## *1st Day Program: 25th September, 2014*

*Course site:* ***Department of Technologies in Electronics, TU Kosice***
***Park Komenského 2, 040 01 Košice***

16:00-16:10 **Introduction**

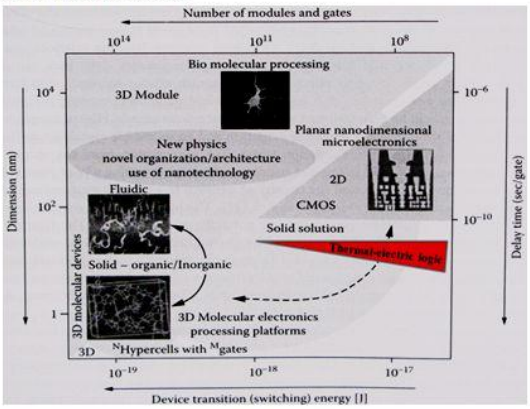
16.10-16.50 **Nanotechnology – novel devices, applications and trends**
Presentation of an invited renowned scientist

János Mizsei: „Electronics, microelectronics, nanoelectronics, ..."

*János Mizsei*
*CSc, PhD, DSc*
*Professor*
Head of the Semi-conductor Laboratory
Department of Electron Devices
Budapest University of Technology and Economics
www.eet.bme.hu/staff/run/en/id/mizsei

**Abstract**

Until now, the continuous development of electronics has been characterized by Moore's law. The scale down resulted in the nanosized CMOS integrated circuits, pushing the "red brick wall" towards the lower dimensions. On the other hand, there are many new ideas for building atomic or molecular scale devices for the information technology. However, there is still a gap between the up-to-date "top-down" CMOS technology and the "bottom-up" devices, i.e. molecular electronics, nanotubes, single electron transistors. The new thermal-electric device (phonsistor) and the CMOS compatible thermal-electric logic circuit (TELC) may help to fill this gap.



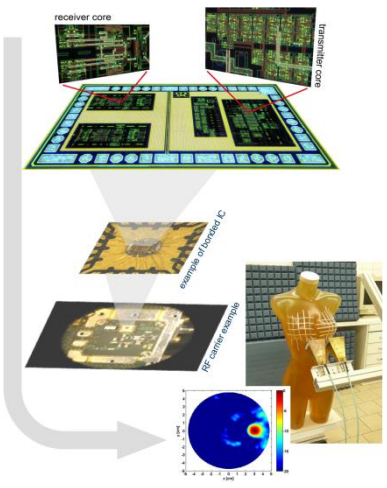

16.50-17.30 **Nanoelectronics – novel applications**
Presentation of an invited renowned scientist

Martin Kmec: M-Sequence based UWB sensing systems

*Martin Kmec*
Research Assistant
Electronic Measurement Research Lab
Institute for Information Technology
Technische Universität Ilmenau

IC design and UWB Applications Responsible
ILMsens, TU Ilmenau Service GmbH, Ilmenau

It is indisputable that the interest in (active) ultra-wideband (UWB) short range sensing systems, i.e. sensors which exploit electromagnetic fields of large fractional bandwidth at the lower end of microwave frequencies, has been over the few last decades rapidly increasing. This fact has gone hand-in-hand with the omnipresent story of continuous miniaturization which is well rooted in the electronics over the past half of the century. But it also brought a claim for novel sensing approaches with enhanced system performance (e.g. with higher operating speeds, higher overall system efficiency, improved dynamic behavior, etc.) and integration ability. Thus at the end of the day among the classical sine or impulse based approaches an alternative sensing techniques, that for instance rely on pseudo noise (PN), become firmly established.




In the most common case, the PN approach beneficially deploys a unique combination of high frequency maximum length binary sequences (M-Sequences) for stimulation of medium under test (MUT) and smart receiver architecture for capturing and processing of the signal interacted with the MUT. Binary PN sequences of large bandwidth may be generated and captured with high precision and temporal stability by comparatively simple means. This hardware in symbiosis with the system specific software opens up a wide range of new high-resolution short range sensing applications.



