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Application of microsystem technology for medical implants

(see details on pages 9, 10)

Electrodes for hearing implants:
- passive cochlear microelectrode containing 22 Pt stimulation sites coated with silicone rubber (left);
- silicon modulus electrode integrated with a piezoresistive deflection sensor and protected with parylene-silicone coating (right);

Division of Silicon Microsystem and Nanostructure Technology Institute of Electron Technology, Warsaw, Poland

Edited by:
National Institute for Research and Development in Microtechnologies
(IMT-Bucharest, www.imt.ro)
Ministry of Education and Research, Romania

Previous issues on web*: www.imt.ro/mnt*

Design for Micro & Nano Manufacture (DfMM) News

web page: http://www.patent-dfmm.org

The NoE Patent-DfMM aims to establish a collaborative team to provide European industry with support in the field of "design for micro nano manufacture" to ensure that problems affecting the manufacture and reliability of products based on micro nano technologies (MNT) can be addressed before prototype and pre-production.

The PATENT-DfMM NoE - Design for Micro & Nano Manufacture - what has been achieved and what remains to be done?

The EC-funded FP6 Network of Excellence in Design for Micro & Nano Manufacture "Patent-DfMM" is now in its 5th year and in the process of transitioning to a privately funded portfolio of expert clusters. Most of the work of the network in addition to the core skills and capability has been specifically aligned to the field of "Design-for-X", where "X" denotes testability, reliability, packaging etc. This work, as with more conventional Design for Manufacture activities, aims to improve yield, reduce the cost of manufacture and improve outgoing quality and reliability.

So what has been achieved through this pan-European experiment and where is more effort justified and needed? Publications and dissemination activities through events have certainly dominated partner activities but even more importantly, it has generated new multi-disciplinary collaborations that have real potential to significantly impact the scientific AND industrial MNT community. These newly emerged clusters need to be actively promoted and supported through business models that maintain open structures, and continue the quality collaborative research activities with a focus on knowledge and capability capture in addition to maximising delivery into the knowledge-based industrial sector:

HUMS: Led by iSLI Livingston who focus on sensor design and multi-sensor integration. This cluster aims to offer a resource to help companies build highly integrated health and usage monitors that typically feature a number of sensors and electronics with applications usually requiring very high reliability and tolerance against harsh environments. The cluster has positioned itself to offer engineering services to organisations needing assistance with specific design and integration challenges rather than a specific target to generate its own design IP.

EUMIREL, the European Microsystems Reliability Cluster: led by NovaMEMS in Toulouse is a larger cluster of experts who are offering a wide range of reliability services to the industrial sector that includes fault and degradation modelling, stress/test programmes, characterisation, design for reliability, and training. EUMIREL has access to a wide range of test, reliability and failure analysis instrumentation available at different partners.

Design: This cluster has mainly addressed simulation and modelling challenges linked to MEMS integration, Design for Test and Embedded Test Engineering. The cluster is led by Lancaster University - it has made significant progress in the understanding and ability to model damping mechanisms, adhesive technology, and yield in addition to developing new embedded test strategies to reduce production test cost. This cluster is however more aligned to tackling the design challenges associated with the next phase of integration technologies, hence will be seeking further industrial collaboration and public support. The Design cluster is also an umbrella to other activities such as the MEF (Bio-Fluidics).

International Relations and Industry Links

The project's efforts to build strong international relations and close contacts to other projects and programmes are already paying off with for example the first commercial contract for Eumirel coming from one of these projects. To carry results and achievements from PATENT-DfMM into future initiatives will require further collaboration with upcoming new research programmes on a regional and transnational basis. Organisations like NEXUS and MEMS Industry Group (USA) have significantly helped PATENT-DfMM achieve its objectives in terms of industry focus.

Not only as an excuse for industry focus, but to really guide PATENT-DfMM into what industry needs, an Industry Advisory Board (IAB) was established at the start of the project, which not only advised but also was invited to evaluate project ideas and thus steer the workplan of PATENT-DfMM. IAB Chairmen, Benedetto Vigna (STM, Italy) and later Alistair Sutherland (BCF Designs, UK) actively participated in the project Management Board meetings to ensure an effective interface to the needs of the industrial community.

Further Information

With the project coming to an end in June 2008, this MNT Bulletin will be the last issue to feature a printed version of DfMM News. However, the E-Mail Newsletter "DfMM News" will continue, not only to distribute information from upcoming work related to the PATENT-DfMM NoE but also as a source of information on Design Modelling and Simulation in the area of MNT. Registration is free of charge - just email your contact details to dfmm-news@4m2c.com. Please also send us your news items for publication!

Contact PATENT-DfMM Coordinator:
- Andrew Richardson, Lancaster University, UK
E-Mail: a.richardson@lancaster.ac.uk
- Patric Salomon, 4M2C - enablingMNT, Germany
E-Mail: Patric.salomon@4m2c.com

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Nano2Life
Bringing Nanotechnologies To Life

Bringing Nanotehnology to Life - European Network of Excellence

Top 3 major achievements of N2L

The major achievements of Nano2life have been implemented along the three directions of the "**knowledge triangle**", namely **research, education** and **innovation**.

• Research

Future applications of nanobiotechnology are potentially very wide, but their markets are still imprecise, most often as niches. The technical feasibility of many applications has to be validated first by demonstrating proofs of concept and developing prototypes. Therefore Nano2Life has taken advantage of its wide partnership to initiate new collaborations and joint R&D projects in nanobiotechnology, on bi- or multilateral basis (see references about joint R&D projects on **http://www.nano2life.com**, Research section).

The early upstream detection of future trends of nanobio science and technology is carried out by the European Observatory on Nanobiotechnology – EoN - initiated in 2006. Its 20 experts collect and analyse publications, patents, and communications on key predefined fields to monitor weak signals considered as precursors of future trends in nanobiotechnology. EoN has screened so far more than 100 publications, communications and patents and released 4 reports.

Every 6 months, matching events involving public and private partners of N2L are organised at the general assemblies along carefully predefined strategic research topics. More than 35 collaborative projects came out so far out of this process. The key of success of these brainstorming and partnering sessions is their accurate selection of topics and partners as well as the open presentation of the expertise, skills and know-how available within Nano2Life. Finally the N2L mobility scheme gives the opportunity, especially to more than 70 young scientists, to access rare or expensive equipments and know-how, and to visit new partners.

• Education

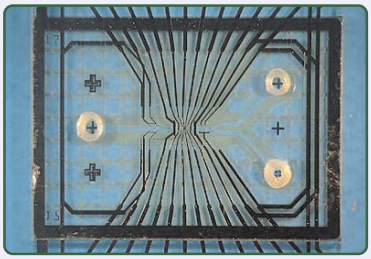
The intrinsic multidisciplinary nature of nanobiotech obliges especially young scientists to reinforce their basic knowledge and/or to train themselves in new disciplines; providing clinicians with insights in technology or physicists with insights in molecular biology are just two obvious examples. Nano2Life implements a very complete set of educational activities addressing these challenges. Nearly 100 young scientists have been trained so far in our summer and research schools or were financially supported to attend existing summer schools More than 15 tutorials have been delivered. More than100 web-casted sessions like tutorials, plenary sessions, and lectures are available on line.

