EUROTRAINING NANO

NANOTECHNOLOGY FOR ELECTRONICS

16-17 June 2014, CIMC, University of Novi Sad, Serbia

COURSE PROGRAM

1st Day Program: 16th June, 2014

*Course site: **C**entre for Integrated **M**icrosystems and **C**omponents – CIMC, Novi Sad*

10:30-10:45 **Introduction**

10.45-11.45 **Nanotechnology – novel devices, applications and trends**
Presentation of invited renowned scientists

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

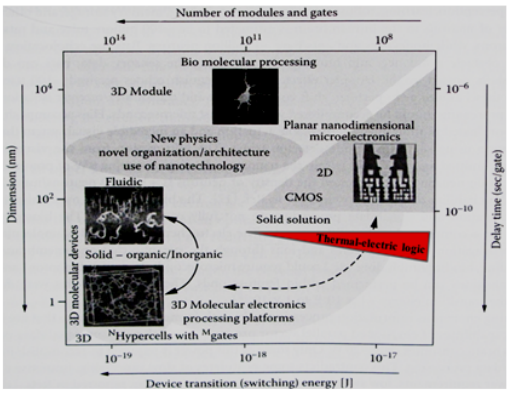
János Mizsei
CSc, PhD, DSc, Professor
Head of Laboratory

László Juhász
PhD, Assistant Professor
Semiconductor Laboratory
Dept. of Electron Devices
Budapest University of Technology and Economics

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.



11.45-12.45 Goran Radosavljević: „LTCC materials and their application for realization of Passive Components and Sensor Systems„

Goran Radosavljević
PhD, Assistant Professor
Vienna University of Technology
Institute of Sensor and Actuator Systems
Department of Applied Electronic Materials

Abstract

The presentation deals with the mechanical, electrical and thermal characterization of electronic components, sensor systems and microfluidic devices that are fabricated with several materials and different technologies, like LTCC (Low Temperature Co-fired Ceramic).

For the successful design of components and/or systems, it is essential to have complete and accurate information of the chemical composition, electrical and mechanical properties of the applied materials. Analyses of the properties have been conducted in order to determine the chemical composition, relative permittivity, elasticity modulus and relative thermal coefficient values of the most important materials, as well as, their effects on the characteristics of the realized components and systems.

Applications of LTCC technology

Microcoil of solenoid shape

12.45-13.45 Lunch break

13.45-15.00 **Presentations about innovations for industry**
Presentation of an expert from CEA-LETI, France

Hervé Fanet: “Energy efficient nanoelectronics”

Hervé Fanet
Director
CEA-Léti
Minatec Campus
Grenoble/France

Abstract:

Energy efficiency is the main nanoelectronic driver…
Many improvements have been done and more innovations are needed at circuit level.
New switches (Tunnel FET and NEMS) have to be confirmed for future ultra low power electronics but FDSOI and FinFETs are the solutions of today.
Adiabatic logic in association with new switches has to be investigated

Why less power?

15.00-16.00 **Delivery of a webcast: Nanotechnology impact on the performance of electronics and materials**

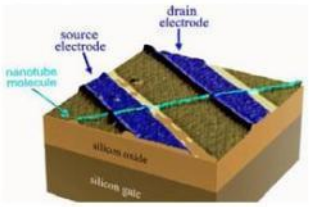
Osama Awadelkarim "How is Nanotechnology Changing the Electronics Industry?"
http://elluminate.mesacc.edu/play_recording.html?recordingId=1311874826010_1330102989559

Osama Awadelkarim
Associate Director, NACK
Professor of Engineering Science and Mechanics
The Pennsylvania State University

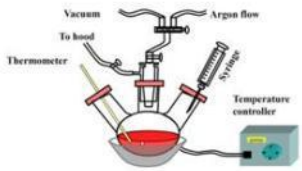
Abstract

For 50 years, electronics have run on silicon transistor technology. Over those years, that technology has continually been scaled down to the point now further shrinkage is difficult. Continuing evolution of electronics beyond the limits of the conventional silicon technology (top-down approach, lithography technology) requires innovative approaches for solving heat dissipation, speed and scaling issues. Many people have suggested that the microelectronics industry has to stop using top-down nanofabrication and must move to bottom-up or hybrid nanofabrication. If this worked, it would stop the spiralling costs of producing nano-scale transistors.