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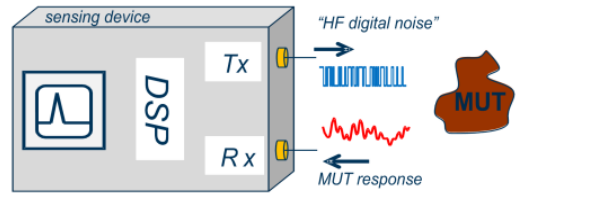
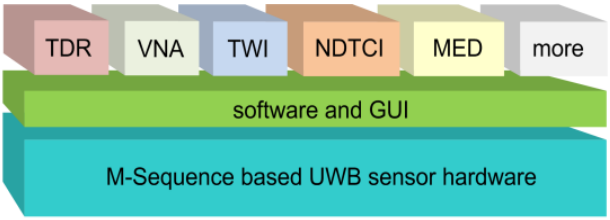



*Generalized:* M - Sequence sensing concept with digital correlation




The course will give an introduction into the basic working principle of the M-Sequence based UWB sensing system and will provide short survey of recent devices and selected technological issues. Moreover the latest research showing broad scale of implementation possibilities of such UWB sensors, ranging from subsoil surveillance and ambient assisted living, through non-destructive testing in civil engineering, foodstuff monitoring, and many others, to medical engineering via new diagnostic and monitoring tasks will be discussed as well.

17.30-17.40 Coffee break



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17.40-18.20 **Presentation about nanotechnology equipment development**
Presentation of an industrial expert from Raith, Germany

Martin Kirchner: “Instrumentation and processing with electron and ion beam lithography”

*Martin Kirchner*
Sales Director New Markets
Raith GmbH
Dortmund/Germany

**Abstract:**

Electron and ion beam lithography are enabling technologies for research and development in many fields of nano technology. The presentation reviews the basics of both technologies. Emphasis is given on instrumentation and processing which is useful in academic or industrial research and in small batch production. Application results from recent years are presented stemming from various disciplines including Electronics and Photonics.

The presenter is with Raith, a high tech company headquartered in Dortmund, Germany. Since two decades Raith instruments are extensively used within the nano fabrication and nano engineering community. Raith made conventional electron beam lithography accessible to a broad research community worldwide. In February 2013 Raith acquired Vistec Lithography who is known for more than 40 years of experience in the field of electron beam lithography under the brands of Philips, Cambridge Instruments and Leica.

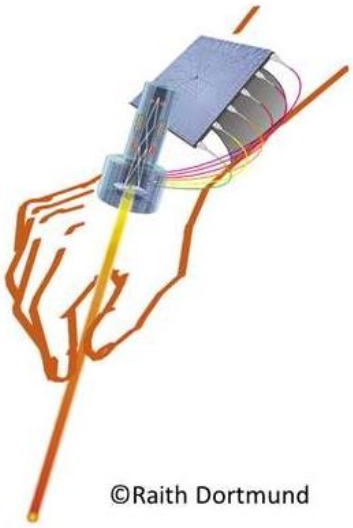



**Figure symbolizes a focused charged particle beam structuring substrates at nano scale.**

18.20-19.00 **Applications of nanotechnology**
Presentation of a young East European scientist

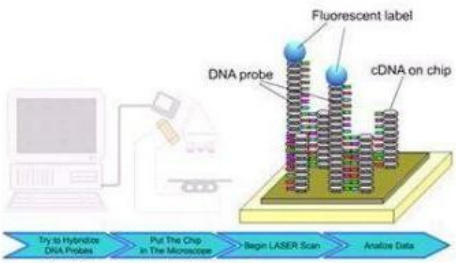
Attila Bonyár: "Enhancing Biosensors with Nanotechnology"

**Abstract**

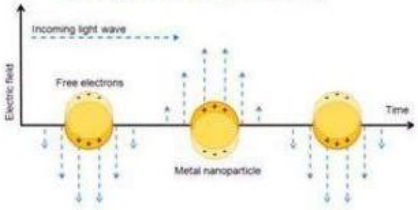
Biosensors applying nanoscale biomaterials such as DNA molecules as sensing elements possess great potential in the fields of disease diagnostics, environment monitoring or in pathogen detection. The optimization of sensor properties (such as sensitivity or limit of detection) is a constant challenge in this multi-disciplinary field. Signal amplification methods, including the application of nano-materials or nano-patterned surfaces for surface plasmon resonance imaging (SPRi); and novel atomic force microscopy (AFM) based nanotechnology tools and investigation methods are in the focus of this presentation.

