Ministry of Education and Research, Romania

National Authority for Scientific Research

IMT - Bucharest

SCIENTIFIC REPORT 2007

National Institute for R&D in Microtechnologies

From micro- and nanotechnologies

to

convergent

technologies

Ministry of Education and Research, Romania
National Authority for Scientific Research

National Institute for Research and Development in Microtechnologies

IMT-Bucharest

SCIENTIFIC REPORT 2007

Research and technological development

Design: Elena Stanila (IMT - Bucharest)

Tables of Contents

Foreword

In contrast with previous scientific reports of IMT- Bucharest (2005, 2006), the Scientific Report 2007 is almost entirely devoted to the presentation of the scientific work of the laboratories, as well as to a list of scientific publications. The European projects at the end of FP6 and the beginning of FP 7 are the same as those presented in the previous report (2006) and they are not longer presented separately. The same is true for the infrastructures for technology transfer and innovation (the Technology Transfer Centre and the Science Park).

In financial terms, the volume of activity of IMT in 2007 continued the rapid increase taking place during the previous three years (2004-2006). The volume of investments was also significant in comparison with the average of the previous three years. Noticeably, at the end of 2007, IMT had on-going 12 projects financing the infrastructure, including 8 new projects in the programme "Capacities" from the new National Plan for Research, Development and Innovation 2007-2013 (usually called National Plan II), more or less mirroring the 7th Framework Programme of the EU (FP7). This campaign of investments shows a good promise for the future experimental capabilities of IMT in the years to come.

In general, IMT-Bucharest started with big success the participation to the National Plan II (results of the first call, 2007), also coordinating no less than 14 R&D projects in the programme "Partnerships", devoted to applied research. These projects just have started at the end of 2007. The report, however, provides plenty of information about a large number of other on-going projects.

Prof. Dan Dascalu
CEO and President of the Board

Dan Dascalu is the General Manager (CEO and President of the Board) of the National Institute for R&D in Microtechnologies (IMT-Bucharest). Prof. Dascalu is the founder (1991) of the Centre for Microtechnology (CMT), then becoming (1993) the Institute of Microtechnology (IMT). The later merged in 1996 with ICCE (an institute of semiconductor electronics) to create the National Institute for Research and Development in Microtechnologies (IMT-Bucharest), having the same director as CMT and IMT. Dan Dascalu is also professor at the "Politehnica" University of Bucharest (PUB), Department of Electronics and Telecommunications and full member (academician) of the Romanian Academy (of Sciences). He is the author of *"Transit-time Effects in Unipolar Solid-State Devices"* and *"Electronic Processes in Unipolar Solid State Devices"* (both published by Abacus Press, Kent, U.K., 1974 and 1977, respectively) as well as of many technical papers published in scientific periodicals or conference proceedings.

Prof. Dan Dascalu is an expert representing Romania in the NMP FP6 and FP7 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. He is a member of the Consultative Board for R&D and President of the Commission for *"New Materials, Micro- and Nanotechnologies"*.

IMT: Brief history and strategy

Brief history: 1993–1996. The Institute for Microtechnologies (IMT) was set up by a decision of the Romanian Government in July 1993, and it was the first institute of this profile from Eastern Europe. The institute was managing the clean room and the CAD centre of "Microelectronica S.A." company, using most of its technical personnel of the enterprise. The existing CMOS technologies have been used by IMT for developing chips for MOS power devices and initiating research on silicon microsystem technologies.

1997–1999. The National Institute was set up at the end of 1996. IMT merged with the former ICCE (Research Institute for Electronic Components, working in semiconductor electronics), however ties with the *"Microelectronica S.A."* (see above) have been broken. External contacts had been developed and the access to laboratories abroad was facilitated. IMT coordinated the *European project MEMSWAVE*, nominated for the Descartes prize in 2002.

2000–2004. IMT became visible at the national level, especially 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, notably with Samsung (Republic of Korea).

2005-2007. The research thematic area of IMT was oriented towards convergent technologies, i.e. micro-nano-bio-technologies. A significant number of research projects has been financed from national programmes, facilitating new investments. IMT intensified its European cooperation by participating to a significant number of FP6 projects. IMT developed a *Centre for Technological Transfer in Microengineering* (CTT-Baneasa) and a *Science and Technology Park in Micro- and Nanotechnologies* (MINATECH-RO).

Strategy: The medium term strategy of the institute has been put forward in 2006. 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.* Therefore, the objectives are: (a) to become a centre of excellence in research and development related to the integration/convergence of technologies (micro-nano-bio-technologies); (b) to 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; (c) to pursue the technology transfer and innovation, by developing a "cluster" of organizations either providing or using the knowledge and the technologies in the domain; the main instrument will be 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.

Human resources

Fig.1 (a, b, c) provides information about the number and distribution of researchers active in IMT in 2006 (78 persons). Half of them are senior researchers (a). More of 60% of them have the Ph.D. degree or are Ph.D. students (b). The average age is slightly above 40 years (c).

Fig 1 - Researchers active in IMT (78)

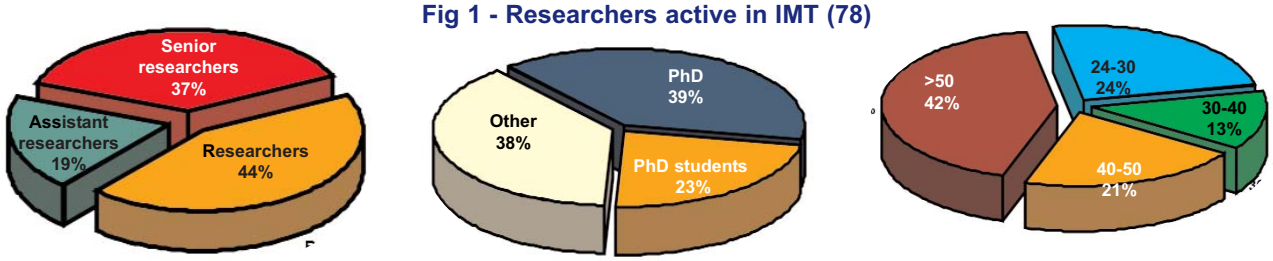


Fig 2 - Background of researchers and specialists providing technical services (103)

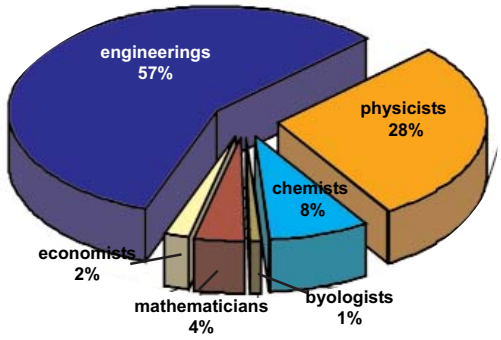
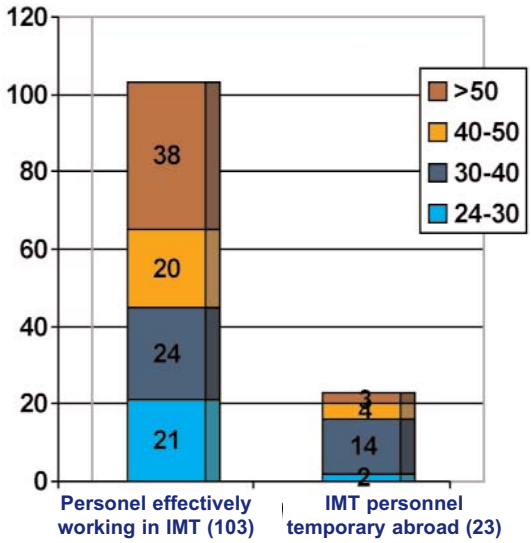


Fig.2 gives information about **the total number of specialists active in IMT** in 2007 (103 people): researchers and specialists providing technical services. Their background is shown in Fig.2. The male (57) - female (46) number is relatively balanced.

Fig 3 - Age distribution of specialised personnel (103+23)



The number (and age distribution) of specialized IMT personnel temporarily working abroad (23) is shown in Fig. 3 in comparison with the personnel active in the institute (103).

Funding sources.

Fig. 4 shows the **funding sources** in 2007 (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 but also acquisition of new equipments. In 2007, the majority of total funding (60%) comes from national R&D programmes (competitive funding, through open calls) and only **20% is provided by core funding** (public money available to national institutes for R&D, since 2003).

Fig 4b - Funding sources (EUR), 2002-2007

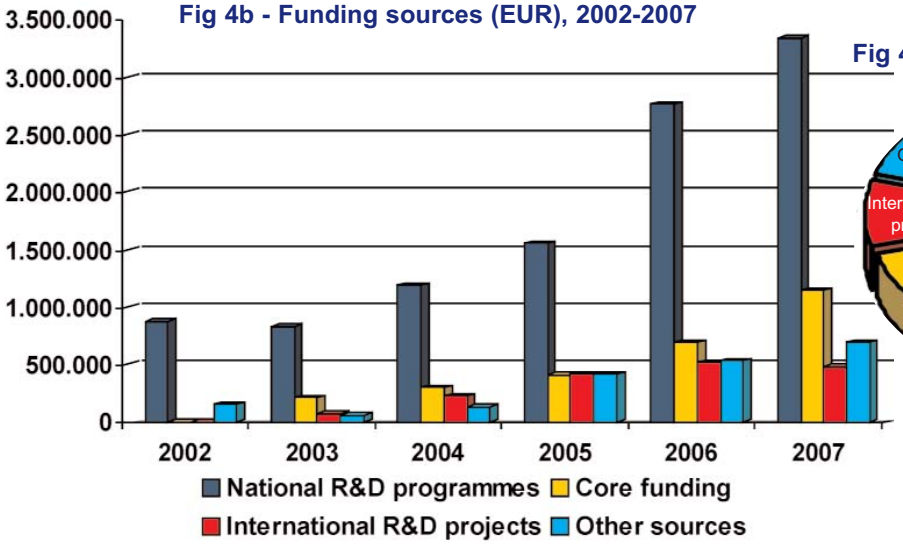
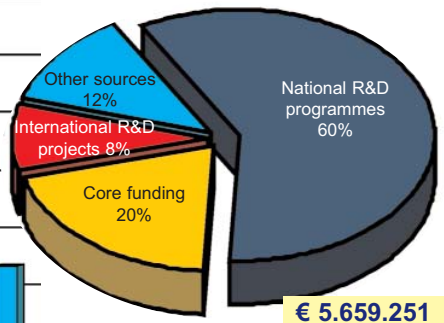


Fig 4a -Funding sources (EUR), 2007

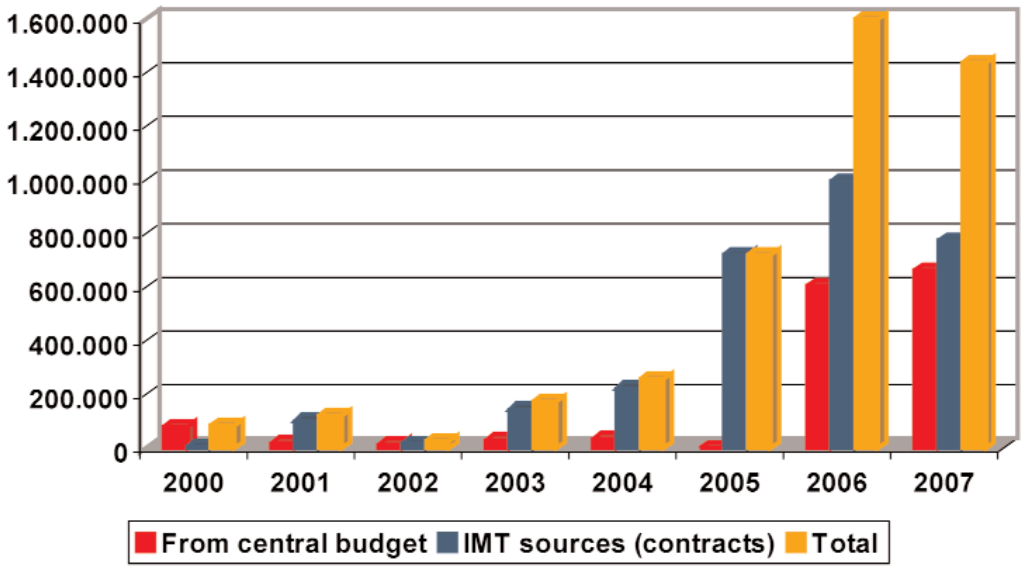


€ 5.659.251

Investments: dynamics and structure.

The dynamics of investments during the ten years of existence of IMT as a national institute (2000-2007) is even more spectacular. Fig. 5 shows the evolution from 2000 to 2007. The average level of annual investments is very low by international standards. The direct investments from central funding (from the public budget) have been in general comparatively low or even negligible, with the exception of the last years. The substantial increase in investments during the last three years was provided to a large proportion by **funding from R&D contacts financed from the national programmes.**

Fig 5 - Evolution of IMT investments (EUR), 2000-2007



The structure of these investments is shown in Fig.6. For the time period (2002-2006) a substantial part of the money (60%) went into technological equipment (Fig. 6.a).

The investments for technological equipments had reached 72.5% from the total amount invested in 2007(Fig. 6.b), whereas the characterization equipments maintains to a significant percentage (19%).

Note: 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.

The partnership with many other research institutes provides the multidisciplinary character of research, whereas the orientation towards applications is certified by the presence of companies in these consortia.

Three S&T networks are focused on common laboratories already installed in IMT (NanoScaleLab and NanoBioLab). IMT is acting as a “technological pole” (providing also access of companies and Ph.D. students).

It is worth while to note that the presence of IMT in successful FP6 and FP7 research proposals was certified before the substantial upgrading of equipments accomplished in the last two years. Today, IMT has much more to offer in this respect.

Fig 6a - IMT investments, per category 2002-2006

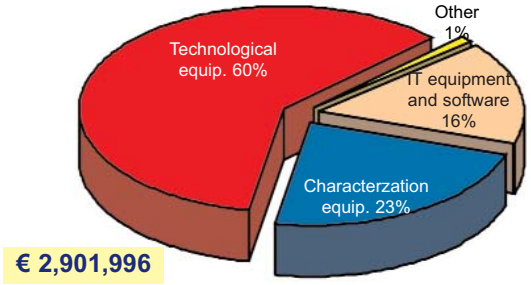
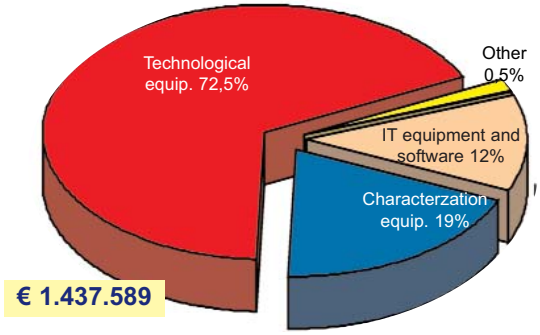


Fig 6b - IMT investments, per category 2007



L1: Laboratory of Nanotechnology

Affiliated to the Romanian Academy (of Sciences)

• **MISSION:** Nanomaterials and nanostructures: design, modelling/simulation and technological experiments.

• **MAIN AREAS OF EXPERTISE:** The research activities carried on in Laboratory of Nanotechnology can be divided into four areas which are: Functional nanomaterials, Nanobiosystems, Nanophotonics and Microelectromechanical Systems. The main research direction in Functional nanomaterials area is study of silicon based nanostructured or composite materials, from preparation to surface functionalisation and integration in complex systems like sensors with improved detection limit or miniaturised fuel cell for clean renewable energy. The Nanobiosystems area focuses on utilizing the various technologies developed in nanofabrication and MEMS to study and solve biological issues. Biomolecular patterns in microarrays, integration of sensing elements onto biochips for study of bioreactions, and implantation of active device elements in cells to study cellular biochemistry are examples of research activities being carried out. The Nanophotonics area is represented by two directions, porous silicon with emission in the visible spectrum for optical biosensors and metallic nanoparticles (Au, Ag) on silicon substrates for SERS/ SEIRS applications. The Bio-Micro- Electromechanical Systems (Bio-MEMS) area focuses on the design, modelling/simulation and fabrication of new complex devices on silicon for applications in many inter disciplinary areas, and recently results in biochips, or microfluidic systems as laboratory-on-a-chip were obtained with applications in biomedicine and environmental monitoring.

• **INTERNATIONAL PARTICIPATION**

• Partner in international projects: FP6-NoE: Nanostructured and Functional Polymer-Based Materials and Nano composites (NANOFUN-POLY) (2004-2008);

• "Drug delivery system based on microreservoirs array with porous silicon resorbable membrane caps", Romanian-Greece International Cooperation, December 2005-2007;

• "Nanostructured silicon for optical biosensors", Romanian-Italian Cooperation, 2005-2008;

• **RESEARCH TEAM** has multidisciplinary expertise and is composed by 4 senior researchers (with background in physics, chemistry), 5 PhD students (with background in physics, chemistry, computers and specializations in pharmacy and bio-chemistry).

• **INSTRUMENTS AND EQUIPMENT** 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. We have full access to IMT technological and characterisation facilities.

• **AWARDS:** Marioara Avram, Anca Angelescu, Irina Kleps, Gold medal to the International Salon of Inventions and New techniques from Geneve: Un procédé de réalisation d`un magnetotransistor á valve de spin April 2007;
Marioara Avram, Anca Angelescu, Irina Kleps, Silver medal to the INVENTIKA 2007 : Technology for spin valve transistor fabrication, Bucharest, October 2007

Team from left to right: Florea Craciunoiu; Adina Bragaru; Mihaela Miu;Monica Simion; Irina Kleps; Marioara Avram; Teodora Ignat; Mihai Danila; Andrei Avram;

Laboratory Head - Dr. Irina Kleps irina.kleps@imt.ro)

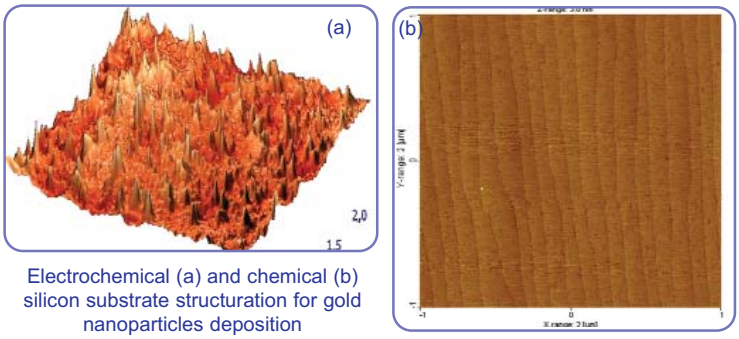
She obtained her MSc. in Chemistry Engineering, in 1973, and the PhD in chemistry in 1998 at Politehnica University of Bucharest. Her competence domains are: nanomaterials, nanostructures, nanotechnology, new materials and technological development for MEMS/NEMS, bio-medical devices, protein microarray.

Dr. Kleps participated in several European projects: 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, CEEX and PN2 national programs. Other activities: Golden medal (2001 and 2007) Salon International des Inventions-Geneve; Chapter Electrochemical Nanoelectrodes, in Encyclopedia of Nanoscience and Nanotechnology; Co-editor of the Nanoscience and Nanoengineering (2002), Advances in Micro and NanoEngineering (2004), Convergence of Micro-nano-Biotehnologies (2006), Progress in nanoscience and nanotechnologies (2007), Series in Micro and Nanoengineering, (Romanian Academy). More than 150 papers published in international journals/conferences, 90 technical reports, and 5 Romanian patents.

STUDY OF SILICON-PROTEIN TYPE BIOHYBRIDE NANOSTRUCTURED SURFACES WITH APPLICATIONS IN BIO(NANO)SENZING

This project contains multidisciplinary experimental researches which lead to changes of the silicon surface chemistry, in view to obtain biomolecule microdevice interface.

The aim is the investigation and optimization of protein immobilization methods on silicon substrate in order to obtain structures with properties in bionanodetection. For protein immobilization, we are proposing the preparation of Au/Si nanostructured surfaces (Au/Si nanodots; Au/Si thin layers; Au/nanostructured Si thin layers).



Electrochemical (a) and chemical (b) silicon substrate structuration for gold nanoparticles deposition

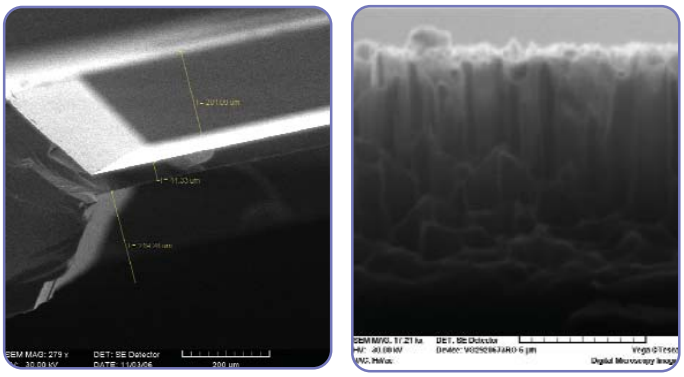
The main objectives of the project are:
(i) acheiving the self assembly monolayer (SAM) on Si substrate. (ii) development of a method to control the molecule attacment (imobilisation). (iii) using of SERS substrates for bio(nano) detection.

Financed by the National University Research Council (2007- 2010); Coordinator: Dr. Irina Kleps, irina.kleps@imt.ro

STUDY OF MEMBRANE - ELECTRO-CATALYST NANOCOMPOSITE ASSEMBLIES ON SILICON FOR FUEL CELL APPLICATION

The aim of the project is design and fabrication of some new membrane/electro-catalyst architectures using micro-nanotechnologies for miniaturized fuel cells development, with potential for applications in some priority domains, like: portable electronics, military industry, implantable medical devices industry.

The main objectives of the project are: (i) A nanocomposite membrane will be obtained by proton polymer impregnation (Nafion) of porous silicon (PS) layers. (ii) different physico chemical methods will be studied for PS pore walls grafting to behave like a good proton conductive material. (iii) will be deposited metallic nanocatalyst.


Porous silicon membrane on Si-n+ substrate which has proton exchange function after proper chemical grafting

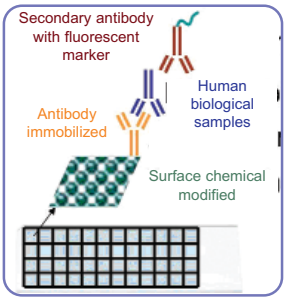
This project is offering important information to obtain an integrated device, with longer autonomy in the functioning than classical batteries, and also the relatively simple supply with the liquid fuel.

Financed by the National University Research Council (2007- 2010)
Coordinator: IMT Bucharest, Dr. Mihaela Miu, mihaela.miu@imt.ro

MULTI ALERGEN BIOCHIP REALISED BY MICROARRAY TECHNOLOGY - MAMA

The aim of this project is to make biochips using Microarray Technology (TMA) for allergies diagnosing. The research area is a cutting edge one, and is absolutely new in Romania.

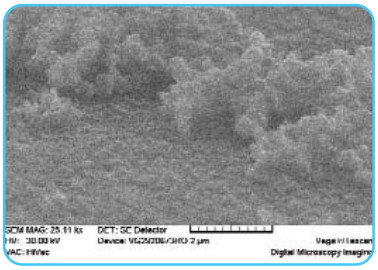
The detailed objectives of this project are: 1. a biochip for quick diagnosis of the allergies by specific immunoglobulin (Ig E) immobilisation on technological micro fabricated surfaces; and 2) a Biohybrid Interfaces platform (PIB) for the electrical/ electrochemical reactions investigation at the interface between the substrate and biological material. The advantages of the proposed biochip are: the increase of the analyzed data number in real time; a good specificity and sensitivity and the absence of the false positive and false negative reactions; quick diagnosis. The allergens immobilization by covalent bonding on the biochip surface is faster and more stable and it needs a smaller incubation time. The bio-chips are designed and made in such way to allow the simultaneous analysis of a great number of allergen proteins on a small surface, giving the possibility to identify the specific IgEs by a unique determination using small serum volumes (nano-grams).

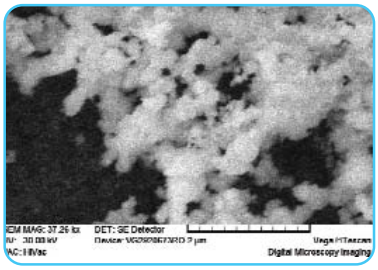


Biochip schematic representation

PNCDI Program (2007- 2010). Coordinator: IMT Bucharest, Dr. Irina Kleps, Irina.kleps@imt.ro
Partners: "Carol Davila" University of Medicine and Pharmacy- Bucharest; Bucharest University, Faculty of Chemistry; Telemedica SA and DDS Diagnostic SRL;

MINIATURISED POWER SOURCE FOR PORTABLE ELECTRONICS REALISED BY 3D ASSEMBLING OF COMPLEX HYBRID MICRO- AND NANOSYSTEMS - MINASEP





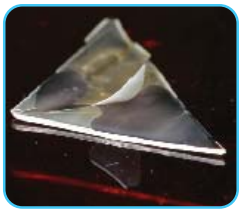
Pt nanoparticles chemical deposited from H_2PtCl_6 precursor solution on Si nanostructured surface to work as electro-catalyst

This project is making a connection between the researches from micro- and nanotechnologies and the portable electronic devices requirements and it is envied the development of a new power sources as a hybrid micro- and nanosystems assembly.

The theme represents an important research subject in the recent years at international level, and in our country is for the first time when it is proposed the development of a 3D assembly technology in order to miniaturise the actual fuel cell systems and also to simplify and to optimise their working performances. In this scope, the following components are proposed:
1. originally structures - membrane / electro-catalyst nanosystems, with new catalyst geometries, which will lead to improvement of: (i) the low temperature methanol / ethanol electro-oxidation activity of the anode; (ii) the oxygen reduction activity of cathode and increase its selectivity.
2. complex microfluidic system, on silicon (Si) and polydimethylsiloxane (PDMS), microsystem for fuel / water management (supply/storage).

PNCDI Program (2007- 2010)
Coordinator: IMT Bucharest, Dr. Mihaela Miu, mihaela.miu@imt.ro
Partners: University of Bucharest, Faculty of Physics and Petroleum- Gas University of Ploiesti;

NANOSTRUCTURES FOR ACTIVE DRUG DELIVERY WITH THERAPEUTICAL POTENTIAL - NANOCONTER



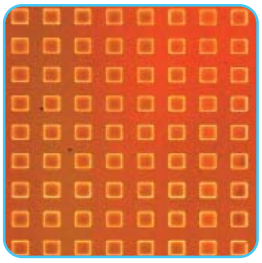
Porous silicon membrane obtained stripped off the silicon surface

The aim of the project is to investigate the potential of some nanostructures (NS) for active drug delivery with therapeutical potential.

Nano-porous silicon (PS) functionalized with antitumoural substances are prepared. Two processes were experimented: (i) porous silicon membrane and (ii) nanostructured PS microparticle fabrication using a controled process with a photolotographic mask. The as-prepared micro-particles functionalised with different substances, such as chondroitin sulfate, lactoferrin and N-butyldeoxynojirimycin are tested at the Intitute of Biochemistry.

CEEX Project (2006- 2009). Coordinator: Institute of Biochemistry, Bucharest, Dr. Mihaela Trif, trif@bichim.ro
Partners: IOB; INSB; University of Bucharest Faculty of Biology; IMT- Bucharest; ICECHIM;

SILICON BASED MULTIFUNCTIONAL NANOPARTICLES FOR CANCER THERAPY - NANOSIC



Nanostructured Si microparticles (50 μmx 50 μm) on Si before separation

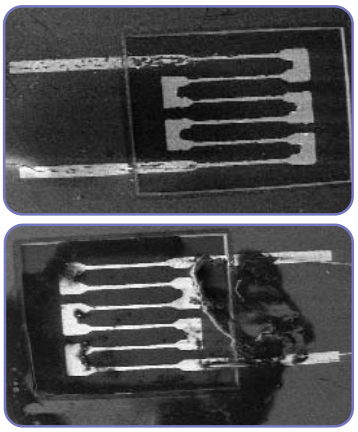
This project, offers a new approach in the domain of nanobiotechnologies and nanomedicine, joining the existing concerns in these domains, at national and international level. The proposed systems consists from superparamagnetic microparticules of nanostructured silicon carriering iron oxides (Super Paramagnetic Iron Oxide Nanosized Particles -SPION) and drugs integrated in an organic matrix in order to facilitate the controlled delivery process direct to specific sites (normal or pathologic) from the human body or animals. In this project the research is oriented towards two innovative systems with applications in cancer therapy, as follows: (1)The first system consists from Si based multifunctional microparticles which contains the active substance (chemotherapeutic agent) covered by a polymeric-gel membrane with the aim to hinder the active substance diffusion during vectorisation; this system could be injected and vectorised by the EM external field, in this way avoiding the surgical operation; (2) The second system is a sandwich structure that consists of three layers: two polymeric membranes and between them, a Si microparticle layer; this system is like a plaster with extern application, allowing a transdermic diffusion and vectorisation of active substances direct to the affected organ. It was proposed fabrication of smart microparticles which combines in a synergetic way the incorporation of the active substance, vectorisation, and imagistic function by magnetic resonance (RMI).

PNCDI Program (2007- 2010). Coordinator: IMT Bucharest, Dr. Irina Kleps, irina.kleps@imt.ro
Partners: INSB Bucharest and IOB Bucharest;

DEVELOPMENT OF NEW COMPLEX TOOLS FOR PROTECTING HEALTH: LABORATORY-ON-A-CHIP SYSTEM (TOOPROLAB)

The aim of this project is to design and fabricate two devices for health applications, using microfluidics and microarray probes technologies: (i) CELL-Lab-on-a-chip for in-vitro drug testing and (ii) DNA - Lab-on-a-chip for genetic diagnosis.