Besides this scientific education scheme, Nano2life has a strong policy in human resource management to build a strong community. Nano2life is not just a juxtaposition of more than 400 scientists from different disciplines with an increasing proportion of young scientists. To boost communication within this very heterogeneous community, several tools have been implemented. Poster sessions were organized at "bazaars" with elevator pitches and "speed dating". A very innovative electronic (e)-mentoring program with currently 16 mentor/mentee couples is also installed especially for young researchers which promotes the development of young researchers. 24 senior people having responsibilities in N2L have also attended the PROGRESS course where they are taught how to organize and lead heterogeneous groups coming from very diverse scientific and cultural backgrounds, developing a very coherent nucleus for a European nanobiotech community.

Thanks to its structuring impact, Nano2Life is considered nowadays as the most lively and active network in nanobiotechnology in Europe, where research results and collaborations can be discussed in an open spirit. This explains why so many collaborations initiated within Nano2Life have been successfully funded. This "family spirit" attracts more than 400 experts. By doing so, Nano2Life is often recognised as a quality label in terms of cooperation and even a trade mark.

Nanobiotechnology in Europe has now **meeting places,** a **visible face** and a **spirit: it's called Nano2Life!!**

Platform for in Vitro Cytotoxicity Testing
Developing "Chips" for the Prediction of Cytotoxicity



A microfluidic chip for cell handling and analysis (photo above)
Details on: http://www.nano2life.com
Contact: Maurice Whelan, Joint Research Centre JRC **(m.whelan@jrc.it)**

• Innovation

Nano2Life continuously explores further applied research areas and opens new avenues for public/private cooperation. What kind of nanobiotech products can companies sell, what devices do medical doctors need for their patients? How can we get the input from both for the identification and definition of the relevant priorities in research and development in nanobiotechnology? These questions were successfully answered in a series of eight prospective workshops on specific application areas like drug development and discovery, in vitro diagnostics, neuro-rehabilitation, nanotechnology based oncology or even environmental monitoring. More than 180 experts, including 44 companies jointly developed a joint vision for the future development of nanotechnology in these eight markets. However a sound, reasonable and concerted development of nanobiotechnology requires bridging the gap between ethicists and scientists or technologists about the new and unaddressed ethical, regulatory and societal concerns. So Nano2Life has set up an Ethical, Legal and Societal Aspects board with 11 experts in philosophy, law, economy, theology, sociology, technology assessment, and medicine. It opens a dialog where both ethicists and R&D project leaders jointly analyse the possible concerns associated with their project or more generally with nanobiotechnology.

Nano2Life Coordinator: BOISSEAU Patrick, CEA-Léti-MiNaTec, France. Tel: +33 4 38 78 38 54; Fax: +33 4 38 78 51 64.
http://www-leti.cea.fr; http://www.nano2life.org

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4M Network of Excellence
Multi-Material Micro Manufacture

The 4M Network of Excellence has created a Knowledge Community in Multi-Material Micro Manufacture, comprising over 150 researchers from 30 partner institutions in 15 European countries, including Bulgaria, Hungary, Slovenia and Romania. Funded by the EC, the Network has brought together expertise in Micro- and Nano- Technology (MNT) for the batch-manufacture of microcomponents and devices in a variety of materials for future microsystems products and acts as a knowledge resource to both the research community and industry in the development of microsystems devices that provide increased functionality in tiny packages, integrating micro and nano scale features and properties into products and systems.

Since its launch in October 2004 the Network has, through its joint programme of activities, encouraged Partners to work collaboratively, taking advantage of the range expertise and equipment available across the Network. Partners have integrated their research into eight 4M Divisions. Five are Technology Divisions, three based on materials processing: Polymers, Metals and Ceramics, and two based on process technologies: Metrology and Assembly & Packaging. These are complemented by three Applications Divisions: Micro-optics, Micro-fluidics and Micro-sensors & Actuators. Each Division, with its own appointed leader and mangement board, have covered specific topics of research and development, and have been free to choose their own method of operation, organising their own workshops, training and initiating partner exchanges. The deliverables produced by the Divisions were described as being "of a high quality" at the last project review. In addition to this Divisional working, in order to encourage further collaboration and integration and ensuring common research topics were addressed across the divisions, a series of competitive internal calls for cross-divisional project proposals have been held. In the first three years of the network competitive internal calls led to 19 projects being funded and completed and are considered to have been a great success.

The work carried out in both the Divisions and in the cross-divisional projects was recently described by the project reviewer as "of high quality and relevance to industry".

In Year 3 the 4M Network held its first 4M Summer School, hosted by the Department of Manufacturing Engineering and Management (IPL), at the Technical University of Denmark (DTU) in Lyngby, Denmark. The school (sponsored by SARIX and by ESPRIT) was considered to be a great success and is being held again in 2008. At these schools participants are led through the various stages of developing and manufacturing a micro device, giving the attendees an overview of the complete product development process, from a list of requirements and technology possibilities through to manufacturing, characterisation and testing.

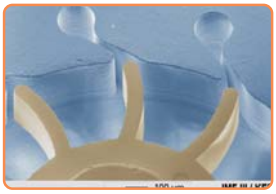
Another major achievement of the Network, and one that has played a major role in the dissemination of our work, has been the now well established annual 4M Conference. Following on from the successful conferences in 2005 and 2006 which were held in Germany and France respectively, the third conference 4M2007 was held in Bulgaria. 4M2007 was held in the mountain resort of Borovets in Bulgaria, and attracted some 120 delegates. Six fascinating addresses were delivered by the invited speakers to the interested and knowledgeable audience of over 120 attendees. These were complemented by the papers selected for oral presentation in the thematic sessions. A well-presented poster session gave everyone further opportunity to network and discuss each other's work. In total **84 papers were accepted for publication** in the proceedings which were published by Whittles Publishing in time for the conference. The fourth conference will be held in Cardiff, UK, from 9th - 11th September 2008 and will be the last conference held during the funded life of the project. However there are already plans to continue the 4M series of conferences with a suitable venue for 4M2009 currently being sought.

A series of Special Issues have arisen from these conferences which have further disseminated the work of the Network and raised its profile before a wider audience.

Working together in the 4M Network an awareness of the skills and expertise of fellow partners has gradually been built up, along with a perhaps even more valuable commodity- trust- which is a very important prerequisite for achieving a sustainable integration. Partners report that this has been the principal benefit arising from their participation in 4M.

This is also the aspect that the Partners themselves would like to preserve after the funded period of the Network. In fact the partners see great potential in enjoying the benefits of the Network without having to fulfil the negative aspects (reporting, performance indicators, deliverables etc) associated with any funded project. With this in mind it is proposed to establish a 4M Association.

The 4M Network of Excellence believes that by setting up such an Association the relationships formed during the lifetime of the NoE will be converted into a durable and sustainable format, creating an open and permanent forum for the knowledge community, allowing it to grow, spreading the benefits of membership to a wider micro and nano manufacturing constituency than the current 4M NoE, as future membership will be open to all.



