engineering domain**, cumulating the offers coming from the Romanian research in the domain.

Medaille D'Argent, Technologie pour obtenir des micromatrices photo-detectrices "PIN", I. Cernica, E. Manea, I. Dinoiu, Salon International des Inventions, 8 April 2005, Geneve

The activities developed by CTT-Baneasa are:

- Facilitation of information exchange and partnerships (*networking*) by setting up **a network of suppliers and users for the technological transfer and innovation in the micro- and nanotechnologies domain**;
- Promote the access to characterisation and design technological services of IMT and its partners from the country and abroad, including also the assurance of "*one-stop shop*" services, for companies interested in the micro and nanotechnologies domain;
- Assistance and consultancy in business, including reliability studies, for "start-ups", "spin-offs" and other innovative companies;
- Realize reliability and marketing studies;
- Provide consultancy and assistance in problems related to protection of industrial property;
- Services of technological audit for small and medium enterprises and innovative enterprises;
- Services of information, documentation and training, including practical training in using technological equipments, characterisation equipments or simulation and computer aided design programmes, and also in technological processing (individual technological processes and technologies design);
- Support for networking by assuring an informatics infrastructure for dissemination and establishing contacts and common activities on the internet;
- Technology forecast.



Medaille D'Or, Microconcentrateur pour cellules solaires basees sur la microstructuration de surface du substrat, E. Manea, I Cernica, N. Dumbravescu, EUREKA! 2005, 19 November 2005, Brussels

The Centre also will contribute to the **access to microsystem technologies** in the frame of the European system **EUROPRACTICE**, IMT being partner of the European consortium INTREGRAM+, developing new services in micro- and nano-technology (FP6 IP, starting in 2005).

This system includes facilities and high level expertise which allow a **complete assistance for companies** (a "one-stop" shop): from product to project, prototype and batch production and manufacturing. IMT has experience in such activities from earlier EU project (MST-Systems, 2003-2005), related to technology transfer from the EUROPRACTICE system. This project was carried out with the "MST Design" consortium (mostly companies from UK, but also IMEC, Belgium).

Medaille D'Argent, Structures pour la gestion thermique de circuits integres, G. Moagar-Poladian and V. Moagar -Poladian, Salon International des Inventions, 8 April 2005, Geneve

The contract for the **Romanian-German Center for micro and nano-technologies**, which will develop pilot activities for technological transfer in Romanian industry, is developing in the frame of CTT-Baneasa starting October 1st, 2005. IMT has a good visibility at **regional level**, playing a distinct role in attracting in this domain the SMEs in Eastern Europe, according to the projects MINATUSE (Eureka), 4M (Network of Excellence in FP6, priority 3), MINOS-EURONET (SSA in FP6, priority 2).

CTT-Baneasa will play an essential role in **providing the services for the scientific park MINATECH-RO** and collaborates with the Chamber of Commerce and Industry of Romania, University "Politehnica" of Bucharest, S.C. ROMES S.A. (the collaboration will be extended also to other partners which will provide services for the Center).

Contact data: CTT-Baneasa (www.imt.ro/ctt); Tel/Fax: 021-490 82 36; E-mail: **info-ctt@imt.ro**
Address: 32 B Erou Iancu Street, Bucharest, 077190. Conventional mail delivery: C.P. 38-160, Bucharest 023573.

The Science and Technology Park for Micro and Nanotechnologies (MINATECH-RO)
www.minatech.ro

The Science and Technology Park for Micro and Nanotechnologies was set-up by a consortium including National Institute for R&D in Microtechnologies (IMT), "Politehnica" University of Bucharest (PUB) and S.C. ROMES S.A. The partners in the consortium have experience in working together, in national and also international projects. During 2004 and 2005 MINATECH-RO received institutional funding from the national programme INFRATECH. This financing was used for new clean room spaces, new equipments and also for preparing the room for accommodating a number of small companies active in the micro- and nanotechnologies (MNT) field, or providing support to these companies. The official inauguration of the park is due early spring 2006. The main location is in IMT, with a secondary one in PUB.

***The specific activities* of MINATECH-RO** (many implemented through CTT-Baneasa) are: Technological transfer (realization of prototypes, demonstrators or experimental models; small scale/pilot production after realizing the prototype); Incubation; Technological services, micro-physical characterization, simulation and computer aided design; Learning/training by preparation courses and stages (with practical training) in the Microsystems, micro- and nanotechnologies and microengineering domains; Assistance and consultancy activities for SMEs and small innovative enterprises: information in micro-engineering, Microsystems, micro- and nanotechnologies, access to databases, documentation, etc.; Technological consultancy; Brokerage (for services in the domain), reliability studies; Facilitating the access of Romanian innovative SMEs in European partnerships; Dissemination of information (organizing conferences, workshops, editing publications, etc.); Research and development.

Fig 1. workshop on 7th of December, 2005, CCIRB

Fig 2. Mr. Daniel Cosnita (GTZ)

An essential function of the park is **"incubation"**. The park provides **not only standard conditions** (room for offices, telephones, internet, secretary services), **but also the possibility to use equipments requiring special working conditions**, characteristic for chemistry laboratories or laboratories in the semiconductor industry: cleanliness, air conditioning, stove aspiration (for chemical substances), neutralization of waste products (for environment protection), deionised water, nitrogen, protection from explosion, etc. These equipments will be installed in spaces rent to companies or in common spaces. Technical assistance will be provided for all these equipments, together with consultancy for the activities of the companies and also the rent of certain equipments.

The incubation area of the park is situated in IMT, on the **industrial platform Baneasa**. **The research offer of IMT is considerable**, with a number of R&D laboratories involved in dozens of applied research contracts, including R&D partners and companies from abroad (some activities are financed by FP6 projects). Some laboratories **are contact points of European networks of excellence**, offering access to their activities. The network-type **CEEX projects** (2005-2008) **supporting the networks** RO-NANOMED (nanomedicine) and respectively NANOSCALE-CONV (facilities for nano-characterization and nano-structuring). Both networks have technological laboratories in MINATECH-RO, as interaction platform between partners.

Fig 4. Day of "open gates", 15th of December, 2005, Lecture hall

The influence of the **University "Politehnica" of Bucharest**, is also present in this area through the common laboratories and working points assured for teachers and also for master or doctoral students.

In order to promote CTT-Baneasa (see the previous page) and MINATECH-RO, IMT organized at the Chamber of Commerce and Industry of Romania, on 7th of December, 2005 a workshop devoted to "Access to micro- and nanotechnologies" (see the figure 1). The event was focused on the facilities provided to SMEs and opportunities open by the direct and indirect use of the new technologies. This event was attended by about 75 people from industry and research. Due to its technical experience, broad offer of services and the involvement in the EUROPRACTICE system of services, IMT is an ideal partner for the innovative SMEs. At the same event, Mr. Daniel Cosnita (GTZ) anticipated the launching of the Romanian-German Centre for Micro- and Nanotechnologies (actually taking place on 15th of February 2006), by explaining the advantages of this bilateral partnership (see the figure 2).

Fig 5. Day of "open gates", 15th of December, 2005, Exhibition hall

Fig 3. Visit of Chinese Delegation in November 2005

A visit of a Chinese delegation is also illustrated in figure 3.

