1st Day Program: 23rd September, 2014

Course site: ***38th IMAPS-CMPT 2014 Conference, Czarna, Poland***
Hotel Perła Bieszczadów, 38-710 Czarna

10.30-11.00 **Presentations about current research results**

Presentation of local scientists

Title: **Carbon nanomaterials dedicated to PV module heating system**

Authors: *Wroblewski, Grzegorz (1); Jakubowska, Malgorzata (1); Kiełbasinski, Konrad (3); Marszalek, Konstanty (2); Stapiński, Tomasz (2)*

Institutes: *1: Faculty of Mechatronics, Warsaw University of Technology, Poland;*
2: AGH University of Science and Technology, Poland;
3: Institute of Electronic Materials Technology, Poland

Grzegorz Wroblewski
PhD Student
Faculty of Mechatronics
Warsaw University of Technology
Poland

Abstract:

The increase in energy conversion of photovoltaic modules is one of the main tasks for renewable energy sources. Snow and ice should be removed from the panel surface as soon as possible to enable proper illumination of solar cells by sun. The use of heating system enables the reduction of light absorption in winter and in spring period. Transparent heaters were made with spray coating technique and specially developed paints based on carbon nanomaterials. Paints consisted of solvent – carbitol butyl acetate, polymer resin – polymethacrylate and carbon functional nanomaterials – double walled carbon nanotubes and graphene nanoplatelets. Diverse amounts of polymer resin were used to prepare four kinds of paints for each carbon material. Layers deposition was performed using specially developed spray coating equipment with ultra-fine nozzle spray gun and oil-free compressed air system. Afterwards coatings were cured in a chamber dryer to evaporate the solvent. The sheet resistance of obtained layers was between 9 to 12 kΩ/□ however double walled carbon nanotubes showed significantly higher optical transmittance (around 70 % for 550 nm wavelength) than graphene nanoplatelets (around 30 % for 550 nm wavelength). The amount of polymer resin had the influence on the paints stability, electrical properties and coatings adhesion.

The work was supported by Operational Programme 'Innovative Economy' the project no POIG.01.03.01-30-056/12 entitled: 'Research on the development of guidelines, techniques and technologies for power compensation systems, intelligent monitoring internal power grids and solar cells systems dedicated to hybrid objects based exclusively on renewable sources'.

11:00–11:30 Coffee break

11:30–13:00 **Poster presentations**

Title: **Application of molecular modelling in micro and nano material technologies**

Authors: *Allaf, Kamil Nouri; Wymysłowski, Artur*

Institution: *Wroclaw University of Technology, Faculty of Microsystem Electronics and Photonics, Poland*

Title: **Microstructure and NO2 gas-sensing properties of SnO2 thin films and nanowires.**

Authors: *Izydorczyk, Weronika; Domański, Wiesław; Waczyński, Krzysztof; Mazurkiewicz, Janusz; Uljanow, Jerzy*

Institution: *Silesian University of Technology, Poland*

EuroTraining (GA No.: 316526) – Funded by the European Union

Title: **Modification of Liquid Crystalline Phases by Nanomaterial Dopants for the Electronic Devices Elements**

Authors: *Grzegorz Błąd (1), Andriy Fechan, Zenon Hotra, Zinoviy Mykytyuk, Orest Sushynskyi, Maria Vistak*

Institution: *Lviv Polytechnic National University, Ukraine,*
1: Rzeszow University of Technology, Poland

Title: **Global Networks on Nanotechnology Education**

Authors: *Illyefalvi-Vitez, Zsolt; Krammer, Oliver*

Institution: *Budapest University of Technology and Economics, Hungary*

Title: **Graphene inks for industrial printing techniques**

Authors: *Wyżkiewicz, Iwona (1); Zwierkowska, Elżbieta (1); Kiełbasiński, Konrad (1); Młożniak, Anna (1); Jakubowska, Małgorzata (1,2)*