Consequently in Year 3 and continuing into Year 4, there has been much debate about what the 4M Association should offer in order to achieve its goal of being sustainable through the collection of membership fees. This has not only been a debate amongst Partners, for the coordinator has also conducted an online survey of its industrial Affiliates in which they were invited to rank a list of proposed services. This was an interesting exercise, as a result of which an initial offering of the 4M Association has been arrived at and will include the following:

- **networking** (local/regional/technical contact groups /clusters);
- **an interface between research community & industry**;
- **joint working/interest groups** addressing specific, but common, topics;
- **brokerage service** offering access to the expert design, prototype and manufacturing services of the other member organisations;
- **new business opportunities** via contacts among membership
- **consortium building for industry-led joint projects** in emerging research areas in order to bid jointly for EC, national and industrial funding;
- **access to 4M research infrastructure** and knowledge (4M Knowledge repository)
- **an annual 4M Conference**

If you wish to know more about the 4M Association please visit: **www.4m-net.org/4MAssociation**

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Brokerage activities in micro- and nanotechnologies domain,
Consejo Superior de Investigaciones Cientificas (CNM-CSIC)

CNM has been in charge of the task of looking at events already organised by other institutions that could help eastern MINOS partners to disseminate their activities and establish contacts with western research teams and companies
Although three events taking place during the first 4 months of 2008, only two were selected according availability of potential attendees:

Brokerage Event of the European Technology Platform for Micro- and NanoManufacturing (MINAM) in Brussels, 24th of January.

Representatives from industry, research, the EU Commission and from other EU Technology Platforms gave statements on the chances for European Micro- and NanoManufacturing. MINOS was participating through an active presentation of posters about the activities of the following Eastern partners: IMT-Bucharest, ITE-Warsaw, Vilnius, TU-Sofia and U-Bratislava.Additionally, some western partners (U.Cardiff, U.Viena and CNM Barcelona) were also present in the event supporting MINOS.

NANOTEC Brokerage Event and Workshop in Venice, 14th of March.

The event consisted on a workshop about "Nanotechnologies in the Market" hold by a panel of experts followed by a session of pre-scheduled bilateral meetings. MINOS was participating in active meetings with partners from TU-Sofia and University of Bratislava and CNM-CSIC, who was in charge of the presentation of MINOS network during the event. MINOS partners summed up to 18 contacts in the face-to-face meetings session.

Posters about MINOS project and MINOS partners activities at MINAM

View of the meeting room for bilateral discussions at NANOTECH

Brokerage event output was monitored with the preparation of a post-event fiche that had to be fulfilled by MINOS partners after their attendance to the event. Some general remarks are:

- In addition to the presentation of their own activities, some eastern partners represented other research groups of their country not being directly involved in MINOS
- MINOS partners established some contacts for future collaborations in NMP and ICT calls
- The feeling of the eastern attendees is that good ideas and positive synergies were established with western attendees but in general nobody showed interest in being project coordinator
- Lack of coordinator spirit can be an opportunity for eastern partners to participate in projects by assuming this task in next calls
- Brokerage events based on face-to-face pre-scheduled meetings increase significantly the number of contacts and the commitment of potential partners when compared to booth-based events.

GOSPEL Network
Something in the air at the sensor fair

The new International Society for Olfaction and Chemical Sensing (ISOCS) is being launched at SENSOR+TEST 2008. ***ISOCS will build on the success of GOSPEL, the European network of excellence in artificial olfaction.***

Artificial olfaction (AO) - the science of complex gas sensing – provides highly accurate and sensitive technologies that improve conventional sensing techniques. By mimicking the biological sense of smell, AO provides an objective and quantitative assessment of odour, and can target non-odorant gases in complex mixtures.

ISOCS has the expertise to help industry and academics to exploit AO and chemical sensing opportunities in sectors including food, environment, security, healthcare and process control. **AO** is already being applied in the food sector where it can be used to inspect raw materials, control blending, improve shelf life surveillance, assess freshness and detect tampering. It is also important for environmental monitoring of odours coming from landfill sites, wastewater treatment plants, piggeries, paper or sugar factories, and breweries.

ISOCS is multidisciplinary and international in reach, with members chemists, physicists, biologists and computer scientists from Europe, US and Asia. It will raise the profile of olfaction and chemical sensing, and give the community a voice in the wider European technology community.

ISOCS will provide training and workshops, and give members early notification of developing AO technologies. ISOCS is contributing to **ISOEN 2009** – the olfaction and electronic nose symposium.

For more information about ISOCS services and activities, please contact the Institute of **Physical Chemistry, University of Tübingen**, Germany.
Phone: +49 7071 29 77636 Fax: +49 7071 29 5960
Email: **gospel-ipc@ipc.uni-tuebingen.de**
For media enquiries, please contact **Terri Telford** at Proof Communication, Ph: +44 845 680 1865
Email: **terri@proofcommunication.com** or Jonathon Rees
Email: **jonathon@proofcommunication.com**

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FP7 participation of the Optical Microsystem Laboratory
Koc University

The **Optical Microsystem Laboratory (OML)** at Koc University, Istanbul, Turkey, has expertise on design, testing, and characterization of MOEMS (Micro-Opto-Electro-Mechanical-Systems) and MEMS-devices and -systems. Our expertise and facilities have been published earlier (**http://www.minos-euro.net/wbm/wbm3/national_infrastructures/oml.htm**) in MINOS' Web-Based Magazine. We keep expanding our capabilities, the latest additions include a sputter and a Computer aided manufacturing machine (CAMM) for high resolution PCB manufacturing. OML was active in several FP6-project and are now members of two funded FP-7 projects.

HELIUM3D - High Efficiency Laser-Based Multi-User Multi-Modal 3D Display

3D Displays are often seen as the next big step in the history of visual communications. Numerous innovative 3D technologies are already present. HELIUM3D has chosen to focus on auto-stereoscopic displays (i.e. glasses free) that can create realistic 3D. HELIUM3D aims to address the efficiency and colour limitations of current and next generation displays by developing a new display technology based on direct-view RGB laser projection via a low loss transparent display screen to the eyes of multiple mobile viewers.

The major goals of the display technology are:

- Support for multiple viewers
- Allow for viewer freedom of movement
- Motion parallax to all viewers
- High brightness and colour gamut
- Viewer gesture/interaction tracking
- User-centred design, ensuring that future products are "fit for purpose" in terms of perception and usability

HELIUM3D can be seen as a continuation of the FP5 program ATTEST (Advanced Three-Dimensional Television Systems) as well as the FP6 programs MUTED (Multi-User 3D Television Display) and the 3DTV Network of Excellence. OML was a member of the latter and was invited to HELIUM3D for specific technical expertise in MEMS and laser scanning display systems.

The eight members of the consortium include, in addition to five universities, participants from large industry, SME and one research institute including one partner from China.