The promotion of the park continued on 15th of December, 2005, during the "day of open gates". On this occasion, the lecture hall of the MINATECH-RO park was officially used for the first time (see the figure 4) for the presentation of technical and logistical capabilities of IMT used for technological transfer and services. The participants visited the exhibition space (see the figure 5), which will be also used by the residents in the park. They also visited the main laboratories and the technological area.

Contact: MINATECH-RO (www.minatech.ro); E-mail: **team@minatech.ro**
Main location: National Institute for R&D in Microtechnologies, 32 B Erou Iancu Street, Bucharest.

"Integrated Research Network Devoted to Nanobiotechnology for Health - Romanian Nanomedicine Network" RO-NANOMED , http://www.imt.ro/ro-nanomed

The ***RO-NANOMED*** project is devoted to the creation and development of an integrated research network in the field of nanobiotechnology for health. This network is targeting integration into the European Technology Platform (ETP) "NanoMedicine".

IMT-Bucharest (Prof. Dan Dascalu) was nominated as contact point of the mirror group for the European Technology Platform (ETP) "NanoMedicine" (each country may have a national representative, acting as a contact point). IMT has created an interest group - "Nanomedicine" Romania - with 71 participants: 25 participants from 10 National R&D Institutes, 5 participants from 3 R&D Institutes of the Romanian Academy, 3 participants from 3 R&D Institutes, 28 participants from 15 Universities, 6 participants from 6 SMEs, 4 participants from 4 Hospitals. The contact address is nanobio@imt.ro.

RO-NANOMED PARTNERS:
Project Coordinator: *National Institute for R&D in Microtechnologies (IMT-Bucharest)*; Contact person: **Prof. Dan Dascalu (dascalu@imt.ro)**
P2: *National Institute for Lasers, Plasma and Radiation Physics, Bucharest (INCDFLPR)*; Contact person: Prof. **Dr. Ion N. Mihailescu (ion.mihailescu@inflpr.ro)**
P3: *Institute for Macromolecular Chemistry "Petru Poni"*, Iasi; Contact person: **Dr. Gabrielle Charlotte Chitanu (chita@icmpp.ro)**
P4: *Institute of Biochemistry of the Romanian Academy*; Contact person: **Dr. Stefana Petrescu (stefana@biochim.ro)**
P5: *National Institute for Chemical-Pharmaceutical R&D (ICF)*; Contact person: **Dr. Biochim. Mihaela Albulescu (mihaela@ncpri.ro)**
P6: *R&D National Institute for Nonferrous and Rare Metals (IMNR)*; Contact person: **Dr. Ing. Radu Robert Piticescu (rpiticescu@imnr.ro)**
P7: *Institute of Biology of the Romanian Academy*; Contact person: **Dr. Lucia Dumitru (lucia.dumitru@ibiol.ro)**
P8: *University of Bucharest*; Contact person: **Dr. Marieta Costache (costache@bio.bio.unibuc.ro)**
P9: *Medical-Military Research Centre*; Contact person: **Dr.ing.chim. Lavinia Hinescu (lhinescu@yahoo.com)**
P10: *"Victor Babes" University of Medicine and Pharmacy, Timisoara*; Contact person: **Dr. Gabriela Tanasie (gtanasie@umft.ro)**
P11: *"Victor Babes" National Institute of Research and Development in Pathology and Biomedical Sciences, Bucharest*; Contact person: **Medic Primar-Doctor in Stiinte Medicale Cristiana Tanase (bioch@vbabes.ro)**
P12: *National Institute for R&D in Electrical Engineering*; Contact person: **CP II Nicolae Verga; CPIII Drd. Teodora Malaeru (teodora_malaeru@yahoo.com)**
P13: *National Institute for R&D in Technical Physics, Iasi*; Contact person: **Prof. Dr. Horia Chiriac (hchiriac@phys-iasi.ro)**

ASSOCIATED PARTNERS: **PA 14**: *University of Medicine and Pharmacy Iasi ; PA 15: University "Politehnica" of Bucharest;* ***PA 16:*** *Emergency Hospital Iasi, Plastic and Reconstructive Surgery Clinic;* ***PA17:*** *Emergency Hospital Bucharest, Orthopaedic Clinic ;* ***PA18:*** *University of Agricultural Science and Veterinary Medicine Cluj-Napoca*

The project consortium involves all 9 partners collaborating previously in a network of centres of excellence (the Virtual Centre of Research for Nano-biotechnology called CENOBITE). The focus of this very successful CENOBITE has been already on biomedical applications (with significant multi-disciplinary scientific results), and the present RO-NANOMED is a natural continuation and extension of the previous network.

OBJECTIVES:
1. Creating a Romanian research network in nano-biotechnology for health, which is continuing and amplifying the previous activity of the CENOBITE network (2002-2004).
2. Focusing the research on the domains targeted by the ETP Nanomedicine. This will be achieved by financing 14 "research mini-projects", devoted precisely to the three domains of the ETP NanoMedicine (i.e. regenerative medicine, targeted drug-delivery, nano-diagnostics).
3. Creating a physical platform of research integration through NANOBIOLAB, a laboratory implemented in the technological area of IMT-Bucharest, part of MINATECH-RO (The Scientific and Technological Park in Micro and Nanotechnologies).
4. Providing intensive networking at national level, by extending the network with new partners (including companies, NGOs etc.)
5. Promoting durable integration of national activities in the European Technology Platform. The previous experience of the common work, as well as the focus on the main scientific topics in Nanomedicine will facilitate European cooperation.

Services offered by RO-NANOMED partners inside the network. **IMT-Bucharest** offer access to: • equipments
• facilities for micro-nanofabrication: the only clean room class 100 in Romania, offering conditions for controlled temperature and humidity; services for silicon, glass and quartz micromachining.
• laboratories for simulation and computer aided design for Microsystems and micro-nanostructures (COVENTOR and CADENCE and Mentor Graphics)
• characterization equipment
• education and training through the International Centre for Education and Training in Micro and Nanotechnology (ICETMNT)
Institute of Macromolecular Chemistry "Petru Poni", Iasi:
• Training activities on specific equipments, training during different courses and summer schools
• Dissemination during various events
• Access to equipments
• Consultancy
Institute of Biochemistry of the Romanian Academy:
• Access to equipments
• Consultancy: for biocompatibility tests of different materials; for evaluating the nanomaterials applications
R&D National Institute for Nonferrous and Rare Metals:
• Access to equipments
• Assistance for the following activities: Functionalized nanoparticles synthesis by sol-gel and hydrothermal processes; Thin films obtaining by hydrothermal-electro-chemical and electrophoresis techniques; Obtaining of compact sintered layers; Methods for complete chemical analysis;
• Training and educational activities
• Dissemination and protection of property rights, promotion participation to international and European projects by collaborating with CTT AVANMAT and CTT Baneasa
"Victor-Babes" University of Medicine and Pharmacy Timisoara: • Offers educational program at European level to Romanian or foreign PhD students.
• Will develop a program for biomedical research, according to European standards and educational and research programs, assuring also competent clinical services.

New equipments in IMT-Bucharest acquired through RO-NANOMED

GeneTAC UC4 Microarray Scanner - this equipment will be used for reading the chips, acting as a pair of the nano-plotter, for DNA detecting and deposition. The Microarray Scanner offers high resolution scanning across the entire surface of standard microarray substrates. This two-colour system includes green (532nm) and red (635nm) lasers coupled with high performance optics optimized to maximize collection of fluorescence signal while minimizing the damage caused by photobleaching.