The first device is dedicated to both optical and bioelectrochemical analyses of biological materials - different type of cells - subjected to external stimuli. The test structure contains an electrical circuit integrated in a microfluidic network, and nanoelectrodes microfabricated on the reactor base for the enhacement of sensitivity in electrochemical processes detection. The second device is designed to act as a micro-PCR (microreactor, resistor for thermal cycling, and temperature sensor) in conection with an microfluidic electrophoretic system for DNA separation (microchannel and microelectrodes). For a good heat dissipation, the heating resistor was made inside the reservoir. The back of the reservoir was porosified in order to assure the thermal isolation to reduce the environmental effect.

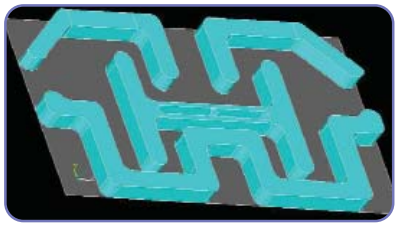


SEM image of the final device: a) before using; b) after using for PCR reaction

CEEX Project (2005-2007).
Coordinator: IMT-Bucharest, Dr. Irina Kleps Irina.kleps@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;

INTEGRATED MICROFLUIDIC SYSTEM FOR ADVANCED IN VITRO BIOCHEMICAL ANALYSIS FOR DIAGNOSTIC AND TREATMENT IN MEDICAL APPLICATIONS - MICRO-DIAG

The biodynamic analysis microsystem consists of two main modules. The first module is the microfluidic system consisting of the microgearing wheels and microchannels (for the determination of molecular transport coefficients in biological fluids), microchannels with high-doped walls and nanoelectrodes (for the detection, sorting and differentiating of suspended bioparticles) and heaters. The second module is the detection and measuring system.



The selector for low pressure (SI logical gate).

The central element is the piston which is moving under the applied pressures of the piston. The devices entries are located to the right and the left related to the piston.The SI logical gate functionality is presented in next table 1.

The image selector for high pressure (SAU logical gate). The central element is the piston which is moving under the applied pressures at the entry. The devices entries are located to the right and the left related to the piston. The SAU logical gate functionality is presented in table 2.

table1

Imput 1	Imput 2	Output
0	0	0
0	1	0
1	0	0
1	1	1

table2

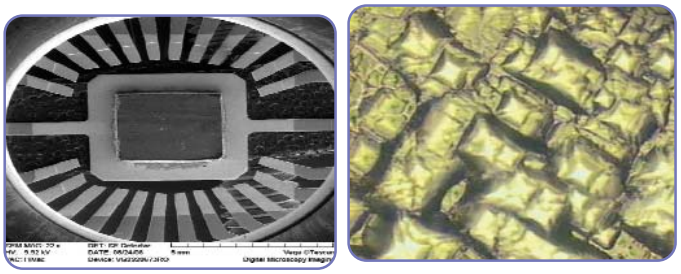
Imput 1	Imput 2	Output
0	0	0
0	1	1
1	0	1
1	1	1

Coordinator: IMT-Bucharest, Dr. Marioara Avram, marioara.avram@imt.ro;
Partners: "Politehnica" University of Bucharest, "Transilvania" University of Brasov, ROMES SA, Genetic Lab SRL, Bucharest;

SENSOR DIODES DIODE ON DIAMOND AND SIC WITH APPLICATIONS IN CEMENT INDUSTRY - DIASENZOR

In the frame of this project the following technological steps for SiC and diamond syntesis and processing were analyzed:
(i) methods for crystals growth; (ii) methods for epitaxial layers growth; (iii) doping techniques; (iv) oxidizing techniques; (v) plating techniques for ohmic contacts/ Schottky barriers techniques;
(vi) etching techniques.

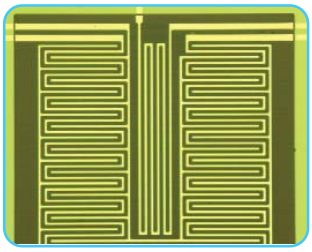
The fabrication process of the diamond and SiC devices were implemented on the silicon processing facilities.



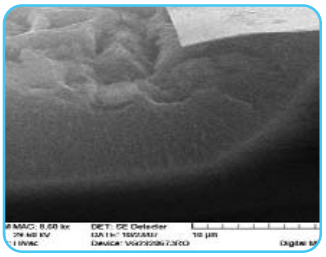
CrAu deposited on diamond

PNCDI Program (2007- 2010). Coordinator: Politehnica University of Bucharest, Prof. Dr. Brezeanu Gheorghe;
Partners: IMT Bucharest, Dr. Marioara Avram, marioara.avram@imt.ro; METAV SA, CEPROCEM, CARPAT-CEMENT;

FABRICATION TECHNOLOGY OF NANOSTRUCTURED SILICON MEMBRANES WITH APPLICATIONS IN SENSORS AND BIOMEDICAL DEVICES



Plan view of the humidity sensor chip

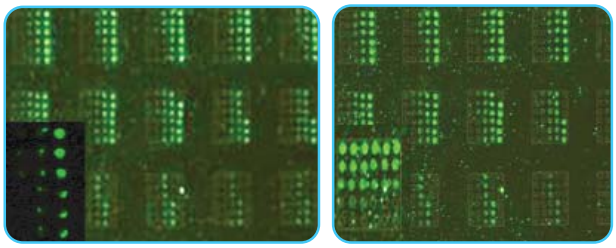


Cross- section detail of the sensitive PS layers

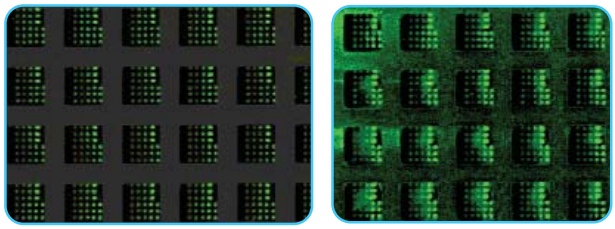
One of the project objectives is to establish a fabrication technology for a silicon based capacitive humidity sensor using porous silicon nanostructurated membrane as sensitive layer. The process flow and corresponding photolithographic masks have been designed to integrate on the same chip both the interdigitated recording microelectrodes, the heating resistor to achieve rapidly desorption and temperature sensor for its monitoring. In order to obtain a better fiability of the sensor, to increase its response, two types of metals for desorbtion resistivities and for the temperature sensor, gold and platinum, have been used; the interdigitated electrodes will be made of gold. The test structure were characterised after each experimental process. The advantage of using Au for all the electrical circuits is the simplicity of process flow, a single process being enough to obtain all the features.

MINASIST-Program (2006-2007). Coordinator: IMT-Bucharest, Dr. Mihaela Miu, mihaela.miu@imt.ro;

SILICON AND GLASS SURFACE FUNCTIONALIZATION IN ORDER TO OBTAIN BIOCHIPS FOR PRINTING MICROARRAY



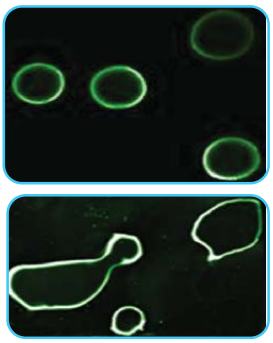
Silicon slides functionalized with poly-L-lysine: a) after spotting and b) washed after 60 minutes



Silicon skides functionalized with APTS: a) after spotting and b) after washing for 60 minutes

The microarray technology allows the simultaneous investigation of several parameters in one single experiment. It is important to choose a proper chemistry of the substrate for spot uniformity, signal intensity and low evaporation rate of the biological material.

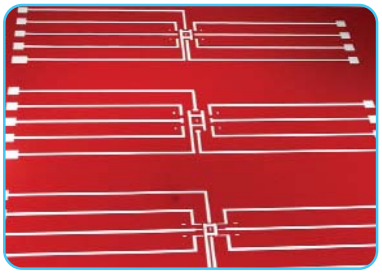
BSA (Bovine Serum Albumin) fluorescent marked was immobilised on porous silicon functionalization with APTS (3 - aminopropyltriethoxysilane) using OmniGrid Micro printer machine controled by Genomic Solutions software.



Microarray Scaner images of APTS on deoxidized PS, (a) before washing in water and (b), after washing

MINASIST-Program (2006-2007). Coordinator: IMT-Bucharest, Phys. Monica Simion monica.simion@imt.ro;

THE INTERACTION BETWEEN HUMAN AND BACTERIAL CELLS WITH NANOSTRUCTURED SURFACES; STRATEGIES FOR ACHIEVEMENT "INTELLIGENT" BIOSURFACES, NANOINT



Electrodes microfabricated on SiO_2/Si substrate

The aim of this project is to control the interaction between the human and bacterial cells with nanostructurated surfaces. A device with submicrons interdigitates electrodes, made in a 100 nm gold film was developed. In the area of the microscale interdigitates electrodes the gold layer is about 40-50 nm in order to make SPR (Surface Plasmon Resonance) measurements it was developed.

The areas of the interdigitates electrodes are accessible by the circuits and metal pads which assure the interface with the measurement devices. The interested elements are 8 areas of the interdigitates electrodes (1 micrometer, 0.5 micrometer and 0.2 micrometer), made in a 50 nm gold layer, deposited on silicon

Program CEEX (2006-2008).
Coordinator: International Centre of Biodynamics, Bucharest, Dr. Eugen Gheorghiu, egheorghiu@biodyn.ro;
Contact person for IMT Bucharest: Phys. Florea Craciunoiu, florea.craciunoiu@imt.ro;

SERVICE OFFER:

(i) MICRO- AND NANOSTRUCTURED SILICON FABRICATION

• Fabrication of porous silicon (PS) layers (2-500 μm thickness) on n^+ or p^+ Si, 4inch diameter.
• Fabrication of meso- and macroporous silicon membrane (thickness 500 μm) on n^+ or p^+ Si, 4inch diameter.
Contact person: Mihaela Miu (mihaela.miu@imt.ro)

(ii) MICROARRAY BIOCHIPS

Microarray technology includes applications for functional genomics, pharmacogenomics, SNP genotyping, proteomics and cell signaling. We have expertise for microarray manufacturing, processing, surface chemistry, detection reagents, scanning and analysis. Specific preparation protocols and probe design workflow can be developed in function of requested application. We are working using the new facilities, nano-plotter and microarray scanner from **NanoBioLab**.
Contact person: Monica Simion (monica.simion@imt.ro)

CONSULTANCE ACTIVITIES:

• Nanostructures/nanomaterials integration into the microsystems structures;
• Technological processes on silicon;
• Luminescent properties of the porous silicon;
• nanostructured bioactive silicon for biomedical applications; porous silicon biocompatibility;
• functionalization of silicon surface;
• microsystems for drug delivery;
• Magnetic sensors and magnetic nanostructurated nanomaterials;
• CVD processes using liquid precursors;
• Project evaluation for national/ international competitions.

L1: Participation to NoE's in FP6

NANOSTRUCTURED AND FUNCTIONAL POLYMER-BASED MATERIALS AND NANOCOMPOSITES

Acronym: NANOFUN-POLY

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

Contact person for IMT Bucharest: **Dr. Irina Kleps (irina.kleps@imt.ro)**;

IMT collaboration proposal for nanobiomaterials internal projects **in the frame of NANOFUNPOLY**:
Surface engineering techniques to investigate inorganic-biomolecular interfaces

Information on mobility

(i) **Teodora Ignat**, was effectuated a working stage in **INASMET, San Sebastian, Spain, *on SERS characterization*** of the Au/Si samples realised in IMT Bucharest, September 6th- October 20th, 2007;
(ii) Participation in the **3rd International Symposium on Nanostructured and functional polymer-based materials and Nanocomposites** (Corfu, Greece, May 13-15, 2007) organised by **NANOFUN-Poly** project with the following papers:
- **Protein attachment via polymers in microarray technology**, Monica Simion, Lavinia Ruta, Teodora Ignat, Irina Kleps, Dana Stan, Carmen Mihailescu, Codruta Paraschivescu, Florin Craciunoiu, Mihaela Miu;
- **Investigation of nanocrystalline s-layers, mesoporous silicon matrix for sensors and biomedical applications**, Irina Kleps, Teodora Ignat, Mihaela Miu, Monica Simion, Adrian Dinescu, Dan Dascalu, Gabriela Teodosiu Popescu, Madalin Enache, Lucia Dumitru;
- **AFM method for investigation of the piezoelectric properties of the polymeric thin films**, Florea Craciunoiu, Mihaela Miu, Raluca Gavrila, Adrian Dinescu, Elena Hamciuc;
(iii) Participation in the **1st Workshop - Polymers in Nanotechnology,** September 27th - 28th , 2007, Salerno, Italy, **"Silicon surface functionalization for biomolecules attachment"**, Adina Bragaru, Mihaela Miu, Monica Simion, Teodora Ignat, Irina Kleps, Andrei Avram, Veronica Schiopu, Florin Craciunoiu.

L2: Laboratory for Microsystems in biomedical and environmental applications

• The **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, microfluidics and integrated technologies (silicon, polymers, biomaterials), 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. Microfluidic platforms simulation and realization including tubes, microfluidic connectors and reservoirs, pumping system and microsensors integration are part of the laboratory expertise.
The team was working in 20 national projects during the last 5 years, and is currently involved in seven FP6 projects, both research projects and support actions.

The laboratory is involved in several **national** and **FP6 projects and networks**.

• **International projects:** The most important International projects: INTEGRAMplus ("Integrated MNT platforms and services – Service Action") – FP6 IP, IST, 2006 – 2008, TOXICHIP ("Development of a toxin screening multi-parameter on-line biochip system") – FP6 STREP, IST, 2006 – 2009; networks: , 4M ("Multi-Material Micro Manufacture: Technologies and Applications") – FP6 NMP NoE, 2004 – 2008; .PATENT-DfMM ("Design for Micro and Nano Manufacture") – FP6 IST NoE, 2004 – 2007.

• **National projects:** NEUROSENSE ("Integrated system for concurrent electrophysiological and chemical recording at neuronal level"); IMUNOSENSE ("Miniaturized immunosensor arrays technology, for herbicide detection"); HINAMASENS – ("Nanostructured hybrid materials for sensors, for therapy and diagnostic usage"") – all are national complex projects.

• **Research team:**
The Laboratory team includes 12 people, seniors and young researchers with multidisciplinary expertise (microelectronics, physics, chemistry, biology).

Team from left to right: Cladia Roman; Carmen Moldovan; Boagdan Firtat; Rodica Iosub; Cristina Pachiu; Marian Ion;

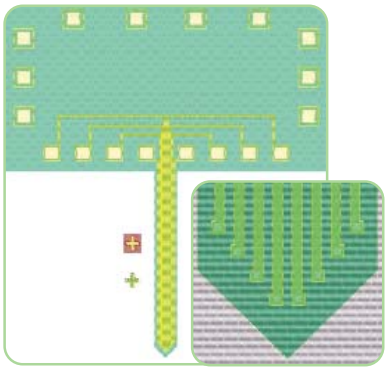
Laboratory Head - Dr. Carmen Moldovan (carmen.moldovan@imt.ro)

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 she owns a PhD in Microsensors. She is contact person for IMT in **INTEGRAMplus IP** (IST), dealing with technology convergence and integration and virtual design and manufacturing. She is responsible from IMT side in the **TOXICHIP** project, STREP (IST), for the development of temperature, pH sensors and O_2 sensor integrated into a microfluidic platform for toxicity detection. She is involved in the **4M** NoE (NMP), working on demonstrators, in Ceramic cluster, having the goal to integrate a non-standard micromachining process into a ceramic substrate and in the Sensors and Actuators cluster. She is a **member of: IEEE and Science and Technology Commission of the Romanian Academy and NEXUS Steering Committee Member.** The scientific activity is published in more than 55 papers in journals, books and communications in Proceedings.

INTEGRATED SYSTEM FOR CONCURRENT ELECTROPHYSIOLOGICAL AND CHEMICAL RECORDING AT NEURONAL LEVEL - NEUROSENSE

The project, coordinated by IMT, is developing a complete, integrated system for neural recording, with direct applicability in fundamental and applied neuro-research. It's main objective is to develop a recording microelectrode with multiple recording sites, fabricated in silicon based MEMS technology, for combined extracellular electrical recording (action potentials) and electrochemical sensing (pH and dopamine level in the extra-cellular environment), with special emphasis on reproducibility, quality, cost.



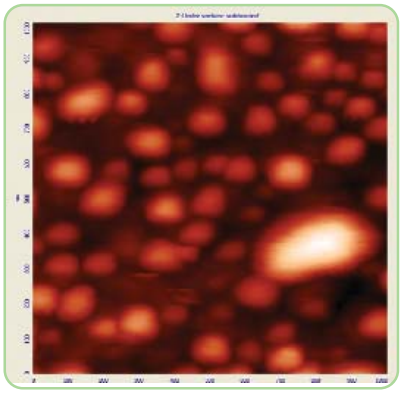
a) Microprobe layout;
b) Microprobe layout detail (The probe tip)

Preliminary Results:
The project, started in 2007, has already reached some of it's proposed results, including:
• development of the associated electronic circuitry for signal processing, digitization and computer transfer, display and acquisition, such that a ready-to-be-used experimental chain to be realized;
• design of the microprobe and technology steps;
• preliminary study of the interconnecting technology.

Project coordinator (Contract no. 11-006): Dr. Carmen Moldovan carmen.moldovan@imt.ro, IMT-Bucharest. Consortium members: "Victor Babes" Institute, "Politehnica" University", Romelgen, National Institute for Laser, Plasma and Radiation Physics.

MINIATURIZED IMMUNOSENSOR ARRAYS TECHNOLOGY, FOR HERBICIDE DETECTION - IMUNOSENSE

Aim: The development of the technology of integrated immunosensor arrays with optic and electric detection, in the ng/L domain for herbicide in alimentation products and water. The project is developing and involving technologies of the fabrication of immunosensor arrays integrated on semiconductor substrate (silicon) and piezoelectric substrate (langasite) for ultrarapide analyses with high accuracy and increased sensitivity (3 orders magnitude comparative to ELISA technique). Within the IMUNOSENSE project, two different types of sensors are developed: a silicon-based sensor and a piezoelectric one.



AFM picture of SAM of thiol on gold

Preliminary results:
• Design of the 2D configuration for microelectrodes structures, adapting the technologies for the deposition of biological material on substrate with the study of the reactive surface linkers for the adherence of biological material (antibody, antigen, marker) on substrate.
• Experiments and optimization of two procedures for the adhesion and bonding of the biomaterial: the organo-functionalisation method (organic compounds with: thiol (-SH) group, amino (-NH_2) group, medium modifier is organic group) and inorgano-functionalisation method (inorganic compounds, e.g.; organometalic compound or a metal (gold).
• Definition of the targeted herbicides to be detected: atrazine, hydroxy-atrazine, BAM, Dichlobenil in the range of the concentration:of 10÷100ng/L, with a short answer time.

The continue monitoring of analysed medium with the help of the integrated biosensors make this method unique and irreplaceable by another immune analytic method currently used in laboratory.

Project coordinator (Contract no: 51-083): Dr. Carmen Moldovan, carmen.moldovan@imt.ro, IMT-Bucharest.
Consortium members: "Victor Babes" Institute, Institute for Public Health, DDS-Diagnostic, RomQuartz, ROMES.

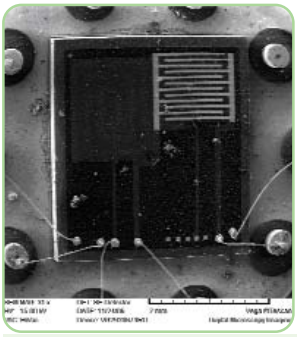
HYBRID NANOSTRUCTURED MATERIALS FOR SENSORS, FOR THERAPY AND DIAGNOSTIC USAGE - HINAMASENS

The project is addressed to the nanomedicine domain, with direct aims to regenerative medicine and tissues engineering. The project aim is to study and develop new hybrid materials based on hydroxyapatite and macromolecular organic architectures with controlled structure at nanometric level, for developing sensors with diagnosis applications.

IMT will be in charge with developing and characterization of the sensorial substrate, on silicon. The main projects result will be developing an instrument able to control the immobilized biomolecules.

Project coordinator (Contract no: 3335/2007): National Institute for R&D for nonferrous and rare materials.
Consortium members: IMT-Bucharest (dr. Carmen Moldovan, **carmen.moldovan@imt.ro**), "Petru Poni" Macromolecular Chemistry Institute – Iasi, Chemical Institute of the Romanian Academy – Timisoara, Biochemistry Institute of the Romanian Academy – Bucharest, METAV R&D, SITEX 45.

MICROSENSORS FOR DETECTION OF AMMONIA AND SULPHURETTED HYDROGEN, AS RESULTED FROM THE FOOD PRODUCTS DEGRADATION



SEM picture of the resistive electrodes area, covered with copper and zinc phtalocyanine. It's thickness is in the nm range.

The project's main goal is to study and implement a new technology for chemical microsensors, with a main application in the food industry, but the sensors will be used also in other areas, for pollution detection.
One of the most important technological aspects of developing the sensors was to integrate the planar MEMS technologies with a conductive, sensitive phtalocyanine layer, deposited by evaporation. The resulted microsensors were investigated by impedance measurements.

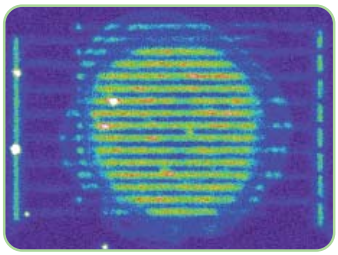
The developed sensors are chemoresistive ones, with gold interdigital electrodes on a thin silicon membrane. The membrane will also contain an integrated polysilicon heater, for heating the substrate (since the sensor's active layers needs to run at high temperatures). This system assures an even heating of the active area and minimises the heat losses through the substrate, this leading to a small power consumption. This means that the sensors can be easily implemented in portable instruments.

Core Project (Contract no: 24N/2006),
Project coordinator: Dr. Carmen Moldovan, carmen.moldovan@imt.ro,IMT-Bucharest.

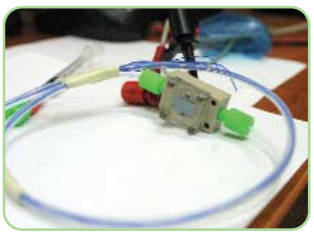
L2: Participation to NoE's, IP's, STREP's in FP6

Integrated MNT platforms and services – *Service Action*
Acronym: **INTERGRAMplus**, **IP**, Priority 2 -**IST**, Contract no.: 027540; 2005-2007
Coordinator: Chris Pickering; **e-mail:** cpickerig@qinetiq.com; **QinetiQ Ltd**, UK.; **http://www.integramplus.com**

Within INTEGRAMplus, IMT is involved in different ACTIVITIES, corresponding to different project tasks:
Related to Design and virtual manufacture, IMT deals with modelling and simulation for MEMS, optical and microfluidic devices as well as Silicon-Polymer hybrid simulation. Different tools are used and analyzed in order to provide complete and comparative modelling for multi-domain design and simulation. IMT is involved also in the Technology convergence and integration activities, acting in microfluidic simulation (3-D models and fluidic functions), developing methodologies for integration of biomaterials into micro and nanosystems, including new processes for biomaterials deposition, packaging and measurement.
Due to it's previous experience from FP6 SSA projects, IMT has also training and educational activities, developing new training modules for the INTEGRAMplus portfolio, preparing and delivering courses, training visits (presenting and visiting the technological facilities), organizing regional events for Eastern participants to attract industry as potential users of the project services.



Interdigital electrodes, with biomaterials deposited on the sensitive area



The bio-electrode tested, (packaged within the microfluidics device, developed by Epigem, Ltd., UK)

RESULTS in INTEGRAMplus:
IMT worked on Si/MEMS process convergence, for biomaterials integration:
The chemistry of a deposited enzymatic layer (AChE enzyme) has been developed (taking into account the concentration, enzymatic activity measuring and deposition protocol) for demonstration purposes. The immobilization technique for AChE has been developed. For the fabrication of enzymatic sensors, the accurately deposition and immobilization only on the surface of the working electrodes has been achieved. The coating with organic polymers contains functional groups for attachment of bio active molecules (enzymes) on the surface of silicon has been used for AChE sensor such as: polyethilenglicol (PEG) or chitosane. The electrical measurements showed and validated the sensor's functionality.

Also, IMT was responsible for the interdigital electrodes design and fabrication, for biomaterials deposition. Corresponding masks were fabricated and the wafers were processed. The chip have biomaterials deposited on the inter-digital electrodes area and it was be integrated in a microfluidics module, for the biomaterials characterization.

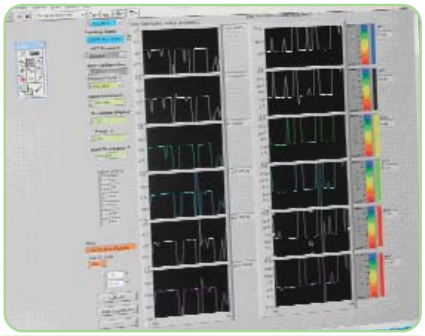
Within INTEGRAMplus, IMT organized (as part of the dissemination and training activities) an international course on "Design, Technology and Simulation of Microfluidic Structures". The course was held in Bucharest, on December, 5th, 2007, and was primarily aimed at students, PhD students, postgraduates, engineers and physicians from European universities and research institutes interested in developing MEMS design skills and accessing low-cost fabrication services, who participated free of charge. Over 20 participants took place in the event that gathered speakers from Romania, Italy and Norway.

Results obtained within the FP6 project **INTEGAMplus (Contract no. 027540).**
Consortium members: Coventor, France; CSEM, Switzerland; Epigem, UK; IMM, Germany; IMT, Romania; ITE, Poland; Silex, Sweden; ULAN, UK; Yole, France.

Development of a toxin screening multi-parameter on-line biochip system

Acronym: **ToxiChip**, **STREP**, Priority 2 -**IST**, Contract Number: 027900, 2006-2009,
Coordinator: PhD. Eric Moore, e-maileric.moore@tyndall.ie; Univ College Cork - National University of Ireland.
http://www.toxichip.org

Within **TOXICHIP**, Within TOXICHIP, IMT is mainly responsible for the development of a temperature sensor, as well as a pH sensor and an O2 sensor that will be integrated with the microfluidic platforms. This objective was carried out within WP4 (Development of Sensor Platforms), led by IMT and included the microsensors (fabricated on glass substrate) and the complete microfluidic platform, used for delivering the bio-fluids to the cells. Furthermore, a heating system for the fluids was incorporated with the platform (for assuring a constant temperature 37°C, as specific to bio-fluids).
Also, IMT activities included the development of the data acquisition system to be used with these platforms. The data acquisition system was designed, developed and tested using the sensors previously developed and it consists of a 6-channel, Lab-View system. The whole system proved it's efficiency and sensitivity during tests.
Together with the consortium's members, IMT contributed to the dissemination and exploitation activities within TOXICHIP, through dissemination at national and international scientific events.



(a) The software interface for the data acquisition system, performing measurements on 6 channels.

(b) The pumping system for the microfluidic platform, for pumping approx. 2 μl/min

RESULTS in TOXICHIP:

After performing microfluidic simulation, IMT has developed the microfluidic platform for the bio-fluids delivery. The sensors (developed on glass substrate) are integrated on the same platform. The data measurement and acquisition system was also developed (using hardware – data acquisition boards and software – LabView), and tests were performed, which proved the device's functionality and sensitivity.

The microfluidic platform, developed by IMT, is contributing to the project's goal, of creating a prokaryote and eukaryote cell based biochip platform, which will be capable of examining cytotoxicity. The TOXICHIP consortium is using the platform and will further develop it, by adding optical measurements mean (complementary to the electrical ones, developed by IMT). Also, the eukaryote and prokaryote cell based biochips developed by the partners will be integrated into the microfluidic platform, developed by IMT, by means of a "plug-and-play" approach.

Results obtained within the FP6 project TOXICHIP (Contract no. 027900).
Project coordinator: Tyndall National Institute, Cork, Ireland. **Consortium members:** HUJ, Israel; IMT, Romania; JRC, Italy; TAU, Israel; Scienion, France; Vigicell, France; ISMB, Italy.

IT Girls – Great careers for great women

European Commission initiative in Information and Communication Technologies (ICT) domain.

"IT Girls – Great Careers for Great Women" is an important initiative taken by the *European Commission* to convey the message that rewarding career opportunities in the ever-growing domain of *Information and Communication Technologies (ICT)* exist for both men and women. *To encourage young girls to choose a career in the ICT sector, the European Commission coordinated the organization of* ***Shadowing Days in ICT*** *companies and institutions.*

Delia Dogaru, Adina Corbu, Irina Damascan and Luiza Cicone, from the **"Tudor Vianu" National College**, shadowed four female engineers throughout the day as they carried out their regular professional commitments. They spent the day seeing the seniors in action in some of the main departments of IMT and visited the main technological facilities, including the clean room:

- **Carmen Moldovan** – Wafer Processing
- **Gabriela Dragan** – Mask Fabrication
- **Monica Simion** – NanoBioLab
- **Raluca Gavrila** – Atomic Force Microscopy
- **Oana Nedelcu** – CAD Design & Simulation

Within IMT, 40% of the researchers are women proving exceptional qualities for research and development in nanotechnology area. The event was a great experience for the IMT's researcher women and for the young girls spending a full working day inside the microfabrication facility and trying to use the new software programmes or new equipments. The girls were very impressed by the activities within IMT, and declared that research is, from now, a domain to think about when choosing their future careers.

Irina Damascan (left) and Gabriela Dragan (right) - Mask Fabrication Shop

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, simulation, design of micro and nano photonic structures and optoelectronic devices;

◆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 structural investigation of semiconductors, dielectrics and polymers nanocomposites thin layers

• **European Projects**

FP6: ◆Waferbonding and Active Passive Integration Technology (WAPITI), STREP, Priority 2 (IST), Thematic area: optical, opto-electronic, photonic functional components.