Acronym: **HELIUM3D**; - ***High Efficiency Laser-Based Multi-User Multi-Modal 3D Display***; Call: FP7-ICT-2007-1 Start date: January 2008; End date: December 2010; Project Coordinator: Dr. Ian Sexton, De Montfort University - UK

MEMFIS - Ultrasmall MEMS Fourier Transform InfraRed Spectrometer

The sheer size and complexity have made FTIR-spectrometers for mid and far RI hard to use outside of the laboratory. This project aims at changing this situation. The project covers the design, fabrication and characterization of Fourier transform microspectrometers (FTS), for chemical, biological, and agricultural inspection applications. Main advantages offered by the proposed devices are long travel range (good spectral resolution), a large clear aperture (high light efficiency), and simple and robust system structure. A simple CMOS compatible process based on bulk micromachining of a silicon-on-insulator wafer will be used for the device fabrication.

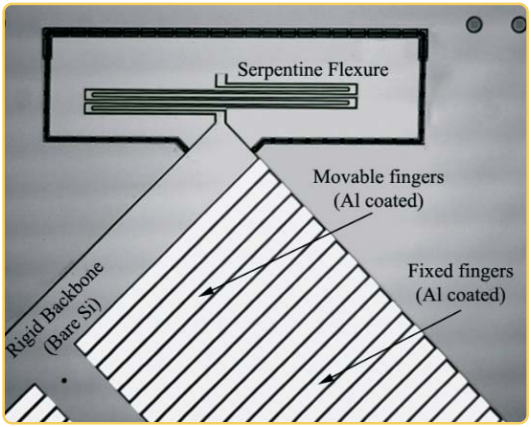

Fig.1. Grating-based FT spectrometer conceived and designed at Koç University

The consortium has a very strong base in industry with one large company and several SMEs with specific competences among its members.

Acronym: MEMFIS; - ***Ultrasmall MEMS Fourier Transform InfraRed Spectrometer***; Call: FP7-ICT-2007-2; Start date: September 2008; End date: August 2011.

Other research project:

- Laser imaging system development using MEMS stages and Microlens Arrays for Endoscopic Imaging (Sponsor: TÜBITAK, FP6 Programme-Network of Excellence in Micro-Optics (NEMO), FP6 Programme-MC2ACCESS Project)

- Nano-biosensor using MEMS cantilevers (Sponsor: TÜBÝTAK. People involved: Prof. Erdem Alaca, Prof. Hakan Ürey, Prof. Halil Kavaklý, Ilker Ocakli, Alibey Ozturk, Natali Ozber)

Fig.2. Microfluidic chip with housing

This research project combines micro-electro-mechanical systems (MEMS) with microoptical sensor readout systems to develop a high-sensitivity biosensor. The biosensor is designed to recognize drug ligands in body fluids, but the same technique is possible to use for applications in medicine, defence as well as well as in pure science. Procedures available today depend on expensive laboratory equipment run by experts. Being an alternative, biosensors can provide a small and cheaper alternative with a parallel procedure and a fast response that is easy to use in both clinical and criminal environments.

Contact: **Dr. Hakan Ürey (hurey@ku.edu.tr). Faculty of Electric Engineering, Koç University, Istanbul, Turkey**

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Research Center for Microsystems and Nanotechnology (RCMN)

Nanotechnology research centers in Lithuania, Kaunas University of Technology

The RCMN established in 1998 is focus to interdisciplinary research into microsystems and nano-instrumentation through which new ideas for improved performance based on new materials and miniatiurization may be brought into industrial practice as innovations. *The Center aims to stimulate nanoscience and microsystems technology activity in Lithuania and Baltic region by participating in European and global networks, research projects and by dissemination of information.* The Center coordinate Lithuanian Nanoscience and Nanotechnology network, National research priorities program "Functional materials and molecular mechanisms", partner of EU FP6 projects Micro-NanoSystems European Network pursuing the integration of NMS and ACC in ERA, Improving the understanding of the impact of the nanoparticles on human health and environment, NATO security programme grant "Optical nanosensors based on organic nanofibres".

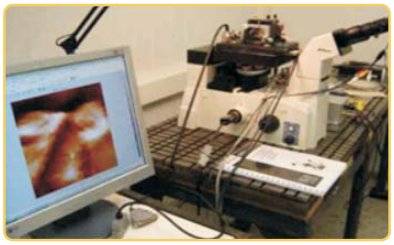
As a part of FP6 project activities Center organized the international workshop "Second MINOS-EURONET Strategy Forum for Baltic Region "Converging Technologies and Regional Competitiveness" Micro- Nano Manufacturing, Vilnius, 12-13 April, 2007 (**www.minoseuro.info**). The aim was to provoke an open debate about the future role of EU regional policy and emerging technologies in stimulating Baltic sea area innovation performance, growth and jobs and to serve as a food for thought to policy makers that they cannot blindly mimic the policies of the 'innovation hotspots' but rather need to build their own approach tailored to Baltic area potential.

Research directions: The RCMN anchors an efforts to investigate the behavior of single molecules and nanostructures, with an emphasis on nanomedicine, biological and materials science applications. RCMN is operated as a highly multidisciplinary facility bridging medicine, science, materials science, and engineering disciplines integrated within existing interdisciplinary campus-based and nationally and internationally networking efforts. The RCMN, located in the KTU campus, provides researchers with state-of-the-art single molecule imaging and nanoscale characterization and manipulation tools, such as multi-cell and single cell electroporation and impedance measurement instrumentation, Scanning Near Field Optical Microscopy, wide-field single molecule fluorescence microscopy and photon counting, Scanning Tunneling Microscopy, a BioAFM (combined atomic force and optical microscopy), magnetic force microscopy, Kelvin probe, SPM nanolitography, and UV-VIS spectroscopy.

RCMN focus includes the areas of:

New SPM methods and development of next generation nanoscale imaging probes and instrumentation

The center has 15 years experience in scanning probe microscopy, including STM, AFM and SNOM. In 1996 we have constructed a versatile contact/force modulation /noncontact AFM and demonstrated possibility to work on higher modes of cantilever to increase a resolution and in 2003 we have implemented an aperture-SNOM head in the illumination mode which can be operated in both transmission and reflection configurations. The photon counting module was developed and inserted in our SNOM equipment. In 2004 we developed and built the Bio-AFM with integrated flexures type XYZ positioning stage and combined with inverted Nicon-2000 optical microscope. Currently we are working on apertureless SNOM which uses AFM tips as scattering source of near field photons and possibilities to implement TERS methods into our SPM technique. We have investigated the AFM long range interaction forces between silicon tips and surfaces and we have experience on ferroelectric thin films and piezo-AFM.



Bio AFM built at the Centre

Biomimetics for nanomaterials and nanosensors

Ionic self-assembly is the coupling of structurally different building blocks by electrostatic interactions. Advantages of this method are the commercial availability of relatively cheap building blocks and the simplicity of the synthesis. Functional materials with interesting optical, electrical, magnetic, thermal, structural, or mechanical properties can be designed by a proper choice of the building blocks. We investigate the self-assembly of porphyrins in to nanotube like structures for possible application in nanosensors. The possibility to build nanotubes of different structure by ionic self-assembly of porphyrins was investigated theorethically and demonstrated . It was shown that the porphyrin nanotubes can be functionalized by metals from solution.