Institution: *1: Institute of Electronic Materials Technology, Poland;*
2: Faculty of Mechatronics, Warsaw University of Technology, Poland

Title: **High refractive index ultra-thin nanocrystalline boron doped diamond film for NIR waveguiding**

Authors: *Sobaszek, Michał (1); Skowroński, Łukasz (2); Bogdanowicz, Robert (1); Gnyba, Marcin (1); Gołuński, Łukasz (1); Płotka, Piotr (3)*

Institution: *1: Department of Metrology and Optoelectronics, Gdańsk University of Technology, Poland;*
2: Institute of Mathematics and Physics, University of Technology and Life Sciences, Bydgoszcz Poland;
3: Department of Microelectronics Systems, Gdansk University of Technology, Poland

Title: **Low-temperature sintered nano-silver based thermal interface materials**

Authors: *Fałat, Tomasz (1); Matkowski, Przemysław (1); Felba, Jan (1); Mościcki, Andrzej (2)*

Institution: *1: Wroclaw University of Technology, Poland;*
2: Amepox Microelectronics, Ltd., Poland

Title: **Spray coated graphene nanoplatelets and carbon nanotubes oriented in constant electric field for transparent and elastic electrodes.**

Authors: *Wróblewski, Grzegorz (1); Słoma, Marcin (1,2); Janczak, Daniel (1); Młożniak, Anna (2); Jakubowska, Małgorzata (1,2)*

Institution: *1: Warsaw University of Technology, Poland;*
2: Institute of Electronic Materials Technology, Poland

Title: **Micro- and nano characterisation of intermetallics in lead-free solder joints**

Authors: *Krammer, Oliver; Illyefalvi-Vitéz, Zsolt; Bonyár, Attila; Hurtony, Tamás*

Institution: *Budapest University of Technology and Economics, Hungary*

Title: **Inkjet printed microwave circuits on flexible substrates using heterophase graphene based inks**

Authors: *Futera, Konrad (1,3); Kiełbasiński, Konrad (2); Młozniak, Anna (2); Kozioł, Grażyna (1); Jakubowska, Małgorzata (2,3)*

Institution: *1: Tele & Radio Research Institute, Poland;*
2: Institute of Electronic Materials Technology, Poland;
3: Warsaw University of Technology, Faculty of Mechatronics, Poland

Title: **Investigation of ink spreading on various substrates in inkjet technology**

Authors: *Tomaszewski, Grzegorz; Potencki, Jerzy; Wałach, Tadeusz; Pilecki, Mariusz*

Institution: *Rzeszow University of Technology;*

EuroTraining (GA No.: 316526) –
Funded by the European Union

2nd Day Program: 24th September, 2014

Course site: ***38th IMAPS-CMPT 2014 Conference, Czarna, Poland***

Hotel Perła Bieszczadów, 38-710 Czarna

9:00-9:10 **Introduction**

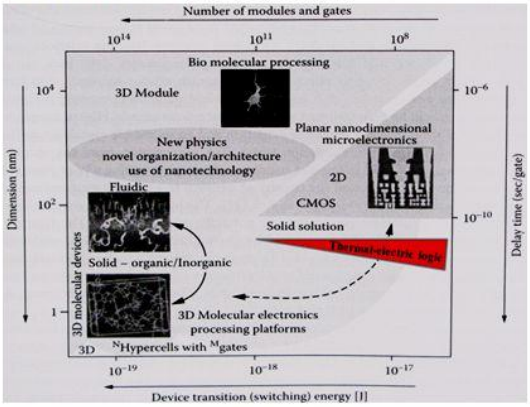
9.10-9.50 **Nanotechnology – novel devices, applications and trends**
Presentation of an invited renowned scientist

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.



9.50-10.30 **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.