◆Advanced Handling and Assembly in Microtechnology - ASSEMIC (2004-2008), Marie Curie Research Training Network;

◆Multi-Material Micro Manufacture: Technologies and Applications4M, NoE - priority 3, NMP;

FP7: ◆Flexible Patterning of Complex Micro Structures using Adaptive Embossing Technology - IP priority NMP

◆European Centre of Excellence in Microwave, Millimeter Wave and Optical Devices - CSA-programme capacities

• **Team** has multidisciplinary expertise and is composed of 6 senior researchers (5 with PhD in optoelectronics, materials for optoelectronics, microsystems, 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).

Team from left to right:
1st row: Cristian Kusko; Florin Comanescu; Dana Cristea; Catalin Cimpulungeanu;
2nd row: Roxana Rebigan; Munizer Purica; Elena Budianu; Paula Obreja; Mihai Kusko;

• **Specific facilities**: **Modelling and simulation**: Finite-Difference Time-Domain (FDTD) simulation and design software Opti FDTD 6.0, waveguide optics design software- OptiBPM 8.1, software for design and modelling of active devices based on semiconductor heterostructures (Opti-HS); integrated and fiber optical gratings design software (OptiGrating); software for active device simulation (transport, thermal and optical properties) -LaserMod.

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 optoelectronic and photonic components, circuits.

New: High Resolution Raman Spectrometers LabRAM HR - High resolution confocal Raman microscope, offers unique spectral resolution and sensitivity on a bench-top microscope system.

Applications: microscopy and analysis into semiconductors, nano-materials , polymers.

Laboratory Head – Dr. Dana Cristea (dana.cristea@imt.ro)

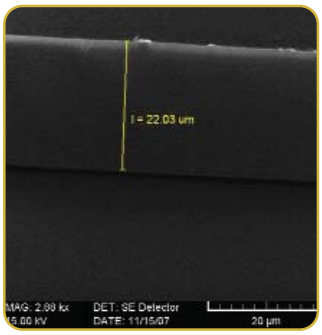
Dr. Dana Cristea obtained the MSc in Electronics (1982) and PhD in Optoelectronics and Materials for Electronics from "Politehnica" University, Bucharest, Romania. From 1982 until 1994 she was a research scientist in the Department of Optoelectronics and Sensors from the Research & Development Institute 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 is 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 is author of more than 80 publications in international scientific journals and conference proceedings. She is also a reviewer in Romanian and international scientific journals and evaluator of European projects (FP6, FP7). She is project manager for national and European projects.

MIXED TECHNOLOGIES FOR MICROPHOTONICS

• SOL-GEL NANOCOMPOSITES FOR MICROPHOTONICS

The sol-gel method is a flexible and convenient way to prepare oxide films on several types of substrates, and for this reasons it was extensively investigated for optical waveguides fabrication. The multilayer SiO_2-TiO_2 and SiO_2-TiO_2-Al_2O_3 waveguides undoped and doped with Er_3^+ were prepared by sol-gel method. The films were deposited on Si/SiO_2 substrate by spin coating methods, followed by annealing at 900°C.



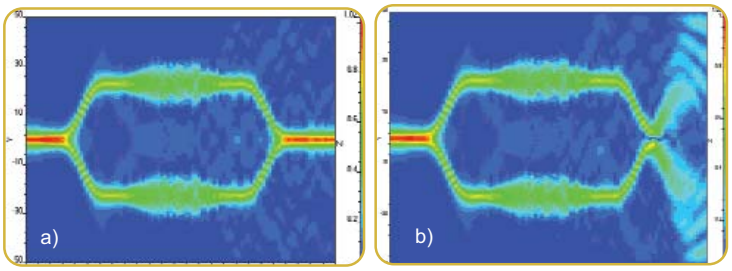
Optical waveguide (Er doped SiO_2-TiO_2-) patterned using wet etching

Optical waveguides were obtained by patterning Er-doped sol-gel layers deposited on oxidized silicon wafers (oxide thickness over 3 μm). Two techniques were used for patterning: wet etching in buffered oxide etch (BOE) solution (40% NH_4F: 49% HF = 6:1) with an etching rate 120 nm/min at 22°C and reactive ion etching in CF4 (max. etching rate: 80nm/min – at 250 W). Reactive ion etching (RIE) offers a better control of the etching process and lower over-etching. SiO_2-TiO_2-Al2O_3 based layers can be patterned only by RIE.

Co-operation with Institute of Physical Chemistry "I.G.Murgulescu" of Romanian Academy

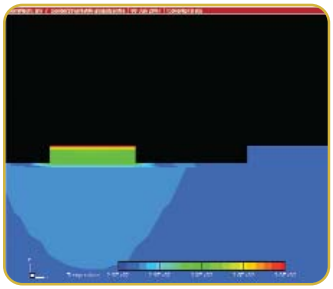
• DESIGN OF A THERMOOPTICAL MODULATOR BASED ON SOI WAVEGUIDES

There is an increasing interest in the area of relatively low-speed, low cost modulators and switches for local area networks (LANs). Silicon is an appropriate material for modulation based on thermo optic effect due to its high value of the thermo optic coefficient. The silicon waveguides can be used for devices working at wavelengths centered around 1.55 μm, since the silicon is transparent in this wavelength domain.



Propagation in a Mach-Zehnder interferometer if there is a temperature difference between the arms: a) ΔT = 0 K; b) ΔT = 4 K

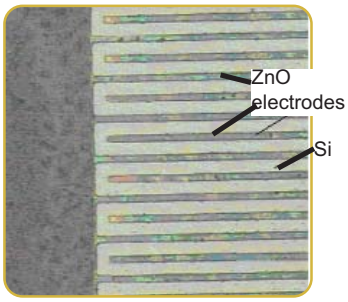
Achievements: it was designed a Mach-Zehnder modulator based on silicon on insulator (SOI) waveguides. It was used optical analysis for designing a single mode, polarization insensitive Mach-Zehnder interferometer and for solving the coupling issues regarding transition from the rib waveguide to the rectangular section waveguide used in the active zone. Also, it was used the thermal analysis for determining the required applied voltage for switching from ON to OFF state. The obtained value is 2.6 V.
The software packages employed were OptiBPM 8.0 software based on BPM (Beam Propagation Method) provided by Optiwave for the optical analysis and Coventorware 2006 software provided by Coventor Inc. for the thermal analysis


Transversal section temperature distribution in the structure.

The results obtained will be used for fabrication of a thermo optical modulator.

• THIN TRANSPARENT CONDUCTING LAYERS WITH OPTICAL AND ELECTRICAL PROPERTIES SUITABLE FOR MICRO/NANOPHOTONIC APPLICATIONS.

Transparent conducting oxides (TCO) thin layers, due to their optical and electrical properties, can be used as transparent electrodes in micro/nano photonics and optoelectronics devices applications. The advantage of TCO thin layers consist in: the improvement of the photoresponse by eliminating the shadowing of active area by opaque metallic electrodes; compatibility with silicon and AIIIBV compounds technology; the posibility to obtain multilayered structures with selective spectral response and low costs for materials and deposition processes.



ZnO transparent electrodes on silicon to obtain MSM photodetector.

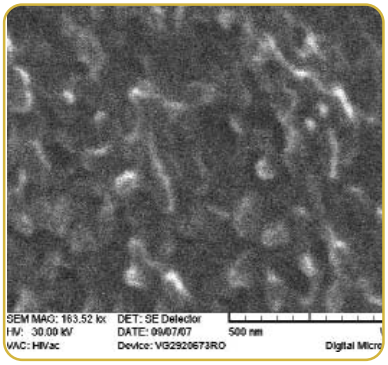
Achievements: Thin transparent conducting layers of ITO, ZnO used as transparent electrodes for high response MSM photodetector; undoped CdS and doped with Mn, Se, Sb; multiple pairs of TiO_2/SiO_2 thin layers for optical filter integrated with photodetector structure.

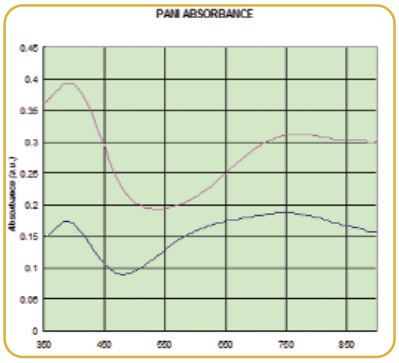
FOTONTECH, CEEX Project 2006-2008, Co-ordinator: IMT-Bucharest,
Project mamager: Dr.Dana Cristea (dana.cristea@imt.ro)

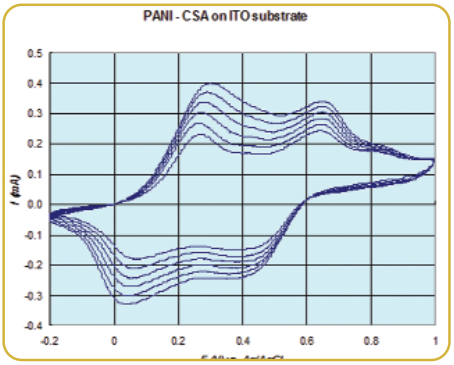
POLYANILINE FILMS FOR SENSOR APPLICATIONS

Polyaniline films (PANI) were prepared chemically by oxidative polymerisation on glass substrates, starting from aniline + ammonium persulfate. The electrodeposition of PANI films has been investigated by cyclic voltammetry with a scan rate 20 mV/s. PANI was electrochemically synthesised by anodic polymerization from an acidic solution of the monomer on ITO/glass substrates at 0.8-1 V (vs.Ag/AgCl).

Conducting polymers, especially polyaniline can be used in bio-chemical sensor applications, as well as in organic light emitting diodes, electromechanical actuators, anticorrosion coatings, electromagnetic screens, microwave absorbing material, antireflection coating, electrochromic mirrors and ultracapacitors.

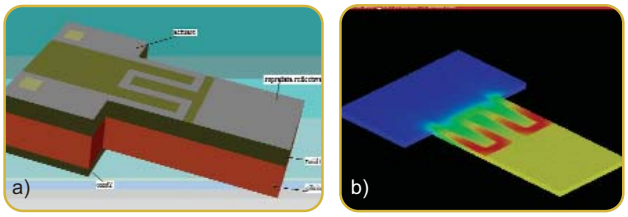




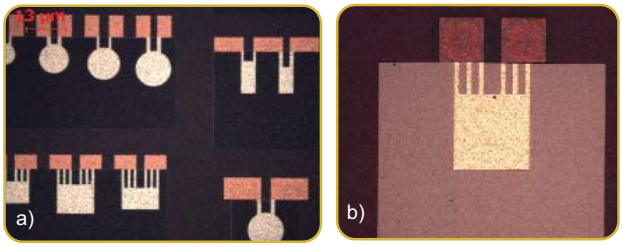


co-operation with Politehnica University in CEEX Project 2006-2008

MOVABLE MICROMIRRORS ON SILICON-ON-INSULATOR



a) micromirror structure ; b) temperature distribution versus;



Optical image of the obtained micromirrors on silicon substrate: a) with different geometry b) micromirror with three arms and SiO_2/Cr/Au membrans

Optical MEMS (MOEMS) are widely used in various applications such as optical tomography, optical switches, laser adjustable cavities, and many other applications.
As a specific type of MOEMS, movable micromirrors are widely used in different types of applications such as miniature optical scanning devices, optical spectroscopy, adaptive optical systems, cross connects and switches in optical microsystems, communication and sensors applications. These devices can be excited by different means, such as electromagnetic actuation, electrostatic actuation, piezoelectric actuation and thermal actuation .

Achievements: modeling/simulation and design of movable micromirrors on silicon and SOI substrates, thermally actuated based on bimorph layer or a resistance integrated on silicon substrates. The displacement along z axe was investigated using Coventorware software taking into account material properties and structure geometry.

The micromirrors with different geometry were obtained on silicon substrate using RIE etching and wet etching processes

MINASIST + project (2006-2008) contact person dr. Munizer Purica (munizer.purica@imt.ro)

NUMERICAL INVESTIGATION OF LEFT – HANDED METAMATERIALS

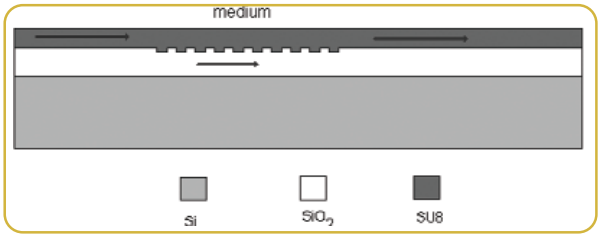
Metamaterilas are novel periodic systems, patterned at micro and nanoscale, for which the effective electromagnetic proprieties like electric permittivity and magnetic permeability can be artificially engineered. A very interesting class of metamaterials are the left - handed metamaterials (LHM) which present simultaneously a negative permittivity and permeability, and implicitly, a negative refraction index. Beside the interesting electromagnetic and optical phenomena occuring in LHMs, threre is a plethora of novel application in imaging (perfect lens), invisibility, waveguiding, etc. We use a combination of theoretical methods and numerical algorithms to investigate and design various LHM at microwave, infrared and optical frequencies.

CEEX Project (2006 – 2008) Optical properties of nanostructured materials.
Coordinator: IMT Bucharest, Project manager: Cristian Kusko (cristian.kusko@imt.ro)

DESIGN OF A REFRACTOMETRIC CHEMO-OPTICAL SENSOR BASED ON LONG PERIOD WAVEGUIDE GRATING

A long period waveguide grating device for sensing the change of the refractive index of the medium was designed and modeled with the OptiGrating software. This sensor works by coupling the radiation propagating in the fundamental mode to the leaky, substrate modes with the influence of the long period gratings.

MINASIST + project (2006-2008)
Contact person dr. Dana Cristea (dana.cristea@imt.ro)

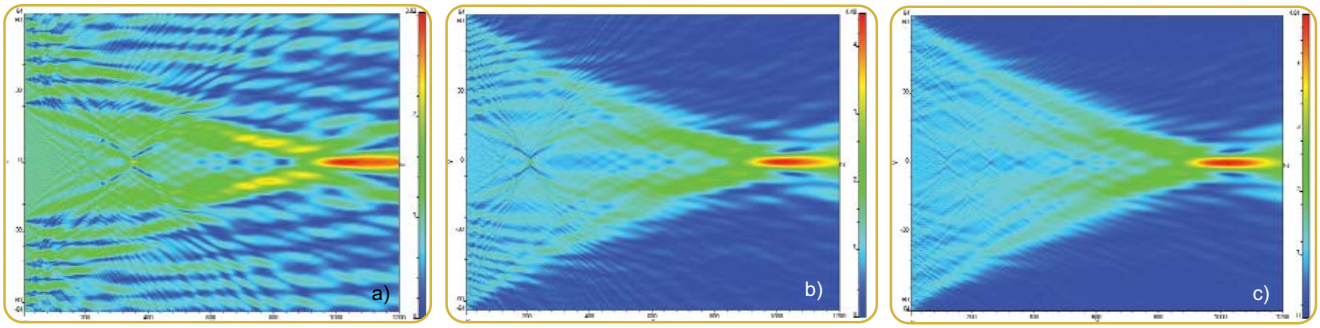


Scheme of the proposed LPWG sensor.

MICRO-OPTICAL DEVICES FOR OPTICAL PROCESSING

DESIGN OF THE DIFFRACTIVE OPTICAL ELEMENTS

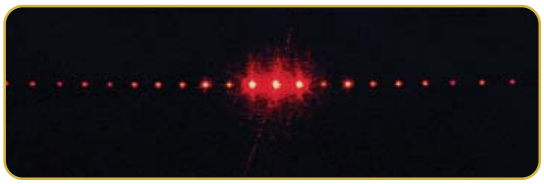
Diffractive Optical Elements (DOEs) are used in many areas like optical communication, optical interconnection, sensors, beam shaping, etc. The team from our laboratory designs DOEs using analytical expressions in the case of the Fresnel lens or diffraction grating and the dedicated software 3Lith provided by Raith. Gmbh for DOEs with complex function. The designed DOEs are based on discrete levels configuration (2, 4 and 8 levels).



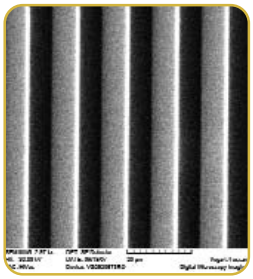
Simulation with OptiBPM software of radiation propagation trough Fresnel Lens with a) 2 levels; b) 4 levels; c) 8 levels.

FABRICATION MICRO-OPTICAL COMPONENT

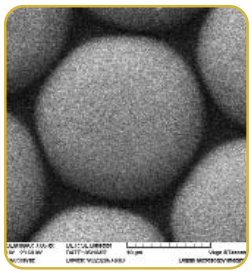
Results: polimer-based microoptical elements obtain using replication techniques



Application: diffractive optical elements



PDMS grating



PMMA diffractive optical element Microlens array in epoxy resin

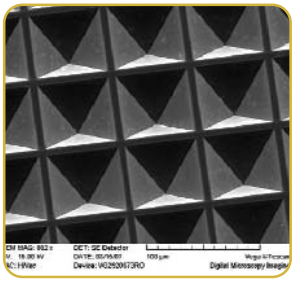
CEEX Project (2006 – 2008) Micro-optical devices for optical processing. Coordinator: IMT Bucharest , Project manager: Dana Cristea (dana.cristea@imt.ro)

REPLICATION TECHNIQUES FOR MICRO-OPTICS

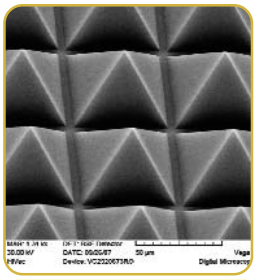
Replica molding is one the most simple soft-lithography techniques that can be used to generate micro and nanostructures in polymers with a resolution of a few nm. This technique is based on direct 3D replication in a polymeric material of molds easily obtained by standard processes.

Achievements: replicas for various patterns (dots, lines, prism and lens) were obtained in polymethylmethacrylate (PMMA), epoxy resin and polydimethylsiloxane (PDMS) in different conditions for polymer coating and curing.

PN II Project (2007-2010), Development of soft lithography techniques for micro and nano-photonics. Coordinator: IMT Bucharest, Project manager: Paula Obreja (paula.obreja@imt.ro)



Masters obtained in SiO_2/Si by anisotropic etching



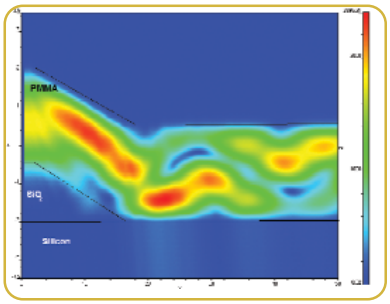
Replica in PMMA and epoxy resin

INTEGRATED BIOPHOTONICS POLYMER CHIP

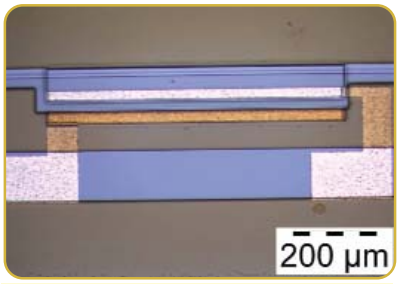
PMMA waveguides fabricated by deep-UV induced refractive index modification were integrated with a silicon photodiode. The optical copling between waveguide and the photodiode is achieved by leaky-waves.

The propagation loss of the waveguides was 0.16 dB/cm at 650 nm. The fiber to chip coupling loss was 1.2-2.7 dB/facet depending on the dicing quality.

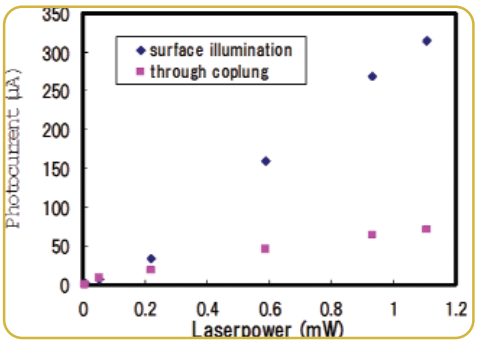
The measurements indicated that 47% of the guided optical power can be coupled in the photodiode within a coupligh length of 200 μm.



Field distribution in the waveguide-photodiode coupling region (simulation with OptiFDTD software; PMMA-waveguide – 2500 nm thick, wavelength – 800 nm



Optical micrograph of the PMMA waveguide integrated with the silicon photodiode



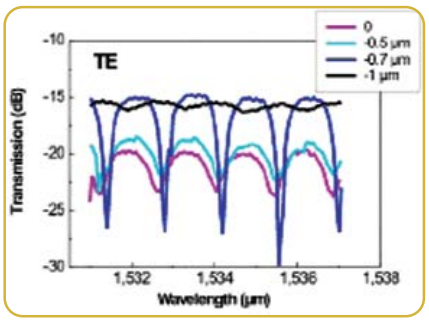
Photocurrent versus laser power in case of top ilumination and in case of copuling with the PMMA waveguide

Joint research project in the frame of the FP6 Network of Excellece MULTI-MATERIAL MICRO MANUFACTURE: Technologies and Applications (4M)
Co-operation with Institute for Microstructure Technology (IMT), Forschungszentrum Karlsruhe (FZK), Germany

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)

The **main objectives** of the **WAPITI** project:



Experimental spectra obtained at HHI for structures designed by IMT

- Establish a novel and feasible method of fabrication for vertically coupled micro ring resonators by wafer bonding technology.
- Development of passive and active micro ring resonators devices based on this technology

IMT role: IMT team has modeled simulated and designed both passive and active micro ring resonators devices using photonic simulation packages OptiFDTD and OptiBPM.

IMT team studies aimed obtaining single-mode operating micro ring resonators and adjustment of the fabrication parameters in order to achieve the desired working characteristics of the devices. HHI has fabricated micro ring resonators designed by IMT that presented good working characteristics.

Main scientific papers:

1. **M. Kusko**, et al, *Numerical analysis of microring resonator obtained by wafer-bonding technology*, Proc. SPIE 5956, 59561E (2005) .
2. **M. Kusko,** et al, *Design of single-mode vertically coupled microring resonators*, Journal of Optics A: Pure and Applied Optics, (accepted)

L4: Laboratory of micromachined structures, microwave circuits and devices

The laboratory is one of the promoters of the RF – MEMS topics in Europe, The laboratory is participating in the FP6 network of excellence "AMICOM" (2004 -2007). The laboratory was recognized at national level as RF-MEMS Center of Excellence, financed by the National Programme MATNANTECH (2002-2005).

The laboratory has successful applied to a FP7 project in the REGPOT 1 /2007 call. The project "European Centre of Excellence in Microwave, Millimetre Wave and Optical Devices, based on Micro-Electro-Mechanical Systems for Advanced Communication Systems and Sensors" will start in 2008 and it will be coordinated by Dr A Müller.

• **Mission:** scientific research and technological development of micromachined microwave and millimetre wave devices and circuits, contributions to the developing strategy of the domain. The new RF MEMS technologies including the "membrane supported circuits" represents a solution to manufacture high performance microwave and millimeter wave devices and circuits devoted to the emerging communication systems.

• **Main area expertise:** ♦ Development of a new generation of circuits devoted to the millimeter wave communications based on the semiconductor (Si, GaAs, GaN) micromachining and nanoprocessing materials; ♦ Design and manufacturing of passive circuits elements, monolithically and hybrid integrated receiver front-ends based on silicon and GaAs micromachining;

♦ Acoustic devices (FBARs and SAWs) based on micromachining and nanoprocessing of wide band gap semiconductors (AIN, GaN); ♦ Micowave devices based on carbon nanotubes; ♦ Microwave devices using CRLH materials (metamaterials); ♦ MEMS and NEMS technologies developement.

• **International network:** Partner in the international network FP6 Network of Excellence "Advanced MEMS for RF and Millimeter Wave Communications" coor. LAAS-CNRS Toulouse/ Univ. Perugia (2004 – 2007)

• **International cooperations:** The laboratory has bilateral governmental cooperation with ITC-irst Trento, Univ Tor Vergata, Rome and CNR Rome.

• **National projects:** In the PN II programme, the laboratory has 4 new started projects (3 Partnership and 1 Capacities) as coordinator and one as partner, three CEEX projects (INFOSOC and RENAR) as coordinator, two CEEX projects as partners and four projects in the MINASIST+ programme. The laboratory had finished also 6 projects in the MATNANTECH Programme (PNI) one in the MINASIST programme.

• **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), and 2 PhD students in physics.

• **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; "On wafer" measurement system in the 0.1 -65 GHz range: microwave network analyzer Anristu in the range 0.04-65 GHz, and Karl SUSS Microtec Probe Station, obtained through a successful CEEX project (Module 4)

• **Awards: Finalist of the Descartes Prize 2002** of the EC for the coordination of the MEMSWAVE 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).

Team from left to right:
Alina Cismaru;
Alexandru Muller;
Gheorghe Sajin;
Mircea Dragoman;
Dan Neculoiu;
Cristina Buiculescu;
Ioana Petrini;
Dan Vasilache;

Laboratory Head – Dr. Alexandru Muller (alexandru.muller@imt.ro)

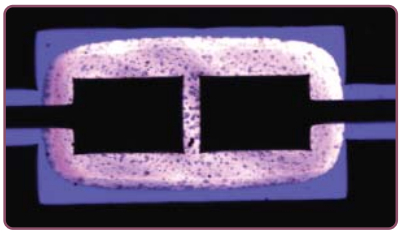
He obtained M.Sc.in physics (1972) and PhD in physics at Bucharest University in 1990;

Competences: Silicon, GaAs and GaN micromachining and nanomachining: manufacturing of RF MEMS components and circuits, technological process in GaAs MMICs, design, modeling and manufacuring of microwave passive membrane supported circuits (1997-European priority), micromachined inductors, filters and antennae, monolithically as well as hybrid integrated receiver front end modules.

Dr. Müller is the coordinator of the European project FP7 REGPOT (2008 – 2010) "European Centre of Excellence in Microwave, Millimetre Wave and Optical Devices, based on Micro-Electro-Mechanical Systems for Advanced Communication Systems and Sensors" - Project No 202897. He has coordinated the ***European Project FP 4 MEMSWAVE (1998-2001)***, and ***was 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 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. He has more than 150 contributions in books and international journals/conferences.

Dr. Müller is finalist of the Descartes Prize competition 2002 of the European Community with the MEMSWAVE Project, Romanian Academy Prize "Tudor Tanasescu"; second prize for the MATNANTECH project, SIRMEMS (CONRO 2003).

MEMBRANE SUPPORTED AlN FBAR STRUCTURES OBTAINED BY MICROMACHINING OF HIGH RESISTIVITY SILICON



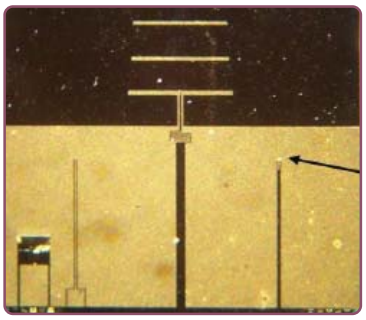
Top optical photo of the manufactured FBAR structure (w = 300μm, membrane dimensions: 1000x400μm).

AlN membrane supported F-BAR structures were manufactured and characterized. The 2μm thin AlN layer was grown using sputtering techniques, on a high resistivity (111) oriented silicon substrate. Conventional contact lithography, e-gun Ti/Au evaporation and lift-off techniques were used to define top-side metallization of the the FBAR structures. Bulk micromachinig techniques were used for the release of the AlN membrane. The bottom side metallization of the micromachined structure was obtained by means of sputtered gold. S-parameter measurements have shown a resonance around 1.6 GHz. Microwave measurements have proved the viability of these types of FBAR structures as the relevant material parameters like effective coupling coefficient are comparable to those obtained by other material deposition methods

Achievements: An AlN based resonator on high resistivity (111) silicon substrate for operation around 1.5 GHz has been fabricated using micromachining techniques and magnetron sputtering for AlN layer deposition. Resonator structures of this type can be used as building blocks for the fabrication of high Q and wide bandwidth filters, for use in reconfigurable front-ends of various mobile and wireless applications.

CEEX INFOSOC Project "Integrated RF-MEMS circuits based on silicon, gallium arsenide and wide band gap semiconductors for advanced communication systems – ACOMEMS" (2006-2008) Co-ordinator, IMT-Bucharest, Project Manager: Dr. A Müller (alexandru.muller@imt.ro)
Partners: National Institute for Material Physics, "Politehnica " Univ. Bucharest, "Valahia" Univ. Targoviste, "Ovidius" Univ. Constanta, Institute of the Macromolecular Chemistry "Petru Poni", Iasi.

GaAs MEMBRANE SUPPORTED MILLIMETER WAVE RECEIVER MODULE FOR 60 GHz



Optical photo of the 60 GHz receiver structure micromachined on GaAs

GaAs membrane supported millimeter wave receiver operating in the 60 GHz frequency range was fabricated and characterized. The receiver structure is based on the monolithic integration of a Yagi-Uda antenna with a Schottky diode, both having as support the same 2.2 μm thin semi-insulating GaAs membrane. The fabrication processes is based on GaAs micromachining. The experimental characterization of the Yagi-Uda antenna receiver was performed using a measuring set-up designed and realized in the laboratory.

Achievements: Design, modeling and manufacturing of 60 GHz GaAs micromachined receiver structures. The design procedure, the technological processing and characterization techniques open a window of opportunity for the development of innovative architectures for circuits and systems operating at higher frequency, up to the sub-millimetre wave frequency range

CEEX INFOSOC Project "Integrated RF-MEMS circuits based on silicon, gallium arsenide and wide band gap semiconductors for advanced communication systems – ACOMEMS" (2005-2008) Co-ordinator, IMT-Bucharest, Project Manager: Dr. A Müller (alexandru.muller@imt.ro)
Partners: National Institute for Material Physics, "Politehnica " Univ. Bucharest, "Valahia" Univ. Targoviste, "Ovidius" Univ. Constanta, Institute of the Macromolecular Chemistry "Petru Poni", Iasi.