Carbon Nanotube Transistor



Synthesis of Quantum Dots



16.00-16.15 Coffee break

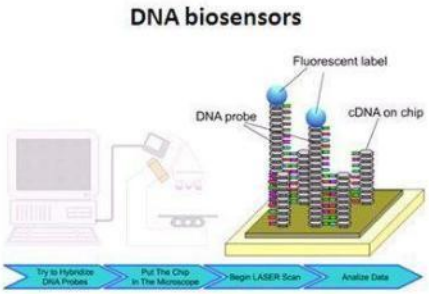
16.15-17.15 **Applications of nanotechnology**
Presentation of a young East European scientist

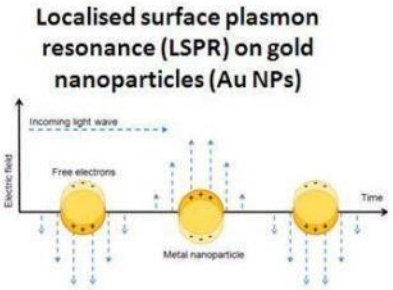
Attila Bonyár: "Enhancing Biosensors with Nanotechnology"

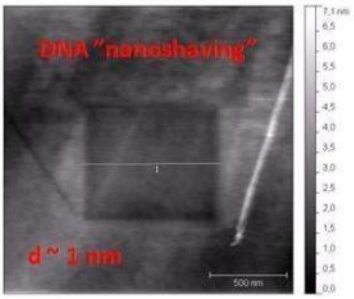
Abstract

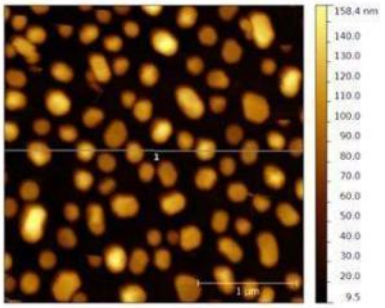
Biosensors applying nanoscale biomaterials such as DNA molecules as sensing elements possess great potential in the fields of disease diagnostics, environment monitoring or in pathogen detection. The optimization of sensor properties (such as sensitivity or limit of detection) is a constant challenge 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









17.15-17.30 **Problem solving discussion** – with the participation of the invited scientists, local professors, the industrial expert and the EuroTraining delegates.

2nd Day Program: 17th June, 2014

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08.30-10.00 **Presentations about current research results**

Presentation of local scientists about up-to-date research results

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

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

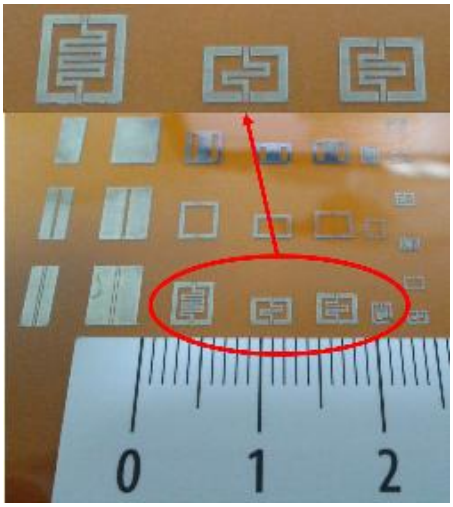
Abstract:

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.