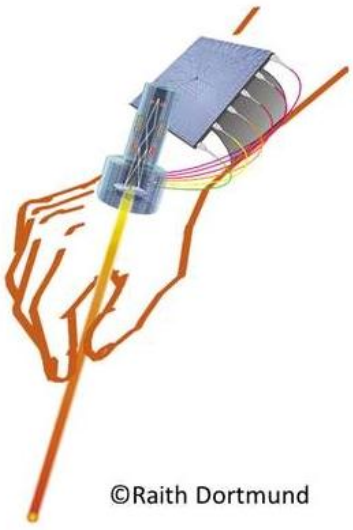


Figure symbolizes a focused charged particle beam structuring substrates at nano scale.

10.30-10.50 Coffee break

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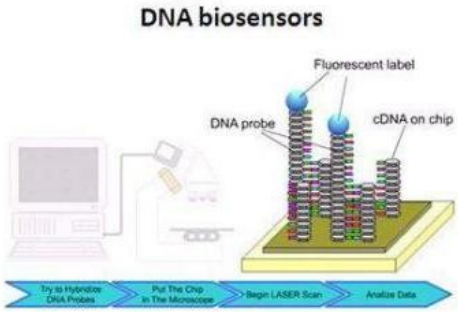
10.50-11.30 **Applications of nanotechnology**
Presentation of a young East European scientist

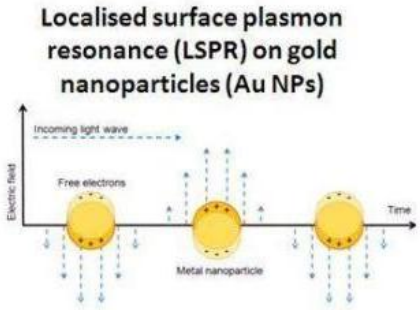
Attila Bonyár: "Enhancing Biosensors with Nanotechnology"

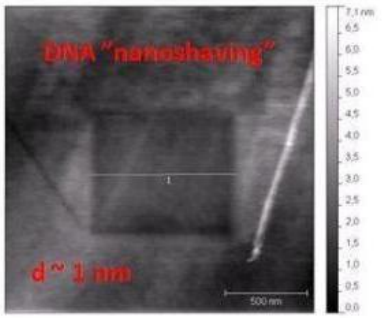
Abstract

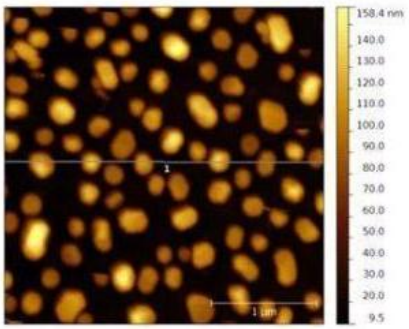
Biosensors applying nanoscale biomaterials such as DNA molecules as sensing elements possess great potential in the fields of disease diagnostics, environment monitoring or in pathogen detection. The optimization of sensor properties (such as sensitivity or limit of detection) is a constant challenge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









11.30-12.00 **Presentations about current research results**
Presentation of a local senior scientist

Title: **Deposition of nanocrystalline boron-doped diamond onto epitaxial GaN films for high power electronic and optoelectronic devices**

Authors: *Bogdanowicz, Robert; Sobaszek, Michał; Ryl, Jacek; Gnyba, Marcin*
Institute: *Gdansk University of Technology, Poland*

Robert Bogdanovicz, PhD
Assistant Professor
Gdansk University of Technology
Faculty of Electronics, Telecommunications and Informatics
Poland

Abstract: The paper reports deposition of continuous boron-doped diamond films on epitaxial GaN films in a microwave plasma assisted chemical vapor deposition (MW PACVD) system. The novel approach for the integration of CVD diamond and GaN via deposition of the nanocrystalline diamond (NCD) films directly on GaN films pre-treated in hydrogen plasma is proposed. Growth of NCD at low temperatures of 500°C is reported. It was found that two step seeding procedure: (I) short pre-treatment of GaN films in hydrogen plasma, (II) ultrasonic seeding in nanodiamond slurry results in rapid diamond film nucleation and increases its growth rate.