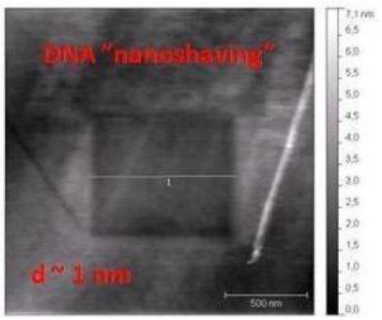
*Attila Bonyár*
Assistant Professor
Department of Electronics Technology, Budapest University of Technology and Economics

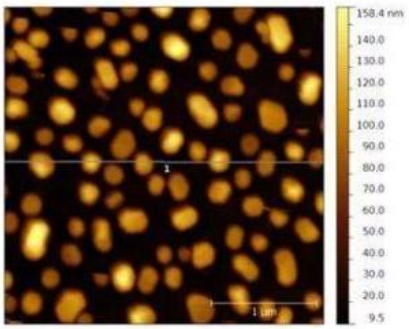
**DNA biosensors**




**Localised surface plasmon resonance (LSPR) on gold nanoparticles (Au NPs)**





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## *2nd Day Program: 26th September, 2014*

*Course site:* ***Department of Technologies in Electronics, TU Kosice***

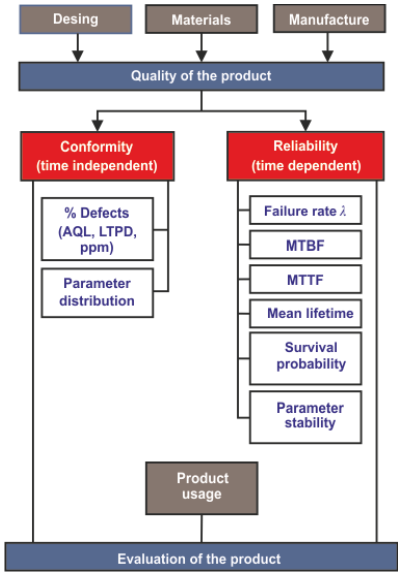
***Park Komenského 2, 040 01 Košice***

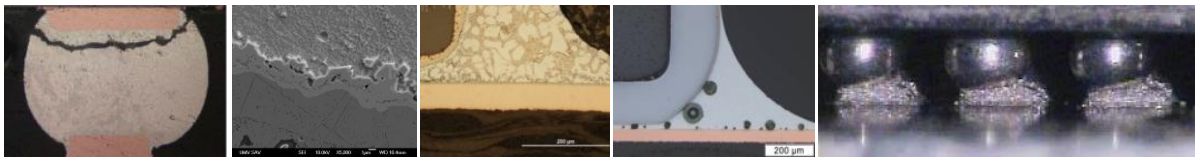
9.00-9.40 **Presentations about current research results**
Presentation of a local renowned scientist

Alena Pietrikova: “Reliability aspects of lead-free solders applied in electronics”

*Alena Pietrikova*
Professor
Department of Technologies in Electronics
Faculty of Electrical Engineering and Informatics
Technical University of Kosice
Slovakia

**Abstract:** The electronics industry is seeing ever strong demands for increasing functionality at low cost in the end products. The technologies used for mounting devices (packages) are critical for responding to these demands and a wide range of techniques and processes have been studied and applied. Solder joint reliability is the ability of the interconnect to retain functionality when exposed to a variety of environments that include mechanical and environmental stress. As the number of joints increase and their size decreases, the reliability of solder joints becomes an issue because they are more difficult to manufacture and functionality requirements become stricter. New generation of solders should minimize of various defects and it should be characterised by low melting temperature and low temperature range above melting temperature. The efforts of researchers have been concentrated on establishing lifetime. The quality is characterized by the acknowledged % of defects in the studied batch.



9.40-10.20 **Presentations about current research results**
Presentation of an invited senior scientist

Aleksandar Menićanin: "Inkjet Printed Layers with Nanoparticle Silver on Polyimide Substrate - CPW Inductors"

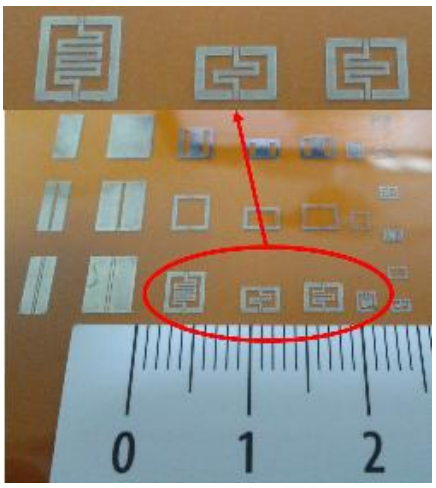
*Dr Aleksandar B Menićanin*
PhD. Senior Researcher
Center for Integrated Micro-systems and Components (CIMC) at University Novi Sad, Republic of Serbia
and
Research Assistant Professor
Institute for Multidisciplinary Research, University of Belgrade, Republic of Serbia

**Abstract:** The research aimed at the fabrication and characterization of silver layers on polyimide substrate made by inkjet printing technology using nanoparticle inks with 20 wt% and 40 wt% silver.