STUDIES OF THE BIOLOGICAL EFFECTS OF ELECTROMAGNETIC FIELDS

Human beings are bioelectrical systems. Our hearts and brains are regulated by internal bioelectrical signals. Environmental exposures to artificial electro-magnetic fields (EMFs) can interact with fundamental biological processes in the human body. In some cases, this can cause discomfort and disease. Since World War II, the background level of EMF from electrical sources has risen exponentially, most recently by the soaring popularity of wireless technologies such as cell phones (two billion and counting in 2006), cordless phones, WI-FI and WI-MAX networks.

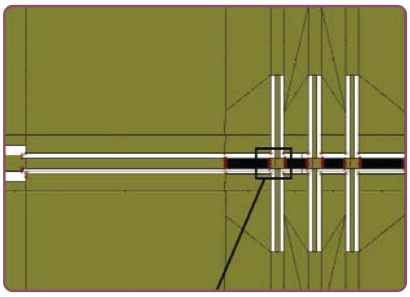
Several decades of international scientific research confirm that EMFs are biologically active in animals and in humans, which could have major public health consequences.

Achievements: Emphasizing biological effects following the specimen exposure in controlled media (in laboratory); Determining of specific absorption ratio (SAR) in biological media following irradiation in controlled condition with electromagnetic waves specific GSM system

CEEX CERES Project „Researches on bio-electro-magnetic interactions and biological effects of human exposure to radiofrequency and microwaves electromagnetic fields - BIO-EM-R"
Co-ordinator: Land Forces Academy „Nicolae Balcescu" Sibiu.
IMT Bucharest: partner in reserch team**, Project manager for IMT Bucharest: Dr. George Sajin**

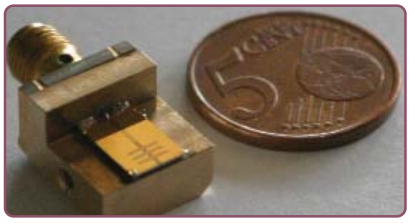
METAMATERIAL MEDIA AND DEVICES IN MICROWAVE FREQUENCY DOMAIN

Due to their unusual but interesting characteristics which are not encountered in nature, the microwave circuits based on metamaterial (MM) properties became a very interesting topic in the actual research field. The present tendency in the European research in this domain is (a) to study new geometrical configurations with special propagation characteristics (b) to "invent" new devices and applications of these media and (c) to "populate" the frequency domain below infrared domain with new EMBG structures and devices, using, mainly, the newest technological approaches. One possibility to obtain transmission media having these characteristics is to develop circuits which under certain conditions may model the homogeneous MMs. For two dimensional circuits, artificial MMs have been proposed by using different lattice structures or periodic repetition of unit cells using circuit components.



CRLH antenna layout

Another class of MMs is the artificial LH (Left-Hand) transmission line. This may be implemented by using chip capacitors and parallel connected inductors. On this way, devices such as branch coupler and antenna have been reported, the main advantage of this type of circuits comparing to the classical ones being the dual frequency response to any frequency ratio.



CRLH antenna in a test fixture

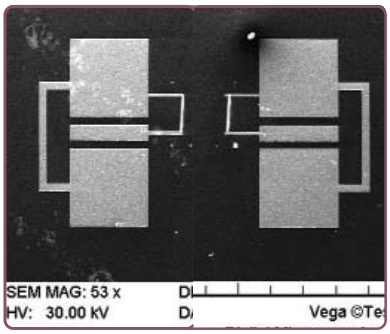
Achievments: Manufacturing of EMBG structures by microprocessing of metallic substrate (Designing and obtaining of the technological masks; Microprocessing of EMBG structures; Functional chracterization of EMBG structures) and designing of microwave devices on EMBG media (Establishment of microwave EMBG device structures; Assesement of the difficulties and establishment of methods to avoid it; Designing of chosen structures)

Measuring test set for S11 scaterring parameter

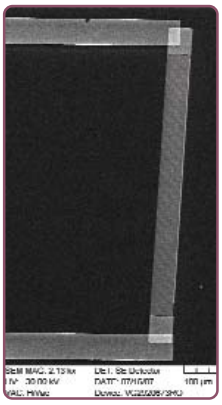
CEEX INFOSOC Project "Microwave structures and devices on microprocessed media with frequency selectivity"-ELMAG_SF (2005-2008), Co-ordinator, IMT-Bucharest. Project Manager: Dr. George Sajin-(gheorghe.sajin@imt.ro);
Partners: INCDIE ICPE CA Bucharest; „Politehnica" University Bucharest, INCD-FM Bucharest.

WIDE BAND GAP SEMICONDUCTOR SAW TYPE DEVICES FOR GHZ APPLICATIONS, MANUFACTURED USING NANO-LITHOGRAPHIC TECHNIQUES

Experiments to develop SAW structures with operating frequencies in the GHz range were performed on AlN and GaN thin films with nano-metric lines for an interdigitated transducer (IDT). After the nanolithography there were obtained some very good quality inerdigitated Ti/Au structures (with 30 digits and 29 interdigits 300nm wide, 220nm high and 200μm long). Lift-off techniques to remove the undesired metal were used. On wafer microwave measurements of the SAW structure have demonstrated its functionality. It was evidenced a pronounced resonance at about 2.8GHz. Future development of WBG semiconductors and nanolithography based techniques will permit the developing of a new generation of SAW devices, operating over 5 GHz, able to be to used in 4G mobile phones and in 5.2 GHz WLAN applications



Two experimental SAW structures with the two IDTs placed "face to face"

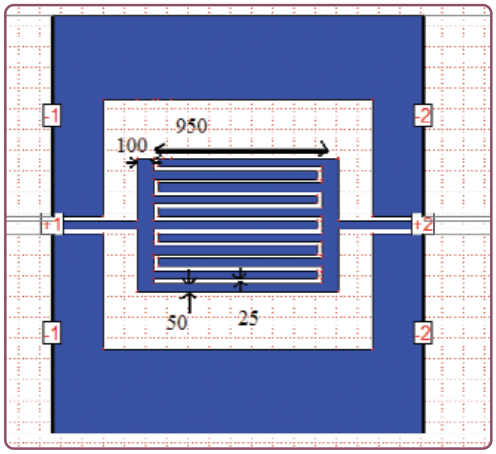


An IDT with 30 TiAu fingers and 29 interdigits (finger width and interdigit width are about 300 nm)

Achievements: A SAW structure for an operating frequency of about 2.8 GHz was successfully developed on a thin AlN layer sputtered on high resistivity silicon. The structures were obtained with the support of the Nanoscale –Conv Project (Nr 6111/2005-CALIST)

CEEX INFOSOC Project "Integrated RF-MEMS circuits based on silicon, gallium arsenide and wide band gap semiconductors for advanced communication systems – ACOMEMS" (2005-2008) Co-ordinator, IMT-Bucharest, Project Manager: Dr. A Müller (alexandru.muller@imt.ro)
Partners: National Institute for Material Physics, "Politehnica " Univ. Bucharest, "Valahia" Univ. Targoviste, "Ovidius" Univ. Constanta, Institute of the Macromolecular Chemistry "Petru Poni", Iasi.

NEW RECONFIGURABLE MICROMACHINED FILTERS DEDICATED TO RECONFIGURABLE FRONTENDS FOR MOBILE COMMUNICATION SYSTEMS 3G AND „BEYOND" 3G" WHICH ENDURE THE DCS 1800MHz AND WLAN 5.2 GHz STANDARDS



Atipical stop band resonator

The project started at the end of 2007 with study regarding the atipical rezonators to be used in the design of the reconfigurable filters.The filters will be manufactured by MEMS technologies usig an original circuit architecture. Complex L-C structures configurated on bulk silicon and others suspended on dielectric membranes will be used. 1.5 μm thick $SiO_2/Si_3N_4/SiO_2$ membranes will be obtained by micromachining of <100> high resistivity silicon.

Achievments: Modeling and electromagnetic simmulations of atipical resonators.

PN II Partnership Project "Advanced circuits for microwave, millimeter wave and photonics based on MEMS technologies MIMFOMEMS" **(2007-2010) Co-ordinator, IMT-Bucharest.**
Project Manager: Dr. A Müller (alexandru.muller@imt.ro)
Partners: National R&D Institute for Material Physics, "Politehnica" Univ. Bucharest, Institute of the Macromolecular Chemistry "Petru Poni" Iasi, SITEX 45 Bucharest.

COMPOSED RIGHT/LEFT HANDED (CRLH) MEDIA AND DEVICES FOR MILLIMETER WAVE FREQUENCY DOMAIN

The purpose of this project is elaborating some devices – directional couplers and miniatural antennae – on MTM to facilitate the filling with devices of the millimetric waves (mm-wave) domain. In this approach the unconventional characteristis of the MTM will be used in order to overpass some difficulties that regular materials cannot. This is also the reason why the frequency area between the microwaves domain and the far infrared is partially uncovered by applications. In order to obtain these devices we will use modern techniques offered by the microprocessing of the CLRH structures through laser ablation controlled at a hundredths/tenths nanometers levels.

Achievements: Studies and analyses concerning the geometries of devices structures on metamaterials for frequencies in the millimeter wave domain.
• Studies and analyses on the geometries of CLRH media in the millimeter wave domain
• Studies and analyses concerning the properties of the used materials
• Studies and analyses concerning the technologies of submicronic substrate processing in order to obtain CLRH media in the millimeter wave domain

PN II Partnership Project "Millimeter wave devices on metamaterials microprocessed by laser ablation METALASER" (2007-2010) Co-ordinator, IMT-Bucharest, Project Manager: Dr. Gh. Sajin (gheorghe.sajin@imt.ro)
Partners: National R&D Institute for Laser Physiscs, Plasma ans Radiation, Bucharest, "Politehnica" Univ. Bucharest, INCDIE ICPE CA Bucharest

ADVANCED FEMTOSECOND LASER SYSTEM FOR METAMATERIALS and PHOTONIC CRYSTALS NANOSTRUCTURING

By materials ablation with fast pulsed lasers (femtoseconds), the thermal effect round the ablated area is negligible. By laser beam focusing at diffraction limit, good quality and reproducible microprocessing with sub micron resolution can be obtained on metals, plastics, and dielectrics. Due to the very high laser pulse power density (GW-TW/cm^2), the nonlinear optical effects of multiphotonic absorption are dominating. So, laser radiation can be absorbed even in transparent materials for the fundamental wavelength (775 nm, in our case). Multiphotonic absorption took place in smaller volumes than laser focused spot size, only where the laser intensity overtakes the threshold of the nonlinear optical effect. Negative refractive materials, very intensive studied worldwide in the last years, open the possibility for new basic phenomena and for promising applications as well in electromagnetic waves communications, development of super lenses with sub-wavelength resolution and antireflective materials. Such new artificial materials can be made as metamaterials (MTM) structures or photonic crystals (CF). MTM are artificial periodic structures with cell dimension much smaller than the electromagnetic radiation wavelength. The incident wave "sees" MTM like a homogenous structure; the refraction prevails over diffraction and scattering phenomena. "Classical" techniques used to manufacture such structures are microelectronic processing (vacuum deposition of metallic or dielectric layers, photolithographic processing). The actual worldwide tendency of extending MTMs from GHz to THz and further to optical domain requires innovative technologies able to lead the processing resolution in the nano-metric domain.

Achievements: Drawing up the functional system of the advanced laser system for nanostructured materials.
• Studies and analyses of the photonic processing necessities for CRLH structures at very high frequencies
• Analyse of the rezults and drawing up the research report

PN II Partnership Project - FEMAT (2007-2010). Co-ordinator, National Institute for Laser Physics, Plasma and Radiation, Bucharest, IMT Bucharest: partner in reserch team, Project manager for IMT Bucharest: Dr. George Sajin

L4: Participation to European Projects

Results obtained by the Laboratory team in the FP6 Network of Excellence AMICOM

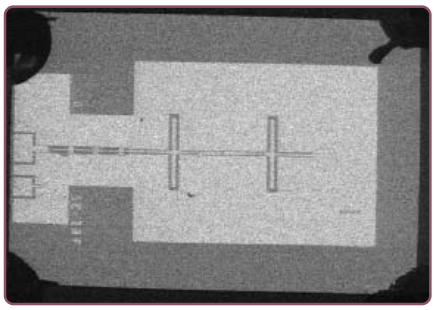
Results obtained by the Laboratory team in the FP6 Network of Excellence "Advanced MEMS for RF and Millimeter Wave Communications" (**AMICOM;** 2004-2007) – ***http:\\www.amicom.info***, coordinator LAAS-CNRS, Toulouse/ Univ Perugia.

IMT contact person for **AMICOM**: Dr. Alexandru Müller, member of Board of Directors (**alexandru.muller@imt.ro**)

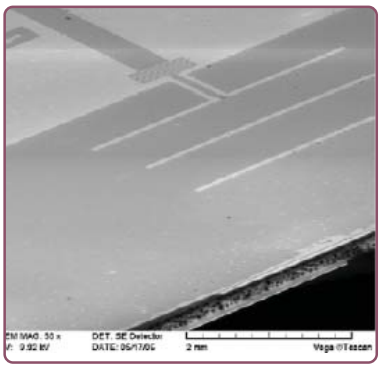
The research work in **AMICOM**, was performed via two "North Star" Projects: "MMID – Millimeter Wave Identification" and "ReRaFE – Reconfigurable Radio Front-End". The technological research was developed together with partners from FORTH Heraklion, VTT Helsinki, TU Darmstadt, LAAS Toulouse, IMEC Leuven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

Achievements:

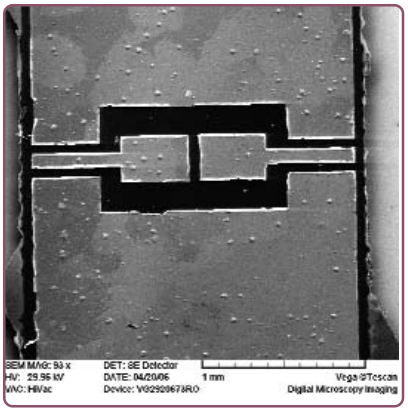
- Design, modelling and manufacturing of a membrane supported Yagi-Uda antenna for 45, 60 and 77 GHz,
- Monolithically integrated receiver front end with a membrane supported Yagi Uda antennae
- Design, modelling and manufacturing of advanced F-BAR test structures;
- Switches for 60 GHz on GaAs substrate;
- 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 identification (MMID) system, Demonstration of the MMID concept;
- 60 GHz Band-pass and band-stop tunable filters using surface and bulk micromachining.
- 60 GHz radiating elements (Yagi-Uda antenna).
- FBAR resonators.
- Tunable band-pass filters for 1-6 GHz frequency range.
- 60 GHz receiver for the MMID tag.



SEM photo of the 77 GHz micromachined receiver structure with folded slot antenna, to be used as tag **(IMT, VTT, ITC irst**) - European Microwave Week , EuMW-EuMC 2007, Munchen, Germany, 8 – 12 October 2007, pp. 1034-1037



SEM photo of the 60 GHz GaAs membrane supported receiver module **(IMT, FORTH, VTT)**- Proc of the MEMSWAVE Conference, Barcelona, Spain, June, 26-29, 2007, pp15-18



SEM pthoto of the series connection of 2 FBAR structures (IMT, FORTH, TUD) - International Microwave Symposium Digest, IEEE MTT-S 2007, pp.877-880

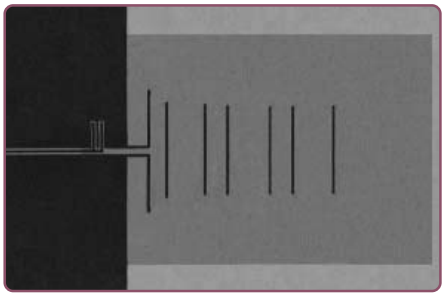


Photo of the 77GHz Yagi-Uda antenna structure

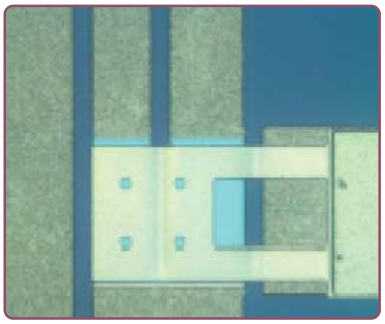
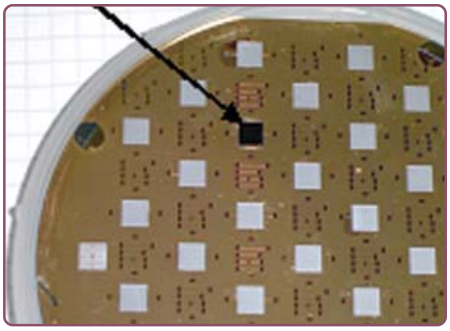


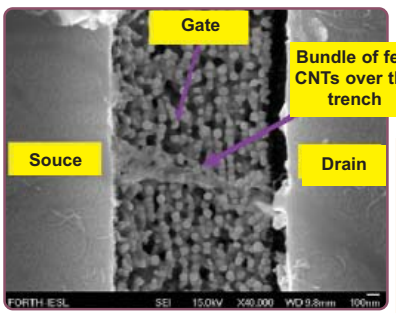
Photo with detail of the cantilever beam from the tunable band-stop filter (IMT, LAAS) - Electronics Letters Vol43 No12, June 2007, p. 676-677



CNT array mounted inside the trench and terminated with two CPW line.

The entire structure formed by millions of nanotubes behaves as a microwave resonator with a quality factor of 800 at 1.4 GHz.

M. Dragoman, D. Neculoiu, A. Cismaru, K. Grenier, S. Pacchini, L. Masenq, and R. Plana, "High quality nanoelectromechanical microwave resonator based on a carbon nanotube array", Appl. Phys. Lett., vol. 92, pp. 063118/1-3, 2008.



Nano-oscillator technological implementation. The nanoscilator consists of a bundle of nanotubes suspended of a metallized trench at its bottom and two electrodes at each end of the trench micromachined into a GaAs substrate. The device has demonstrated amplification and negative differential resistance.

L5: Simulation, Modelling and Computer Aided Design Laboratory

• ***Mission:*** research, simulation and modelling activities oriented to collaborative research projects, education (courses, hands on training, seminars, workshops), services (offering access to hardware and software tools) and consulting (design/ optimization) in the field of micro/bio/nanotechnologies.

• ***Main areas of expertise:*** **design, development and optimization of MEMS/MOEMS components and devices** (switches, cantilevers, bridges, membranes, microgrippers); mechanical, thermal, electrical and electrostatic, piezoelectric, fluidic, as well as coupled field (static and transient) analysis; modelling and simulation for multi-physics problems; **design, modelling and simulations of microfluidic components and systems for biomedical applications and micro-electronic fluidic systems** (valves, pumps - with various actuation principle as electrostatic, piezoelectric, pneumatic, electroosmotic, reservoirs, microchannels, filters, mixers, heaters, etc.) – the microfluidic analyses include: fluid dynamics in microstructures (general flow, fluid mixing, thermal analysis); electrokinetic flow (electrophoresis, electroosmosis); electrokinetic with field switching analysis; fluid diffusion; bubble and droplet simulation (transport, merging, splitting); interaction between fluids and mechanical parts; mechanical, electrostatic, piezoelectric analysis for microfluidic actuators; modelling of optoelectronic devices, neural networks.

Other expertise of the lab's members include: elastomer based microstructures (technology, applications); optical processing and storage of information; micro-systems applications in the field of energy; manufacturing and characterization of materilas for advanced nanoelectronic devices based on oxidic materials; techiques of chracterizations as cathodoluminescence and photoluminecence

• ***Research Team:*** The team has a multidisciplinary expertise in: mathematics, physics, electronic and mechanics 3 PhD, 2 physicists, 2 engineers (mechanical and electrotechnical), 3 PhD students.

• ***Specific facilities:*** **Soft/hard Tools:** • **COVENTOR 2006** (upgraded in 2007) • **MATLAB 7;** • **ANSYS Multiphysics 11.0**; • **COMSOL Multiphysics 3.3, 3.4**; • Workstation with 4 quad-core Intel Xeon MP 2.93 GHz processors, 64 GByte RAM and 584 GByte HDD + 876 GByte external storage;

Characterization equipments:

• Avantes Fiber Optic Spectrometer - AvaSpec NIR256-2.2 • The AvaSpec equipment is used in optical spectra acquisition and characterization of thin films luminescence emission.

• Fluorescence spectrometer in UV-vis-NIR, also for reflection, transmission and absorption

• Reflective conoscope

Processing equipments: Impulse laser at 266 nm, 18 mJ/pulse, 29 psec, 10 Hz repetition frequency

• Supplementary components for the impulse laser: optical table, deflection mirror 90 degrees, x-y positioning equipment with a 15 cm travel, 0.1 μm resolution and 3 μm accuracy.

• ***International FP 6 networks and projects:***

- **MI-Lab on chip**- "Lab-on-a-chip implementation of production processes for new molecular imaging agents- STREP (2005-2009), NMP-No 516984
- **ASSEMIC**- Advanced Handling and Assembly in Microtechnology (2004-2007), 2003-504826, Marie Curie Research Training Network-WP 2- Microhandling (Computational fluid dynamics);
- **PATENT**- Design for Micro & Nano Manufacture, NoE No.507255, (2004-2008), IST: WP 2 Modelling and Simulation; Micro Electronic Fluidics Service Clasuter.
- **IPMMAN**- Improvement of industrial Production Integrating Macro, Micro And Nanotechnologies for more flexible and efficient manufacturing FP 6(CA, NMP-CT-033205, 2006-2009)
- **Microteaching** - New teaching and learning methods and basic qualifications in job education, Leonardo da Vinci, (Contract nr. 146157, 2004-2007)

Team from left to right:
Rodica Voicu;
Victor Moagar-Poladian;
Oana Nedelcu;
Catalin Tibeica;
Florina Ravariu;
Gabriel Moagar-Poladian;
Rodica Plugaru;
Irina Codreanu

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 researcher with ICCE Bucharest; since 1994 she is with IMT Bucharest. Currently R. Müller is ***Head of Scientific Services Department*** and ***Coordinator*** of the ***Simulation, Modelling and Computer Aided Design Laboratory***.

Her main scientific interests include design and technological processes for sensors and actuators based on MEMS/ MOEMS techniques, integrated optics, nanolithography. She was involved in teaching activities as associated professor at University "Valahia Targoviste".

Raluca Muller is coordinator of several national research projects and scientist in charge from IMT - Bucharest in international projects as: *FP 6: ASSEMIC- Marie Curie Training Network (2004-2007)- FP6- PATENT (Modelling and Simulation cluster), Leonardo da Vinci- Microteaching (2005-2007) , IPMMAN- CA (2006-2009)*. She is author and co-author of more than 70 scientific papers presented at conferences and published in journals (Sensor & Actuators, J. of Micromechanics and Microengineering, Appl.Optics., Journal of Luminescence etc).

L5: Participation in FP6 projects

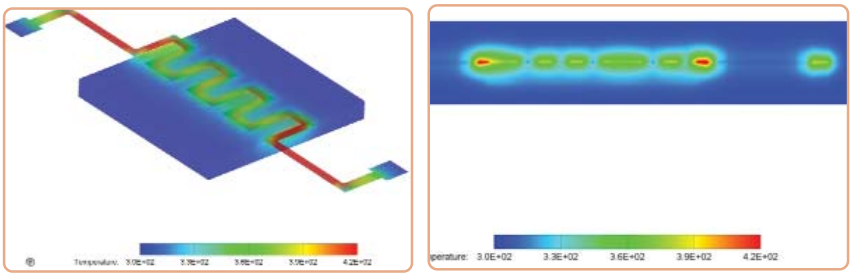
Implementation of Production Processes for New Molecular Imaging Agents
MI-lab on chip-Lab-On-A-Chip

STREP-FP6, Priority 3 **NMP,** No 516984, (2005-2008)

Coordinator: ***University of Liege, Belgium.*** **Partners:** Trasis S.A. Belgium, Bartels Mikrotechnik GmbH Germany, IMT- Bucharest Romania; GG.Tec injection Belgium, Universite Henri Poincare–Nancy France.
IMT- Bucharest (contact person: ***Oana Nedelcu- oana.nedelcu@imt.ro***)
Objective: Developing multiple steps radio-pharmaceutical chemistry processes at the micro molar scale.

RESULTS: **Simulations for circular valve of pneumatically actuated micropump** [TPX; drop (0.2 – 6 bar); variable diameter (2-8 mm); variable thickness (20-50 μm);].

Modelling and simulation of pneumatic actuator: The pneumatic actuation was investigated by considering a long channel, the pneumatic chamber and the inlet valve. Two cases were studied: filling the chamber from 0.1 Bar to 2 bar and emptying the chamber from 2 Bar to 0.1 Bar. A specific geometry of actuating system has been investigated: diffuser/nozzle channel, and diffuser/ nozzle valves respectively. The flow rate as function of pressure drop was obtained.



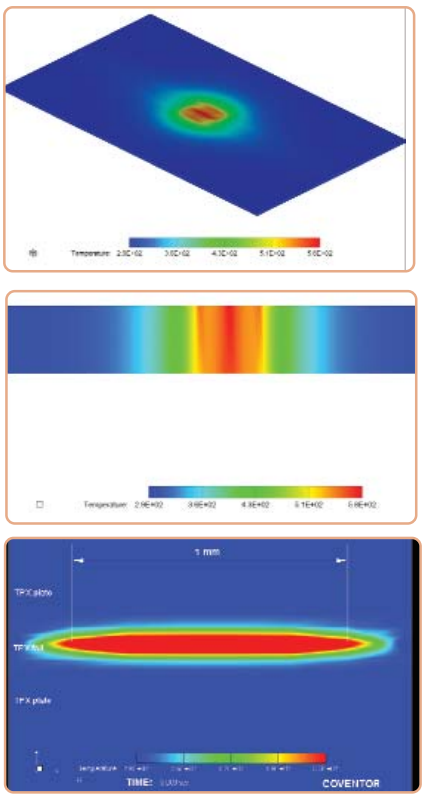
Heating up the water filled chamber - Temperature distribution and variation in time

Modelling and simulation of heaters for lab-on-chip:
Two methods for heating the liquid enclosed in a cavity were investigated:
- by means of an electrical heater configured on the membrane that covers the cavity. The dependence of reached temperature in respect to heater geometry and dimensions, and applied voltage, was simulated.
- by means of a laser radiation that is absorbed in the carbon black loaded TPX foil; The dependence of temperature in respect to laser radiation, penetration depth, geometry, and different boundary conditions, was simulated.

Design of optical systems: various optical systems were investigated and were designed according to the requirements. The propagation of electromagnetic field through the designed optical system was simulated. Also, the effect of misalignments in the optical system was investigated.

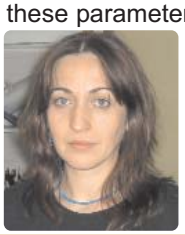
Heating laser system for seal break: The power density needed for melting the carbon black loaded TPX foil was determined. Also, the dynamics of the heating process was investigated. Welding laser system: Simulation of temperature gradient (difference between the two opposite sides of the TPX foil) as function of power density was performed in order to find out the proper pumped energy for welding the TPX foil to the TPX plate.

Filter Simulation. Two design concepts for filter were investigated:
Case 1.1: A restriction in the channel; an inlet and an outlet that is narrow enough to prevent the beads from escaping with the flow, but still be wide enough to allow a fair flow rate. The flow rate was obtained as function of geometrical specifications [by varying restriction length, depth, width and opening angle], and as function of pressure drop.
Case 1.2: Holes (laser microfabricated) in TPX membrane: The hole (flow channel) is connected to two chamber at inlet and outlet respectively. More geometrical specifications set were simulated by varying the holes shape, and length, where hole length is membrane thickness. The flow rate as function of these parameters was obtained.



Piercing the TPX foil by means of electrothermal (Joule) effect and thermal effect of laser radiation

Contact Person IMT: Mat. Oana Tatiana Nedelcu - PhD Student, oana.nedelcu@imt.ro



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.

L5: Participation in FP6 projects

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)**

• The Laboratory was involved in the **Flagship Project "Integrated Characterization of Packaging Hermeticity Combining Test, Modelling, Reliability Characterization and Packaging Integration of a Humidity Microsensor" – HERMETICITY**

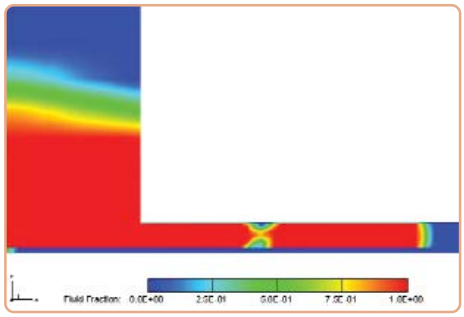
Modelling Effects of Packaging on MEMS - Round Robin Modelling Study

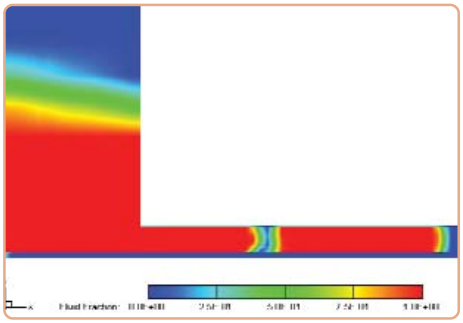
Contact Person IMT: Phys. Catalin Tibeica, PhD student, catalin.tibeica@imt.ro;

Partners: Tyndall (coordinator), IEF - UPS, IXL,LAAS, LIRMM, QinetiQ, BUTE, **IMT- Bucharest**, POLIMI, CEA; Industrial Support: Philips Semiconductors

Objectives: To create a numerical model for the simulation of moisture absorption in packaged Microsystems

Results: Simulations were carried out for evaluating the time of diffusion of external humidity inside a sealed cavity. Moisture absorption in the package was simulated based on the analogy between the mass diffusion and the thermal diffusion described by the same differential equations. The time intervals needed to get the external humidity at the inner surface of the BCB sealing layer having various dimensions and absorption properties were obtained. The graphs below show the vapor partial pressures in the region of BCB-cavity interface versus time for different combinations of external RH (50 and 100%), diffusion coefficients (5.2 and 45 $\mu m^2/s$), and BCB thickness (5 and 20 μm).