The NCD-GaN structures were characterized by scanning electron microscopy (SEM) and Raman spectroscopy. SEM images show that the nucleation density of the films is high and continuous diamond film with grain size of 100–200 nm can deposite in only 30 mins. The Raman spectra include 1335 cm−1 distinctive peak with asymmetric Fano line shape. This fact indicates that deposited NCD films exhibits typical heavily doped character. Moreover, the surface resistance and Hall-mobility measurements have been performed by four point-probe and Hall equipment, respectively.

The low deposition temperature and high growth rate allows to avoid degradation of the GaN quality, which is essential for electronic or biosensing applications. It was shown that the p-type boron doped diamond could be integrated with n-type GaN for application in electronic devices. Moreover, deposition of diamond films onto GaN-based devices may enhance heat dissipation and thus improve device performance for high power loading.

12.00-12.20 **Problem solving discussion** – with the participation of the invited and local scientists and the EuroTraining delegates.

3rd Day Program: 25th September, 2014

Course site: ***Department of Electronic and Communications Systems, PRZ, Rzeszów***
Politechnika Rzeszowska, 35-959 Rzeszów, Poland

9:00–9:40 **Current research results**
Presentations of local scientists about practical works

Title: **Investigation of ink spreading on various substrates in inkjet technology**

Authors: *Tomaszewski, Grzegorz; Potencki, Jerzy; Wałach, Tadeusz; Pilecki, Mariusz*

Institute: *Rzeszów University of Technology, Poland*

Keywords: inkjet printing, cracks, printed electronics, ink spreading

Grzegorz Tomaszewski
PhD Student
Rzeszow University of Technology
Faculty of Electrical and Computer Engineering
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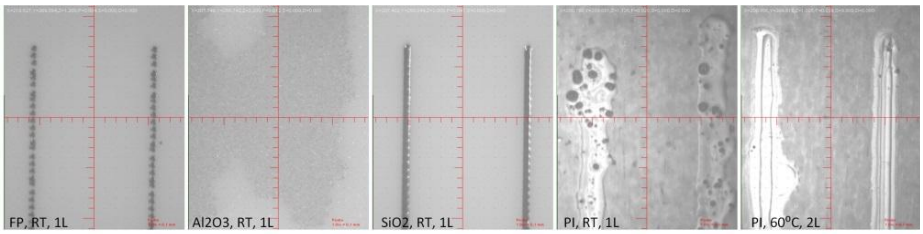
***Abstract*:**

In this paper the problem of ink spreading on various substrates was presented. The ink was dropped by the piezoelectric industrial SE-128 AA printhead using techniques typical for inkjet technology. For the investigation two various conductive inks were used. Materials were printed on various substrates by the PixDro LP 50 system. The investigation concerns physical properties of substrates and technological process parameters. Elaboration of optimal parameters for the RFID antennas inkjet printing process was the ultimate aim of this research.



9:40–11:10 **Practical demonstration and laboratory visit**
Visit to the laboratories of the Department of Electronic and Communication Systems

The research and scientific works of the Department of Electronic and Telecommunications Systems are focused on:

- Standard and polymer thick-film technology,
- LTCC and HTCC technology,
- Thin-film technology,
- Ink-jet printing,
- Multilayer PCB design and manufacturing,
- Nanolithography and structural analyses with AFM,
- Assembly of SMD, BGA and bare structures,
- Heat transfer and heat fields analyses,
- Design, manufacturing and tests RFID systems and antennas,
- Investigations of Electromagnetic Compatibility in electronics circuits.

Research and teaching laboratories:

- Laboratory of integrated electronics micro- and nanotechnologies "HYBRID",
- Laboratory for EMC,
- Laboratory for RFID investigations,
- and 16 specialist teaching laboratories from areas of CAD and EDA, principles of optoelectronics, microprocessors systems design, antennas design, electronics technologies, telecommunications, VHF systems and applied consumer electronics.

