WORKSHOP

PROGRAMME

September 9th morning

9:30 Horizon Europe ICOS- International Cooperation On Semiconductors, and INPACE – Indo-Pacific-European Hub for Digital Partnerships

International cooperation is key for speeding up technological innovation and to boost the resilience of the semiconductor value chains, which is one of the objectives of the EU Chips Act. This SINANO/ICOS/INPACE workshop will deal with the presentation of emerging technologies in advanced computation, advanced functionalities and ground-breaking technologies and the expected impact for international cooperation. It is supported by the European SiNANO Institute, which is the European representative of the International IEEE IRDS Roadmap, and by Horizon Europe projects ICOS, dedicated to International Cooperation on Semiconductors, and INPACE, devoted to EU-Indo-Pacific Digital Partnerships.

Francis BALESTRA, ICOS Coordinator, Grenoble INP/CNRS/ SiNANO Institute

Francis Balestra, CNRS Research Director at CROMA, is Director Emeritus of the European SINANO Institute and President of IEEE Electron Device Society France, and has been Director of several Research labs. He coordinated several European Projects (NEREID, NANOFUNCTION, NANOSIL, etc.) that have represented unprecedented collaborations in Europe in the field of Nanoelectronics, and is currently coordinator of the Horizon Europe ICOS project dedicated to International Cooperation on Semiconductors with leading semiconductor countries. He founded and organized many international Conferences, and has co-authored more than 500 publications. He is member of several European Scientific Councils, of the Advisory Committees of International Journals and of the IRDS (International Roadmap for Devices and Systems) International Roadmap Committee, as representative of Europe.

9:40 Smart Sensors for IoT

According to some estimates, there will be 24 billion interconnected devices by 2050, meaning almost every object around us will be connected to the Internet: streetlights, thermostats, electric meters, fitness trackers, water pumps, cars, elevators, even gym vests. The IoT market size is expected to reach $1.6 trillion by 2025, with a compound annual growth rate (CAGR) of 24.9% from 2020 to 20255. The

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IoT market is highly competitive and fragmented, with many large and small players operating in different segments and regions. Some of the largest IoT companies in the world by 2022 revenue include Apple Google Bosch Siemens etc all of whom are investing billions of dollars into IoT technologies. This talk will review some of the major players in Smart Sensors and Systems by technology, and region looking at the main leading Institutions in different countries and the opportunities for future international research cooperation

Alan O'RIORDAN – Senior Research Fellow at Tyndall

Alan O'Riordan received a PhD in Chemistry (Nanotechnology) in 2005. He leads a team focused on developing smart sensors and systems for Sustainable Agri-food and Environmental applications. He has led the European team's contribution on Smart Sensor Systems for the recent IEEE International roadmap on Devices and Systems – More than Moore white paper. He won the Enterprise Ireland Gold Medal for Most Innovative Technology Emerging from Third Level (National Ploughing Contest 2016/2022). He is Core steering committee member of EPoSS SSI conferences 2021 & 2022, and a H2020 Technical evaluator for ICT photonics call.

10:00 Energy harvesting for autonomous systems

Providing energetic autonomy to electronic devices will be a key factor in booming technologies like sensor networks and IoTs. This is true in particular in applications with specific requirements, where simple batteries would not be sufficient or where power cords cannot be used. Different wasted energy sources can be exploited and converted into electricity and provide energy to small electronic devices (e.g. sun or artificial light, heat, RF power, mechanical movements, etc.) but the converted energy need to be used wisely (e.g. powering sensors, etc.). Thus, power management circuits and energy storage devices are also important elements. This presentation will highlight the most promising technologies in the IRDS roadmap on Energy Harvesting and will gather an overview of the main EU and International activities in leading countries in this field.

Gustavo ARDILA, Univ. Grenoble-Alpes

Gustavo Ardila received his PhD degree in Electrical Engineering in 2008 from the Paul Sabatier University in Toulouse. After his postdoctoral in LAAS-CNRS laboratory in Toulouse, he became Associate Professor at the University Grenoble Alpes and a researcher at IMEP-LaHC in the Micro Nano Electronic Devices group, Grenoble, France. He is involved in several French and EU projects related to energy harvesting or sensing applications using piezoelectric materials. He leads the European team to develop the Roadmap of Energy Harvesting technologies contributing to the IEEE-IRDS "International Roadmap for Devices & Systems".
He is co founder and co-organizer of the International Summer School MEMS-LATAM: Microsystems for Latin America and member of the editorial board of the "Energy" section of ISTE-Wiley publisher.

10:20 Innovative materials for power devices

As outlined in the workshop announcement, international cooperation is key to accelerating technological innovation. This is also of utmost importance for research and development in the field of smart energy. In the Smart Energy part of this workshop, we will provide an overview of the main EU and international activities in leading countries in the field of semiconductors used for future technologies in this specific area. Various devices for industrial and automotive applications are already on the market. However, cost pressures and technological innovation are driving device performance to the next level. We will highlight the research needs and gaps identified to make further progress in the field of smart energy.