Bionanotechnology and subcellular imaging: Atomic force microscope (AFM) is the most versatile member of scanning probe microscopes family. In present it's one of a powerful tool to investigate and imaging biological structures in real time, under natural conditions with molecular, or submolecular resolution. The most serious problem to imaging biological structures is a sample preparation. We investigate the morphology of different virus like particles and it's relation with biochemical procedures and methodology of investigation. We imagine virus-like particles (VLP) and self-assembling proteins VP1 pentamers, which forms VLP. We develop the BioAFM instrumentation and investigate cells micromechanics and interaction with electric field.

Yeast cells AFM Image

Collaborations: We collaborate with partners in EU and globally. Our knowledge we disseminate teaching students at KTU and organizing with partners international PhD courses in micro-nanotechnology (www.minoseuro.info/courses.pdf). The successful collaboration with partners inside the **MINOS-EURONET** network (**NCM, Barselona**) stimulated the project proposal **"The Center of excellence in Nanomaterials"** submitted to **FP7-REGPOT 2008**. *Contacts and more information can be found at* **www.microsys.ktu.lt**.

Contact: **Prof. Valentinas Snitka (valentinas.snitka@ktu.lt), Kaunas University**

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Laboratory of microsensor structures and electronics/LMSE/
Faculty of Electrical Engineering, University of Ljubljana (FE UL)

In this contribution, we report about some recent activities related to microfluidic structures that were partly promoted also through MINOS information, in Laboratory of microsensor structures and electronics/LMSE/, Faculty of Electrical Engineering, University of Ljubljana (FE UL), Slovenia.

Microfluidics from LMSE - In the field of microfluidic structures, we have recently designed and realized various microchannel structures by wet and dry micromachining of silicon. Silicon wafer with various fabricated microchannel structures is shown on Fig.1. We have also designed and fabricated Pyrex glass microchannels cover with inlet/outlet microholes, microaligned and anodically bonded on the silicon wafer. An appropriate microfluidic chip housing, essential for proper microfluidic system operation, was also designed and fabricated, enabling fluid connections etc (Fig.2). On the back of the microfluidic chip, for temperature control, a Pt heater and temperature sensors were designed and realised.

Fig.1. Silicon wafer with microchannel structures

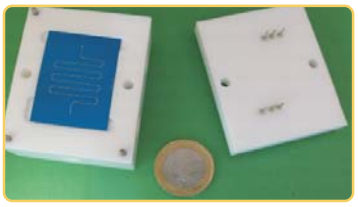

Fig.2. Microfluidic chip with housing

Micro/nano Structures by RIE from LMSE - In the field of silicon micro/nano structures, we have recently designed and realized various micro/nano structures by dry micromachining of silicon. Etching was performed by plasma RIE dry etching of Si with O_2, CHF_3, SF_6 process gases chemistry. Masking layer was in this case silicon thermal oxide paterned by resist photolithography. Processed silicon wafer with various fabricated silicon microstructures is shown on Fig.3.

We have also designed and fabricated sharp tips Fig.4 with small radius of curvature in the range of several tens of nanometers, for applications in Field Emission Devices such as AFM(Atomic Force Microscopy), FED(Field Emission Displays), micrielectrodes for medical applications etc.

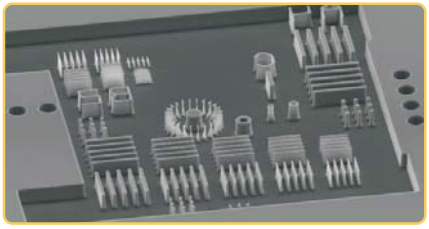

Fig.3. Microstructures realised by RIE dry anisotropic etching in LMSE

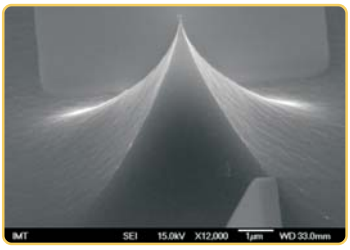

Fig.4. Nanotip realised by RIE dry isotropic etching in LMSE

Contact: **LMSE, Head: Prof.dr. Slavko Amon; Faculty of Electrical Engineering, University of Ljubljana (FE UL)**

Department of Fibres and Textile Chemistry
Institute of Polymer Materials, Faculty of Chemical and Food Technology

Preparation and properties of synthetic polymers and fibres containing additives on micro- and nano-level

Department of Fibres and Textile Chemistry deals with the education of specialists for fibre and textile branches since 1951 and at the same time took part in the national and European research projects in chemistry and technology of fibres and textile materials. *The staff formed by one full professor, 3 associate professors, 2 research fellows and 7 PhD students have participated in the several projects focused to the development of the new types of fibres.*

The Department has the infrastructure of apparatus and equipments and good experience with characterization of fibre-forming polymers, effect of spinning conditions on formation of the structure of fibres as well as with evaluation of their properties. *Department has a collaboration with universities, research institutes and industrial companies in Europe, which was applied in cooperation in two international projects in the framework of 6 FP EU (Biocelsol and Nanohybrid) and several national projects.*

Department is equipped with **two laboratory** spinning plants for synthetic fibres (extruders with screw diameters 16 and 30mm) and with twin-screw extruder (d=20mm) for preparation of polymer blends and composites. Other devices used are: extruder Göttfert, Rheometer Physica MCR 101, plastometers, rotation viscosimeter, TG analyser, DSC 7-Perkin Elmer, thermo-mechanical analyser TMA 50, tensile tester Instron 3343 for testing of mechanical properties, Rheovibron, microscopes, apparatus for dyeing, printing and finishing of textiles.

Department of Fibres and Textile Chemistry will assure all **research works joint with development of nanoparticles dispersions in polymers,** evaluation of the effect of deformation gradients in spinning and drawing on formation of the structure of fibres and properties. In these domains Department has many year experience in cooperation with research and industrial partners such as *Research Institute for Man-Made Fibres, SK, VÚTCH-Chemitex, SK, University Freiburg, D, Technical University of Liberec, CZ, Spolsin, CZ, University of Bielsko-Biala, PL, University of Zagreb, HR, Institute of Chemical Fibres and Biopolymers Lodz, PL*

The **research** at the Department has been focused on the **following topics**:

- pigmentation of synthetic fibres in mass, fibres based on polymer blends, composite and nanocomposite fibres, synthetic fibres modified with copolyamides and organoclays, fibres based on metallocene polyolefins, surface functionalization of synthetic fibres and chemical fibres based on enzyme treated cellulose.

The new methods for evaluation of processing of fibres, their mechanical, thermal, electrical and UV barrier properties as well as light stability are developed at the Department.