Nelu Blaž: “Various types of Displacement Sensors”

Nelu Blaž

Laboratory Assistant

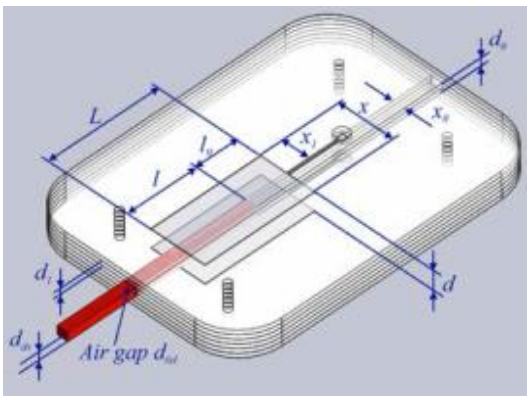
University of Novi Sad, Faculty of Technical Sciences, Department of Power, Electronics and Communication

Novi Sad, Serbia

Abstract:

Precise monitoring, detection and measurement of various physical parameters, such as pressure and displacement, are often required for many applications in different areas of our life. The main requirements of sensor realization are high sensitivity, good linearity, small dimensions and non-contact measurement system for data retrieval. Low temperature co-fired ceramic (LTCC) technology is a suitable approach for the fabrication of multilayer electronic components and assembled modules with good performance.

3D model of capacitive displacement sensor with inserted movable dielectric stick



For displacement detection there are several methods such as capacitive, inductive, LC resonant method, method based on eddy currents, etc.

Čedo Žlebič: “Comparison of Resistive and Capacitive Strain Gauge Sensors Printed on Polyimide Substrate Using Ink-Jet Printing Technology”

Čedo Žlebič

Early Stage Researcher

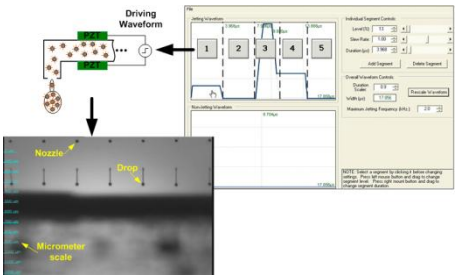
University of Novi Sad, Faculty of Technical Sciences, Department of Power, Electronics and Communication

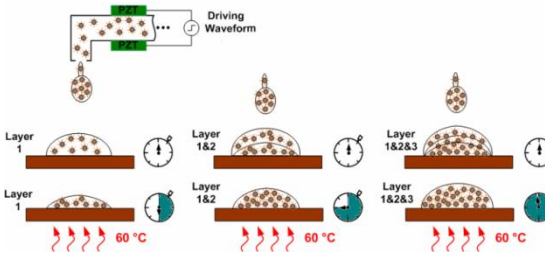
Novi Sad, Serbia

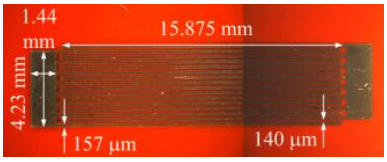
Abstract:

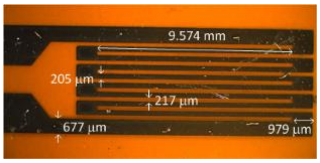
Testing newly developed components using strain sensors has become a standard, particularly in the automotive and aerospace industry. Strain sensors are used for measuring the strength of connection between joint on the bridges. Also, strain sensors are used in medical research.

Compared with commercial strain sensors, which are fabricated in semiconductor fabrication technology, with flexible polyimide backing and nickel-copper alloys, sensors developed in this research are fabricated with ink-jet fabrication drop-on-demand technology on flexible polyimide substrate using silver nanoparticle ink.