The electrical characteristics, namely the electron mobility and the resistivity, of the samples were measured by Hall effect measurement system at 0.37 T, and at temperatures of both 77 and 300 K.

The surface morphology and profiles of the samples were obtained with atomic force and scanning electron microscopes.

**Ink-jet printed coplanar waveguide (CPW) inductors on flexible substrate (in cm).**




Dr. Menićanin will also introduce the audience to the newest results of research projects “Innovative electronic components and systems based on inorganic and organic technologies” and “Zero- to three-dimensional nanostructures for application in electronics and renewable energy sources: synthesis, characterization and processing”, both sponsored by the Serbian Ministry of Education and Science.

10:20–10:40 Coffee break



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10.40-11.20 **Presentations about current research results**
Presentation of an invited young scientist

Djordjije Tripkovic: "Preparation of $BaTiO_3$ sols suitable for thin films fabrication using inkjet printing process"

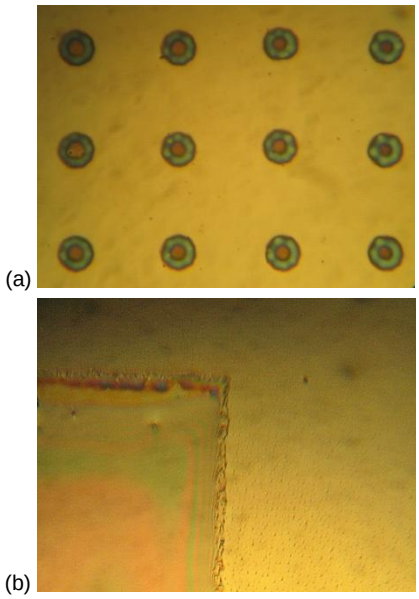
*Djordjije Tripkovic*
Early Stage Researcher
University of Novi Sad, Faculty of Technology, Department of Materials Engineering
Novi Sad, Serbia

**Abstract:**

Inkjet printing is often used as one of the low cost methods for fabrication of ceramic thin films with broad application in microelectronics [1]. By inkjet printing, droplets of a previously prepared sol (ink) can be deposited at predetermined locations on a substrate and after drying and thermal treatment desirable complex structures can be obtained. As it is well known that the sol characteristics determine the performances of the final product [2], this research is focused on preparation of different $BaTiO_3$ sols suitable for use in ink-jet printing. Stability of the sols with variation of the processing parameters was investigated.

$BaTiO_3$ sols were prepared by dissolving barium-carbonate in acetic acid and subsequent addition of tetrabutyl-orthotitanate. In addition, formamide and glycerin were added in the system in several concentrations to improve sol stability.

**Optical microscopy images of deposited BaTiO3 droplets (a) and continuous film (b) Magnification 40x**




Since there are certain requirements which an ink must meet in order to be printable, determination of viscosity, surface tension and particle size distribution, are necessary prior to printing [3]. The prepared sols were printed on previously cleaned silicon substrates using a Dimatix Materials Printer. In this step thoughtful manipulation of the printing parameters is crucial for obtaining continuous films. Further investigation performed over deposited films after the thermal treatment includes XRD analysis, SEM and optical microscopy.