CoventorWare simulation of droplet formation using the electrowetting principle

• **Droplet-Based Micro-Electronic Fluidic Operations for Production and Evaluation Platform BioMEMS (BioDrop).**

Contact Person IMT: Mat. Irina Codreanu,PhD student, irina.codreanu@imt.ro

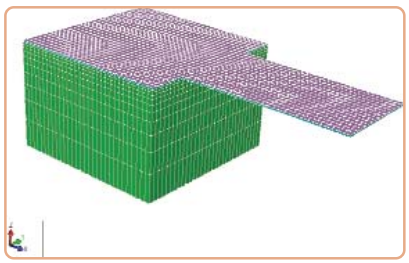
Partners: CTIT University of Twente (NL)- coordinator, CCLRC, Daresbury (UK), QinetiQ Ltd (UK), MESA+Enschede (NL), MultiSynTech GmbH, Witten (G), University of Lancaster (UK), Pepscan Systems BV (NL), LIRMM, Montpellier (F), **IMT-Bucharest** (Ro)

IMT-Bucharest performed analysis of dynamic behaviour of droplets transfer, merge and split and comparison with the experimental data and the simulations of the droplet insertion mechanisms, using COVENTOR-WARE 2006. For the insertion of droplets in the device the electrowetting principle was considered.

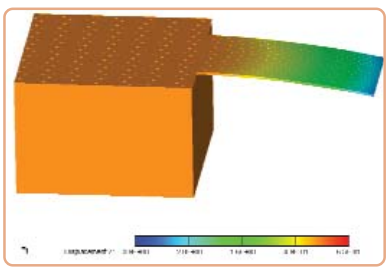
ASSEMIC - Advanced Methods and Tools for Handling and Assembly in Microtechnology

Acronym: **ASSEMIC**, Contract 504826 (2004-2007), Marie Curie- Research Training Network -
Coordinator: **Prof. W. Brenner**- ISAS- TU Vienna;
WP II- Microhandling – scientist in charge from IMT- Bucharest: **Dr. Raluca Muller**

Contact person: Mat. Rodica Voicu, PhD student, rodica.voicu@imt.ro



The meshed model of the cantilever with 1.7 μm thick SiO_2 used in simulations



Vertical Displacement for the cantilever with 1.7 μm of SiO_2 and 502 nm of ZnO

FEM-based simulations using CoventorWare 2006 software tools were performed for **ZnO cantilevers**, to be used in gas detection. A 3D structure model have used in simulation (following figures).

We studied:

a) the displacement of the cantilevers performing nonlinear, mechanical analysis considering for the ZnO stress values between – 300-50 MPa

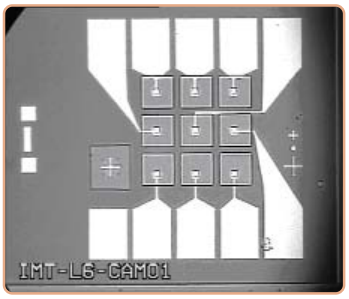
b) the oscillating frequencies of the cantilevers (without any stress) performing modal and nonlinear analysis for cantilevers.

NATIONAL PROJECTS

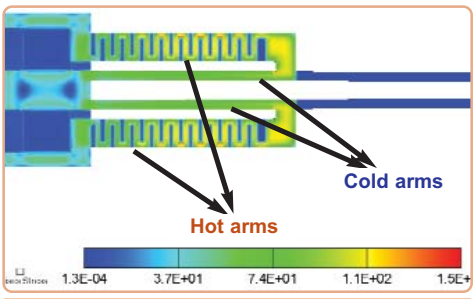
SENSORS AND ACTUATORS MICROSTRUCTURES FOR MICROROBOTIC POZITIONING, MECHANICAL AND BIOLOGICAL MANIPULATION - MEMSAS

The project scope is to develop two kinds of structures, using microelectronic and MEMS technologies: **optical position sensors**, based on different configurations and thermo-actuated **microgrippers**, using surface micromachining techniques.

We developed multi-element PIN photodiodes (linear and quadrant areas) for detection of the position of a light beam.

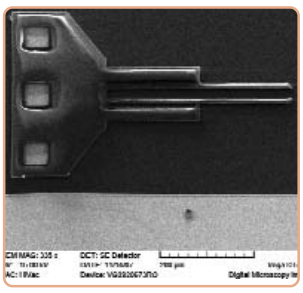


SEM photo of a PIN photodetector multielement position sensor (3x3 active elements)

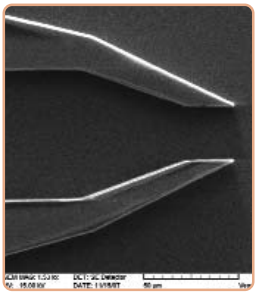


Stress distribution of the microgripper, when 0.1 V is applied

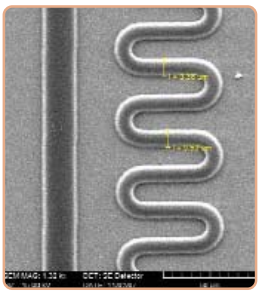
We designed, simulated and started experiments for the fabrication of polymeric microgrippers using SU-8 as structural materials for the arms. These structures can be used as end-effectors in handling, positioning and micro-assembling of different micro elements or biological cells. The proposed structures are sensitive and can operate at very low actuation voltages (0.3 V). The shape of the resistors (the heating element) was optimized in order to reduce the effects of residual stress which influence the mechanical behaviour. Various displacements of the arms were analysed and compared, based on FEM simulations, using CoventorWare 2006 software. Coupled thermo-electro-mechanical simulations have been performed in order to predict the microgrippers behaviour in air as function of the applied voltage and temperatures. We optimized the microgripper's configuration and proposed an original approach in order to reduce the unnecessary displacement (vertical) of the two arms.



SU8 polymeric microgripper - preliminary results(SEM photo)



20 μm – the opening of the two arms (SEM photo)



CrAu meander resistance of the hot arm ((SEM photo)

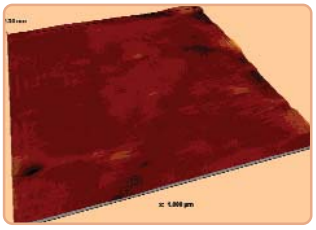
Project type: CEEX – Contract 28/2005, (2005-2008) - INFOSOC; Project coordinator: IMT Bucharest, Project manager: Dr. Raluca Müller (raluca.muller@imt.ro); Partners: INCD-SB, INCD-FLPR, UPB, Univ. "Valahia" Targoviste

LIGHT EMITTING AND MODULATING POLYCOMPOZITE MICROSTRUCTURES – ELECTRO-OPTICAL PROPERTIES

We succeeded in preparing Alq3 (Aluminium Tri-8-hydroxiquinoline) microcrystals by using a technology developed during the project.

We also obtained Alq3 thin films by thermal evaporation in vacuum. It is seen that the surface of the Alq3 layer is very uniform, with a roughness of less than 88 nm.

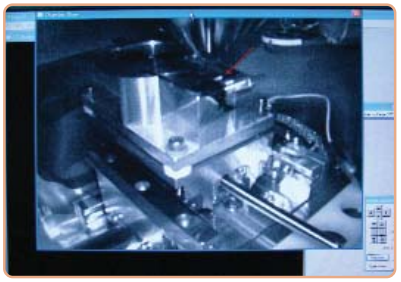
In all the cases (microcrystals, respectively the thin films), the Alq3 was naked eye photoluminescent under UV radiation and also electronoluminescent (light emission under electron beam bombardement), see figure below.

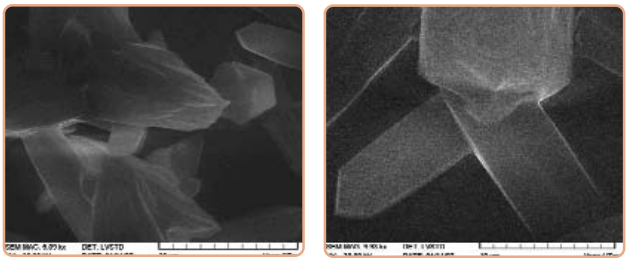


AFM image of the Alq3 layer obtained by vacuum evaporation

The optical microscopy image of one of the samples prepared by slow evaporation from solution. The image size -300μmx500μm

Photo image of the SEM equipment screen with the illuminating LED connected. The spot is still clearly visible. The illuminating LED allows see the sample chamber when the SEM is working. The image is taken from there by a black-and-white CCD camera.

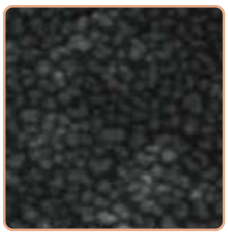




SEM images of the Alq3 microcrystals: a) details of the microscrystallite surface; b) detailes of the microscrystallite section.

Project type: CEEX 44 / 2005(2005-2007), Coordinated by INCD-FLPR;
IMT-Bucharest –partner – Project Manager: Dr.Gabriel Moagar Poladian (gabriel.moagar@imt.ro)

UNCONVENTIONAL MATERIALS FOR MICROTECHNOLOGY – RESEARCH AND EXPERIMENTATION OF ELASTOMER BASED MICROSTRUCTURES FOR APPLICATIONS IN THE FIELD OF MICROSYSTEMS



SEM images at nanoscale of the polycloroprenic elastomer thin film surface

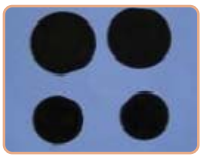


Photo image of four samples covered with polycloroprenic elastomer thin film (Silicon subtrate)

Results: Deposition of elastomeric thin films (policloroprenic, butilic and butadien-styrenic rubbers) with very good adherence to surface and good surface topography. Nano-crystallization of the film as a consequence of its thermal annealing was observed.

Project Type: CEEX 15 I 03 / 2005 INFOSOC (2005-2008)
Coordinator IMT- Bucharest; Project manager: Dr.Gabriel Moagar Poladian (gabriel.moagar@imt.ro)
Partners: S.C. ICEMENERG S.A., Univ. Bucuresti, S.C. IPEE-ATI S.A., S.C. ProOptica S.A., S.C. Optoelectronica – 2001 S.A.

UNIT OF ANALOG OPTICAL PROCESSING OF IMAGE TYPE INFORMATION

Original image.

Image obtained with a final voltage of 900 V

a)The specific algorithms for the optical processing unit were conceived and developed, regarding grey level variation, all-optical grey level selection (to select only those regions of an image that have the respective grey level), all-optical contour extraction.
b) The algebra of the device was established.
c) An emulation software is conceived and now is under development for simulating the optical processing unit behaviour. The software is useful for the design of an optical processor containing several processing units and it is based on the mentioned algorithms. The software is created both in Visual Basic and Java. Below are some examples of the software windows and processing capabilities. We mention that the processing is made according to the working principle of the unit and not to the general established rules for digital image processing. It is applicable to units based on Pockels crystals.
From the figures one can observe that soft tissue is clearer visible than in the original image (for example, the vascular part in the right front image). By selecting the proper voltage, different parts (tissues) become more visible, according to the needs. The original image was taken from Internet. It is also observed that the original image was counterfeited (see bottom right part of the image, were it is observed an intervention onto the lower part of the profile image).

Project Type: CEEX 139 I 03 / 2006 INFOSOC (2006-2008)
Coordinator IMT- Bucharest; Project manager: Dr.Gabriel Moagar Poladian (gabriel.moagar@imt.ro)
Partners: Univ. Bucharest, S.C. Optoelectronica – 2001 S.A., S.C. RD Concept S.R.L.

ELECTRONIC NANODEVICES BASED ON OXIDIC MATERIALS- NANOXI

The project aim is to develop new, atomic-scale designed materials as thin films for specific nano-device applications. Knowledge with fundamental character will be derived from the results on film compositions, structures, magnetic phases, texture, and structural defect distributions in the bulk and at interfaces. As a new approach for the partners in this proposal, structural models of the films will be used in the optimization/tuning of material functional properties. Study of carefully built models of the materials will reveal fundamental aspects of material physics and chemistry, as well as the synthesis conditions. The models will reflect various experimentally controllable parameters, such as the film structure and thickness, doping type and concentration.

Project Type: PNII- Contract Nr. 11-048 (2007-2010)
Coordinator IMT- Bucharest; Project manager: Dr. Rodica Plugaru (rodica.plugaru@imt.ro)
Partners: University Politehnica of Bucharest, Institute of Physical Chemistry "I.G. Murgulescu" Romanian Academy, National Research and Development Institute for Electrical Engineering- ICPE-CA, S.C. METAV-Research & Development S.A.

MICRO-WELDING SYSTEMS FOR MICROSENSORS AND ACTUATORS FOR MICRO-JOINING OF CIRCUIT ELEMENTS AND PACKAGING – MICROWELD

The aim of the project is the development of the knowledge in the field of technologies dedicated to micro-assembling of MEMS components by developing 3 methods of micro-joining of metallic and non-metallic materials that are commonly used in MEMS devices. These welding procedures will respect either one of the following conditions: - to realize a good electrical contact between different components of MEMS; - to enable a good sealing for MEMS devices.

IMT-Bucharest role in the project is the design and simulation of the behavior of the micro-welded components under exploitation conditions and the characterization of the quality and the properties of the welding.

Project Type: PN II Project (2007-2008)). Coordinator ISIM,
IMT-Bucharest partner, Contact person: Eng. Phys. Victor Moagar-Poladian (victor.moagar@imt.ro)

KNOWLEDGE BASED ECOLOGICAL MATERIALS FOR FIRE PROTECTION WITH SECTORIAL AND INTERSECTORIAL APPLICATIONS WITH–ECOMAF

The aim of this project was to develop a highly protective paint against the heating of fire. This paint will cover structures like metallic reinforcements for buildings, walls, gas tanks, etc. providing enough thermal insulation for certain time (until the fire is extinguished). The principle of this protective paint is to develop and trap bubbles of gas when the paint is exposed to the fire. This way the thickness of the layer will become considerable, and the thermal conduction will be reduced due to its porous structure. Due to the complexity of phenomena, the ANSYS simulation was carried out by IMT, studying initially the development of only one bubble of gas in the layer of protective paint, and then using the result to create home made software in order to deal with foam development. The next step was the transient thermal simulation over the foam structure (with gas inside the bubbles) in order to estimate the amount of the provided isolation as a function of time.

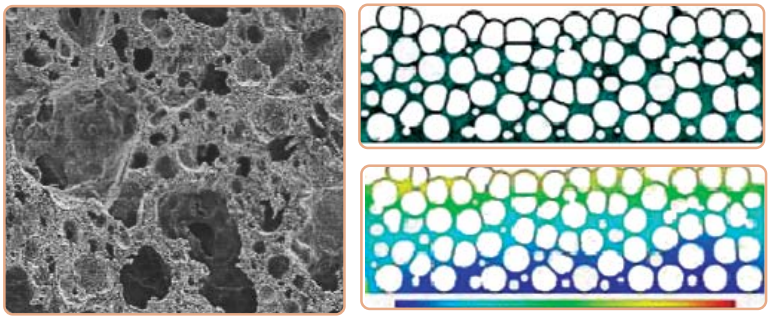
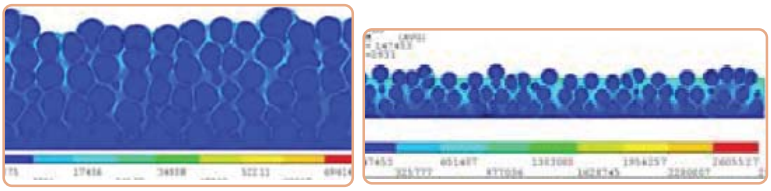


Photo of he sample, the simulated foam development and the thermal distribution inside the intumescent foam.

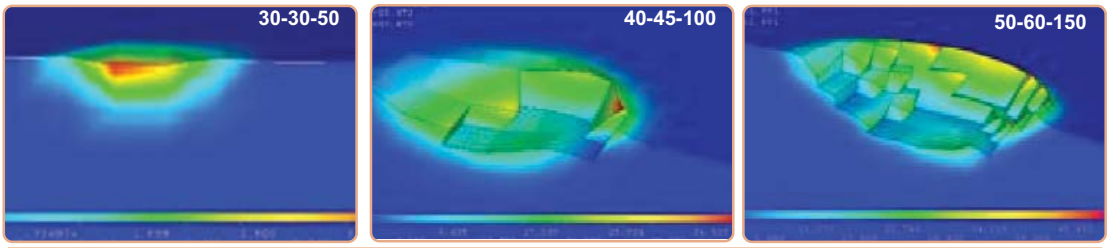


Thermal flux in the initial stage (a) and last (b) of foam formation (note the thermal flux differences)

Project Type: CEEX (2005-2007). Coordinator ICEMENERG,
IMT-Bucharest partner, Contact person: Eng. Phys. Victor Moagar-Poladian (victor.moagar@imt.ro)

NEW MATERIALS HAVING HIGH ANTI-CORROSIVE PERFORMANCE WITH APPLICATIONS ACROSS DIFFERENT DOMAINS FOR THE USE ENVIRONTMENTS PRESENTING COMPLEX AND SEVERE LOADS- INTERMAT

The project has as expected result the fabrication of new protection materials for mediums having high anticorrosive loads. These materials have to eliminate the disadvantages of the present protection materials, namely: limited or specialized domains usefulness, toxicity, high number of different types of layers needed to provide enough resilience to aggressive environment. These new materials will have a use in industrial fields like (energy production, chemistry, constructions, transportation, etc.) by providing protection against harsh environments (high temperature, aggressive chemical agents, abrasion, thermal and mechanical shocks, etc.). The role of IMT-Bucharest in this project is to provide simulations regarding the protective layer behaviour in contact with different types of aggressive agents. Due to the complexity of the problem, the software used was ANSYS Multiphysics 11.0. Until this stage simulations regarding abrasion resistance were performed. This type of simulations is taking into account material removal from protective layer as a result of the impact of particles with diameters in the range of 50-150 micrometers, different speeds (30-45-60 m/s) and different contact angles (30-40-50 degrees).



Layer integrity and summed deformation after impact is presented. The numbers above the figures are representing the angle, speed and diameter of the impacting particle.

Project Type: CEEX Project (2006-2008)); Coordinator ICEMENERG,
IMT-Bucharest partner, Contact person: Eng. Phys. Victor Moagar-Poladian (victor.moagar@imt.ro)

NATIONAL PROJECTS: CAPACITIES

1. *LABORATORY FOR MODELING AND SIMULATION OF MICROSYSTEMS* (LAMSYS). PN II- Capacities; Contract no.7/2007 (2007-2009). Coordinator IMT- Bucharest; Project manager: **Mat. Oana Tatiana Nedelcu**

The main objective of the project is the development of the research infrastructure in the field of modeling, simulation and computer aided design for micro- and nano-systems, improvement of the research capabilities and offering scientific services in a dedicated laboratory, by modernization the existing capabilities.

2.*INTEGRATED LABORATORY OF ADVANCED TECHNOLOGIES FOR MICRO AND NANOSYSTEMS* - (MICRONANOLAB). PN II -- Capacities Contract no.13/2007 (2007-2009)- Project manager: **Dr. Gabi Moagar**.

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. The lab is the first and the only one in Romania (in this moment) developing research and providing services for nanolithography, using EBL technique.

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

• **Research Team:** 3 senior researchers with background in Physics and Electronic Engineering an early stage researcher (Physics) and 2 MS students in Electronics.

Team from left to right: Adrian Dinescu, Cecilia Codreanu, Loredana Draghiciu, Marian Popescu, Laura Eftime, Mihaela Marinescu, Raluca Gavrila, Alexandru Herghelegiu

• **Specific facilities:** - **Multifunctional Scanning Probe Microscope (SPM) Ntegra Aura –NT-MDT**. It enables several related techniques for imaging and measuring surfaces on a scale from microns down to the nanometric molecular level. The properties which could be characterized depend on the chosen technique and include 3D morphology, spatial distribution of electric and magnetic forces on surfaces, local conductivities, discrimination of phases and/or region with different elastic and/or tribological properties etc. *Features:* built-in capacitive sensors, antivibrational table, operational under different environments: air, liquid, controlled gaseous atmosphere, low vacuum (10-2torr). Scan range: 100x100x10 μm, noise level, XY: 0,3nm, Z: 0,06nm, non-linearity in X, Y with closed-loop sensors < 0.15 %.

- **SEM-Scanning Electron Microscope TESCAN VEGA II LMU** (resolution: 3nm @ 30kV, accelerating voltage 200V-30kV, electron gun source: tungsten; filament, magnification: 13X – 1.000.000X, detectors: SE, BSE, LVSTD)

- **EBL- Raith Elphy Plus** pattern generator for Electron Beam Lithography

- **AFM** home-built non-commercial Atomic Force Microscope (max scan area: 20μm x 20μm, vertical resolution: 2nm, lateral resolution: 20nm) + 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, calibration, tip characterization.

- **On-wafer electro-thermal characterization** equipment for micro and nanostructures.

Our lab is the coordinator of **NANOMORPH** (Accredited laboratory for morphological analyses at nanometric scale) CEEX/INFRAS project, 2006-2007

• **FP 7 International Projects: CATHERINE "Carbon nAnotube Technology for High-speed nExt-geneRation nano-InterconNEcts"-STREP-FET proactive (2008-2010), FP7, *coordinator Consorzio Sapienza Innovazione, Italy***

Partners: CNIS, Italy, TUD-Netherlands, CIRIMAT, France; USL-Italy, ULV, Lativia; IMT-Bucharest, Romania; FOI, Sweden; INFN, Italy; PHILIPS, Netherlands; Smoltech, Sweden;

Contact person form IMT **Phys. Adrian Dinescu.**

CATHERINE project aims is to provide a new unconventional concept for local and chip-level interconnects that will bridge ICT beyond the limits of CMOS technology.

The main goals of CATHERINE are:

- To develop an innovative cost-effective and reliable technological solution for high-performance next-generation nanointerconnects.

- To develop proof-of-concept nanointerconnects to assess and verify the new proposed solution.

Acting Laboratory Head – Phys. Adrian Dinescu (adrian.dinescu@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 Laboratory***.

His main scientific interests include: Electron Beam Lithography, Scanning Electron Microscopy and Scanning Probe Microscopy (mainly AFM Surface morphology imaging and characterization), force sensors for Atomic Force Microscopy. A Dinescu was the leader of several national research projects (Matnantech, Ceres, CEEX) and partner in international projects (CATHERINE FP7, ASSEMIC- Marie Curie Training Network, FP6) and the author more than 10 scientific papers presented at conferences and published in journals.

Scanning Probe Microscope (SPM) (Ntegra Aura) – NTMDT

PROJECTS DEDICATED FOR EQUIPMENTS ACQUISITION

• **Accredited laboratory for morphological analyses at nanometric scale – NANOMORPH**

The main goal of the project consists in establishing an accredited laboratory for nanometric scale morphological characterization and analyses of material surfaces. The laboratory will be certified to ISO IEC 17025:2005 standard for testing and calibration laboratories and will provide high- quality AFM and SEM characterization services for research and/or production of materials whose surfaces have a nanometric scale structure, ex: optical surfaces (in optical components), biocompatible metals and ceramics, materials for semiconductor industry, coating and protection films etc.

Project type: CEEX- Modul 4/INFRAS no. 234/2006, (2006-2008)
Coordinator: IMT Bucharest; Project manager: Phys. Raluca Gavrila (raluca.gavrila@imt.ro).

• **NANOSERV - Enhancement of functionality for nanoscale structuring and characterization laboratory - NANOSCALE-LAB -**

The main purpose of the project is to complete the endowment of **"NanoScaleLab" Laboratory of IMT – Bucharest** with a state-of-the art equipment for nanomechanical characterization and several equipments that would allow the use at maximum performance of the existing EBL installation. By completing this project it will be extended and developed the material base for structuring and characterization at nanoscale and it will be improved the capacity of offering scientific services in the area.

Project type: PN II /Capacities no. 9/2007 (2007-2009).
Coordinator: IMT- Bucharest; Project manager: Acad. Dan Dascalu (dan.dascalu@imt.ro)

• **NANOSCAN - Development of topographical and compositional analysis capabilities at nanoscale of Microphysical Characterization Laboratory**

The main goal of this project is to complete the equipments of the lab with a state of the art Field Emission Gun Scanning Electron Microscope (**FEG-SEM**) able to work with low accelerating voltages for true surface imaging: resolution bellow 1.5 nm at 1kV accelerating voltage, in-lens detectors for SE and BSE, true eucentric sample stage, charge compensation system.

Project type: PN II/Capacities no. 12/2007, (2007-2009).
Coordinator: IMT Bucharest (Project manager: Phys. Adrian Dinescu – adrian.dinescu@imt.ro).

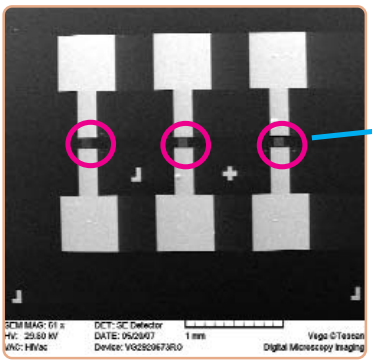
• **µDIGIHOLAB - Development of Digital Holography Laboratory with equipments for characterization of micro-electro-mechanical systems**

Project type: PN II /Capacities, No. 4/2007 (2007-2009).
Coordinator: UPB. Contact person for IMT Bucharest: Phys. Adrian Dinescu – adrian.dinescu@imt.ro).

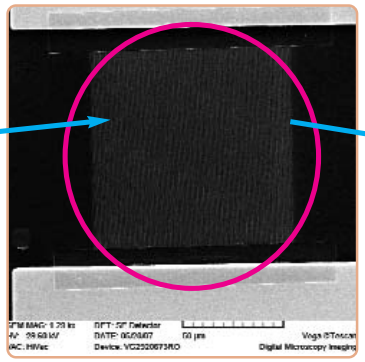
NANOSCALECONV - NETWORK OF SCIENTIFIC SERVICES FOR NANO-SCALE STRUCTURING AND CHARACTERIZATION, WITH APPLICATIONS IN THE DEVELOPMENT OF CONVERGENT TECHNOLOGIES

The **Network for scientific research services and characterization tools at nano-scale** bring together 11 well known research institutes and academia, which use in common **characterization** and **manufacturing equipments** and **complementary skills** in a network of nanofacilities, in order to successfully utilize in co-operation and partnerships the complete range of nano potential. The network acquired a new equipment **(SEM and EBL)** representing in this moment state of the art in the country for **nanolithography**. An important number of scientific services, labs for students (hands on training) were performed. Also access for students (MS and PhDs) and industry was facilitated within the project. Different configurations using nanolithography and mixed match lithography were developed (examples in next figures).

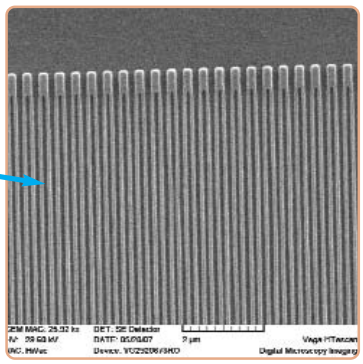
Example of mix and match lithography: optical lithography and EBL



Structures obtained by classical optical lithography (developed by L4 - IMT-Bucharest)



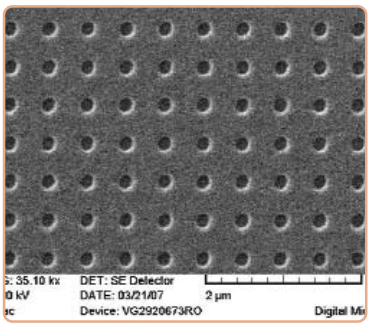
Structures obtained by EBL lithography (IMT-Bucharest)



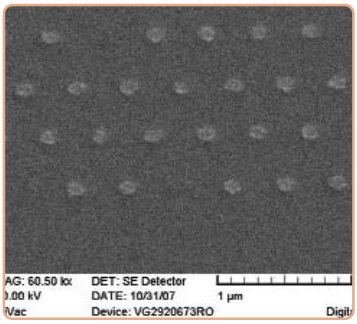
Details of the EBL structure 300nm TiAu fingers obtained by lift-off (IMT-Bucharest and IESL FORTH-Heraklion)

NATIONAL PROJECTS

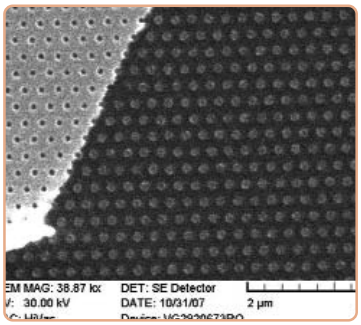
Nanolitogrphy tests using EBL to obtaine 30 nm nanodtos



30 nm dots in PMMA

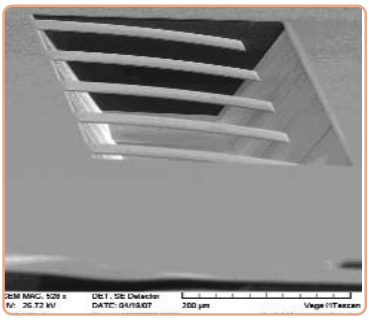


30 nm Au nanodots

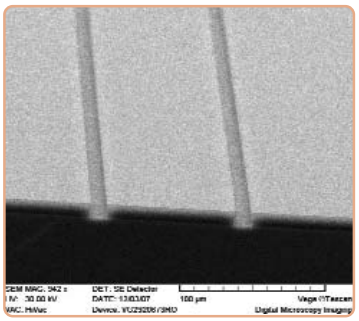


30 Nm Au nandots obtained by lift-off technique

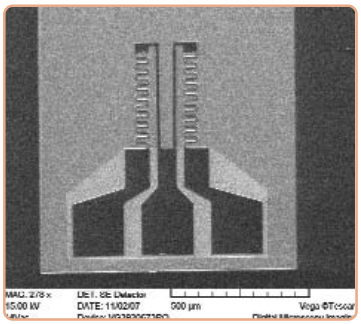
SEM - investigation services offered by Nanoscaleconv to partners using the SEM acquired by the project.