GeneMachines OmniGrid Micro - Nano-Plotter, allowing bio-chips development; dispersing of adhesives and liquid crystals; analysis of adherent cells or tissue slices, for nanobiotechnology projects as lab on chip, biochips. The equipment has a print speed of 10,000 spots/11 slides in less than 3.5 hr with optional split pin. A Control Computer assures the utilization interface.

Contact: **Prof. Dan Dascalu** (dascalu@imt.ro); **Eng. Claudia Roman** (claudiae@imt.ro) , IMT-Bucharest, Romania

"Network of scientific services for nano-scale structuring and characterization, with applications in the development of convergent technologies" NANOSCALE-CONV, http://www.imt.ro/nanoscaleconv

The main goal of the project proposed by 11 partners, from national research institutes and universities, spread all over the country and with an interdisciplinary expertise is the realization of a critical mass at national level, to spread excellence, overcome fragmentation, creating a long term national integration in the structured and characterization domain at nanometer scale, in order to advance knowledge-based research and to create a knowledge-based society in convergent nano technologies (micro-nano-bio technologies) for becoming competitive at European level and also to enhance the potential of Romanian production companies.

The consortium will use in common the existent and the new infrastructure, the characterization and manufacturing equipments, often quite costly and the complementary scientific competences.

The partners from the consortium will use in common the existent infrastructure and the new infrastructure, the characterization and manufacturing equipments, often quite costly and the complementary scientific competences, realizing a national network.

NANOSCALE-CONV PARTNERS:

Project Coordinator: *National Institute for R&D in Microtechnologies (IMT-Bucharest);* Contact person: **Dr. Raluca Muller (ralucam@imt.ro)**

P2: *Institute for Macromolecular Chemistry "Petru Poni",* Iasi; Contact person: **Dr. Daniel Timpu (dtimpu@icmpp.ro)**

P3: *National Institute for Lasers, Plasma and Radiation Physics, Bucharest (INCDFLPR)*; Contact person: Prof. **Dr. Ion Morjan (ion.morjan@inflpr.ro)**

P4: *National Institute for R&D in Materials Physics,*; Contact person: **Dr. Magdalena Ciurea (ciurea@infim.ro)**

P5: *National Institute for R&D in Electrical Engineering*; Contact person: **Dr. Jenica Neamtu (jenica_neamtu@icpe-ca.ro)**

P6: *"Ovidius" University Constanta;* Contact person: **Prof. Victor Ciupina (vciupina@univ-ovidius.ro)**

P7: *Politechnica University Bucharest;* Contact person: **Prof. Gheorghe Stanciu (stanciu@physics.pub.ro)**

P8: *National institute for R&D of Isotopic and Molecular Technologies, Cluj;* Contact person: **Prof. Liviu Giurgiu (giurgiu@s3.itim-cj.ro)**

P9: *Institute for Nuclear Research*; Contact person: **Dr. Victor Andrei (andvic12@yahoo.com)**

P10: *R&D National Institute for Nonferrous and Rare Metals (IMNR)*; Contact person: **Dr. Ing. Radu Robert Piticescu (rpiticescu@imnr.ro)**

P11: *Chemical Institute of Romanian Academy, Timisoara*; Contact person: **Dr. Cecilia Savii (cecilias@acad-icht.tm.edu.ro)**

The **general objects** of the project are:

- common use at the network level of the equipments; new innovative research
- inventory of characterization/existent resources equipments,
- acquisition of a new equipment, that would reflect the state of the art, for research at nanometer scale, equipment that will be located in clean room of IMT Bucharest, all partners of the network having access to it
- realization a web page and data base
- working point for different partners in IMT technological area
- common research activities oriented to developing demonstrators of nanodevices
- experimentations of nanolithography on different materials elaborated by partners
- realizations of nano devices, utilizing the nanolithography equipment
- identification of solutions for the convergence of technologies used by consortium members
- elaboration and realization of a program for education
- dissemination of obtained results and excellence
- establishing an offer of complex services
- increasing number of common projects of partners at national an international level,

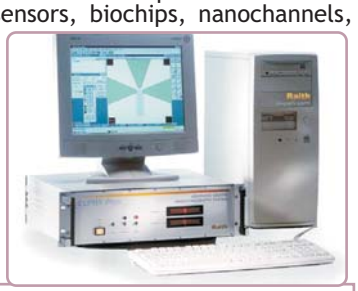
The successful achievement of this project is possible as well due to the fact that some of the partners have also cooperate in other national networks. The network core will be composed of the partners involved in **MINAMAT-NET** - (Network of Laboratories for Characterization of Materials and Microstructures for micro and nanoengineering), supported by **MATNANTECH Program** in 2001-2004 and of some of the partners involved in **NANOMATFAB, 3N** etc networks.

In addition, the network could be coupled to the following international projects in FP6: NnaofunPoly, 4M, INTEGRAM+ (priority 2), in which IMT is partner, ensuring the success of the project also by means of access to equipments and know-how. The network coordinator - IMT possesses a clean room (mask fabrication facilities, etc), which allows performing multidisciplinary research, experimenting of non-standard technologies, based on a large variety of nanomaterials which will be used in nanodevice demonstrator structures.

The acquisition of a versatile and expensive, high performance equipment, not available elsewhere in the country, composed by a high-resolution SEM and an EBL will contribute to the success of the project, being of major importance in the developing of novel and state-of- the-art nanodevices and opening the way to new research at European level, allowing the integration of Romanian institutes and companies in ERA.

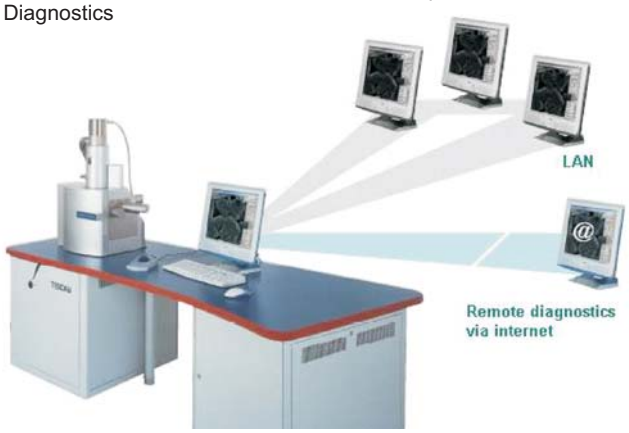
New equipments in IMT-Bucharest acquired through NANOSCALE-CONV

TESCAN VEGA 5136 LM and ELPHY Plus - Nanolithography equipment, is a dedicated tool for nanolithography, offering a resolution in the range of nanometers. Nanolithography is a strong challenge for all researchers and engineers involved in nanotechnology. Future applications are expected as: nano-structures for bio and chemosensors, biochips, nanochannels, resonant nanocantilevers.