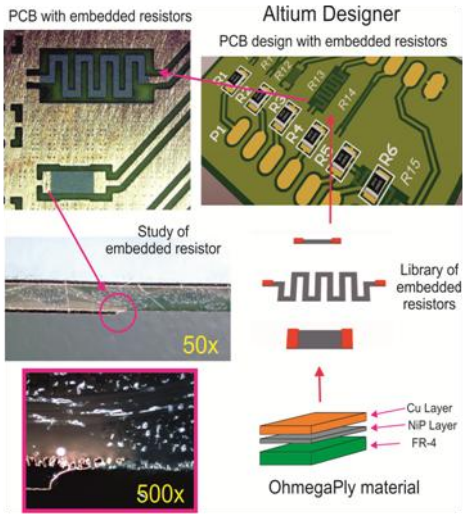
11.20-12.00 **Presentations about current research results**
Presentation of a local senior scientist

Ľubomír Livovský: "PCB design with embedded resistors"

*Ľubomír Livovský*
*PhD, Assistant Professor*
Technical University of Košice
Faculty of Electrical Engineering and Informatics
Department of Technologies in Electronics

**Abstract**

Passive components represent large portion of electronic devices. Requirements for new devices with larger integration of functions and smaller size demand smaller, more compact and more complicated circuit solutions. Accomplishment of these requirements is for example possible by lowering the number of passive components (resistors) mounted on surface of the PCB substrates. Technology of encapsulated passive components is one of choices how to minimize dimensions of the substrate, how to reduce parasitic effects and how to improve overall performance of electronic circuits. Design of topology of a multilayer PCB assumes application of a powerful design tool, such as e.g. Altium Designer. In the case of Altium Designer it is necessary to elaborate a method how to use encapsulated resistors in a design of a multilayer PCB.




12.00-12.30 **Problem solving discussion** – with the participation of the invited and local scientists and the EuroTraining delegates.

12:30-13:30 Lunch break



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13:30-14:00 **Current research results, running projects and future plans –** free discussion of all participants with the research staff of the Department of Technologies in Electronics

14.00-14.45 **Practical demonstration and laboratory visit –** Presentation of the virtual and research laboratories of the Department

The research and scientific works of the Department of Technologies in Electronics are focused on:

- Standard and polymer thick film technology,
- Surface mounting technology,
- Complete technology for multichip modules,
- Thick film sensors technologies.

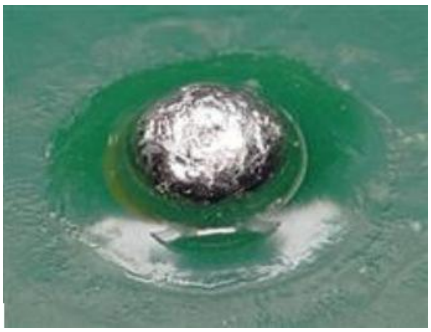
Teaching and research laboratories are as follows:

- Laboratory for the preparation and fabrication of the photo-masks for thick film technology and PCB including the screens treatment,
- Laboratory with complete line for production of the thick film based Hybrid Integrated Circuits including processing of the Low Temperature Co-fired Ceramics,
- SMT Laboratory,
- Laboratory equipped for the design and manufacturing of Multi Chip Modules (MCM-C).

The Department of Technologies in Electronics is equipped with complete modern technology for the production of hybrid integrated circuits, surface mounting technology and multi chip modules (ceramics technology). Special measuring instruments and computers include the following items:

- Viscosimeter HAAKE - viscosity measurement of specific and standard rheology properties for thick film pastes and soldering dopes for SMT
- Batch Furnace with Programmable Profile - furnace for thermal processing of thick film structures which offers programmable thermal profiles,
- Four Zones Conveyer Oven - standard furnace for thermal processing of thick film based technology,
- Ultrasonic Wire Bonder - the basic equipment for assembly of chips to substrates, which enables realized wire bonding of active chips to the passive conductive layout on substrate,
- Reflow Oven - for Surface Mounted Technology,
- Cutting Plotter FC-2200-50M - for realization both of the conventional and substandard shapes of LTCC based substrates,
- ATC Isostatic Lamination System - high-pressure isostatic lamination on hydraulics system for processing of the standard and MCM structures based on LTCC,
- Programmable Furnace PEO-602 - furnace for thermal processing of thick film structures which offers programmable thermal profiles,
- MICROTRONIC-M2 – Screen-print equipment,
- PC equipped laboratory for electronic layout and design processing.

**Equipment and process results at the Department of Technologies in Electronics**



14.45-15.00 **Farewell coffee with discussion and course evaluation**

15.00 **Disperse**

**Further information / contact persons:**

Dr. Olivér Krammer (krammer@ett.bme.hu tel: +36 1 4632755)
Dr. Zsolt Illyefalvi-Vitez (illye@ett.bme.hu tel: +36 1 4632753)
Budapest University of Technology and Economics,
Department of Electronics Technology, Hungary



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