Authors of this contribution: Assoc. Prof. Eng. **Anna Ujhelyiova,** PhD, Department Head, E-mail: **anna.ujhelyiova@stuba.sk;** Assoc. Prof. Eng**. Michal Kristofic, PhD.,** E-mail: **michal.kristofic@stuba.sk, and** Prof. Eng**. Anton Marcincin, PhD.,** E-mail: **anton.marcincin@stuba.sk. *Slovak University of Technology in Bratislava***

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Application of microsystem technology for medical implants

Institute of Electron Technology, Warsaw, Poland
Division of Silicon Microsystem and Nanostructure Technology

Microsystems containing **microelectrode arrays integrated** in flexible substrates are often used as components of medical implants for electrical stimulation of nerves or recording of neural signals. ***We present examples of microelectrodes for hearing and visual implants developed in the frame of the Healthy Aims project***. The structures have been designed in collaboration with partners developing medical products: Cochlear Technology - responsible for development of Cochlear Implant and Intelligent Medical Implants - responsible for development of Retina Implant.

The retinal and cochlear implant systems have a modular design and consist of a few main components: stimulators implanted in the body, external vision or hearing interfaces and external pocket processor, which translate sound or image information into stimulation commands. The stimulators are implantable heterogeneous microsystems build of flexible matrix of stimulation electrodes and a receiver comprising of several electronic components including an antenna and ASICs.

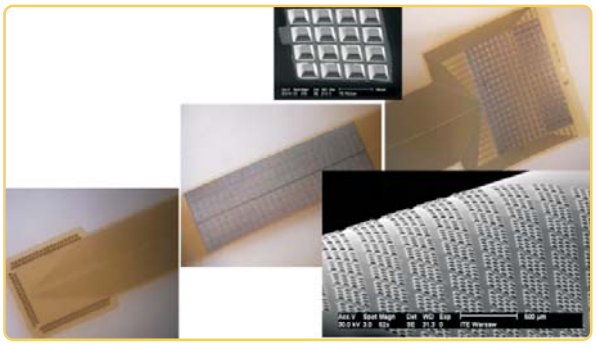

Fig. 1 The test structure of retina microelectrode manufactured at ITE, insets show a dense matrix of 3D stimulation electrodes.

A microelectrode developed for retina implant is built of a planar polymer foil integrated with circuit paths, metal electrodes, and bonding pads. This structure serves as both the stimulation interface and the multilayer flexible circuit board for assembling electronic components. The matrix of 252 electrodes consists of 4032 3D-shaped stimulation sites to increase the electrode surface area to enable more energy to be applied to the nerves

Two types of microelectrodes are developed in ITE for hearing implants: passive cochlear microelectrodes and modiolus microelectrodes. The conventional intra-cochlear microelectrode interacts with the spiral ganglion cells in the cochlea, while the modiolus microelectrode inserted in the nerve bundle enables more direct coupling between the stimulation electrodes and the cochlear nerve. The modiolus microelectrode improves the restoration of hearing (more stimulation electrodes can be used) and could reduces the power requirement for the implant by decreasing stimulation thresholds. The passive cochlear electrode manufactured in ITE has consisted of 22 Pt stimulation sites connected with bonding pads using 2μm thick Pt strips. The platinum structure has been coated with 120μm thick parylene-silicone layers. The modiolus electrodes have been manufactured in ITE using double side bulk micromachining technology. The Pt stimulation electrodes have been arranged in a single row on a straight silicon beam. To facilitate the monitoring of beam deflection during the surgical insertion of these electrodes, a piezoresistive deflection sensor has been designed at the base of the cantilever beam. The structure has been entirely isolated with double parylene-silicone coating.

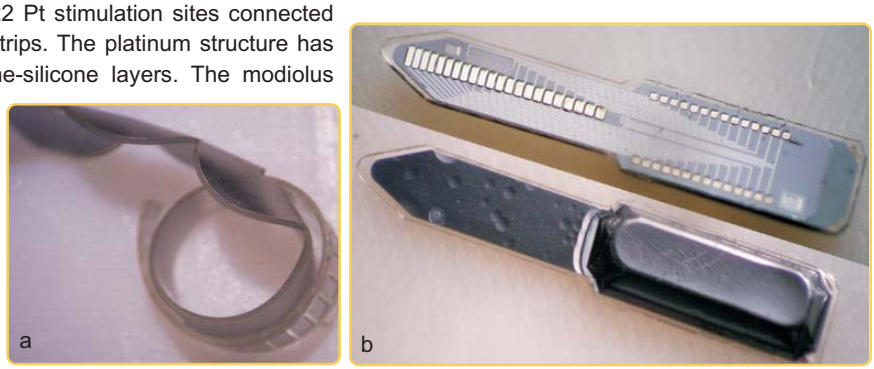

Fig. 2 Examples of electrodes for hearing implants: a) passive cochlear microelectrode containing 22 Pt stimulation sites coated with silicone rubber, b) silicon modulus electrode integrated with a piezoresistive deflection sensor and protected with parylene-silicone coating

Implantable devices, in order to be safely inserted into a human body and remain there for many years, must be constructed with use of materials that are biocompatible or must be isolated form the body with a biocompatible coating. One of the materials, which has been used for construction of implanted flexible electrodes is a silicone rubber. The advantages of this material are good mechanical properties (high tensile strength and superior flexibility) and its biocompatibility. The shape of silicone structures is usually formed by use of injection molding process supported by laser ablation but more precise pattern may be defined in silicone using plasma etching and thus ITE has developed a process of deep plasma etching of silicones. Plasma treatment and other technological operations, however, can change physical and mechanical properties of the silicone layer and can also induce specific biological responses when a device is placed in the body. Therefore, plasma treated silicone layers has been investigated using XPS analysis, wetting and cytotoxicity tests. The formation of a top layer rich in plasma originated fluorine has been detected but silicone surface has preserved its hydrophobic properties after plasma processes. Moreover, the cell viability on a raw and plasma treated silicone has been found to be high. The morphology of silicone layer has been examined as well using SEM analysis. Hardly removable grass-like etching residues have been observed. Its formation has been found the main disadvantage of plasma processing since the residues cannot be easily removed from the surface of the stimulation electrode. It has been found that the post-etch residues can be decrease or even eliminate completely by increasing the temperature of the wafer etched in plasma.

