EUROTRAINING NANO

NANOTECHNOLOGY FOR ELECTRONICS

9-10 October, 2013, Technical University, Cluj-Napoca, Romania

COURSE PROGRAM

TECHNICAL UNIVERSITY OF CLUJ-NAPOCA ROMANIA

1st Day Program: 9th October, 2013

Course site: Aula Domsa, 15 Strada Constantin Daicoviciu, Cluj-Napoca

09:00-09:30 **Introduction**

09.30-10.45 **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

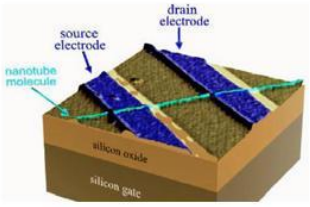
Professor of Engineering Science and Mechanics

The Pennsylvania State University

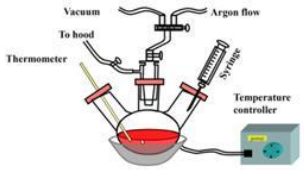
Abstract

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



10.45-11.00 Coffee break

11.00-13.00 **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

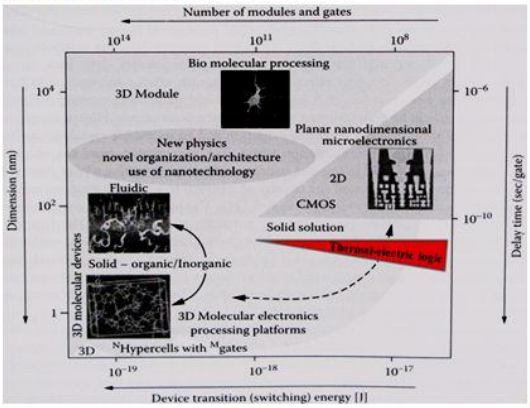
Department of Electron Devices

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.



13.00-14.00 Lunch break

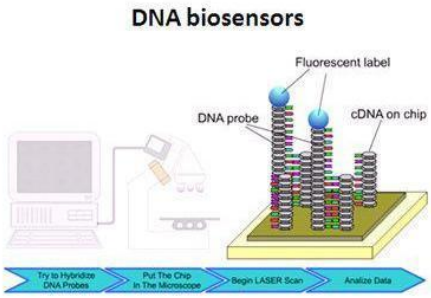
14.00-15.15 **Applications of nanotechnology**
Presentation of a young East European scientist

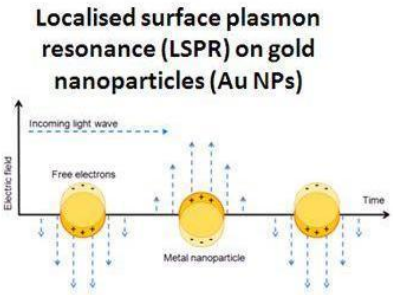
Attila Bonyár: "Enhancing Biosensors with Nanotechnology"

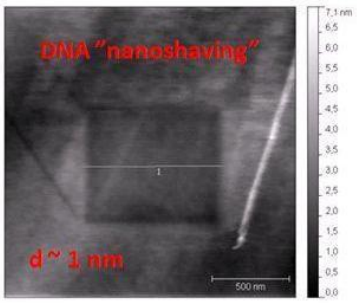
Abstract

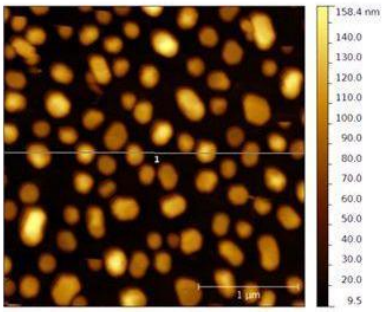
Biosensors applying nanoscale biomaterials such as DNA molecules as sensing elements possess great potential in the fields of disease diagnostics, environment monitoring or in pathogen detection. The optimization of sensor properties (such as sensitivity or limit of detection) is a constant challenge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









15.15-15.30 Coffee break

15.30-17.00 **Presentations 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.

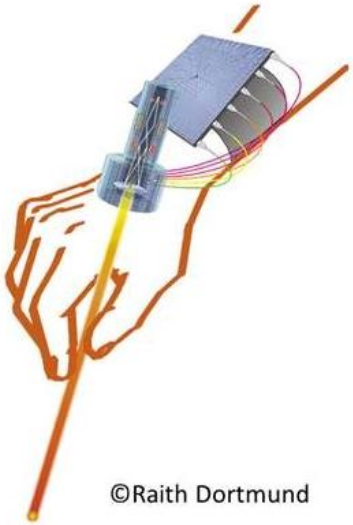


Figure symbolizes a focused charged particle beam structuring substrates at nano scale.

16.45-17.30 **Problem solving discussion** – with the participation of the invited scientists, local professors, the industrial expert and the EuroTraining delegates.