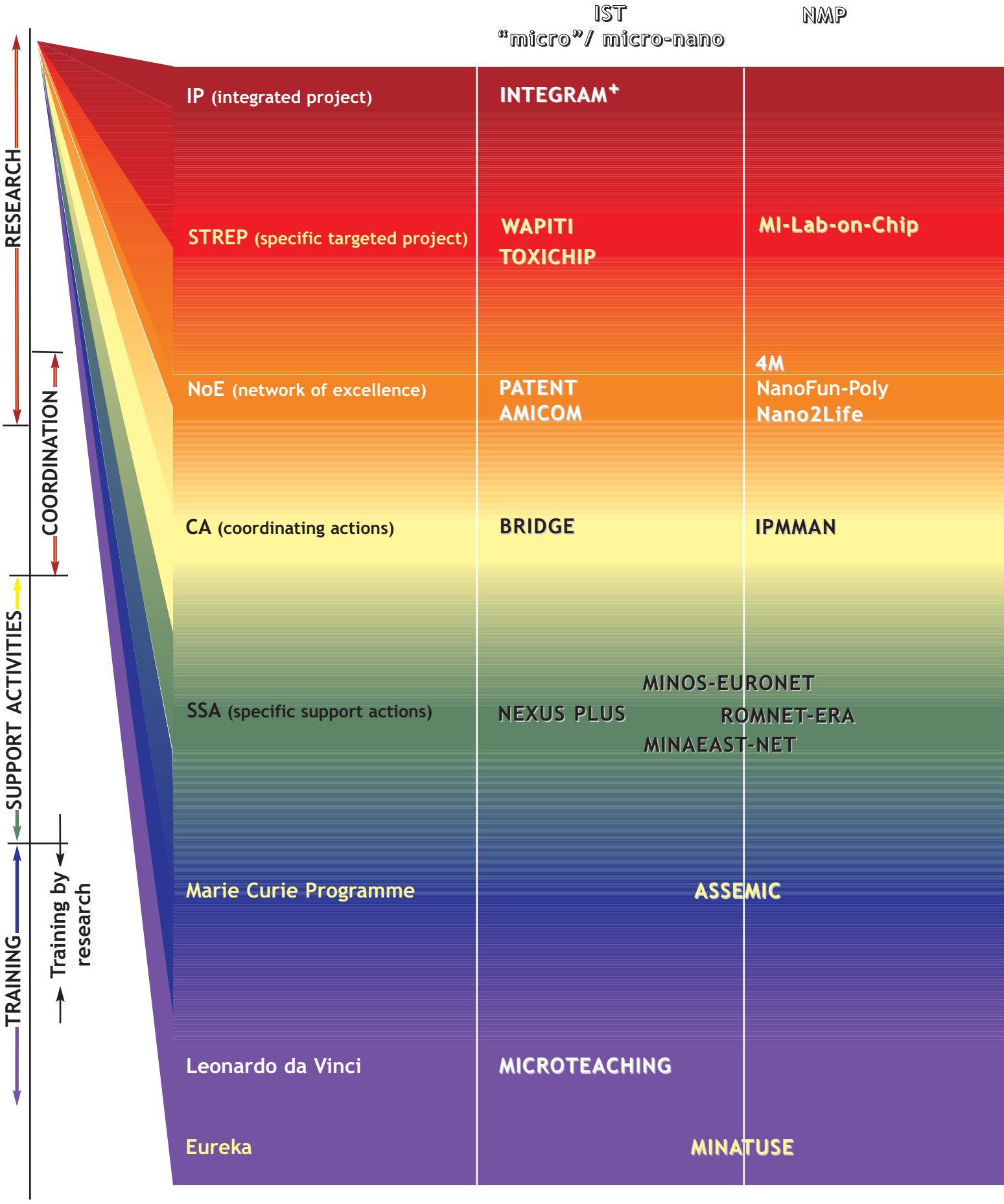
ELPHY Plus – Advanced SEM System for Nanolitography

Network TESCAN VEGA 5136 LM SEM Operations and Remote Diagnostics



Contact: **Prof. Dan Dascalu (dascalu@imt.ro)**; **Dr. Raluca Muller (ralucam@imt.ro)**, IMT-Bucharest, Romania

IMT-Bucharest participation in EU Programmes



IMT-Bucharest participation in EU programmes spans a number of instruments on two FP6 priorities (2005-2006). In 2005 IMT also participated to **MST-Design** and **REASON** (IST in FP5)

Details about participation of IMT in European projects

• *Multi-domain platforms for integrated micro-nano technology systems – Service Action* (**INTERGRAMplus**), **IP**, Priority 2 - **IST**, Contract no.: 027540 (2005-2007), **Coordinator: QinetiQ Ltd**, UK. IMT position: partner; Contact person for IMT: **PHD. Carmen Moldovan** (**cmoldovan@imt.ro**)

• *Waferbonding and Active Passive Integration Technology and Implementation* (**WAPITI**), **STREP**, Priority 2 -**IST**, Contract no: 004073 507352 (2004-2007). **Coordinator: Prof. Helmut Heidrich**, Fraunhofer Institute for Telecommunications, Heinrich Hertz-Institut (FhG/HHI), Germany; IMT position: partner; Contact person for IMT: **PHD. Dana Cristea** (**danac@imt.ro**)

• *Development of a toxin screening multi-parameter on-line biochip system* (**ToxiChip**), **STREP**, Priority 2 -**IST**, Contract Number: 027900 (2006-2009), **Coordinator: Dr. Terri Wood, University College Cork - National University of Ireland**. IMT position: partner; Contact person for IMT: **PHD. Carmen Moldovan** (**cmoldovan@imt.ro**)

• Lab-On-A-Chip Implementation of Production Processes for New Molecular Imaging Agents (**MI-lab-on-chip**), **STREP**, Priority 3 -**NMP**, Contract no: 516984 (2005-2007). **Coordinator: Dr. Jean-Luc MorelleTRASIS SA, Liege, Belgium;** 5 partners involved. IMT position: partner; Contact person for IMT: **PHD. Student Oana Nedelcu** (**oanan@imt.ro**).

• *Design for Micro & Nano Manufacture* (**PATENT**), **NoE**, Priority 2 -**IST**, Contract no.: 507255 (2004-2007), **Coordinator: Andrew Richardson, University of Lancaster**, UK. IMT position in the project – Core Partner; Contact person for IMT: **Prof. Dan Dascalu** (**dascalu@imt.ro**).

• Advanced MEMS for RF and Millimeter Wave Communications (**AMICOM**), **NoE**, Priority 2 -**IST**, Contract no: 507352 (2004-2006), **Coordinator: Prof. R. Plana, LAAS_CNRS Toulouse,** France; 22 partners. IMT position: partner; Contact person for IMT: **PHD. A. Muller** (**alexm@imt.ro**)

• *Multi-Material Micro Manufacture: Technologies and Applications* (**4M**), **NoE**, Priority 3 -**NMP**; Contract number: NMP2-CT-2004-500274 (01.10.2004 – 30.09.2008). **Coordinator: PHD. Stefan Dimov,** Cardiff University, UK, IMT position: Partner; Contact person for IMT: **PHD. Carmen Moldovan** (**cmoldovan@imt.ro**)

• *Nanostructured and Functional Polymer-Based Materials and Nanocomposites* (**NANOFUN-POLY**), **NoE**, (2003-2007), Priority 3 -**NMP**, **Coordinator: Prof. José M. Kenny**, **Italian Consortium for Science and Technology of Materials (INSTM),** Italy; Contact person: **PHD. Irina Kleps** (**irinak@imt.ro**).

• *A network for bringing NANOtechnologies TO LIFE* (**Nano2Life**), **NoE**, (2003-2007), Priority 3 -**NMP**, **Coordinator: Dr. Patrick Boisseau, CEA** France. IMT position: Associated Partner; Contact person for IMT: **Prof. Dan Dascalu** (**dascalu@imt.ro**).