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Application of microsystem technology for medical implants (II)

The barrier coating for the implantable microelectrodes is essential for ensuring the reliability of the device and it is one of the most important components of the electrode structure. The most obvious function of the coating is protection of a fragile device against mechanical damage during the surgical insertion. However, in many applications, the coating should provide also a hermetic barrier against possible leakage of contamination from the electrode to the human body. It should also effectively protect the electronic circuit against humidity and corrosive biological effects. Silicone rubber, polyimide and parylene have been

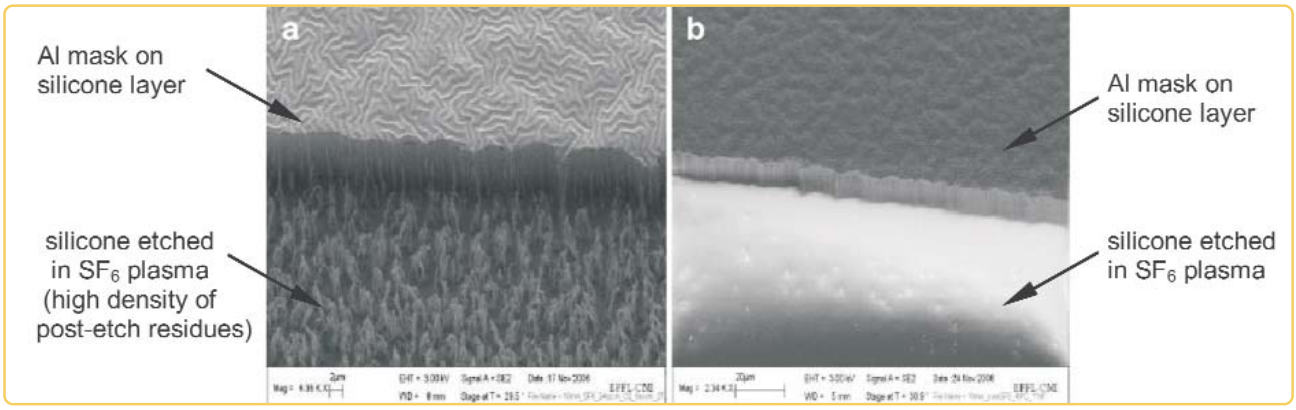

Fig. 3 SEM graphs showing the silicone morphology after exposure in SF6 plasma at 5 mTorr pressure, 800 W power, 100 V bias and substrate temperature of 20° C (a) or 40°C (b)

considered as the basic coating materials due to their biocompatibility and sufficient chemical stability. The hermeticity of parylene-silicone coating has been verified by electrical measurement of capacitive humidity detectors used in accelerated ageing tests. The comparative ageing test has shown a good seal performance against moisture and water ingress up to 72 hours immersion in hot salt water. It has been also found that structures coated with parylene and additional silicone structures protecting the edge of parylene had usually longer time to failure than structures with single parylene coating. Therefore, it has been suggested that the leakage observed during this experiment was related rather to the penetration of water below edges of parylene than to the migration of water through the parylene layer. The experiments have proven that silicone-parylene coating on the electrode manufactured in ITE had created a hermetic barrier, which could be sufficient for a short-term medical implants.

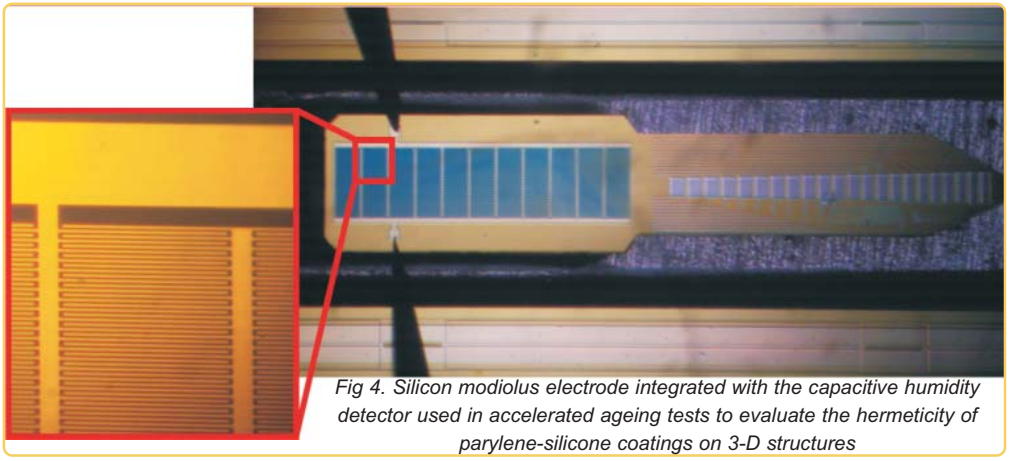

Fig 4. Silicon modiolus electrode integrated with the capacitive humidity detector used in accelerated ageing tests to evaluate the hermeticity of parylene-silicone coatings on 3-D structures

Contact: **Krzysztof Domanski, kdoman@ite.waw.pl, Institute of Electron Technology, Poland**

Division of Silicon Microsystem and Nanostructure Technology (mInTE) located in Piaseczno near Warsaw, Poland, is a part of the Institute of Electron Technology (ITE).

The Institute is a major Polish R&D center with the primary focus on: **semiconductor electronics and technology**. **The mission** of the ITE is ***to conduct basic and applied research to develop and commercialize innovative micro- and nanotechnologies and their applications*** in the area of ***microelectronics, optoelectronics, photonics and microsystems***.

The goal of the research and development activities carried out at the division is to provide industry and scientific communities (with special emphasize on the New EU Member States region) with access to advanced technology of silicon based and heterogeneous micro- and nano-devices. Thus, scope of the R&D covers broad range of technologies, from silicon photo- and radiation detectors through Integrated Circuits up to sensor and microsystem (MEMS and MOEMS) with a special emphasize on integration of different technologies and devices for interdisciplinary applications. Significant results achieved in co-operation with our partners in research on technology of micro/nano- based sensors and probes have led us into a fascinating world of nano-technology.

Vice-Director for Division: **Piotr GRABIEC, Ph.D**. E-mail: **grabiec@ite.waw.pl**

The publication of this page is supported by the ***MINOS-EURONET*** project (EC Contract No 015704)

The MINOS Roadshow - *Activity in MINOS-EURONET project*

Make the western institutes aware of the capabilities existing in the East

The objectives of the roadshow was to make the western institutes aware of the capabilities existing in the East. Many FP7 proposals require the addition of eastern partners in order to achieve a geographic balance, and man western institutes have trouble identifying who to include in their applications. Roadshow participants have the ability to promote their expertise and be top of the list when eastern partners are required.

Furthermore, the nature of the roadshow allowed the eastern partners to gain a good understanding of the capabilities of the western institutes, allowing them to prepare better future proposals. Trough development of face-to-face contacts with researchers at leading western institutions, eastern partners will have the ability to widen their scientific network, giving them enhanced scientific and commercial opportunities in the future.

Second part: *Continental Europe Road Show* (26-30 May 2008) - Visit Summary

University of Aarhus iNano (http://www.inano.dk) hosted by the ***Director Prof. Flemming Bessenbacher***

Interdisciplinary Nanoscience Center (iNano) at the University of Aarhus and Aalborg University. The center constitutes an interdisciplinary research and educational effort with the long-term goal of merging nanoscale biology, chemistry and physics into a new scientific discipline: Nanoscience. The centre has participated in numerous EU projects and heads the NanoFood Consortium. Research at the centre ranges through self assembly to clean energy.

IDEON Science Park, Lund (http://www.eng.ideon.se)

IDEON is one of Europe's largest and most successful science parks hosting a range of high technology companies mostly spun out from the University of Lund. As much of Eastern Europe is taking its first steps in technology commercialisation (and the EU has large amounts of funding available for this area) the visit will provide an insight into how to spin out companies and what factors make a successful science park.