2nd Day Program: 10th October, 2013

Course site: Aula Domsa, 15 Strada Constantin Daicoviciu, Cluj-Napoca

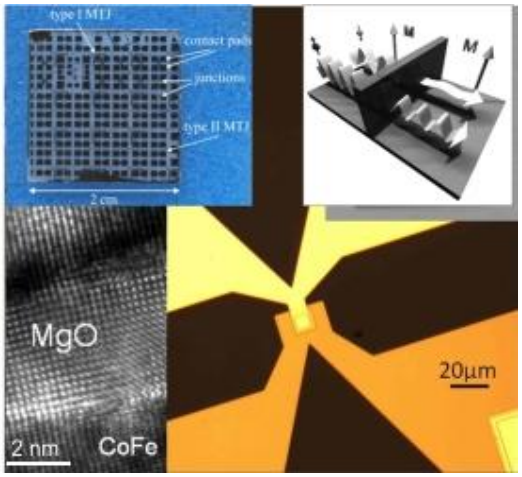
08.30-10.00 **Presentations about current research results**
Presentation of local scientists about up-to-date research results

Mihai Gabor: "Spintronic devices for sensor and data storage applications"

Mihai Gabor
PhD. Assistant Professor
Center for Superconductivity, Spintronics and Surface Science (C4S)
Department of Physics and Chemistry
Technical University of Cluj-Napoca, Romania

Abstract:

The manipulation of the spin degree of freedom in solid-state systems and the study of the related physical phenomena generated, over the last decades, a rapidly emerging field of science and technology: the spintronics. The discovery of Giant Magnetoresistance effect (GMR) and Tunneling Magnetoresistance (TMR) effect in multilayer structures radically changed the data storage technology.



Nowadays, the MTJs constitute the elementary bricks of different magnetic random-access memories (MRAM) prototypes, field sensors and read-heads in HDD hard disk drives or high frequency oscillators. Within the extremely dynamic research field of spintronics, ongoing studies are focused on elaboration and study of new materials and devices with customized magnetic and spin dependent transport properties.

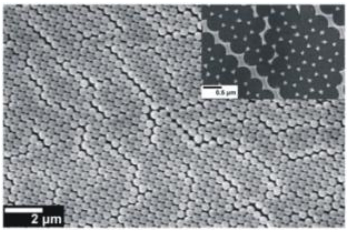
Traian Petrişor Jr. “Alternative methods for nanolithography”

Traian Petrişor Jr
PhD, Assistant Professor
Center for Superconductivity, Spintronics and Surface Science (C4S)
Department of Physics and Chemistry
Technical University of Cluj-Napoca, Romania

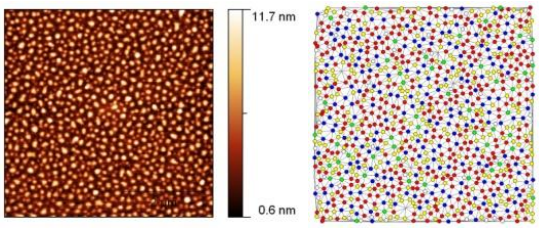
Abstract:

Two paths are presented for the fabrication of nano-scale objects. They represent alternatives to the other well-established techniques currently used in nano-fabrication. The first consists in the use of self-assembled polystyrene nano-spheres correlated with ion beam etching, for defining different nanometric geometries. The second makes use of the micro-domain separation of diblock copolymers in order to produce nanometric lithographic mask for the ion beam etching of thin films or multilayers. The presentation focuses on the results, current research status and issues regarding the described techniques.

Self-assembly of PS nano-spheres



Microphase separation of PS-b-PMMA diblock copolymer

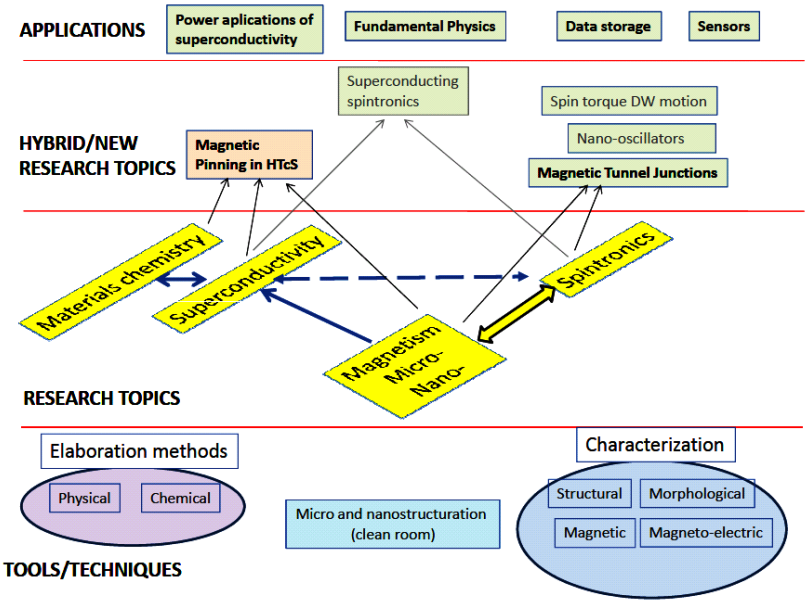


10.00-10.15 **Coffee break, preparation for the laboratory visit**

10.15-12.00 **Practical demonstration and laboratory visit**

Visit to the Center of Superconductivity, Spintronics and Surface Science (C4S), Faculty of Materials Science and Engineering at the Technical University of Cluj-Napoca (TUCN), http://www.c4s.utcluj.ro

The research activity of the C4S center mainly regards the superconducting, dielectric and magnetic thin films grown both by physical and chemical methods. Thus, the laboratory is involved in the development of $YBa_2Cu_3O_{7-x}$ (YBCO) high temperature coated conductors fabrication technology comprising the chemical methods for the epitaxial deposition of YBCO superconducting films and oxide buffer layers on Ni-based biaxially textured substrates. Over the last few years, in tight collaboration with the Material Science Laboratory of Nancy University (France) new research axes have been opened. They envisage research and development in the top scientific and technological field of Spintronics: the physics and technology of spintronic devices based on thin film systems.



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

12.30 **Disperse**

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