SEM image of InO cantilever beams nufactured at IESL-FORTH Heraklion and IMT- Bucharest



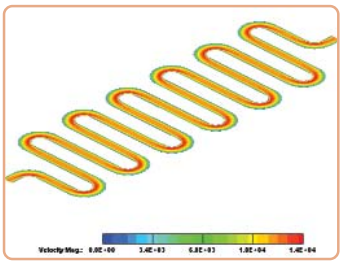
SEM image of SU8 microchannels manufactured at IMT- Bucharest



SEM image of a microgripper manufactured at IMT- Bucharest

NANOSCALE-CONV (2005-2008). Project type: PN II CEEX- CALIST; No. 6111/2005 (2005-2008)
Coordinator: IMT- Bucharest; Project manager: Dr.Raluca Müller (raluca.muller@imt.ro)

ROMANIAN TECHNOLOGICAL NETWORK FOR INTEGRATION IN THE EUROPEAN PLATFORM FOR NANOELECTRONICS (ENIAC) - RTN-NANOEL



Distribution of maximum speed along a microfluidic channel (COVENTOR-WARE 2006 Simullation)

The main goal of the project is to design a technological network in order to promote scientifically and technological Romanian community integration into the Nanoelectronics European Platform. The network contributed to the integration in Nanoelectronics ETP (ENIAC) by: a) developing common research in certain thematic areas from ENIAC agenda with some support of external collaborations: financing pilot projects with new, explorer character– miniprojects); b) creating an experimental facilities and software system used in common by all network partners, enlarging the offer area for participating to the European FP7; c) creating and diversifying a technological services system and a technological offer of the network; d) human resources training and formation; e) developing critical mass of human and material resources by collaboration with other consortia financed by national and EU founds and direct support for participation to **Nanoelectronics ETP "ENIAC".**

The activities of the network, which joins 10 partners are: **research (new electronic nanodevices, new materials and technological processes, new architectures of the electronic systems) technological and scientific services, training, dissemination and technological transfer in the field of nanoelectronics**.

The network provides experimental technological services (nanostructuring and nanolithography) as well as **computer-aided design and simulation**.

The main research activities of **RTN-NANOEL** project were focused on **RF components (radio frequency) and micro-fluidics**, mentioned in the **"ENIAC agenda"**, domains where IMT- Bucharest already have experience in working with foreign companies (through European Projects), considering also the technological transfer.

Modules for the existing nanolithography equipments were acquired.

The two innovative **networks NANOSCALE-CONV** (presented on the next page) and **RTN-NANOEL** coordinated by **IMT–Bucharest** are acting in **nanoelectronic** and **nanotechnology** area, developing advanced **research**, providing **services**. Also the two this projects contributed to the development of a **new special lab** dedicated to characterization and structuring at nanometric scale: **NANOSCALE-LAB**.

CEEX INFOSOC Project, No 75/2006 (2006-2008);
Coordinator: IMT- Bucharest; Project manager: Acad. Dan Dascalu (dan.dascalu@imt.ro)

AFM APPLICATIONS TO NANOMECHANICAL CHARACTERIZATION OF POLYMERIC SURFACES

Main goals: Design and performing AFM-based experiments on various polymeric materials for studying their elastic, viscoelastic and adhesive properties.
Results: Force-distance curves were traced using AFM on different types of polymers, prepared and thermal treated in various conditions. Comparative assessment of their elasticity and adhesion was made by this method and correlations with polymer types and obtaining conditions could be established. Time-dependent effects (viscoelasticity and creep) in the mechanical response of polymers were studied using variable loading rates.

Project Type: National basic funding Project MINASIST +, PN 06240105: - (2006-2008);
Project manager: Raluca Gavrila - raluca.gavrila@imt.ro

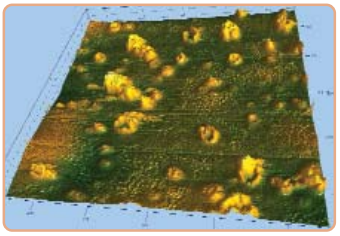
VIRTUAL INSTRUMENTATION FOR THE CHARACTERIZATION AND EXPERIMENTATION OF MICROFLUIDIC DEVICES

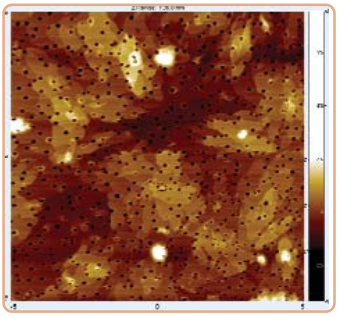
Experimental set-up

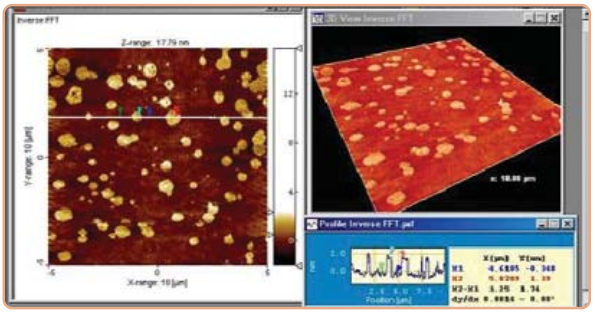
An EXPERIMENTAL SET-UP FOR THE MEASUREMENT OF THE THERMAL CONDUCTIVITY OF LIQUIDS was realized. The Transient Hot Wire Technique for measurement of the thermal conductivity in liquids was implemented in an in-house made computer controlled experimental set-up. The heater & sensor test cell, the thermal isolated recipient, and also the measurement & data acquisition and processing chains were designed and implemented in such a way that the major error sources to be eliminated and to provide proper corrections in certain circumstances, when the errors could not be avoided. The measurement and control processes are accomplished and integrated by using the Quick Start Development System from Analog Devices which is based on the MicroConverter ADuC845. The acquired data are transmitted to the computer by means of the RS 232 serial, and subsequently, they are processed through the Instrument Control Tool Box in MATLAB. Data can be also imported, processed and represented graphical form in Microsoft Excel.

Project Type: National basic funding Project MINASIST+, PN06240203
Project manager: Cecilia Codreanu -cecilia.codreanu@imt.ro

SERVICES OFFERED by the LAB: AFM, SEM, EBL



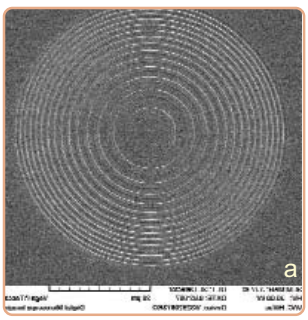


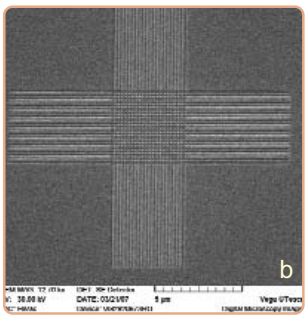


Ssurface morphology studies for various IMT-Bucharest and partner projects

• High resolution surface morphology investigations by **Multifunctional Scanning Probe Microscope (SPM) Ntegra Aura NT-MDT** - techniques for imaging and measuring surfaces on a scale from microns down to the nanometric molecular level. **Atomic Force Microscopy (AFM):** 3D surface topography recording and measurement (waviness, roughness, step heights, grains, particles etc);

Contact person: Phys. Raluca Gavrila (raluca.gavrila@imt.ro).





• **SEM (Scanning Electron Microscopy) -** Investigations using TESCAN VEGA 5136 LM Resolution: 3 nm @ 30 kV, accelerating voltage 200V-30 kV, electron gun source: tungsten filament, magnification: 13X – 1.000.000X, detectors: SE, BSE, LVSTD.
• **Nanolitography using PG Elphy Plus** from RAITH-6 MHz high-speed pattern generation hardware

Contact person:Phys. Adrian Dinescu (adrian,dinescu@imt.ro)

a) Nanolitography test: Configurations in PMMA resist for manufacturing Fresnel lens, realised for Photonic Lab of IMT- Buchares
b) Ttest of nanostructure obtained using E-Beam lithography

L7: Reliability Laboratory

• ***Mission:*** Providing tools and expertise to improve the design & technology of sensors, actuators, microsystems, nanostructures and microelectronic 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, Reliability monitoring & screening of micro and nanostructures, Burn-in and selection, Reliability of components used in harsh environment (nuclear, geology, automotive, aeronautics, etc.);
Reliability assessing: Accelerated testing of micro and nanostructures; Failure analysis & physics, Data processing & Reliability prediction, Behaviour of electronic components in harsh environment, Virtual prototyping;
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.

• ***Specific facilities:*** Reliability Laboratory contains the Laboratory for evaluating the quality of the products of microtechnologies according to EU requirements, with equipment for: - *Environmental testing:* Constant mechanical acceleration, Vibration, Damp heat, Salt mist, Storage at temperature, Ultracryostat;
Electrical characterization: - System for electrical characterization of conventional semiconductor devices and microsystems (Keithley 4200)
- Equipment for electrical measurement at temperature (Temptronic)
- accelerated testing: Bias & temp., Tilting & 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 microphysical characterization by: Atomic force microscopy (AFM), Confocal microscopy with laser scanning and High resolution characterizations by laser beam and holographic interferometry.

• ***Partner in international Networks:*** Dr.M.Bazu is member of the Management Board and leader of the cluster "Reliability & Characterisation" of the Network of Excellence "Design for Micro and Manufacture PATENT-DfMM" - (FP6/IST project of NoE, 2004-2008).

The Reliability Laboratory is in the Board of the Service Cluster EUMIREL (European Microsystem Reliability), aimed to deliver services in the reliability of micro and nanosystems, developed in 2007 by the network "Patent-DfMM" (other members: IMEC, Politecnico di Milano, Fraunhofer Inst.Duisburg, 4M2C, CSL Liege, BME Budapest, Warsaw Technical University, QinetiQ, Lancaster University, Herriot Watt University, NovaMems, Baolab).

• ***National projects:*** -Contractor of "Micro-biosensors for pesticide detection in environment and food samples", project (2007-2010) in the National Research Programme "PARTNERSHIP";
- Contractor of "Infrastructure development for reliability research in integrated micro-nano systems", project (2007-2009) in the National Research Programme "CAPACITIES";
- Contractor of "Development of a laboratory for assessing the quality of the products of microtechnologies according to EU requirements - LIMIT", project (2006-2008) in the National Research Programme - CEEX ;
- 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 - CEEX, 8 partners (co-ordinated by the University Politehnica Bucharest).

Laboratory Head – Dr. Marius Bazu (marius.bazu@imt.ro)

He received the B.E. and PhD. degrees from the University "Politehnica" Bucharest, Romania. He was involved in device design and semiconductor physics. 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), Workpackage leader and Member of the Management Board of the NoE "Patent-DfMM", FP6/IST (2004-2007).

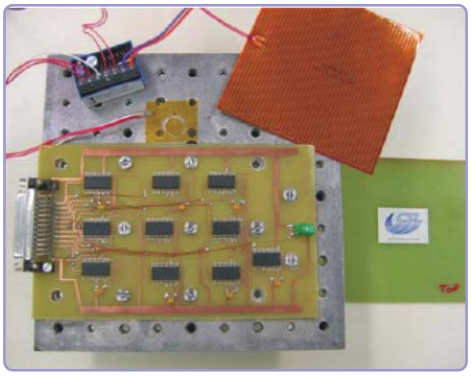
He is referent of the journals IEEE Transactions on Reliability, IEEE Transactions on Components and Packaging and IEEE Electron Device Letters. Recipient of the AGIR (General Association of Romanian Engineers) Award for the year 2000. Chairman/lecturer at international conferences: CIMCA'99 (Vienna, Austria), CAS 1991 (Sinaia, Romania), MIEL 2004 (Nis, Serbia & Montenegro). 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.

MEMS ACCELERATED TESTING

The team which developed in 2006 a methodology for accelerated life testing of MEMS accelerometers became a working group of the Service Cluster "European Microsystem Reliability - EUMIREL", set-up in 2007.

Achievements: The procedure and the equipment for executing tilting & high temperature, developed in 2006 by IMT, were the subject of two requests for patents. MEMS accelerometers were tested at vibration & temperature and tilting & temperature, the failure rate being assessed (paper published in Sensors, v.7, pp.2846-2859, 2007)

Project: "European Microsystem Reliability (EUMIREL)", grant of the NoE "PATENT-DfMM". Co-ordinators: IMT-Bucharest (Contact person: Marius Bazu, marius.bazu@imt.ro), IMEC Leuven, Fraunhofer IMS Duisburg, Politecnico di Milano. Partners: 11 European research institutions.



Experimental set-up for testing the reliability of MEMS accelerometers at vibration and high temperature

RELIABILITY OF NANOSTRUCTURES

The time degradation phenomena arising in the three main areas of nanotechnologies (nanostructured materials, nanoelectronic structures and NEMS) are studied.

Achievements: Databases on Failure and degradation mechanisms in nanostructures and on Equipment for reliability testing and for investigating NEMS degradation were created and are accessible from the project webpage (**www.imt.ro/nanofiabilitate**). The annual project workshop, common with the CEEX project NANOCRYSTALNET (Nov.9, 2007), held in IMT, gathered Romanian specialists in nanotechnologies.

Project: Technologies at nanometric scale: time degradation phenomena, CNCSIS grant (2006-2008), Contact person: Marius Bazu (marius.bazu@imt.ro)

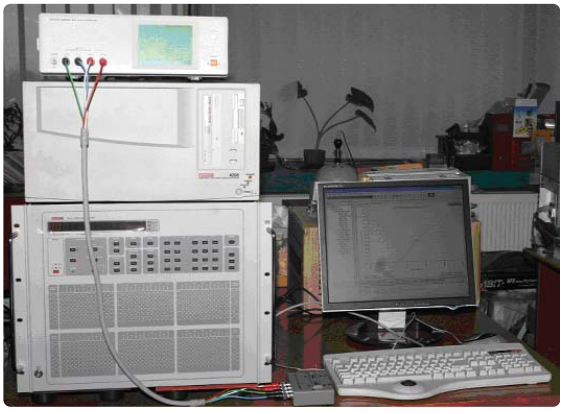
BIOSENSOR FOR ENVIRONMENT MONITORING

New steps for developing biosensors for the detection of the environmental pollutant concentrations and offering the possibility to generate information continuously were covered.

Achievements: The original results obtained in the previous period in the frame of a MATNANTECH Project (Biosensor for detecting and monitoring of xenobiotics in the effluents of the installations for biological purging of worn-out waters, 2004-2006) were the subject of two requests for patents in the area of micro-biosensors based on the detection of photosynthesis inhibition at cyanobacteria.
A new work for obtaining micro-biosensors based on colinesteraze (ChE) for detecting the organophosphoric pesticides in food products and environment samples was started in the frame of a "PARTNERSHIP" project (Micro-biosensors for pesticide detection in environment and food sample, 2007-2010).
Also, a system of electrical characterisation for micro-biosensors was developed in the frame of Core Financing Programme (2006-2008).

Contact person Lucian Galateanu (lucian.galateanu@imt.ro).

Equipment for electrical measurement at temperature (Temptronic)



System for electrical characterization of conventional semiconductor devices and microsystems (Keithley 4200)

A4: Prototype development laboratory

• ***Mission:*** • Developing new technologies in the areas of Microsystems technologies: technological design, simulation and technological development up to the prototype level.
• New materials development (i.e. nanocompozites)
• New assembly techniques for Microsystems (based on MCM)
• Technological services: technological assistance and consultance (technological flows design, control gates, technological compatibilities) and defect analysis on technological flow.

• ***Main areas of expertise:*** Design, simulation and develop individual technological processes for Microsystems technology (as piezoelectric integrated microsensors, high speed photodetectors and white LED micromatrix) and control technological compatibilities for M(O)EMS integrated using CMOS technology. MCM technologies and other nonstandard assembly technologies for Microsystems technological design.

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

• ***Research Team:*** The team is represented by a senior researcher (PhD), a senior technological development engineer, 3 PhD students (with background in chemistry and mechanics) and a young engineer specialized in electronic applications field. The team seniors 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
• Consultancy in technological compatibilities;
• Spectrometric characterization;
• Defect analysis on technological flow;
• Assembly techniques for MST;
• Dicing;

Example:
New FTIR Equipment for characterization.
Contact person: Veronica Schiopu
(veronica.schiopu@imt.ro)

Example of assembly
Contact person: **Ileana Cernica**
(**ileana.cernica@imt.ro**)

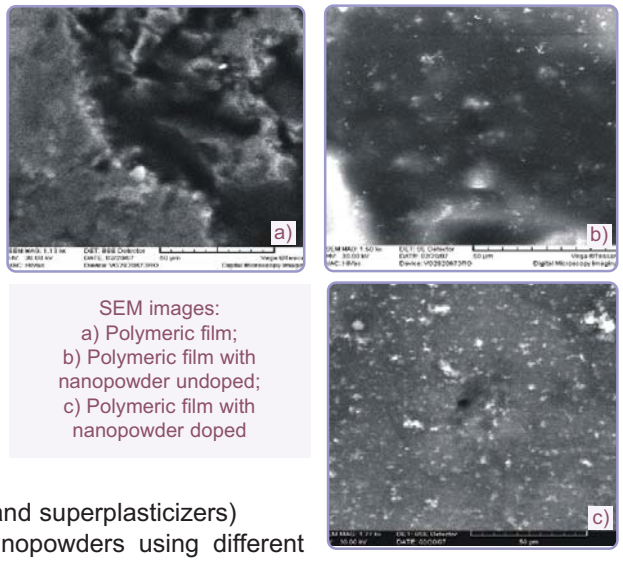
Laboratory Head – Dr. Ileana Cernica (ileana.cernica@imt.ro)

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 the sole Romanian CMOS ICs industrial company for 10 years.
Now she is senior research scientist, currently coordinates 6 national R&D projects and is project manager of Romanian - German Centre for micro and nanotechnology Project. She is also involved in technology transfer activities being Project manager of Romanian- German Centre for Micro and Nanotechnologies Project and former executive director of Centre for Technological Transfer in Microengineering (CTT-Baneasa).
She is secretary of Scientific Committee of IMT. Other activities: is project evaluator in national RD programs (CEEX, CNCSIS PNCDI II) IEEE and SPIE member and associate professor at University "Politehnica" of Bucharest (Faculty of Electronic, telecommunication and information technology and Faculty of Mechanics). Her Scientific activity was published in more than 50 papers in international journals/conferences, 98 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 Brussels and Geneva) and 3 books.

ADVANCED NANOCOMPOSITES MATERIALS USED IN CIVIL CONSTRUCTION WITH ANTIBACTERIAL, SELFCLEANING PROPERTIES AND SOLAR ENERGY CONCENTRATORS INTEGRATED STRUCTURES FOR AMBIENTAL IMPROVEMENT -NANOAMBIENT-

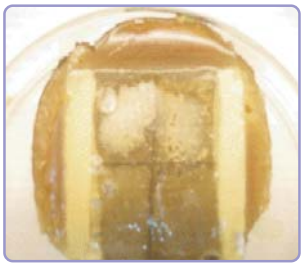
Aim of the project:
To develope a new construction material, a “smart wall”, from composites cement- wood. Thin polymeric composites films with oxide nanopowders content (having antibacterial, antistatic, selfcleaning tailored proprieties) and solar concentrators were applied.

Achievements:
The technological experiments were focused to obtain cement - wood composite and polymeric films with nanopowders. Using the polymeric composites developed in our experiments we expect to obtain multifunctional characteristics moisture resistance, antibacterial and self-cleaning properties.



SEM images:
a) Polymeric film;
b) Polymeric film with nanopowder undoped;
c) Polymeric film with nanopowder doped

Results:
We obtain:
• Cement - wood composite with nanomaterials (silica fume and superplasticizers)
• Zinc oxide and titanium oxide (undoped and doped) nanopowders using different methods;
• Polymeric composite materials with content of nanopowders;
The polymeric films with nanopowders were used as thin films in covering wood-cements composites in order to obtain tailored properties of the wall surface and were characterized (using optical microscopy, scanning electron microscopy and FTIR analysis) and tested (antibacterial and antimicotic properties).



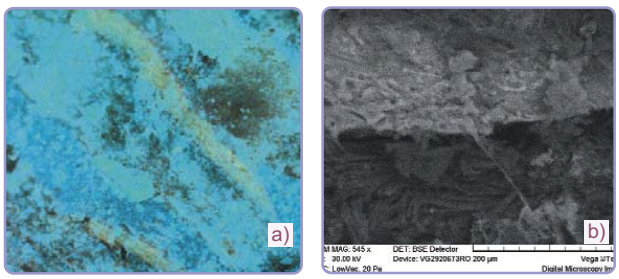
1 Cement-wood composite substrate
2 Polymeric film
3- Polymeric films with undoped nanopowder
4- Polymeric films with doped nanopowder

CEEX - INFOSOC Project 2006-2008; Coordinator IMT Bucharest.
Project manager: Ileana Cernica (ileana.cernica@imt.ro)
Partners: National Institute of Wood Bucharest; S.C. CEPROCIM S.A; R&D Institute for Nonferrous and Rare Metals Bucharest; Research Institute For Auxiliary Organics Products Medias; National Institute For R&D In Electrochemistry And Condensed Matter Timisoara; Research Institute For Analytical Instrumentation Cluj; University Politehnica Of Bucharest (CCO, DCAE); "Valahia" University Of Targoviste; "Alexandru Ioan Cuza" University Of Iasi; Ovidius University Of Constanta

WOOD- POLYMER COMPOSITE WITH COMPONENTS OF NANOSTRUCTURED MATERIALS AND NANOSENSORS FOR IMPROVEMENT OF INDOOR ENVIRONMENT" -NANOPROTECT-

Aim of the project:
To obtain a complex structure (walls and sensors) that could be used in construction of safety andconfortable indoor microclimate (i.e. wall resistance, easy structure, high mechanical resistance), monitoring temperature, humidity, contamination with bacteria's and fungies.

The first achievements:
We obtain polymer - wood composites from wood flours and polymers wastes. The polymeric component was obtained from low density polyethylene wastes and the lignocellulosic materials were obtained by fraying the wastes from laminated manufacturing.
The polymer-wood composites were characterized by optical and electronic microscope and tested by our partners.



a) Optical image of polymer-wood composite;
b) SEM image of polymer-wood composite

PN II Project 2007-2009; Coordinator IMT Bucharest
Project manager: Ileana Cernica (ileana.cernica@imt.ro)
Partners: "Petru Poni" Institute of Macromolecular Chemistry Iasi, National Institute of Wood Bucharest, INCDO-INOE2000, Research Institute for Analytical Instrumentation Cluj, S.C. NATURA SRL - Biertan; University "Transilvania" of Brasov

A2: Technology Laboratory for Microstructures

• ***Mission:*** The Technology Laboratory for Microstructures provides technical support for the research activity developed in institute. Our laboratory acts as a technological support for institute projects belonging to other laboratories. The spectrum of research activities was considerably expanded through recent investments in new equipments.

• ***Main areas of expertise:*** The Laboratory covers a broad range of technological process in order to fulfil the requirements for implementation of semiconductor devices, sensors, micromechanical and microoptical structure, microstructures for bio-medical 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.

The projects in which the working group was involved, merge the following disciplines: semiconductors technology, semiconductors physics, materials physics, optics, chemistry and biochemistry.

In the last time the current research topics include:

• Development of novel technologies for photovoltaic applications

• Development and optimization of nanoporous silicon and new oxides layers for solar cells applications, essentially as antireflection coating and surface structuring to reduce reflection loss

• The preparation of macroporous Si as carrier matrix for enzyme, by means of an anodic etching process, compatible to the semiconductor processing in sensor fabrication

• Development of novel technology to obtain micro-fluidic devices by substrate microprocessing having applications in thermal transfer and biology.

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

• ***International Projects:***

The technology Laboratory for Microstructures, provides the technological support for the research activity, particularly for the following european projects:

• Multi - Material Micro Manufacture: Technologies and Applications (4M), NoE, Priority 3 - NMP

• Design for Micro& Nano Manufacture (PATENT), NoE, priority 2 - IST

• Advanced Handling and Assembly in Microtechnology (ASSEMIC), Marie Curie Research Training Network.

Team from left to right:
back row: Colotela Mircea, Gheorghe Elena, Dragan Gabriela, Mihailescu C-tin, Diaconu Adrian, Coraci Antonie, Isar Gheorghe; front row: Podaru Cecilia, Pandele Elena, Manea Elena, Dobre Tamita, Gheorghe Marin, Stama Vasile;

Equipments for photolithography

Equipments for chemical 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. Available materials: 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 electro-platting or chemical plattings, anodic oxidation, sol gel techniques.

Laboratory Head – Dr. Elena Manea (elena.manea@imt.ro)

Present position: Dr. Elena Manea obtained the MSc degree in Physics (1978) and Ph.D. in Solid State Physics (1999) at University from Bucharest. 21 years experience in silicon planar technology. Research efforts aiming to develop the scientific knowledge concerning micro and nanaotechnologies and nanostructured materials for applications in the PV solar cells, technologies for microsystems and microsensors domains.

In this year the scientific activity is published in 18 scientific papers in journals (12 published in periodicals ISI ranked), 2 book, more then 180 communications in Proceedings and 2 patents.

SURFACE MICROPROCESSED MICRO HEAT SINK

In the last ten years microprocessing techniques were used to develop many microfluidic systems obtained onto silicon, glass, quartz, or plastic substrates. The proposed technology in this project has the main advantage to use low temperature processing, being cheap and IC processing technology compatible.

The present project aims to innovate and develop technological processes in the field of microfluidic devices, having applications in the thermal transfer to the silicon surface microprocessed micro heat sinks based on Ni or Cu microchannels having near rectangular cross-section and dimensions 20 - 60 μm (width), 20 - 40 μm (hieght), and 1700 - 1500 (length).

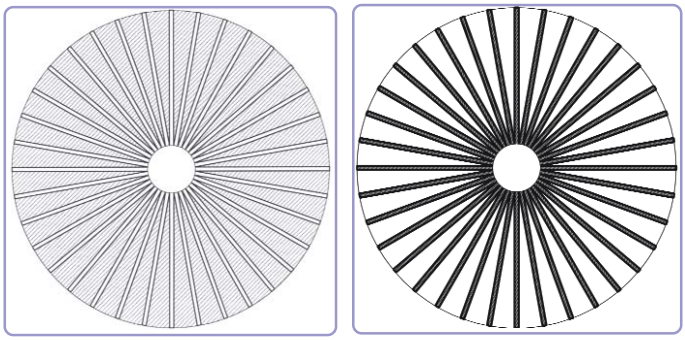


Fig 1. Miicroprocessed micro heat sink having 36 radial channels with: (a) width 40 μm at the entrance, and 336 μm at the margin of the channel, and (b) having constant channel width of 40 μm, "lay-out".

To obtain Ni, or Cu microchannels (or microchambers) will be used 3 - 4 in silicon wafers, appropriate chemical cleaned (using acid and / or solvent solutions), processed then by the electrochemical deposition onto a resist mask patterned by photolithographic techniques in microchannel/lines arrays radial oriented, see Fig 1, of a metal (Ni, or Cu) predeposited in a thin film having about 1000-2000 Å onto the substrate (having also a Cr thin film of about 200-300 Å to enhance the adherence). The metal will be subsequently electrochemical thickened. The resist film is used as sacrificial layer, because it will be subsequently removed in hot acetone.

These microfluidic devices (micro heat sinks) will be designed using mass and thermal transfer considerations, to could realize the air forced cooling of the IC's chips. Micro heat sinks will be realized in the last step of the planar semiconductor devices fabrications directly onto the chip (wafer) before testing and dicing.

The proposed technology to process the microfluidic devices has also the advantage to use a processing technique simple and cheap, has low process temperatures (less than 200ºC) and it is compatible with the power devices fabrication technology. It provides also a very good thermal contact between micro heat sink and chip.

Project Manager: Antonie Coraci; antonie.coraci@imt.ro), IMT - Bucharest

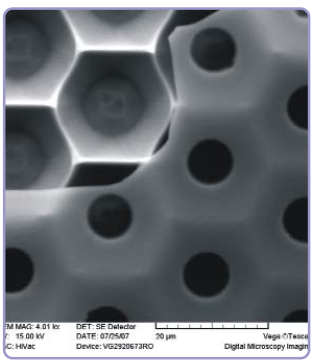
INTEGRATED RESEARCH TO DEVELOP HIGH EFFICIENCY AMORPHOUS AND POLYCRYSTALLINE SILICON SOLAR CELLS BASED ON QUANTUM EFFECTS USING NANOTECHNOLOGY AND NONCONVENTIONAL PROCESSES - HES - CELL

Short description:

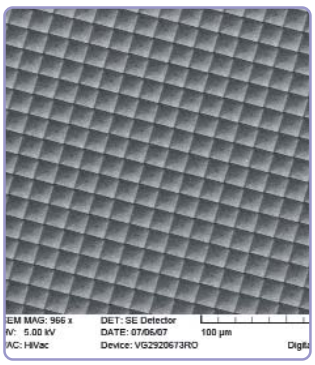
- The project purposes to design and fabricate high efficiency and low cost PV solar cells on different substrates, using non-conventional technologies and nanostructured materials.
- Photovoltaic technology permits the transformation of solar light directly into electricity. PV systems can deliver electrical energy to a specific apliance or to the electric grid. It has the potential to play an important role transition towards a sustainable energy supply system of the 21 century and to cover a significant electricity needs of Europe.

Design and Fabrication:

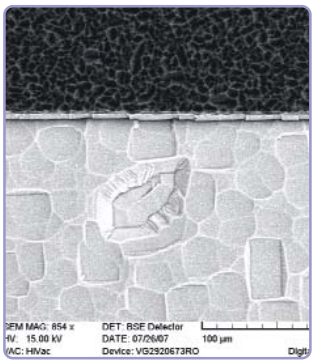
- For the structuring processes of the high efficiency solar cell surface it was used p-type, <100> Si mono wafers having 3" diameter, thickness 380 μm, and 1-2 Ωcm resistivity.
- In solar cell fabrication a way of increasing efficiency consists in the elimination of the solar radiation losses on the surface.