• *EUROPRACTICE - coordination of proactive NAS interaction and an awareness dissemination and exploitation bridge* (**BRIDGE**), **CA**, Priority 2 -**IST**, Contract number: 507307, (2004-2005), **Coordinator: Rutherford Appleton Laboratory, Oxfordshire,** UK, IMT position: subcontractor; Contact person in Romania for IMT: **PHD. Carmen Moldovan** (**cmoldovan@imt.ro**)

• *Improvement of industrial Production Integrating Macro, Micro And Nanotechnologies for more flexible and efficient manufacturing* (**IPMMAN**), **CA,** Priority 3 - **NMP**. **Coordinator PHD. Ana Almansa, A.R.C. Seibersdorf Research GmbH**, Austria. Contact person for IMT: **Dr Raluca Muller** (**ralucam@imt.ro**).

• *MIcro-NanOSystems EUROpean NETwork pursuing the integration of NMS and ACC in ERA* (**MINOS-EURONET**), **SSA**, Priority 2 -**IST**, Contract no: 015704 (2005-2007), **Coordinator: National Institute for R&D in Microtechnologies (IMT-Bucharest)**; 17 partners. Coordonator: **Prof. Dan Dascalu** (**dascalu@imt.ro**).

• *Micro and Nanotechnologies going to EAESTern Europe through NETworking* (**MINAEAST-NET**), **SSA-General**, Contract no: 510470 (2004-2006), **Coordinator: National Institute for R&D in Microtechnologies (IMT-Bucharest)**; 12 partners. Coordonator: **Prof. Dan Dascalu** (**dascalu@imt.ro**).

• *NEXUS - Supporting IP's and NOE's ensuring SME representation and introducing NAS partners* (**NEXUSPLUS**), **SSA**, Priority 2 -**IST**, Contract number: 507293 (2004-2007), IMT position: subcontractor; Contact person for IMT: **PHD. Carmen Moldovan** (**cmoldovan@imt.ro**)

• *ROManian Inventory and NETworking for Integration in ERA* (**ROMNET-ERA**), **SSA-General**, Contract no: 510475 (2004-2006), **Coordinator: National Institute for R&D in Microtechnologies (IMT-Bucharest)**; 5 partners. Coordonator: **Prof. Dan Dascalu** (**dascalu@imt.ro**).

• *Advanced Handling and Assembly in Microtechnology* (**ASSEMIC**), **Marie Curie Research Training Network**, Contract: 504826 (2004-2007), **Coordinator: Prof. Dr. Werner Brenner from Institute of Sensors and Actuators Systems, Vienna Univesity of Technology-ISAS**; IMT position: partner; Contact person for IMT: **PHD. Raluca Muller** (**ralucam@imt.ro**)

• *New teaching and learning methods and basic qualifications in job education* (***Microteaching***), **LEONARDO DA VINCI** Project, Priority 2 - **IST**, Contract number: 146157 (2004-2007), **Coordinator: Zentrum für Lern- und Wissensmanagement und Lehrstuhl Informatik im Maschinenbau (ZLW/IMA) der RWTH Aachen,** Germany. Contact person for IMT: **PHD. Raluca Muller** (**ralucam@imt.ro**).

• *Micro-Nano Technology Use by SMEs*, (**MiNATUSE**), **EUREKA** Project, (2005-2011), **Coordinator: CEA / LETI Grenoble**, Contact person for IMT: **PHD. Ileana Cernica** (**ileanac@imt.ro**)

• *Research and Training Action for System on Chip Design* (**REASON**), **FP5 – IST,** Contract no. IST-2000-30193, (2002-2005), 22 partners, **Coordinated by Prof. Wieslaw Kuzmicz, Warsaw University of Technology**, Poland. IMT position: subcontractor. Contact person for IMT: **PHD.. Carmen Moldovan**.

• **MST-Design**, **FP5 – IST**, Contract no. IST-2001-33393, 2003-2005, 6 partners, **Coordinator: European Technology for Business Ltd.**, UK. IMT position: participant. Contact person for IMT: **Prof. Dan Dascalu**.

Under the nano-link Initiative: www.nano-link.net, IMT is coordinating three SSA (specific support action)-type projects in FP6 - *financed by the European Commission*. They are mainly devoted to networking in micro- and nanotechnologies. These projects are MINOS-EURONET (2005-2008), MINAEAST-NET (2004-2006) and ROMNET-ERA (2004-2006).

MINOS-EURONET, Contract no. **015704. Web page: www.minos-euro.net.**
MIcro-NanOSystems EUROpean NETwork pursuing the integration of NMS and ACC in ERA (June 2005-May 2008).

The specific feature of this project is given by the presence in the project consortium of ***eight coordinators of big FP6 projects***. 5 NoEs (GOSPEL, PATENT-DfMM, AMICOM, 4M, Nano2Life) and 2 IPs (GOOD FOOD, HEALTHY AIMS) are involved. These projects are representing a very powerful cluster, providing a unique pool of potential connections for the human resources in NMS and ACC.

This project is financed under an IST call, with the strategic objective of integrating the scientists from NMS and ACC (i.e. Eastern Europe). The project will use most of its financial resources for promotion of NMS and ACC competencies, creating databases, organising events in Eastern Europe, but also visits at Western institutes and universities. A key issue is the ***dissemination and utilization of information***. The project takes into account: ***targets groups*** and how the participants are identified and approached; the ***appropriate message*** (matching both the purpose and the peculiar characteristics of the group); ***adequate and complementary communication channel***; ***monitoring the dissemination*** and ***providing feedback*** for corrective measures. ***Dissemination*** is done through the web page, interactive databases, the **e-newsletter** and **e-flash news** (common issues MINAEAST-NET and MINOS-EURONET), a Web-based Magazine, **articles** printed in MNT Bulletin. All information is available on www.minos-euro.net.

Three international Forums on relevant strategic fields for NMS / ACC will be organised under MINOS-EURONET. All the major actors will be invited: from policy makers, industrial, academic and research organizations. Three editions of the **"Microsystems as a platform for integrating technologies" Conference** will be organised, in Romania, Poland and Lithuania. This conference will select the best results in micro-nanosystems from NMS and ACC.

Contact address **MINOS-EURONET team**: minos@nano-link.net. Project coordinator: Dan Dascalu (dascalu@nano-link.net). IMPORTANT: The consortium is seeking collaboration with other European or national networks in the same field.

MINAEAST-NET, Contract no. **510470. Web page: www.minaeast.net**
MIcro and NAnotechnologies going EASTern Europe through Networking (May 2004-October 2006).

The main objective of the MINAEAST-NET project is networking on micro and nano-technologies, according to the priority thematic areas 2 (IST) and 3 (NMP) from FP 6.

MINAEAST-NET was intended to be a tool for achieving a better integration of eight ACCs (Romania, Hungary, Poland, Slovenia, Slovakia, Lithuania, Bulgaria and Turkey), in projects for FP6 on Micro and Nano Technologies. MINAEAST-NET should be the **premier source of information about resources and results in MNT** from ACCs and about the strong points of the ACC organisations. Organisations and companies from MS (and world-wide) that are looking for partners in MNT for any kind of projects, should address their needs to MINAEAST-NET and **MINAEAST-NET will definitely find the best partner suited for them**. This activity is mainly addressed to FP 6 projects, but also to any other kind of cooperation in research or commercial activities. For all MNT interested organisations from ACC, MINAEAST-NET should be the **main source of MNT specific project and partnership information**: MNT related information about EC calls, international networking activities, partnership search from abroad.