The Department of Electronic and Communications systems is equipped with complete set of modern technologies (thick-film, LTCC, HTCC, thin-film, PCB and ink-jet) which are applied for synthesis of micro and nanostructures for hybrid electronics, especially implementation in RFID technology, optoelectronic devices, sensors, alternative sources of power and energy storage systems.

Equipment and process results at the Department of Electronic and Communications Systems of PRz

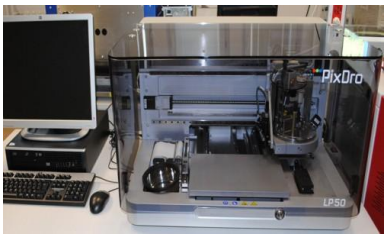


Fig. 1. Ink-jet printer PixDro LP50

Fig. 2. Technological line for LTCC and HTCC

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Technological and instrumentation equipment:

- Laboratory “HYBRID”:
  - Four Zones Conveyer Furnace BTU (for standard thick-film technology),
  - set of screen printers,
  - full technological line for LTCC and HTCC (Fig. 2),
  - thin-film technology – PVD Prevac system (Fig. 4),
  - ink-jet printer PixDro LP50 (Fig. 1)
  - PCB plotter LPKF, ProtoMat S100, Electroplating tank LPKF, MiniContact RS, PCB press LPKF MultiPress S – for PCB prototypes manufacturing,
  - Laser Trotec Finemarker Hybrid Strong,
  - assembly: Rework system VJ ELECTRONIX SUMMIT 400R, Ovens SEF GmbH 548.04 and Gold-Flow GFC2- HT,
  - Atomic Force Microscope (Fig. 3)
  - Infra red camera FLIR SC7600MB,
  - CAD and EDA laboratory for electronic circuits and system design – with full Mentor Graphics Expedition Enterprises software.
- RFID (Fig. 5):
  - components of stationary and mobile RFID systems,
  - measurements of antenna parameters: network and spectrum analysers, anechoic chamber, antenna radiation pattern and electromagnetic field measurement systems,
  - multiaspect analysis of radio frequency identification processes: protocol and spectrum analysers, multichannel digital oscilloscopes, signal, current, electromagnetic field probe sets, RLC bridge, vector generator, arbitrary signal generator,
  - stand for stationary and dynamic investigations,
  - software for designing antennas and RFID systems,
  - equipment from Agilent, Tektronix, R&S, MI Technologies, Sonul Sciences, A.H. Systems, Mentor Graphics and others.
- EMC (Fig. 6):
  - fully equipped anechoic chamber with control room (26 MHz-18 GHz),
  - turntable table (up to 1000kg),
  - antenna masts (monitoring; emission measurements of conducted and radiated disturbances (20 Hz - 18 GHz, 63 A/100 A),
  - receivers ESU 22 GHz, ESC-EMI 3 GHz,
  - antenna sets, artificial mains networks; immunity measurements (80 MHz - 1 GHz, 1 GHz - 6 GHz, up to 10 V/m),
  - specialised generators, antennas, amplifiers,
  - generators of normalized conducted disturbances: surges, transient states, dynamic changes, drops, decays and dips of voltage,
  - generator of electrostatic discharge up to 30 kV,
  - harmonics and flicker analysers,
  - conducted disturbance generator,
  - three-phase voltage source.

Fig. 3. AFM SPM NT-MDT NTEGRA Prima

Fig. 4. PVD system PREVAC

Fig. 5. Set of RFID Laboratory equipment

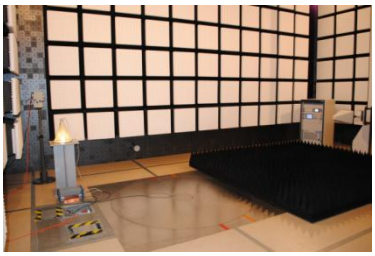

Fig. 6. Anechoic chamber with control room (26 MHz - 18 GHz),

11:10–11:30 **Farewell coffee with discussion and course evaluation**

11.30 **Disperse**

Further information / contact persons:

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