"Honeycamb" structure



Pyramidal structure with the side of 10 μm



Textured in KOH an untextured silicon substrate

- There were studied three types of surface structures: honeycomb structure, regular pyramids structure and electrochemical porosification of the silicon.

The first two structural types were obtained using technological processes from planar technology of the integrated circuit.

Project Manager: Ph.D. Elena Manea; (elena.manea@imt.ro), IMT – Bucharest.

Papers published in ISI ranked periodicals

1. **"Structure–Properties Correlations for Barium Ttanate thin Flms Obtained by RF-Sputtering"**, A. Ianculescu, B. Despax, V. Bley, T. Lebey, R. Gavrilă, N. Drăgan, **Journal of European Ceramic Society**, 2007, Vol. 27, pp. 1129–1135.

2. **"A Test Biodevice with Lipophylic and Hidrophylic Bioliquids"**, C. Ravariu, F. Ravariu., **Journal of Optoelectronics and Advanced Materials**, 2007, pp. 2589–2592.

3. **"Design of Hybrid Nanomaterials Based on Silica-Porphyrin. AFM Characterization"**, E. Fagadar-Cosma, C. Enache, G. Fagadar-Cosma, C. Savii, R. Gavrila, **Journal of Optoelectronics and Advanced Materials**, 2007, Vol. 9, No. 6, pp. 1878–1882.

4. **"On the Light Pressure Induced in a Medium by bhe Non-Uniform Light Intensity Distribution"**, G. Moagăr-Poladian, **Journal of Optics A: Pure and Applied**, 2007, Vol. 9, 2007, pp. 767–776.

5. **"Using Differential Evanescent Light Intensity for Evaluating Profiles and Growth Rates in KrF Laser Photodeposited Nanostructures"**, G. Socol, E. Axente, M. Oane, L. Voicu, A. Dinescu, A. Petris, V. Vlad, I. N. Mihailescu, N. Mirchin, R. Margolin, D. Naot, A. Peled, **Journal of Materials Science: Materials in Electronics**, 2007, Vol. 18, Supplement 1, pp. 207–211.

6. **"Nanoporous Silicon Matrix Used as Biomaterial"**, M. Simion, I. Kleps, T. Neghina, A. Angelescu, M. Miu, A. Bragaru, M. Danila, E. Condac, M. Costache, L. Savu, **Journal of Alloys and Compounds**, 2007, Vol. 434–435, pp. 830–832.

7. **"Millimeter Wave Carbon Nanotube Gas Sensor"**, M. Dragoman, K. Grenier, D. Dubuc, L. Bary, R. Plana, E. Fourn, E. Flahaut, **Journal of Applied Physics**, 2007, Vol.101, pp. 6103/1-2.

8. **"Metamaterials for Ballistic Electrons"**, D. Dragoman M. Dragoman, **Journal of Applied Physics**, 2007, Vol. 101, pp. 104316/1-4.

9. **"Variable Capacitance Mechanisms in Carbon Nanotubes"**, D. Dragoman, M. Dragoman, **Journal of Applied Physics**, 2007, Vol. 101, pp. 036111/1-3.

10. **"Development of the Micro- and Nanoelectrodes for Cells Investigation"**, I. Kleps, M. Miu, F. Craciunoiu, M. Simion, **Microelectronic Engineering**, 2007, Vol. 84, pp. 1744–1748.

11. **"Gold and Silver/Si Nanocomposite Layers"**, I. Kleps, M. Danila, A. Angelescu, M. Miu, M. Simion, T. Ignat, A. Bragaru, L. Dumitru, G. Teodosiu, **Materials Science and Engineering: C**, 2007, Vol. 27, pp. 1439–1443.

12. **"Nanoelectromechanical Switches Based on Carbon Nanotubes for Microwave and Millimeter Waves"**, M. Dragoman, A. Takacs, A. A. Muller, H. Hartnagel, R. Plana, K. Grenier, D. Dubuc, **Applied Physics Letters**, 2007, Vol. 90, 113102.

13. **"Negative Differential Resitance of Electrons in Graphene, Barrier"**, D. Dragoman, M. Dragoman, **Applied Physics Letter**, 2007, Vol. 90, pp. 143111/1-3.

14. **"Giant Thermoelectric Effect In Graphene"**, D. Dragoman, M. Dragoman, **Applied Physics Letters**, 2007, Vol. 91, 203116.

15. **"Modeling of RF Energy Sensing and Harvesting Using Giant Thermoelectric Effect in Carbon Nanotubes"**, M. Dragoman, D. Dragoman, R. Plana, **Applied Physics Letters**, 2007, Vol. 91, , pp. 73117.

16. **"Small-Size CPW Silicon Resonating Antenna Based on Transmission-Line Meta-Material Approach"**, S. Simion, R. Marcelli, G. Sajin, **Electronics Letters**, 2007, Vol. 43, 2007, pp. 908–909.

17. **"Tunable Bandstop MEMS Filter for Millimetre-Wave Applications"**, A.Takacs, D. Neculoiu, D. Vasilache, A. Muller, P. Pons, L. Bary, P. Calmon, H. Aubert, R. Plana, **Electronics Letters**, 2007, Vol. 43, No. 12, pp. 676–677..

18. **"Development of a New Microfluidic Analysis System Based on Porous Silicon as Sensitive Element"**, M. Miu, A. Angelescu, I. Kleps, F. Craciunoiu, M. Simion, A. Bragaru, T. Ignat, **Physica Status Solidi (C)**, 2007, Vol. 4, No. 6, pp. 2093–2097.

19. **"Structural Studies on Some Doped CdS Thin Films Deposited by Thermal Evaporation"**, F. Iacomi, M. Purica, E. Budianu, P. Prepelita and D. Macovei, **Thin Solid Films**, Vol. 515, 2007, pp. 6080–6084.

20. **"Investigation of Structural Properties of ITO Thin Films Deposited on Different Substrates"**, M. Purica, F. Iacomi, C. Baban, P. Prepelita, N. Apetroaei, D. Mardare, D. Luca, **Thin Solid Films**, 2007, Vol. 515, 24, pp. 8674–8678.

21. **"Polymers Doped With Metal Oxide Nanoparticles With Controlled Refractive Index"**, P. Obreja, D. Cristea, M. Purica, R. Gavrila, F. Comanescu, **Polymery**, 2007, Vol, 52, No. 9, pp.679-685.

22. **"New Materials for Micro-Scale Sensors and Actuators: An Engineering Review"**, S. A. Wilson, R.P.J. Jourdain, Qi Zhang, R. A. Dorey, C.R. Bowen, M. Willander, Q. Ul Wahab, M. Willander, S.M. Al-hilli, O. Nur, C. Moldovan et al., **Materials Science and Engineering**, R: Reports, Vol. 56, 1-6, June, 2007, pp. 1–129.

23. **"Physical Mechanism of Negative Diffrential Conductance in Substrateless Metallic Carbon Nanotubes"**, D. Dragoman, M. Dragoman, **Physica E**, 2007, Vol. 36, pp. 158–162.

24. **"Modern Materials with Antimicrobial Properties for Construction Finishing"**, O. Cadar, C. Roman, L. Gagea, I. Cernica, A. Matei, **Romanian Journal of Materials** 2007, Vol. 37, No. 4, pp. 316–322.

25. **"Quantitative Accelerated Life Testing of MEMS Accelerometers"**, M. Bazu, L. Galateanu, V. Ilian, J. Loicq, S. Habraken, J.-P. Collette, **Sensors**, Vol. 7, 2007, pp. 2846–2859.

Papers published in other periodicals

1. **"Characterization of Fabrication Errors in Structure Geometry for Microtextured Surfaces"**, D. Duminica, G. Ionasca, L. Bogatu, E. Manea, I. Cernica, **Recent Advances in Mecatronics**, Springer-Verlag Berlin Heidelberg, pp. 288-292.

2. **"Study of Friction on Microtextured Surfaces"**, G. Ionascu, C. Rizescu, L. Bogatu, A. Sandu, S. Sorohan, I. Cernica, E. Manea, **Recent Advances in Mecatronics**, Springer-Verlag Berlin Heidelberg 2007, pp. 391–395.

3. **"SiO_2 Microcantilevers Designed for Biosensing: Experiments and Simulations"**, I. Bineva, R. Voicu, A. Dinescu, R. Gavrila, R. Muller, D. Esinenco, B. Bucur, M. Diaconu, L.G. Radu, **Romanian Journal of Information Science and Technology (ROMJIST)**, Vol. 10, No. 1, 2007, pp. 13–23.

4. **"Investigation of Silver- Meso- and Nanoporous Silicon Composite Layers for Biomedical Applications"**, I. Kleps, M. Miu, M. Danila, M. Simion, T. Ignat, A. Bragaru, L. Dumitru, G. Teodosiu, **Romanian Journal of Information Science and Technology (ROMJIST)**, Vol. 10, No. 1, 2007, pp. 97–111.

5. **"Silicon Chip Technology – Electrophoretic DNA Analisys"**, M. Simion, I. Kleps, F. Craciunoiu, L. Savu, M. Miu, A. Bragaru, **Romanian Journal of Information Science and Technology (ROMJIST)**, Vol. 10, No.1, 2007, pp. 35–41.

6. **"A Power Spectral Density Study of thin Films Morphology Based on AFM Profiling"**, R. Gavrila, A. Dinescu, D. Mardare, **Romanian Journal of Information Science and Technology (ROMJIST)**, Vol.10, No. 3, 2007, pp. 291-300.

7. **"Design, Modeling and Fabrication of Microsensor Components"**, G. Ionascu, L. Bogatu, A. Sandu, E. Manea, I. Cernica, **The Romanian Review Precision Mechanics, Optics & Mecatronics**, 17, No. 32, pp. 884–887.

8. **"Preparation and Characterization of Indium Tin Oxide Films by Sol-Gel Method"**, A. Ciuciumis, I. Cernica, **SPIE Proc**., Vol. 6635, May 8, 2007, pp. 663510– 663510-6.

9. **"Theoretical and Numerical Analysis of the Microring Resonator Refractometers"**, M. Kusko, D Cristea, **SPIE Proc**., Vol. 6635, May 8, 2007, pp. 663504– 663504-8.

10. **"Optical Encoder Measurement Technology"**, I. Iordache, M. Bojan, D. Apostol, V. Damian, F. Garoi, P.C. Logofatu, R. Muller, B. Savu, **SPIE Proc.**, Vol. 6635, May 8, 2007, pp. 663506– 663506-6.

11. **"Synthesis of Yttrium Aluminum Garnet Dopped with Cerium for Application in a New Generation Luminescent Lighting Devices"**, V. Schiopu, M. Macrin, I. Cernica, **SPIE Proc**., Vol. 6635, May 8, 2007, pp. 66351 – 663511-6.

12. **"Micromecanizado Mediante Lasers de Femtosegundos de Ceramicas LTCC. Fabricacion de Microcalentadores Para un Sensor de Monoxido de Carbono"**, D. Gomez, I. Goenaga, P. Johander, C. Moldovan, **Boletin de la Sociedad Espanola de Ceramica y Vidrio**, Vol. 46, No. 4, pp. 191–196.

13. **"Stem Cells & Osteoarticular Regeneration"**, G. Tanasie, C. Tatu, C. Bunu, M. Tascau, C. Igna, R. Vasilco, M. Cristea, V. Paunescu, S. Anghel, L. Schuszler, F. Mirea, A. Voicu, A. Dema, V. Paunescu, **Physiol.**, 2007:17 (3) 7-10, pp. 1223–2076.

14. **"The Grain Fragmentation by Severe Plastic Deformation"**, L. Zaharia, R. Comaneci, A. Dinescu, **Buletinul Institutului Politehnic din Iasi, Tomul LIII, Fasc. 2**, 2007.

Chapters in books

1. **"S-Layer of Haloferax SP. GR 2 (JCM 13922): Isolation, Characterization and Binding to Silicon Nanostructurated Substrates"**, L. Dumitru, G. Teodosiu Popescu, M. Enache, R. Cojoc, I. Kleps, T. Ignat, Vol. 11, Micro and Nanoengineering Series, Editors: Irina Kleps, Alina Catrinel Ion, Dan Dascalu, Publishing House of the Romanian Academy, pp. 146-152.

2. **"Magnetoresistive Sensors for Biomedical Applications- a Micromagnetic Approach"**, M. Volmer, M. Avram, Vol. 11, Micro and Nanoengineering Series, Editors: Irina Kleps, Alina Catrinel Ion, Dan Dascalu, Publishing House of the Romanian Academy, pp. 167-174.

3. **"Wireless Technologies, Circuits, Systems and Devices"**, CRC Press 2007, Taylor&Francis Group, Editor Krzystof Iniewski, Chapter "Membrane supported millimeter wave circuits based on silicon and GaAs micromachining", Authors: Alexandru Müller, Dan Neculoiu, George Konstantinidis and Robert Plana.

Papers published in proceedings

1. **"Zinc Oxide Thin Films Deposited by Pulsed Laser Technique for Optoelectronic Devices Application"**, B. Mitu, G. Epurescu, G. Dinescu, M. Dinescu, E. Budianu, M. Purica, **E-MRS 2007 Spring Meeting,** May 28 - June 1, Strasbourg, France.

2. **"Effect of Sb, Sn Dopant on the Structural and Electro-Optical Properties of CdS Thin Films"**, F. Iacomi, E. Budianu, M. Purica, **E-MRS 2007 Spring Meeting,** May 28 - June 1, Strasbourg, France.

3. **"On the Performance of Supercapacitors with Electrodes Based on Carbon Nanotubes and Carbon Activated Material–a Review"**, V.V.N. Obreja, **E-MRS 2007 Spring Meeting**, May 28-June 1, Strasbourg, France.

4. **"Microfluidic Silicon System for Electrophoresis Separation of DNA Fragments"**, M. Simion, I. Kleps, M. Miu, T. Ignat, F. Craciunoiu, A. Bragaru, **E-MRS 2007 Spring Meeting**, May 26 - June 6, Strasboug, France.

5. **"Applications of Magnetic Materials and Devices in Medicine, Biomagnetism and Magnetic Biosystems Based on Molecular Recognition Processes"**, R. Vasilco, A. Popescu, **EMBO-ESF**, September 2007, San Feliu de Guixols, Spain.

6. **"Tunable bandstop MEMS Filters for Ka and V-Band Applications"**, A. Takacs, D.D. Neculoiu, D. Vasilache, A. Muller, P. Pons, L. Bary, P. Calmon, R. Plana, H. Aubert, Proceedings of the **MEMSWAVE Conference**, June, 26-29, 2007, Barcelona, Spain, pp. 147–150.

7. **"Novel Microachined Lumped Element Bandpass Filter With an Additional Zero in the Bandstop, for WLAN 5200 Applications"**, Andrei A. Muller, D. D. Neculoiu, D. Vasilache, A. Cismaru, P. Pons, R. Plana, L. Bary, A. Muller, Proceedings of the **MEMSWAVE Conference**, June, 26-29, 2007, Barcelona, Spain, pp. 151–154.

8. **"GaAs Membrane Supported 60 GHz Receiver Withyagi-Uda Antenna"**, D. Neculoiu, G.Konstantinidis, T. Vaha-Heikkila, A.Muller D.Vasilache, A.Stavinidris, L. Bary, M. Dragoman, I. Petrini, C. Buiculescu, Z. Hazoupulos, N. Kornilios, P. Pursula, R. Plana, D. Dascalu, Proceedings of the **MEMSWAVE Conference**, June, 26-29, 2007, Barcelona, Spain, pp. 15–18.

9. **"RF NEMEMS-Carbon-Nanotube Based Nanoelectromechanical Systems for Microwave and Millimeter Wave Applications"**, M. Dragoman, A. Cismaru, A. A. Muller, D. Dragoman, H. Hartnagel, R. Plana, Proceedings of the **MEMSWAVE Conference**, June, 26-29, 2007, Barcelona, Spain, pp. 129–131.

10. **"High Frequency Carbon Nanostructures that Smell, Weight, Harvest and Handle"**, M. Dragoman, **IEEE International Semiconductor Conference** (30th edition **CAS Proceedigs**), Vol. 1, 15-17 October, Sinaia, Romania, pp. 25–32.

11. **"High Frequency Devices Based on Graphene"**, M. Dragoman, D. Dragoman, A.A. Muller, **IEEE International Semiconductor Conference** (30th edition CAS Proceedings), Vol. 1, 15-17 October, Sinaia, Romania, pp. 53–56.

12. **"Modelling and Simulation of a Pneumatically Actuated Micropump"**, O.T. Nedelcu, J.-L. Morelle, C. Tibeica, S. Voccia, I. Codreanu, S. Dahms, **IEEE International Semiconductor Conference** (30th edition **CAS Proceedings**), Vol. 1, 15-17 October, Sinaia, Romania, pp. 77–80.

13. **"Experimental Study Concerning the Influence of the Base Fluid Properties on the Thermal Conductivity of Nanofluids"**, C. Codreanu, R. Gavrila, I. Morjan, **IEEE International Semiconductor Conference** (30th edition **CAS Proceedings**), Vol. 1, 15-17 October, Sinaia, Romania, pp. 81-84.

14. **"Differential Piezoresistive Pressure Sensor"**, B. Firtat, C. Moldovan, R. Iosub, D. Necula, M. Nisulescu, **IEEE International Semiconductor Conference** (30th edition **CAS Proceedigs**), Vol. 1, 15-17 October, Sinaia, Romania, pp. 87–90.

15. **"Plasma Surface Modification of Polymer Substrates for Selective Hydrophobic Control"**, M. Avram, M.A. Avram, A. Bragaru, A. Ghiu, C. Iliescu, I**EEE International Semiconductor Conference** (30th edition **CAS Proceedings**), Vol. 1, 15-17 October, Sinaia, Romania, pp. 91–94.

16. **"Simulation of Moisture Diffusion in Sealing Layers by Using Analogous Thermal Simulation"**, C. Tibeica, R. Voicu, V. Moagar-Poladian, **IEEE International Semiconductor Conference** (30th edition **CAS Proceedings**), Vol. 1, 15-17 October, Sinaia, Romania, pp. 95–98.

17. **"Investigation of the Piezoelectric Properties of the Thin Films by AFM"**, F. Craciunoiu, M. Miu, R. Gavrila, A. Dinescu, E. Hamciuc, **IEEE International Semiconductor Conference** (30th edition **CAS Proceedings**), Vol. 1, 15-17 October, Sinaia, Romania, pp. 99–102.

18. **"Reliability Accelerated Testing of MEMS Acccelerometers"**, M. Bazu, L. Galateanu, V.E. Ilian, J. Loicq*, S. Habraken*, J.P. Colette, **IEEE International Semiconductor Conference** (30th edition **CAS Proceedings)**, Vol. 1, 15-17 October, Sinaia, Romania, pp. 103–106.

19. **"Technological Methods for Low Temperature Microfluidic Devices Microfabrication"**, A. Coraci, C. Podaru, E. Manea, E. Iancu, A. Ciuciumis, A. Popescu, O. Corici, **IEEE International Semiconductor Conference** (30th edition **CAS Proceedings**), Vol. 1, 15-17 October, Sinaia, Romania, pp. 107–110.

20. **"Robust Assembling System for Photosynthesis-Based Microbiosensors"**, L. Galateanu, N. Cimpoca, M. Bazu, V. Ilian, A. Dinescu, **IEEE International Semiconductor Conference** (30th edition **CAS Proceedings**), Vol. 1, 15-17 October, Sinaia, Romania, pp. 111–114.

21. **"A Gray-Tons Derived Lithography Method for Silicon Micromachining"**, F. Craciunoiu, **IEEE International Semiconductor Conference** (30th edition **CAS Proceedings**), Vol. 1, 15-17 October, Sinaia, Romania, pp. 119–1222.

22. **"Profiled Metal–Ceramic Matrices for MEMS Application"**, C. Anton, J.P. Lecompte, M. Muntean, **IEEE International Semiconductor Conference** (30th edition **CAS Proceedigs)**, Vol. 1, 15-17 October, Sinaia, Romania, pp. 123–126.

23. "**Solar Panel Energetic Efficiency Optimization Method, Based on an Specific Detector and Orientation Microsystem"**, O. Oltu, P.L. Milea, M. Dragulinescu, E. Franti, I**EEE International Semiconductor Conference** (30th edition **CAS Proceedings**), Vol. 1, 15-17 October, Sinaia, Romania, pp. 127–130.

24. **"Biomems Microprobe for Electrical Activity Recording of Living Cells"**, C. Moldovan, R. Iosub, C.P. Lungu, A.M. Lungu, B. Firtat, C. Roman, R. Albulescu, **IEEE International Semiconductor Conference** (30th edition **CAS Proceedings**), Vol. 1, 15-17 October, Sinaia, Romania, pp. 131–134.

25. **"Surface Functionalization for Protein Microarray"**, M. Simion, L. Ruta, I. Kleps, C. Mihailescu, T. Ignat, D. Stan, F. Craciunoiu, M. Miu, A. Bragaru, **IEEE International Semiconductor Conference** (30th edition **CAS Proceedings**), Vol. 1, 15-17 October, Sinaia, Romania, pp. 135–138.

26. **"Simulation and Design of a Microcantilever for Biosensing Application"**, M. Ion, C. Pachiu, C. Moldovan, **IEEE International Semiconductor Conference**(30th edition **CAS Proceedigs**), Vol. 1, 15-17 October, Sinaia, Romania, pp. 143–146.

27. **"Apts Bio-Functionalization of Porous Silicon Nanostructurated Surface"**, A. Bragaru, M. Simion, M. Miu, T. Ignat, I. Kleps, V. Schiopu, M.A. Avram, F. Craciunoiu, **IEEE International Semiconductor Conference** (30th edition **CAS Proceedings**), Vol. 1, 15-17 October, Sinaia, Romania, pp. 147–150.

28. **"Advanced Laser Microprocessing for Substrates Microprocessing of Microsystems and Optoelectronics Devices Applications"**, D. Lieru, A. Tantau, E. Ulieru, Cernica, A. Matei, V. Schiopu, F. Pistritu, **IEEE International Semiconductor Conference** (30th edition **CAS Proceedings**), Vol. 1, 15-17 October, Sinaia, Romania, pp. 155–158.

29. **"Terahertz Effective Magnetic Activity in Microstructured TiO_2; A Numerical Study"**, C. Kusko, M. Kusko, **IEEE International Semiconductor Conference** (30th edition **CAS Proceedings**), Vol. 1, 15-17 October, Sinaia, Romania, pp. 181–184.

30. **"Replication Techniques for Micro-Optics"**, P. Obreja, D. Cristea, A. Dinescu, E. Manea, **IEEE International Semiconductor Conference** (30th edition **CAS Proceedings**), Vol. 1, 15-17 October, Sinaia, Romania, pp. 187–190.

31. **"Front Surface Texturing Processes for Silicon Solar Cells"**, E. Manea, E. Budianu, M. Purica, C. Podaru, A. Popescu, C. Parvulescu, A. Dinescu, A. Coraci, I. Cernica, F. Babarada, **IEEE International Semiconductor Conference** (30th edition **CAS Proceedings**), Vol. 1, 15-17 October, Sinaia, Romania, pp. 191–194.

32. **"Design of a Thermooptical Modulator Based on SOI Waveguides"**, M. Kusko, F. Comanescu, C. Tibeica, D. Cristea, **IEEE International Semiconductor Conference** (30th edition **CAS Proceedings**), Vol. 1, 15-17 October, Sinaia, Romania, pp. 207–210.

33. "**Design and Proposed Technological Flow of an Y-Splitter Waveguide Grating Sensor"**, R. Rebigan, M. Kusko, A. Avram, D. Cristea, **IEEE International Semiconductor Conference** (30th edition **CAS Proceedings**), Vol. 1, 15-17 October, Sinaia, Romania, pp. 211–214.

34. **"Silicon Supported Microwave Directional Coupler Metamaterial Approach"**, G. Sajin, S. Simion, R. Marcelli, F. Craciunoiu, G. Bartolucci, **IEEE International Semiconductor Conference** (30th edition **CAS Proceedings**), Vol. 1, 15-17 October, Sinaia, Romania, pp. 241–244.

35. **"160 GHz on-Chip Dipole Antenna Structure in Silicon Technology"**, D. Neculoiu, A. Muller, K. Tang, E. Laskin, S.P. Voinigescu, **IEEE International Semiconductor Conference** (30th edition **CAS Proceedings**), Vol. 1, 15-17 October, Sinaia, Romania, pp. 245–248.

36. **"Wide Band Gap Semiconductor Saw Type Devices for GHz Applications, Manufactured Using Nano-Lithographic Techniques"**, A. Muller, A. Dinescu, G. Konstantinidis, D. Vasilache, M. Dragoman, C. Morosanu, G. Sajin, D. Neculoiu, **IEEE International Semiconductor Conference** (30th edition **CAS Proceedings**), Vol. 1, 15-17 October, Sinaia, Romania, pp. 255–258.

37. **"Membrane Supported AlN Fbar Structures Obtained by Micromachining of High Resistivity Silicon"**, D. Neculoiu, D. Vasilache, G. Konstantinidis, C. Morosanu, A. Stavrinidis, A. Kostopoulos, A. Cismaru, C. Buiculescu, I. Petrini, A. Muller, **IEEE International Semiconductor Conference** (30th edition **CAS Proceedings**), Vol. 1, 15-17 October, Sinaia, Romania, pp. 293–296.

38. **"An Innovative and Versatile Topology for Tunable Bandpass Filter"**, A. Takacs, D. Neculoiu, D. Vasilache, A. Muller, P. Pons, H. Aubert, R. Plana, **IEEE International Semiconductor Conference** (30th edition **CAS Proceedings**), Vol. 1, 15-17 October, Sinaia, Romania, pp. 297–300.

39. **"Coprecipitation Synthesis of Ag-Doped ZnO Nanopowders"**, A.O. Cadar, C. Roman, L. Gagea, B.A. Matei, I. Cernica, **IEEE International Semiconductor Conference** (30th edition **CAS Proceedings**), Vol. 2, 15-17 October, Sinaia, Romania, pp. 315–318.

40. **"Synthesis and Characterization of Some Functional Polyimides"**, C. Hulubei, E. Hamciuc, M. Bruma, A. Muller, **IEEE International Semiconductor Conference** (30th edition **CAS Proceedings**), Vol. 2, 15-17 October, Sinaia, Romania, pp. 323–326.

41. **"ZnO Micro/Nano Structures by Mocvd and Vapour Transport Technique: Growth and Characterization"**, E. Rusu, A. Burlacu, V. Ursaki, G. Stratan, M. Purica, E. Budianu, E. Monaico, **IEEE International Semiconductor Conference** (30th edition **CAS Proceedings**), Vol. 2, 15-17 October, Sinaia, Romania, pp. 327–330.

42. **"Nanostructured Silicon for Optical Biosensors"**, M. Miu, I. Kleps, L. Pavesi, F. Craciunoiu, T. Ignat, A. Dinescu, M. Simion, **IEEE International Semiconductor Conference** (30th edition **CAS Proceedings**), Vol. 2, 15-17 October, Sinaia, Romania, pp. 345–348.

43. **"Fluorinated Heterocyclic Polyimides for Potential Use in RF MEMS Devices"**, M. Bruma, I. Sava, E. Hamciuc, C. Hamciuc, C. Buiculescu, **IEEE International Semiconductor Conference** (30th edition CAS Proceedings), Vol. 2, 15-17 October, Sinaia, Romania, pp. 361–364.

44. **"Nano-Metrology Between Necessity and Reality"**, D. Apostol, P.C. Logofatu, R. Muller, **IEEE International Semiconductor Conference** (30th edition CAS Proceedings), Vol 2, 15-17 October, Sinaia, Romania, pp. 381–384.

45. **"Fabrication of Diamond Based Schottky Barrier Diodes With Oxide Ramp Termination"**, G. Brezeanu, M. Avram, M. Brezeanu, C. Boianceanu, F. Udrea, G.A.J. Amaratunga, **IEEE International Semiconductor Conference** (30th edition CAS Proceedings), Vol 2, 15-17 October, Sinaia, Romania, pp. 411–414.

46. **"The Voltage Dependence of Reverse Current of Semiconductor PN Junctions and Its Distribution Over the Device Area"**, V.V.N. Obreja, **IEEE International Semiconductor Conference** (30th edition **CAS Proceedings**), Vol. 2, 15-17 October, Sinaia, Romania, pp. 485–488.

47. **"A Procedure Based on the Anova Method for Estimating the Maximum Number of Generations for Optimization Genetic Algorithms"**, I. Codreanu, **IEEE International Semiconductor Conference** (30th edition **CAS Proceedings**), Vol. 2, 15-17 October, Sinaia, Romania, pp. 497–500.

48. **"Design and Fabrication of New Microfluidic Valves"**, M.A. Avram, M. Avram, **IEEE International Semiconductor Conference** (30th edition **CAS Proceedings**), Vol. 2, 15-17 October, Sinaia, Romania, pp. 559–562.

49. **"Analysis of Displacements of a Polymeric Microgripper"**, R. Voicu, C. Tibeica, L. Eftime, R. Muller, **IEEE International Semiconductor Conference** (30th edition **CAS Proceedings**), Vol. 2, 15-17 October, Sinaia, Romania, pp. 567–570.

50. **"Failure Analysis of Power Silicon Devices at Operation Above 200°C Junction Temperature"**, V.V.N. Obreja, KI Nuttall, O Buiu, S Hall, **International Conference on thermal, mechanical and multyphysics simulation and experiments in micro-electronics and micro-systems (EuroSimE 2007)**, April, 2007, London, UK, pp. 1–6.

51. "**On the Maximum Permissible Working Voltage of Commercial Power Silicon Diodes and Thyristors"**, V.V.N. Obreja, Proceedings **IEEE International Symposium on Industrial Electronics (ISIE 2007)**, June, 2007, Vigo, Spain, pp. 401–406.

