General Conclusions of the 3rd International Conference Micro & Nano 2007

on Micro-Nanoelectronics, Nanotechnology and MEMs Held at NCSR "Demokritos" on 18-21 November 2007

The 3rd International Conference Micro & Nano 2007 on Micro-Nanoelectronics, Nanotechnology and MEMs, organized by the Institute of Microelectronics (IMEL) and having taken place at NCSR Demokritos during November 18-21, 2007, was successfully concluded.

The main topics of the Conference were Micro and Nanoelectronics, Nanotechnology and MEMs. A total of 250 Scientists representing 23 countries attended. There were a total of 205 presentations, 71 of which were oral (including 10 invited talks) and 134 were posters presented at 2 different sessions.

The Conference opening ceremony was honored by the presence of the General Secretary of Research and Technology Prof. I. Tsoukalas. During the ceremony, an honorary plaque was awarded to Prof. G. Kamarinos from the Polytechnic University of Grenoble, France, acknowledging his contributions to the early stages of Microelectronics Research in Greece. In addition, Dr A. G. Nassiopoulou, Conference Chairperson and Director of the Institute of Microelectronics (IMEL) of NCSR Demokritos, gave an overview of the development of Microelectronics research in Greece from the mid 80ies to the present. The first and only Institute of Si Technology in Microelectronics was founded in 1985 in Greece at NCSR Demokritos. Today, the Institute (IMEL) is one of the notable Microelectronics Research Organizations in Europe, is one of the 15 founding members of the newly formed European Institute of Nanoelectronics, is a member of the European platform for Nanoelectronics ENIAC and is a member of a consortium of flexible laboratories of Microelectronics in Europe (Activity "Beyond Moore" of the following four laboratories: VTT-Finland, Tyndall-Ireland, CNM-Spain, IMEL/NCSR Demokritos-Greece). In 2004 a Scientific Society Micro & Nano (www.micro-nano.gr) was started from scientific and academic institutions with the Initiative of the Director of IMEL, Dr Androula Nassiopoulou. The founding members were 5 Research Institutions and 63 scientists (independent members). In 2005, the Association of Microelectronics Industries was created (HSIA: Hellenic Semiconductor Industry Association) that today numbers its members above 30.

On Monday and within the Conference framework, three presentations were given: (1) European platform "ENIAC" by Clivia Sotomayor Torres, member of the Scientific Council of ENIAC (2) Activity "Beyond Moore" by Dr Ahopelto from VTT-Finland and (3) Association of Microelectronics Industries by Dr Koutsogiannopoulos.

Important results presented at the Conference

Some of the results presented at the Conference are as follow:

A) Latest progress in Si integrated circuit technology.

In modern CMOS technology (logic and memories) current dimensions are in the order of nanometers as opposed to last decade's technology where the active

dimension in a transistor was a little under a micron. Thus, we have moved from Microelectronics (critical dimensions in the micron range) to Nanoelelectronics (critical dimensions in the nanometer range). The most advanced semiconductor manufacturers design and build circuits at the 45 nm node and at a research stage, transistors with dimensions of only a few nanometers have been demonstrated.

The invited speaker from Taiwan, Dr. Wei Xin Ni, presented research on new device architectures, new nanoelectronic structures (2D or 3D) as well as research on alternative device technologies for future applications. Nevertheless, it seems that current technology and its evolution following scaling down of all dimensions of a device, still shows a very important potential and it will continue to dominate electronics technology for many years.