MINAEAST-NET will support interaction between ACC and MS organisations **to initiate FP6 proposals** through organising meetings, workshops and support travel cost. ***Individual grants***: for training visits or participation to training events in MS (Western Europe) and for participation to meetings (brokerage, proposal preparations). Info available on web site. MINAEAST-NET workshops have been successfully organised in Berlin, Athens, Grenoble by the three Western partners. Dissemination is done through the web-page, databases, e-newsletter, articles published in MNT Bulletin, MST News.

Contact address **MINAEAST-NET team**: net@imt.ro. Project coordinator: **Dan Dascalu** (dascalu@imt.ro).

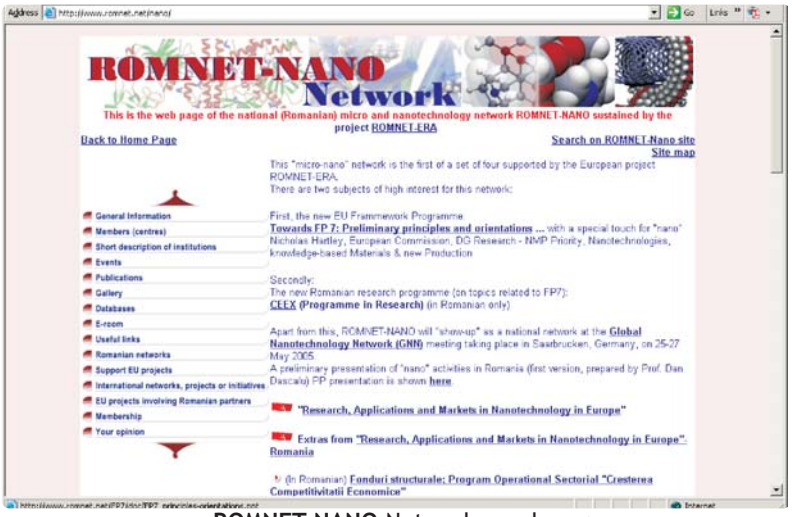
ROMNET-ERA Contract no. **510475. Web page: www.romnet.net**
ROManian Inventory and NETworking for integration in ERA (January 2004-December 2006).

The ROMNET- ERA project addresses three strategic objectives of the ACC SSA General call with the main emphasis on ***networking the high quality centers of research***. The activities con**centrate on Romania**, preparing its integration in ERA. **Restructuring for integration in ERA will be the only realistic chance of the Romanian research to become competitive**. The consortium putting forward this project has the competence and the authority to address the local scientific community.

The important target groups at the national level are: *high-quality research centers, and innovative SMEs*. Identifying, **screening and networking of research groups** (from three separate research systems: national R&D institutes, University research centers, Research units of the Romanian Academy) will be focused on some **priorities of FP 6, catalyzing the participation to EU projects**.

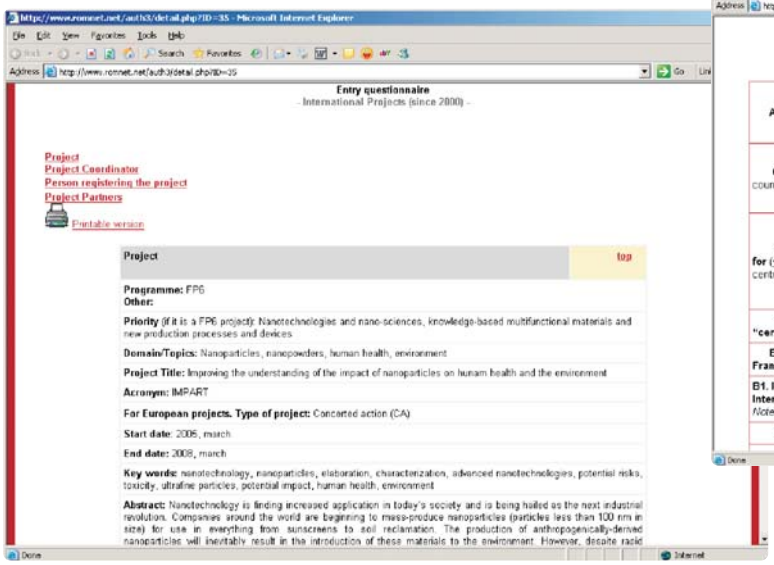
The emphasis is on new materials and new technologies and their implications on the quality of life. Advanced software techniques and the **experience of one EU partner in knowledge management** will increase the efficiency of networking at the national level and make it attractive for interaction at the regional and at the European level. Considerable success was achieved in establishing ROMNET-NANO, a network for exchanging information in micro-nanotechnologies (**www.romnet.net/nano**). The photo nearby presents Dr. Renzo Tomellini, Head of unit Nanotechnologies, Directorate Industrial technologies, DG Research presenting the perspective of the nanotechnology domain at the Info-day taking place at the Romanian Academy, on 17th of January, 2005.

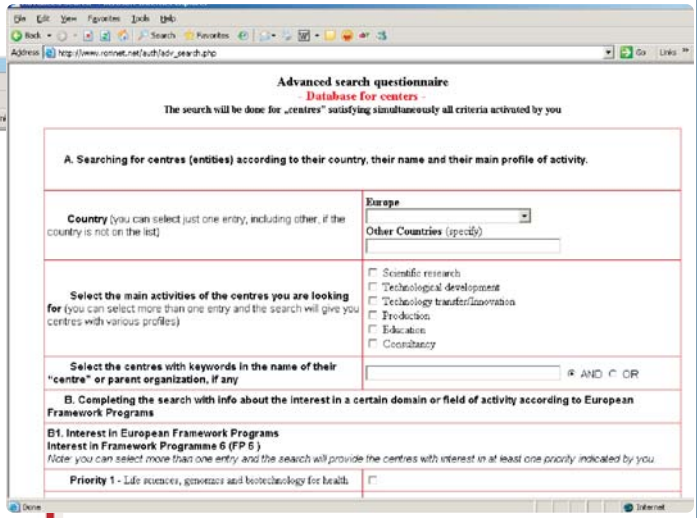
Support Activities: ***Online Databases***: Databases of **Research Centres** (independent or autonomous entities from the scientific point of view, i.e. labs from universities and even institutes), **International research projects**, **Specialists and Networks**. These databases are common for all SSA projects mentioned in this Report, but it was developed in the frame of the ROMNET-ERA project. **Dissemination** through: **web page, e-newsletter and flash news**. The e-newsletter contents: research news, conference, workshops, courses, schools, calls for research projects, books, etc (titles and very short abstracts). **Micro and Nanotechnologies Bulletin**. A special issue was dedicated to Romanian research centres active in the field of micro and nanotechnologies (December 2005).



ROMNET-NANO Network - web page

International research projects - view entry





Advanced search in **Research Centres** database

Contact **ROMNET-ERA Team**: **romnet@imt.ro**. Project coordinator: **Dan Dascalu** (**dascalu@imt.ro**).