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

Djordjije Tripkovic

Early Stage Researcher

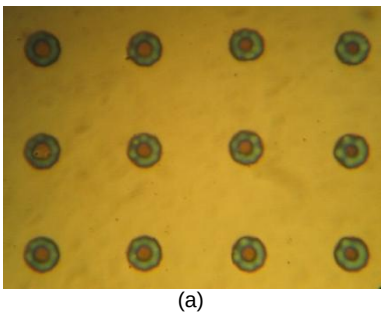
University of Novi Sad, Faculty of Technology, Department of Materials Engineering

Novi Sad, Serbia

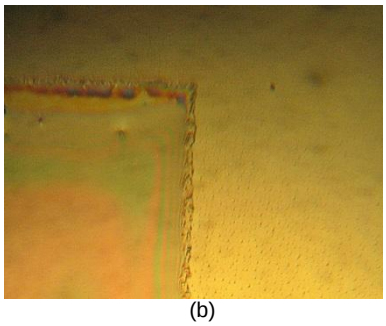
Abstract:

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 BaTiO3 sols suitable for use in ink-jet printing. Stability of the sols with variation of the processing parameters was investigated.

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



(a)



(b)

$BaTiO_3$ 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. 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.

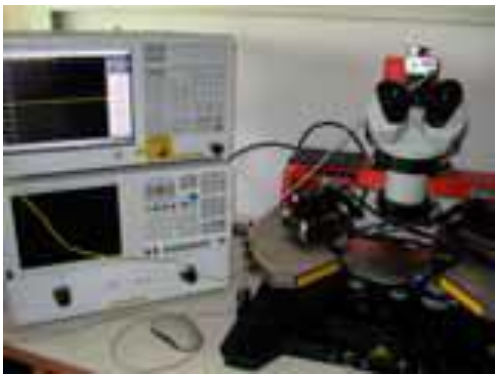
10.00-10.30 **Coffee break, preparation for the laboratory visit**

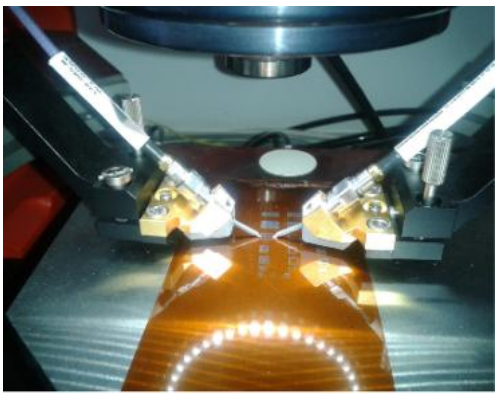
10.30-12.00 **Practical demonstration and laboratory visit**

Visit to the Laboratories of Centre for **Integrated Microsystems and Components - CIMC**, at the Faculty of technical Sciences, University of Novi Sad, Republic of Serbia, http://www.cimc.rs/

CIMC is recognized as a regional leader in the fields of design and optimization of high-performance integrated micro- and nano-systems and components, such as inductors, varistors, termistors, electromagnetic interference (EMI) suppressors, sensors, super-compact high-performance microwave passive devices, novel integrated hybrid circuits, MEMS, nanotubules, etc. It is also acknowledged to be one of the two leaders in the country in the emerging field of metamaterials and their microwave and optical applications. Research performed at CIMC also incorporates integrated digital systems and embedded systems, such as programmable, configurable and reconfigurable components. CIMC staff is active in scientific research and publish regularly in recognized international journals and at leading conferences. systems.
CIMC has developed expertise in the field of design and fabrication (in cooperation with: TU Vienna, ISAS) of electronic components and sensors in LTCC technology, design and fabrication of electronic components and circuits on the PCB using modern rapid prototyping machine LPKF ProtoMat S62 also it has successfully fabricated components circuits and systems like RFID tags, ID cards, sensors using Dimatix ink-jet material deposition printer. Design of complex microprocessor electronic systems, embedded systems and algorithms is one of CIMC's research fields. Additionally detailed functional and formal verification of digital hardware, analog and mixed signals and systems is performed in our facilities.

Measurement set-up using the Süss MicroTec RF probe station PM5





12.00-12.30 **Farewell coffee with discussion and course evaluation**

12.30 **Disperse**

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