Professor Christoloveanu from the Nanotechnology Center Minatec in Grenoble, mentioned that Si CMOS on insulator, where the devices are fabricated on a thin film of Si on top of a thin insulating layer of SiO_2, shows good properties and promise, such that, in the future, it will dominate not only device fabrication but also fabrication of smart, microscopic sensors for a variety of applications

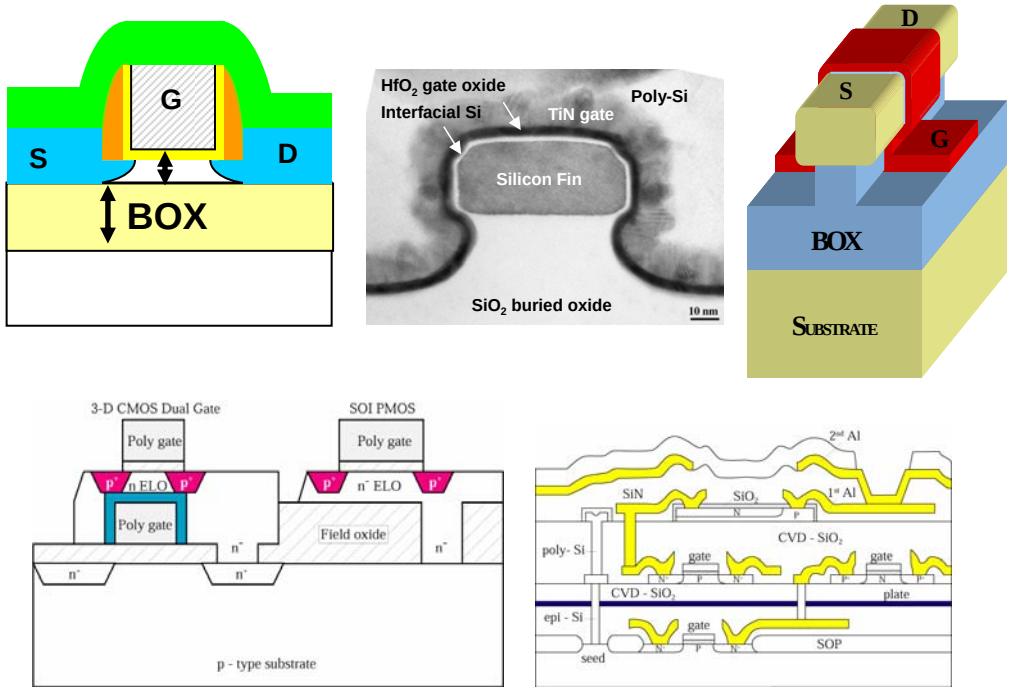

Fig.1 CMOS SOI technology

B) <u>Technologies for thin film and surface nanopatterning</u>

Apart form the classical lithography and etching patterning technologies, a new approach has been detailed. It is nanoimprint lithography which makes it possible to print structures onto polymeric thin films with a 10 nm resolution.

This emerging technology can be used successfully to fabricate novel nanostructures and sensors but it has some limitations in applications that need several masks and accurate alignement.

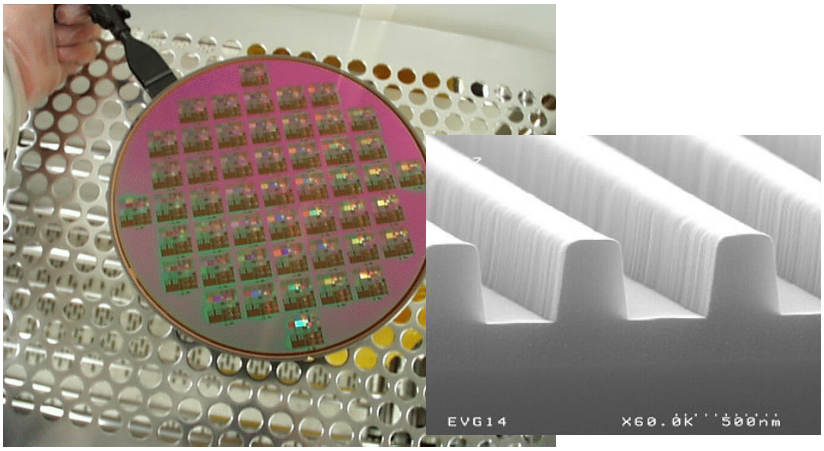

Fig.2 Courtesy of Dr C. Gourgon (CNRS-LTM) and Dr S. Landis (LETI)
Nanoimprint lithography for printing structures in nanodimensions

C) Manufacturing technology of 3D polymeric structures using ultrashort laser pulses.