2005 International Semiconductor Conference

CAS 2005 - IEEE event organized by IMT-Bucharest

The **2005 International Semiconductor Conference (CAS 2005)** was organized at the beginning of October was the 28th of an annual sequence and the 15th edition with international participation. Starting with 1995, the conference has been **an IEEE event, being sponsored by the IEEE Electron Devices Society.** The conference was also sponsored by ***Ministry for Education and Research***, the IEEE - Romania Section and the Electron Devices Chapter and also held under the aegis of the ***Romanian Academy*** as well as under aegis of the Electrochemical Society, Inc., including the European Local Section of the Electrochemical Society, Inc. The conference has a web page (**www.imt.ro/cas**) and every year launch a Call for papers with specific topics.

The Conference profile has been gradually extended from semiconductor device physics and technology **to micro- and nano-technologies.**

The main topics from 2005 – and also for the next CAS 2006 were: Nanoscience and nanoengineering; Micro and nano-technologies for biomedical and environmental applications; Novel materials and intelligent materials; Microoptics and microphotonics; Micromachined devices and circuits for microwave and millimeter wave applications; Micro and nanotechnologies for transducers, interfaces and microsystems; Power devices and microelectronics (including CAD).

In 2005 ***6 invited speakers*** *from Greece, Ireland, Singapore, and United Kingdom were present at CAS.*

G.A.J. Amaratunga, Cambridge University presenting the invited paper "NANOTUBE AND NANOWIRE TRANSISTORS"

M.P. Larsson, Imperial College London, presenting the invited paper "GROWTH OF C60AT's NANOWHISKERS FOR QUIET MILLIMETRE-WAVE DETECTORS"

Mircea Modreanu, Tyndall National Institute, Cork presenting the invited paper "OPTICAL AND MICRO- STRUCTURAL CHARACTERIZATION OF FUNCTIONAL METAL OXIDES"

CAS 2005 (3-5 October 2005) displayed **a total number of 107 papers** (101 regular and 6 invited) structured in oral sessions, with 53 presentations, and poster sessions with 48 presentations. The authors were from 25 countries on 3 continents: Europe (19 countries), America and Asia. The participation was at the level of 123 people from research and industry.

Two satellite events were organized in connection with CAS 2005 by the **networks of excellence AMICOM and 4M**:

• **2nd AMICOM Summer School** (28 September - 1 October), was organized by *FP6 NoE "Advanced MEMS for RF and Millimeter Wave Communications-AMICOM"* (**http://www.amicom.info**) during three and a half days. Topics: "Introduction in RF, for those from a processing background", "Introduction to Processing, for those from an RF background" and "Vision for the future". 39 participants representing 18 partners from 10 countries were present. 19 tutorials given by 14 speakers were presented.

• **Micro and nanotechnologies and Multifunctional Materials for Life quality and Industry applications Workshop** (29-30 September), was organized by FP6 NoE "Multi Material Micro Manufacture: Technology and Applications-4M" (**http://www.4m-net.org**). 41 participants from 6 countries were at the workshop and 16 scientific communications were presented.

In 2006 the conference will be held between 27th September and 29th September. May 28th is the deadline for submission of contributed and invited papers.

Retrospective

In 2003 the CAS Conference was part of the "Micro and Nanotechnologies Decade" (September 28 – October 7, 2003) containing many scientific events. The decade started with the ***EURONET workshop "European networking in micro- and nanotechnologies as bridge between West and East"*** organized in cooperation with the *Romanian Consortium for Nanoscience and Nanotechnology and supported by the European Commission*. Representatives of the European Commission presented problems related to the first call of FP 6, priorities 2 and 3. Coordinators of several Networks of Excellence, financed by the Commission, in the field of micro- and nanotechnologies makes general overviews of the NoE's. As a closing decade event (5-7 October 2003) ***the first "Nanoforum Workshop: Nanomaterials and Applications"*** took place.

At **CAS 2004 "Microphotonics"** session was **a joint session with the WAPITI Project** (STREP/FP6 - **ftp://ftp.hhi.de/wapiti/index.html**) - Waferbonding and Active Passive Integration Technology and Implementation.

Just after the closing of CAS 2004 took place the **PATENT workshop**, organized by the **Reliability Cluster of the NoE "Design for Micro & Nano Manufacturing - PATENT-DfMM"** (IST/FP6 - **http://www.patent-dfmm.org/**) including a scientific session with contributions from members of the Reliability Cluster; topics on MEMS: failure modes, test structures, reliability testing, design rules.

At the "silver jubilee" of CAS in 2002, the interest in microtechnologies was enhanced by coupling the Conference with the **MicroMechanics Europe Workshop (MME'02)**, held for the first time in Eastern Europe.

The interest in microtransducers and microsystems has been illustrated a number of **NEXUS (Network of Excellence for Multifunctional Microsystems)**, NEXUSEAST and NEXUS-PAN events held at CAS editions taking place in 1995, 1998, 1999 and 2000.

The MEMSWAVE workshop

The Inco-Copernicus Project 977131 "Micromachined Circuits for Microwave and Millimeter Wave Application" - MEMSWAVE- was coordinated by IMT Bucharest and has connected nine different Western and Central Eastern European groups.

The workshops organized in 1999 and 2001 in conjunction with the CAS conferences were open events to the groups working in RFMEMS.

The high interest generated by the first workshops, has determined for them a future independent and itinerant existence. Being now an itinerant European event, the third edition (2002) of this workshop was organized at FORTH Heraklion, the forth edition (2003) took place at LAAS Toulouse, the fifth (2004) at Uppsala University and the six edition (2005) took place at EPFL Lausanne.

Continuing the tradition, the extended version of most interesting papers which have been presented at the MEMSWAVE workshops were published in the series Micro and Nanoengineering of the Romanian Academy Printing House in 2003, 2004 and 2005. The volumes were launched at the beginning of the next edition of the workshop.

In 2006, the MEMSWAVE workshop will be held at Orvieto, Italy, June 29 -30 and will be organized by Perugia University (**http://www.memswve2006.org**).

IMT: Papers and patents 2005

Papers published in periodicals ISI ranked

1. ***"Structural and Optical Characterization of AlN Films Grown by Pulsed Laser Deposition"***, C. Ristoscu, C. Ducu, G. Socol, F. Craciunoiu, I.N. Mihailescu, Appl. Surface Science, Vol. 248, pp. 411-415.

2. ***"Experimental Characterization of 38 GHz Micromachined GaAs Receiver"***, G. Bartolucci, D. Neculoiu, R. Marcelli, M. Dragoman, Electronics Letters, Vol. 41, No.5, pp .256-257.

3. ***"Millimeter Wave Passive Circuits Elements Based on GaAs Micromachining"***, A. Pantazis, D. Neculoiu, Z. Hazoupulos, D. Vasilache, M. Lagas, M. Dragoman, C. Buiculescu, I. Petrini, A. A. Muller, G. Konstantinidis, A. Muller, Journal of Micromech. Microeng, Vol.15, pp. S-53-S-59.

4. ***"Dry Followed by Wetbackside Etching Processes for Micromachined Endfire Antennae"***, M. Saadaoui, P. Pons, R. Plana, L. Bary, P. Dureuil, D. Bourrier, D. Vasileche, D. Neculoiu, A. Müller, Journal of Micromech. Microeng, Vol.15, No.7, pp. S-65-S-71.