52. **"The Semiconductor –Dielectric Interface From PN Junction Edge and the Voltage Dependence of Leakage Reverse Current"**, V.V.N. Obreja, Proceedings 2007 **International Semiconductor Device Research Symposium (ISDRS 2007)**, December, Washington, USA, pp. 1-2.

53. **"Silicon Supported Microwave Zeroth-Order Resonance Antenna on Metamaterial Approach"**, G. Sajin, S. Simion, F. Craciunoiu, R. Marcelli, G. Bartolucci, Proceedings of the 2007 **Asia-Pacific Microwave Conference**, **APMC 2007**, Bangkok, Thailanda, 11–14 December, Bangkok, Thailanda, pp. 221–224.

54. **"Electromagnetic Analysis of CPW CRLH TL Directional Coupler"**, S. Simion, R. Marcelli, G. Bartolucci, G. Sajin, Proceedings of the **11th International Symposium on Microwave and Optical Technology, ISMOT 2007**, 17–21 December, Roma, Italy, pp. 567–57.

55. **"Nanocomposite Porous Silicon Layers"**, I. Kleps, M. Miu, T. Ignat, M. Simion, Proceedings of the Sixteenth **International Offshore and Polar Engineering Conference, ISOPE**, July 1-6, 2007, Lisbon, Portugal, pp 2916–2923.

Other papers presented to various international and national conferences and workshops

1. **"Manufacturing of Nanoporous Silicon Membranes for Bio-Medical Applications"**, A. Popescu, C. Podaru, R. Vasilco, E. Manea, R. Gavrila, M. Avram, **4th International Conference on Nonosciences & Nanotechnologies**, Aristotle University of Thessaloniki, 16-18 July, 2007, Salonic, Grecia, Abstract Book–N&N07, pp.169.

2. **"TiO_2 Anodic Oxide Films for Sensors Applications"**, C. Podaru, M. Danila, A. Popescu, E. Manea, A. Dinescu, **4th International Conference on Nonosciences & Nanotechnologies**, Aristotle University of Thessaloniki, 16-18 July 2007, Salonic, Grecia, Abstract Book–N&N07, pp. 124.

3. **"Study of Surface Texturing Processes for High Efficiency Silicon Solar Cells"**, E. Manea, E. Budianu, M. Purica, C. Podaru, A. Popescu, C.C. Parvulescu, **4th International Conference on Nonosciences & Nanotechnologies**, Aristotle Univ. of Thessaloniki, 16-18 July 2007, Salonic, Grecia, Abstract Book–N&N07, pp. 86.

4. **"The Optimised Spin Valve Magnetotransistor"**, M. Avram, A. M. Avram, R. Vasilco, M. Volmer, A. Popescu, A. Ghiu, **4th International Conference on Nonosciences & Nanotechnologies**, Aristotle University of Thessaloniki, 16-18 July 2007, Salonic, Grecia, Abstract Book–N&N07, p. 120.

5. **"The Optimised Spin Valve Magnetotransistor"**, M. Avram, A. M. Avram, R. Vasilco, M. Volmer*, A. Popescu, A. Ghiu, **4th International Conference on Nonosciences & Nanotechnologies**, Aristotle University of Thessaloniki, 16-18 July 2007, Salonic, Grecia, Abstract Book–N&N07.

6. **"Cooling Nanofluids Based on Fe-C Nanocomposites"**, C. Codreanu, R. Gavrila, **2nd International Conference on Experiments / Process / System Modeling / Simulation & Optimization, 2nd IC-EpsMsO**, Athens, 4-7 July, 2007.

7. **"Compact Vertically-Coupled Microring Laser Array Dual-Wavelength Source for Terahertz Mode Beating"**, C.W. Tee, K. Williams, R. Penty, I. White, M. Hamacher, U. Troppenz, H. Heidrich, V. Dragoi, M. Alexe, D. Alexandropoulos, S. Mikroulis, H. Simos, D. Syvridis, M. Kusko, D. Cristea, **European Conference on Integrated Optics**, April 25-27, 2007, Copenhagen, Denmark.

8. **"Left Handed Electromagnetism in a Metallo Dielectric Structure"**, C. Kusko, M. Kusko, **First European Topical Meeting on Nanophotonics and Metamaterials**, Nanometa 2007, 8–11 January, Seefeld, Austria.

9. **"Left Handed Electromagnetism in a Composite Dielectric Structure"**, C. Kusko, M. Kusko, **Third International Conference on Surface Plasmon Photonics**, 17-22 June, 2007, Dijon, France.

10. **"Left Handed Electromagnetism in a Three-Dimensional Dielectric Structure"**, C. Kusko, **Symposium Nano and Giga in Europe, Communicating at the global level**, 25 May 2007, Acad. Romana, Bucuresti.

11. **"Application of Laser Microprocessing for High Density Interconnections of Microsystems Manufacturing"**, D. Ulieru, A. Matei, E. Ulieru, Proceedings of the **2nd International Conferince on Micro-manufacturing, ICOMM2007**, 10-13 September., 2007, Greenville, Greenville, SC, pp. 299–302.

12. **"Design of Single-Mode Vertically Coupled Microring Rezontaors"**, M. Kusko, A. Kapsalis, C. Kusko, D. Alexandropoulus, D. Cristea, D. Syvridis, **2nd European Optical Society Topical Meeting Optical Microsystems**, 30 September–3 October 2007, Capri (Napoli), Italy, Book of Abstracts, p. 72.

13. "**Polymer-Based Chip for SPR Sensors"**, D. Cristea, P. Obreja, M. Kusko, A. Dinescu, **2nd European Optical Society Topical Meeting**, 30 September–3 October 2007, Capri (Napoli), Italy, Book of Abstracts, p. 109.

14. **"Simple Replication Technique for Low Cost Diffractive Optical Elements"**, P. Obreja, A. Dinescu, E. Manea, D. Apostol, D. Cristea, **2nd European Optical Society Topical Meeting, Optical Microsystems**, 30 September–3 October 2007, Capri (Napoli), Italy, Book of Abstracts, p. 96.

15. **"Micromachined AlN Based FBAR Structures"**, D. Vasilache, G. Konstantinidis, D. Neculoiu, C. Morosanu, A. Stavrinidis, A.Kostopoulos, A. Cismaru, C. Buiculescu, A. Muller, Proceedings of **Micromechanics Europe MME 2007**, 16-18 Sept., Guimaraes, Portugal, pp. 39–42.

16. **"Optical Properties of Nanocrystalline Titanium Oxide"**, R. Plugaru, **E-MRS Fall Meeting**, 17-21 September, 2007, Warsaw, Poland, Proceeding, Abstract Books, p. 213.

17. "**Comparison Study of Front Surface Texturing Processes for High Efficiency Silicon Solar Cells"**, E. Manea, E. Budianu, M. Purica, C. Podaru, A. Popescu, C.C. Parvulescu, **XIV– International Materials Research Congress (IMRC 2007)**, Symposium 4 Photovoltaic, Cancun, Mexico, 19-23 August, Abstracts Book S4-73, pp. 70.

18. **"Comparison Study of Front Surface Texturing Processes for High Efficiency Silicon Solar Cells"**, E. Manea, E. Budianu, M. Purica, C. Podaru, A. Popescu, C.C. Parvulescu, **8th International Balkanic Workshop on Applied Physics**, 5-7 July 2007, Constanta, Romania, Book of Abstract, S1 P82.

19. **"A Method of Noise Reduction in Microsensors"**, G. Moagăr-Poladian, Proceedings of the **8th International Balkan Conference on Applied Physics**, Constanþa, România.

20. **"Topography and Structural Characterization of Alq3 Layers Deposited by Different Methods"**, G. Moagăr-Poladian, A. Popescu, C. Podaru, A. Dinescu, A. Corâci, R. Gavrilă, Proceedings of the **8th International Balkan Conference on Applied Physics**, Constanþa, România.

21. **"Investigation of Defects and Electronic Structure of TiO_2 Treated in Oxygen and Hydrogen"**, R. Plugaru, N. Plugaru, Book of Abst., **8th International Balkan Workshop on Applied Physics**, 5-7 July, Constanta, Romania, p. 81.

26. **"Sub-Wavelength Resolution Laser Lithography in the Field of MEMS"**, G. Moagăr-Poladian, Proceedings SPIE of the **1st International Conference of the Industrial Applications of Lasers INDLAS**, 23-25 May 2007, Bran, Romania.

27. **"Laser Applications in the Field of MEMS"**, G. Moagăr-Poladian, Z. Illyefalvi-Vitez, B. Balogh, D. Ulieru, A. Corâci, Proceedings SPIE of the **1st International Conference of the Industrial Applications of Lasers INDLAS**, 23-25 May 2007, Bran, Romania.

28. **"Computer Assisted Laser Micro-Patterning"**, Grigoriu, I. Nicolae, M. Sima, S. Dumitrescu, D. Cristea, Proceedings SPIE of the **1st International Conference of the Industrial Applications of Lasers INDLAS**, 23-25 May 2007, Bran, Romania.

29. **"CPW Silicon Zeroth-Order Resonance Antenna Using Composite Right/Left-Handed Transmission Lines"**, G. Sajin, S. Simion, F. Craciunoiu, R. Marcelli, **Mediterranean Microwave Symposium, MMS**, 14–16 May 2007, Budapest, Hungary, pp. 65–68.

30. **"Vertically Coupled GaInAsP/InP Microring Lasers Fabricated by Using Full Wafer Bonding"**, H. Heidrich, M. Hamacher, U. Troppenz, D. Syvridis, D. Alexandropoulos, S. Mikroulis, C.W. Tee, K. Williams, V. Dragoi, M. Alexe, D. Cristea, C. Kusko, M. Kusko, **33rd European Conference and Exhibition on Optical Communication, ECOC, International Congress Center (ICC)**, 16-20 September 2007, Berlin, Germany.

31. **"Nano-Porous Silicon for Sensors and Solar Cells"**, E. Manea, C. Podaru, A. Popescu, E. Budianu, M. Purica, F. Bbabarada, C. Parvulescu, 6th International Conference of the Balkan Physical Union, Simpozion **13th Alternative Sources of Energy, AIP** (American Institute of Physics) Conference Proceeding, Vol. 899, 23 April 2007, Istanbul, Turky, p. 759.

32. **"The Optimised Spin Valve Magnetotransistor"**, M. Avram, A. M. Avram, R. Vasilco, M. Volmer, A. Popescu, A. Ghiu, **4th International Workshop in Nanoscience and Nanotechnologies NN-07**, July, Greece.

33. **"The Optimized Spin Valve Magnetotransistor",** M. Avram, A.M. Avram, R. Vasilco, A.Popescu, A. Ghiu, 4th **International Workshop in Nanoscience and Nanotechnologies NN-07**, 08. 2007,Salonic, Greece.

34. **"Manufacturing of Nanoporous Si Membranes for Biomedical Applications"**, A. Popescu, C. Podaru, R. Vasilco, E. Manea, R. Gavrila, M. Avram, **4th International Workshop in Nanoscience and Nanotechnologies NN-07**, 08. 2007, Salonic, Greece.

35. "**Vertically Coupled Microring Laser Devices Based on InP Using BCB Waferbonding"**, M. Hamacher, U. Troppenz, H. Heidrich, V. Dragoi, A. Kapsalis, D. Syvridis, C.W. Tee, K.A. Williams, M. Alexe, M. Kusko, D. Cristea, Conference: **CLEO-Europe IQEC**, 17-22 June 2007, Munich, Germany.

36. **"Vertically Coupled and Waferbonded μRing Resonators on InP"**, M. Hamacher, U. Troppenz, H. Heidrich, V. Dragoi, A. Kapsalis, D. Syvridis, C.W. Tee, K.A. Williams, M. Alexe, M. Kusko, D. Cristea, **European Semiconductor Laser Workshop 2007**, 14-15 September, Berlin, Germany.

37. **"High Frequency Micromixing Applications: Interactions Between Piezoelectric Ceramic and Biological Media"**, M. Sajin, D. Petrescu, G. Sajin, F. Craciunoiu, R. Gavrila, IEEE Proceedings **Asia-Pacific Microwave Conference (APMC 2007)**, 11-14 December, Bangkok, Thailanda.

38. **"Polyaniline Films for Sensor Applications, European Congress on Advanced Materials and Processes"**, P. Obreja, D. Cristea, M. Purica, T. Ignat, R. Gavrila, **European Congress on Advanced Materials and Process**, 10-13 September 2007, Nurnberg, Germany.

39. **"Erbium Doped - SiO_2 - TiO_2 Waveguides Prepared by Sol-Gel Method"**, L. Predoana, M. Gartner, M. Anastasescu, D. Cristea, P. Obreja, A. Dinescu, M. Voicescu, M.Zaharescu, **The XIVth Internaþional Sol-Gel Conference**, 2-7 September, 2007, Montpellier, Feance.

40. **"Influence of Dopants on the Optical Characteristics of the SnO_2-Based Films"**, S. Mihaiu, M. Anastasescu, O. Mocioiu, I. Atkinson, E. Manea, M. Purica, A. Dinescu, M. Gartner, M. Zaharescu, **XIVth International Workshop on Sol-Gel Science & Technology**, 2-7 September 2007, Montpellier, France.

41. **"Comparative Study of Sol-Gel S and AG-Doped TiO_2 Coatings for Environmental Protection"**, M. Raileanu, A. Braileanu, D. Crisan, N. Dragan, M. Crisan, M. Anastasescu, A. Galtayries, A. Ianculescu, R. Gavrila, I. Nitoi, V.E. Marinescu, **XIVth International Sol-Gel Conference**, 2-7 Sepember, 2007, Montpellier, France.

42. "**Sol-Gel S-Doped TiO_2 Coatings With Photocatalytic Activity"**, M. Crisan, A. Braileanu, M. Raileanu, D. Crisan, N. Dragan, M. Anastasescu, A. Galtayries, A. Ianculescu, R. Gavrila, I. Nitoi, P. Oancea, **XIVth International Sol-Gel Conference**, 2-7 Sepember, 2007, Montpellier, France.

43. **"Characteristics of Sol-Gel Pure and Doped $BaTiO_3$ Coatings"**, A. Braileanu, A. Ianculescu, M. Crisan, D. Crisan, N. Dragan, M. Raileanu, M. Gartner, M. Anastasescu, R. Gavrila, V. E. Marinescu, **XIVth International Sol-Gel Conference**, 2-7 Sepember 2007, Montpellier, France.

44. **"Tin Dioxide Films Obtained by Soft Chemistry Route"**, S. Mihaiu, M. Gartner, M. Anastasescu, E. Manea, M. Purica, C. Logofatu, I. Gresoiu, M. Zaharescu, **Xth ECerS Conference**, June, 2007, Berlin, Germany.

45. **"Microstructure and Physical Properties of SnO_2 Thin Films"**, S. Mihaiu, M. Gartner, M. Popa, E. Manea, M. Anastasescua, M. Zaharescua, **31st International Cocoa Beach Conference & Exposition on Advanced Ceramics and Composites**, 21-26 January, 2007, Daytona Beach, Florida, USA.

46. **"CPW Silicon Directional Coupler Based on Composite Right/Left-Handed Transmission Lines"**, S. Simion, G. Sajin, F. Craciunoiu, R. Marcelli, G. Bartolucci, **Mediterranean Microwave Symposium, MMS 2007**, 14–16 May 2007, Budapest, Hungary, pp. 307–310.

47. **"Design and Fabrication of MMIC Coupled Lines Coupler Consisting of Composite Right/Left-Handed Transmission Lines"**, S. Simion, G. Sajin, F. Craciunoiu, R. Marcelli, G. Bartolucci, **The International Conference on Computer as a Tool, EUROCON 2007**, 9–12 September 2007, Warszawa, Poland, pp. 2073–2077.

48. **"CPW Antenna Fabricated on Silicon Substrate, Based on Transmission Line Metamaterial Approach"**, S. Simion, G. Sajin, F. Craciunoiu, R. Marcelli, G. Bartolucci, **10th Edition of Conference on Electromagnetics in Advanced Applications, ICEAA**, 17–21 September 2007, Torino, Italy.

49. **"The PN Junction Passivation Process and Performance of Semiconductor Devices"**, V.V.N. Obreja, Proceedings 30th **ISSE 2007**, May, Cluj-Napoca, Romania, pp. 287–292.

50. **"On the Performance of Commercial Supercapacitors as Storage Devices for Renewable Electrical Energy Systems"**, V.V.N Obreja, **ICREPQ**, (paper No. 329), March, Sevilla, Spain, pp. 189–190.

51. **"The Semiconductor – Dielectric Interface From PN Junction Periphery and its Influence on Reliability of Power Devices at High Temperature"**, V.V.N. Obreja, P.M. Svasta, **MicroNanoReliability 2007**, September, Berlin, Germany, p. 177.

52. **"Composite Material With Addition of Nanoparticles for the Development of a Smart Wall"**, C. Dumitrescu, M. Menicu, I. Cernica, A. Matei, D. Mihalevschi, **Vth ARM**, 5-7 September 2007, Sibiu, Romania.

53. **"Supercapacitors: Manufacturing Technology, Performance and Applications"**, V.V.N. Obreja, E. Sofron, D. Scheianu, M. Raducu, N. Bizon, I. Lita, M. Oproescu, Proceedings of the **2nd International Conference on Electronics, Computers and Artificial Intelligence (ECAI 2007)**, 29–30 June, Pitesti, Romania, pp. 73CE–78CE.

54. **"Influence of Reverse Leakage Current on the Breakdown Voltage of Commercial High Voltage Silicon Rectifier Diodes"**, V.V.N. Obreja, E. Sofron, Proceedings of the **2nd International Conference on Electronics, Computers and Artificial Intelligence (ECAI 2007)**, 29–30 June, Pitesti, Romania, pp. 79CE-82CE.

55. **"Resonating Antenna and Coupled Line Directional Coupler Based on Metamatarials Approach"**, S. Simion, G. Sajin, F. Craciunoiu, Proceedings of the **2nd International Conference on Electronics, Computers and Artificial Intelligence (ECAI 2007)**, 29–30 June, Pitesti, Romania, pp. 20MW–25MW.

56. **"Commercial Supercapacitor Modules: Characteristics and Applications"**, V.V.N. Obreja, **SIITME 2007**, September, Baia Mare, pp. 184–187.

57. **"Method for Overcoming the Unwanted Displacements of an Electro-Thermally Actuated Microgripper"**, R. Voicu, D. Esinenco, R. Müller, L. Eftime, C. Tibeica, Proceedings of **3rd International Conference on Multi-Material Micro Manufacture 4M**, 3-5 October 2007, Borovets, Bulgaria, pp. 39–42.

58. **"A New Approach to Quality Assurance in Resistance Welding for Microsensors Packaging"**, D. Ulieru, A. Matei, E. Ulieru, A. Tantau, Proceedings of **3rd International Conference on Multi-Material Micro Manufacture 4M**, 3-5 October 2007, Borovets, Bulgaria.

59. **"DLC Based BioMEMS Probe for Electronical Activity Recording of Tissues and Cells"**, C. Moldovan, R. Iosub, C.P. Lungu, A. M. Lungu, B. Fartat. C. Roman, R. Albulescu, Proceedings of **3rd International Conference on Multi-Material Micro Manufacture 4M**, 3-5 October 2007, Borovets, Bulgaria, pp. 187–190.

60. **"Different Catalysed Sol-Gel Methods for Obtaining Silica- Materials Entrapping Pyridilporphyrin"**, C. Enache, V. Cosma, C. Savii, R. Gavrila, E. Fagadar-Cosma, **Fifth Conference on Isotopic and Molecular Processes (PIM–2007)**, 20–22 September, Cluj-Napoca, Romania.

61. **"Profiled Ceramic Micropackages for MEMS"**, C. Anton, J. Jarrige, J. P. Lecompte, **Application International Symposium on Signals, Systems and Electronics (ISSSE 2007)**, 1-5 August 2007, Montreal, Canada.

62. **"Biomagnetism and Magnetic Biosystems Based on Molecular Recognition Processes"**, R. Vasilco, A. Popescu, **Applications of Magnetic Materials and Devices in Medicine, EMBO-ESF**, September 2007, San Feliu de Guixols, Spain.

63. **"The Influence of Dopant on the Structure and Dielectric Properties of $Pb(Mg_{1/3}Nb_{2/3})O_3$-$Ln(Mg_{1/2}Ti_{1/2})O_3$ System"**, A.M. Moisin, A.I. Dumitru, G. Sajin, C. Miclea, A. Iuga, S. Hodorogea, Proceedings of the the **11th European Meeting on Ferroelectricity, EMF-2007**, 3–7 September, Bled, Slovenia.

64. **"Silicon CPW Composite Right/Left-Handed Coupled Lines Directional Coupler"**, S. Simion, G. Sajin, F. Craciunoiu, R. Marcelli, G. Bartolucci, Proceedings of the **First International Congress on Advanced Electromagnetic Materials for Microwave and Optics, METAMATERIALS 2007**, 22–26 October, Rome, Italy, pp. 369–372.

65. **"CPW Composite Right/Left-Handed Zeroth-Order Resonance Antenna on Silicon Substrate"**, S. Simion, G. Sajin, F. Craciunoiu, R. Marcelli, G. Bartolucci, Proceedings of the **First International Congress on Advanced Electromagnetic Materials for Microwave and Optics, METAMATERIALS 2007**, 22–26 October, Rome, Italy, pp. 373–376.

66. **"Silicon Resonating Antenna Based on CPW Composite Left/Right-Handed Transmission Line"**, S. Simion, G. Sajin, R. Marcelli, F. Craciunoiu, G. Bartolucci, Proceedings of the **European Microwave Week–European Microwave Conference, EuMW-EuMC 2007**, 8–12 October 2007, Munchen, Germany, pp. 478–481.

67. **"Silicon Surface Functionalization for Biomolecules Attachment"**, A. Bragaru, M. Miu, M. Simion, T Ignat, I. Kleps, A . Avram, V. Schiopu, F. Craciunoiu, **1st Workshop, Polymers in Nanotechnology,** September, Salerno, Italia.

68. "**AFM Method for Investigation of the Piezoelectric Properties of the Polymeric thin Films"**, F. Craciunoiu, M. Miu, R. Gavrila, A. Dinescu, Proceeding of the 3th **International Symposium on Nanostructured and Functional Polymer-based Materials and Nanocomposites, NANOFUN-POLY**, 13-15 May, Corfu, Greece.

69. **"Protein Attachment Via Polymers in Microarray Technology"**, M. Simion, I. Kleps, M. Miu, T. Ignat, F. Craciunoiu, A. Bragaru, Proceeding of the **3th International Symposium on Nanostructured and Functional Polymer-based Materials and Nanocomposites, NANOFUN-POLY**, 13-15 May, Corfu, Greece.

70. **"Investigation of Nanocrystalline S-Layers–Mesoporous Silicon Matrix for Sensors and Biomedical Applications"**, I. Kleps, T. Ignat, M. Miu, M. Simion, A. Dinescu, D. Dascalu, G. Popescu, M.Enache, L. Dumitru, Proceeding of the **3th International Symposium on Nanostructured and Functional Polymer-based Materials and Nanocomposites, NANOFUN-POLY**, 13-15 May, Corfu, Greece.

71. **"Study of Nanocomposite Metal/Porous Silicon Material"**, M. Miu, I. Kleps, M. Simion, T. Ignat, A. Bragaru, **International Symposium on Metastable and Nano Materials**, 24–31.08, 2007, Corfu, Grecia.

72. **"Perspectives of Label-Free Detection for Protein Arrays: Applications in Proteomics"**, M. Simion, I. Kleps, M. Miu, T. Ignat, F. Craciunoiu, A. Bragaru, **1st Label-Free Protein Array Workshop**, 29 March 2007, Paris, France.

73. **"Nanostructured Membranes on Silicon for Specific Applications"**, M. Miu, I. Kleps, F. Craciunoiu, M. Simion, A. Bragaru, T. Ignat, **International Conference on Nanotechnology: Science and Application (NanoTech Insight '07)**, 8-17. March, Luxor, Egypt I.

74. **"Advanced Magnetoresistance Sensing of Rotation Rate for Biomedical Applications Biomagnetism and Magnetic Biosystems Based on Molecular Recognition Processes Biomagnetism and Magnetic Biosystems Based on Molecular Recognition Processes"**, M. Avram, M. Volmer, A.M. Avram, September 2007, Sant Feliu de Guixols, Spania.

75. "**Biocompatible Gold/Silicon Layers"**, T. Ignat, I. Kleps, F. Maroun, P. Allongue, A. Bragaru,Tissue Engineering, **APR 2007**, Vol. 13, No. 4, pp. 922–922.

76. **"Preparation of thin Gold Substrate for SAMs"**, T. Ignat, I. Kleps, M. Danila, M. Miu, A. Bragaru, F. Craciunoiu, M. Simion, F. Maroun, C. Henry de Villeneuve, P. Allongue, F. Ozanam, **Materials Development on the Nanoscale, Romanian-German Workshop UP Bucharest-IFW Dresden**, May 2007, Bucharest, Romania.

77. **"Resonances the Immersed Elastic Plate: Influences of the Physical Parameters and Analyzes of the Interferences"**, C. Pachiu, J.-L. Izbicki, H. Franklin, **12th International Conference on Phonon Scattering in Condensed Matter Phonons 2007**, 15-20 July 2007, Paris, France.

78. "**A New Method to Characterize the Acoustic Rezonances in a Plane Structure of Layers"**, C. Pachiu, J.-L. Izbicki, H. Franklin, **8th International Balkan Workshop on Applied Physics**, 5-7 July 2007, Constanta, Romania.

79. **"Resonating Antenna and Coupled-Line Directional Coupler Based on Metamaterials Approach"**, S. Simion, G. Sajin, F. Crãciunoiu, **Proceedings of the International Conference on Electronics, Computers and Artificial Intelligence, ECAI 2007**, Pitesti, Romania, pp. 20MW–25MW.

80. **"CRLH CPW Resonating Antenna and Coupled-Line Directional Coupler"**, S. Simion, G. Sajin, F. Craciunoiu, Proceedings of the **32nd International Scientific Conference, Modern Technologies in the XXI Century**, Bucharest, 1-2 November 2007, pp. 8.45–8.52.

81. **"Detection of Magnetic-Based Bio-Molecules Using Magnetoresistive Sensors"**, M. Volmer, M. Avram, **IBWAP**, July 2007, Constanta, Romania.

82. **"Micro- and Nanotechnology Potential for Biomedicine"**, I. Kleps, M. Miu, M. Simion, F. Craciunoiu, T. Ignat, A. Bragaru, **Workshop: Microsystems as a Platform for Integrating Micro/Nano/Biotechnologies, Combined with Info- and Brokerage Event: Micro- and Nanosystems Call in FP7/2007**, 23-25 May, Bucharest, Romania.

83. **"Nanostructured Elements on Si for Microsystems with Biomedical Applications"**, I. Kleps, **VIth National Symposium of Nanoscience and Nanotechnologie, organized by Romanian Academy in colaboration with CNCSIS**, Romanian Academy Library, 26 March 2007.

84. **"Development of New Technologies for Fabrication of Si Based Nanostructured Membranes"**, M. Miu, **VIth National Symposium of Nanoscience and Nanotechnologie, organized by Romanian Academy in colaboration with CNCSIS**, Romanian Academy Library, 26 March 2007.

85. **"RIE Surface Functionalization for Microfluidic Applications"**, A.M. Avram, M. Avram, A. Bragaru, A. Ghiu, **VIth National Symposium of Nanoscience and Nanotechnologie, organized by Romanian Academy in colaboration with CNCSIS**, Romanian Academy Library, 26 March 2007.

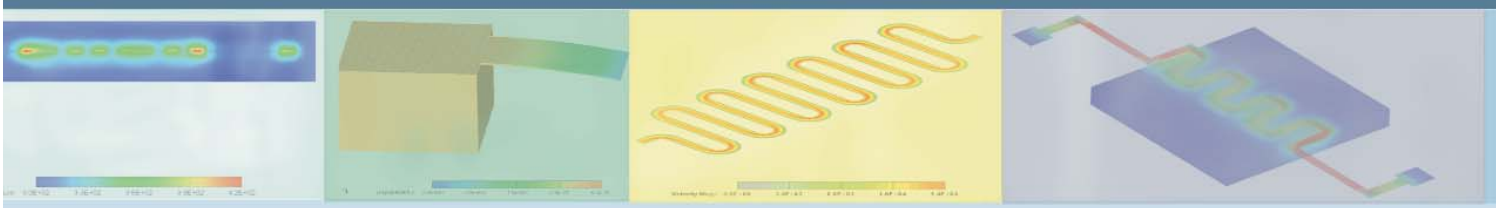
86. **"Traceable Measurement of Lateral Calibrators for Nanoscale Observation Instruments"**, I. Iordache, M. Bojan, S. Florea, F. Garoi, A. Sima, D. Cristea, A. Dinescu, R. Muller, **Young Optician School**, 2-7 May, 2007, Erevan, Armenia.

87. **"White Light Interferometery for Height Artifact Calibration Specimen"**, M. Bojan, I. Iordache, S. Florea, F. Garoi, A. Sima, D. Cristea, A. Dinescu, R. Muller, **Young Optician School**, Erevan, 2-7 May 2007, Armenia.

88.**"New Technological Processes for Integrated Photonic Structures Applications of Photonic Integration"**, R. Rebigan, **ePixnet School**, 11-16 March 2007.

Patents

1. **"Amperometric Glucose Detector Sensor and Method of Realization"**, Cecilia Podaru, Patent No. 121575/30.11.2007.



National Institute for R&D in Microtechnologies

126A, Erou Iancu Nicolae Street, R-077190
Mailing address: PO-BOX 38-160, 023573,
Bucharest, ROMANIA
Tel: +40-21-490.84.12; +40-21-490.82.12;
Fax: +40-21-490.82.38; +40-21-490.85.82;
+40-21-490.82.36;

http://www.imt.ro