The invited speaker from Germany, B.N. Chichkov, presented new developments on nanomanufacturing of 3D polymeric structures using ultrashort laser pulses. With resolution reaching 100 nanometers, it is possible to make 3D structures of great complexity in just a few minutes. This technology is impressive. Corresponding Equipment for this technology is available at FORTH-Crete.

D) Sensors and MEMs

A large part of the Conference was devoted to microscopic sensors and to microelectromechanal (MEMs)or nanoelectromechanical (NEMs) systems. These systems are developed either on a Si substrate or on other substrates using various thin film materials. Important research activities on these technologies are carried out at IMEL, NCSR Demokritos in Greece.
Research at IMEL focuses on microscopic smart devices that can detect with great sensitivity a physical or chemical quantity or biologic element by combining the sensing with the electronic circuit (monitoring and readout). RF switches, pressure sensors, gas flow sensors, gas composition sensors (odor sensors, ambient gas detection), biomolecular sensors (DNA, proteins) and various other devices are developed and were presented in the Conference. Significant advances in this field were presented by Greek research groups.
In addition, current technologies on microfluidics with applications in drug delivery systems, on microscopic structures for chemical or biological reactions (lab-on-a-chip) and various others were discussed. Greek research groups demonstrated significant progress in this area as well.

E) Devices and passive RF components

From IMEL, a breakthrough technology was presented, which has world-wide applications in analog RF devices.

This technology uses a sublayer of low losses at RF frequencies on specific areas on the Si substrate such that with proper design much improved RF passive components, used in oscillators compatible with silicon technology, can be fabricated. These oscillators demonstrate doubling or tripling of the Q factor compared to those fabricated directly on Si. Thus, the energy losses of corresponding systems are divided by 2 or 3. Given that those oscillators are used in cell-phones, this new technology can be used in systems requiring lower power for the same amount of sensitivity. This is a significant gain, since improved wireless systems require less power.

F) Photonic devices and their integration with electronics

New technologies for fabricating photonic crystals as RF filters were presented. Si is a good candidate material if it is used in such a way as to fabricate an appropriate 2D or 3D device. A good example is macroporous Si. By using an electrochemical process layers containing vertical pores of large length and of diameter ranging between 50-300 nm can be fabricated. This material acts as a photonic crystal and it can be used in optical filters for optical communications with wavelengths of 1-2 μm. IMEL introduced a breakthrough here as well, by making pores with specific diameters having a hexagonal 2D symmetry and improved photonic properties.

G) Photoemission devices with organic or inorganic semiconductors

In the area of light emitting devices and solid state lasers significant progress has been made using new materials such as GaN and new technologies for device architecture. Active research is on-going on new polymeric semiconducting materials which seem to open new horizons for photoemission. The main desired application for these would be colored screens. Professor T. Moustakas presented devices and nanostructures using the above mentioned materials and demonstrated photoemission covering all three basic colors of the visible spectrum. Significant development work on these materials is taking place at the University of Crete and at FORTH-Crete. Characterization of such structures using high resolution electron Microscopy is done at the University of Thessaloniki.

From IMEL, a new technology of organic materials for flexible screens was presented. This technology is based on the use of a thin polymeric film which photochemically creates areas that emit in the three basic colors. Thus, using just one material, one can have all the colors of the visible spectrum.

Photo 1: Welcoming remarks from Dr A. Nassiopoulou, Chairperson of the Organizing Committee

Photo 2: Opening remarks for Micro & Nano 2007 from the General Secretary of Research and Technology Prof. I. Tsoukalas

Photo 3: From the Conference opening

Photo 4: From the award ceremony honoring Prof. G. Kamarinos from France for his contributions to the early stages of Microelectronics Research in Greece.

Photo 5: Photograph of the Conference attendees.