5. ***"Terahertz Continuous Wave Amplification in Semiconductor Carbon Nanotubes"***, D. Dragoman, M. Dragoman, Physica E, vol.25, No.4, pp. 492-496.

6. ***"Microwave Applications of Carbon Nanotubes"***, M.Dragoman, H.L. Hratnagel, J. Tuovinen, R.Plana, Frequenz, Vol. 59, pp. 251-263.

7. ***"Electrochemical Sensors for Heavy Metals Detection"***, Mihaela Miu, Irina Kleps, Anca Angelescu, Monica Simion, Intern. J Environ. Anal. Chem., Vol. 85, No. 9-11, pp. 675-679.

8. ***"Theoretical Analysis and Experiment Research of a Novel DEP Chip With 3-D Silicon Electrodes"***, L.M. Yu, G.L. Xu, F.E. H. Tay, C. Iliescu, M. Avram, International Journal of Software Engineering and Knowledge Engineering (IJSEKE), April, Vol. 15, No. 2, pp. 231-236.

9. ***"SU-8 Micro-Biosensor Based on Mach-Zehnder Interferometer"***, D. Esinenco, S.D. Psoma, M. Kusko, A. Schneider, R. Muller, Journal of Reviews of Advanced Materials, Russsia Academy of Science, Vol. 10, No. 3, pp. 295-299.

10. ***"Bipolar Magnetic Microsensor for Longitudinal and Transversal Magnetic Fields"***, Marioara Avram, Ciprian Iliescu, Otilia Neagoe, Corneliu Voitincu, Cecilia Codreanu, Sensors & Actuators, ELSEVIER SCIENCE, A 123 – 124, pp. 296 – 302.

11. ***"Theretical Analysis and Experiment of a Novel DEP Chip"***, C. Iliescu, M. Avram, Francis Tay, International Journal of Software Engineering and Knowledge, Vol.15, No.2, pp. 231 – 239.

12. ***"Optimization of Front Surface Texturing Processes for High Efficiency Silicon Solar Cells"***, E. Manea, E. Budianu, M. Purica, D. Cristea, I. Cernica, R. Muller, V. Moagar Poladian, Solar Energy Materials & Solar Cells, Issues 1-4, May, Vol. 87, pp. 423-431.

13. ***"Modeling Tunable Fabry-Perot Surface Micromachined Inteferometer – Experiments and Modeling"***, R. Muller, D. Cristea, C. Tibeica, P. Pons, P. Arguel, D. Syvridis, M. Kusko, Microsystem Technologies, Vol. 12, No. 1-2, pp. 91-97.

14. ***"Polymer Micromachining for Micro- and Nano-Photonics"***, Dana Cristea, Paula Obreja, Mihai Kusko, Elena Manea, Materials Science and Technologies C 2005, http://www.sciencedirect.com/science/journal/09284931.

15. ***"Nanostructured silicon chip as biosensor components"***, M. Miu, A. Angelescu, I. Kleps, S. Petrescu, L. Zdrentu, M. Simion, T. Ignat, Sensors & Actuators, ELSEVIER SCIENCE.

16. ***"Nanoporous silicon matrix used as biomaterial"***, M. Simion, I. Kleps, T. Ignat, A. Angelescu, M. Miu, A. Bragaru, M. Danila, E. Condac, M. Costache, L. Lavu, Journal of Alloys and Compounds.

Papers published in other periodicals

1. ***"Electrochemical Sensors for Heavy Metals Detection in Liquid Media and Pollution Control"***, Mihaela Miu, Anca Angelescu, Irina Kleps, Monica Simion, Journal of Environ. Protection and Ecology, Vol. 6, No. 1, pp. 64-69.

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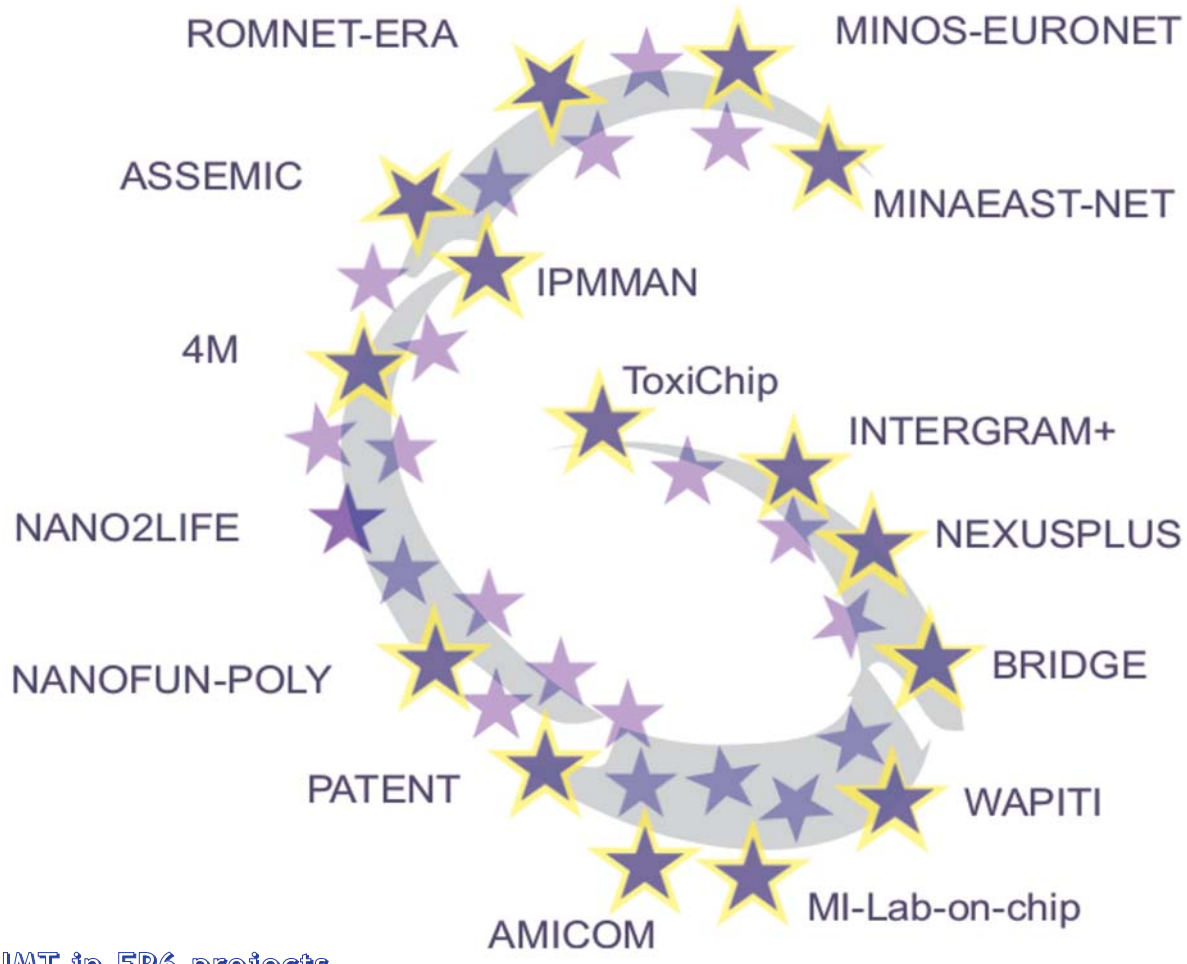

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