IDEON Science Park

The Nanometer Structure Consortium at Lund University (http://www.nano.lth.se/) hosted by ***Director of Research Prof Lars Samuelson***

structures
The Nanometer Structure Consortium at Lund University

Lund University has for more than 15 years been hosting a major interdisciplinary research program in Nanoscience, ranging from materials science and quantum physics to applications in the areas of electronics, photonics and the life sciences. This is a centre for the development of nanotechnology and fields of science & applications based on the uniqueness of properties and opportunities offered at this nanometer length scale.

University of Copenhagen Nanoscience Centre (http://nano.ku.dk/english/) hosted by its director ***Thomas Bjørnholm***

UNIVERSITY OF COPENHAGEN
Nano-Science Center

Nano-Science Center is a part of the University of Copenhagen. There are about 100 researchers, PhDs and post doc at the Center and about 200 students study Nanotechnology here.

CSEM (http://www.csem.ch/) Neuchatel, Switzerland with ***Harry Henzelmann, head of Nanoscale Technology & Biochemical Sensing***

CSEM activities in nanoscience and nanotechnology are concentrated on the development of strategies and technologies to create structures well below the micron scale, and on (optical) microscopy and spectroscopy at high resolution and sensitivity. A third activity, nanoscale materials, is currently being built up and will be complementary to ongoing work on nanocomposite materials

LETI/MINATEC (http://www.minatec.com/minatec_uk/index.htm) hosted by ***Bruno Paing, Strategic Marketing Manager***

MINATEC

MIATEC is a €400m research centre on the site of the CEA in Grenoble, France. Reserach facilities include

- 8,500 sq m of clean rooms in existing CEA-Leti facilities (http://www-leti.cea.fr/);
- Advanced components: 14,000 sq m of new premises for characterization, photonics and design;
- Smart devices: 5,000 sq m with MINATEC IDEAsLaboratory, an idea generator (http://www.ideas-laboratory.com/);
- 1,200 people from CEA and university laboratories working on upstream, fundamental basic and applied technology research.

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Workshop on Surface/adsorbed oxygen on metal oxides; role in gas sensing and catalysis; Tuebingen, Germany 9-10 June 2008.

Our understanding of the role played by surface and/or adsorbed oxygen in the reactions between metal oxides and gases is far from complete. This process must be unravelled before progress can be made in the fields of gas sensing and catalysis. This workshop will explore the role adsorbed oxygen is considered to play in metal oxide based catalysts, and in gas sensing with semiconducting metal oxides. The workshop will bring together researchers from both academia and industry interested in the basic understanding of catalysis and gas sensing, and the further developments of practical catalysts and sensors. It is hosted by GOSPEL, a research network funded by the European Commission to develop new techniques and technologies in artificial olfaction. Detail on **http://www.gospel-network.org/Workshop-on-Surface-adsorbed-o.385.0.html**

4M2008 Conference; Annual Conference on Multi-Material Micro Manufacture; Sep 2008 Cardiff UK

Aim and Themes: The main goal of the Conference is to provide a forum for experts from industry and academia to share the results of their in-depth investigations and engage in interdisciplinary discussions about the creation of micro-manufacturing capabilities. Papers are invited to present the latest advances in developing new processes and process chains for multi-material micro manufacture and their applications in microsystems-based products. Details on: **http://www.4m-net.org**

Microtechnology Workshop; 20 June 2008; CSEM Basle, Area Rosental, Bldg 1047, 2nd Floor, Mattenstrasse 22, CH-4002, Basle, Switzerland.

Polymers Division:This event is jointly organised by Plastipolis (a combination of companies, training centres and either public or private research units working together on common, innovative projects)and the 4M Polymers Division. Details on: **http://www.4m-net.org/node/2646**

Highlights in Microtechnology; Jun 16th - Jun 27th, 2008; Neuchâtel, Switzerland

Created in 2004, Highlights in Microtechnology (HIM) is a successful training program offering a unique opportunity to experience 10 intensive days of high-level teaching on topics at the heart of microtechnology. Like the previous editions, HIM 2008 will take place over two thematic weeks and include both highly specialized lectures and hands-on experience in the clean-room and laboratory. This year, the proposed themes are:"general methods for microtechnology" and "microtechnology for space applications ".

Various visits to high-tech companies, as well as a two-day visit to the University of Besançon in France and several social events are included in the course. Details: **http://www.nano2life.de/calendar.php?did=115**

OPTICAL BIOSENSORS AND BIOCHIPS FOR CLINICAL APPLICATIONS; Jun 27th - Jul 4th, 2008, Erice, Italy.

Scope of the Course is to introduce participants to concept, methods, applications and state of the art in the area of optical biosensing mainly focused to clinical applications. The objective is accomplished through teaching theory and basics on a level every participant can follow. Details on: **http://www.nano2life.de/calendar.php?did=129**

ESOF2008; Jul 18th - Jul 22nd, 2008, Barcelona, Spain

The mission of the Euroscience Open Forum (ESOF) is to provide both the European and the international science communities with an open platform for debate and communication. It presents and profiles Europe's leading research trends in the sciences, humanities and social sciences.

Discover new trends and directions in research, business, science policy and funding; Network with leaders of the international science community; Communicate your research and ideas to an international audience; Participate in the debate, discussion and excitement of European science and technology; Meet and talk to scientific journalists from Europe and around the world; Details: **http://www.nano2life.de/calendar.php?did=118**

NanoMaterials08; The Newcastle Marriott Hotel, Gosforth Park, UK July 7-9, 2008.

NanoCentral® and IntertechPira are pleased to bring you NanoMaterials08 This is the only event of its kind to focus on the commercialisation of nanomaterials. NanoMaterials08 is made up of poster sessions, workshops, exhibitions, a conference and social programme, and will feature a variety of national and international companies active in the nanomaterials revolution. With over 400 attendees expected, this event will provide excellent networking and learning opportunities, and is not to be missed. Details on: **http://www.nanomaterials08.com/**

Micro and NanoTechnology Bulletin is published quarterly by IMT-Bucharest, Romania (**www.imt.ro**). This Bulletin, originally intended to publish **results of Romanian researchers in the micro and nanotechnology (MNT) field,** is extending its coverage since 2004 to Eastern Europe. The purpose is to contribute to a *better communication of MNT scientific communities from Eastern Europe to the rest of the world*. MNT Bulletin is distributed free of charge to interested organisations and individuals.

Editor-in-Chief: ***Dan Dascalu (IMT-Bucharest)***. The Bulletin is also available on the web page: **www.imt.ro/mnt.**

IMT-Bucharest it is also the coordinator of three SSA projects (***MINOS-EURONET***) with *support and dissemination activities* through *web pages, e-newsletter, flash news and online databases:*

- **E-newsletters and flash news:** ***MINOS-EURONET project***: **http://www.minos-euro.net;**
- **Online Databases: http://www.minos-euro.net**

***MINOS-EURONET* Coordinator :** Prof. Dan Dascalu **(dascalu@imt.ro). *MINOS-EURONET Team* (minos@nano-link.net)**

Contributions and correspondence for MNT Bulletin may be sent to **mnt@imt.ro**.