Markus PFEFFER, Group Manager at Fraunhofer IISB

Dr. Markus Pfeffer holds a diploma in Electrical Engineering and a PhD (Dr.-Ing.) with specialization in manufacturing optimization both from the University of Erlangen-Nuremberg. Since 2002 he has been working at Fraunhofer IISB in the Business Department Semiconductor Technology, where he is the deputy fab manager of the Fraunhofer IISB Pi-Fab (SiC Processing and Prototype Fabrication) and he is in charge of quality and process control as well as funded research. He was and is involved in several national and international cooperative R&D projects in different functions.

10:40 Scaling semiconductor photonics – The trends and the challenges

Photonic integrated circuits (PIC) combine many optical functionalities on the surface of a chip, fabricated using the same technologies as used for microelectronics. PICs have become a major enabler for optical communication, first in long-haul fiber-optic telecom systems, and more recently in datacenter links. But even with this crucial role in our current internet infrastructure, PIC technology is still in its early days, comparable to electronics in the late 1980s or early 1990s. To become really impactful, Photonic chips need to scale in multiple aspects, and the emerging trends today are paving the way for this scaling. First of all, we need to enable more complex photonic circuit architectures, and support their design, fabrication, packaging and control. The overall performance of the on-chip building blocks also needs to improve, and this often requires new materials, just like the introduction of copper interconnects, high-k dielectrics and strained silicon boosted electronics. Photonics also needs to break out of its narrow market of optical communication: new demonstrations in sensing, spectrometry, diagnostics, LiDAR and quantum processing will scale the addressable market, and thus the production volumes needed to bring down the cost. But extending to other markets also pushes demand for even more variety in materials, as different applications require the use of different optical wavelengths.

Wim BOGAERTS, Ghent University-IMEC, Photonics Research Group

Wim Bogaerts is a professor in the Photonics Research Group at Ghent University and the IMEC nanotechnology research center in Belgium. He completed his PhD in 2004, pioneering the use of industrial CMOS fabrication tools to build photonic circuits. Between 2000 and 2010, he was the driver behind the buildup of IMEC's silicon photonics technology. In parallel, he started developing design automation tools to implement complex silicon photonic circuits. In 2014, he co-founded Luceda Photonics, bringing the design tool IPKISS to the market. In 2016 he won a research grant from the European Research Council, and since then he is again full-time at Ghent University – IMEC, focusing on the challenges for large-scale photonic circuits and the new field of programmable photonics. He is an IEEE and OPTICA Fellow, and senior member of SPIE.

11:00 : Coffee break

11:30 Emerging semiconductors meet new applications: security, multi-valued computing, and hazard monitoring

Since its proposal by Dr. Dawon Kahng and Dr. Mohamed M. Atalla in 1959, the metal-oxide-semiconductor field-effect transistor (MOSFET) has played a crucial role in modern electronic devices. It has found widespread use in processors, image sensors, memories, and various other applications. However, the scaling of MOSFETs is currently encountering physical limitations, leading to challenges such as low process yields and problems arising from short-channel effects. As a result, there is an increasing demand for next-generation semiconductor devices. In this talk, we propose an approach called "Material-Device-Application Co-Consideration" for developing new applications. This approach involves bottom-up processes that leverage emerging materials. Specifically, we will focus on our recent efforts in the development of multi-valued logic (MVL) by controlling negative differential transconductance (NDT). We will also discuss the utilization of atomically-thin graphene and self-assembled monolayers in the creation of physically unclonable functions (PUFs) for information security. Furthermore, we will explore deep ultraviolet (DUV) region (280 nm – 200 nm)-based emerging applications: (i) partial discharge detection, (ii) flame sensing for fire monitoring and (iii) blood component identification. These topics will be covered in-depth during the presentation.

Hocheon YOO, Gachon University, South Korea

Hocheon Yoo is Associate Professor of Electronic Engineering at Gachon University, and Head Professor of Graduate School (Nano Science and Technology Convergence). He received a PhD in POSTECH, Pohang, Korea. His research aims to develop functional devices using emerging materials such as transition metal dichalcogenides (TMDs), organic, and oxide semiconductors. He is particularly working on: Device design, fabrication, and material and electrical characterization for thin-film electronics ; Physical analysis of emerging materials by means of synchrotron-based spectroscopy (UPS, XPS, and NEXAFS) ; Development of integrated circuits based on thin-film transistors ; Gas/photo sensors based on emerging semiconductors (e.g. gate-tunable multi-gate sensors using ambipolar transistors) ; Heterostructured electronics and its application to multi-valued logic computing ; Electronic devices mimicking synaptic and neuronal function. He published more than 100 papers and won several awards in these fields.

11:55 New nanodevices architectures for advanced compute

This presentation outlines key technological advancements in advanced compute. Beginning with an overview of current trends and challenges, we will look into the computing roadmap, analyzing new CMOS device architectures, emerging materials for FEOL and BEOL, the emergence of CMOS 2.0, next to innovations in memory technologies. We will also assess heterogeneous integration, from chiplets to functional backside, offering technical insights poised to reshape computational paradigms.

Nadine COLLAERT, Fellow at imec

Nadine Collaert is an imec fellow. She is currently responsible for the advanced RF program looking at heterogeneous integration of III-V/III-N devices with advanced CMOS to tackle the challenges of next generation mobile communication. Before that, she was program director of the LOGIC Beyond Si program focused on the research on novel CMOS devices and new material-enabled device and system approaches to increase functionality. She has been involved in the theory, design, and technology of FinFET devices, emerging memories, transducers for biomedical applications and the integration and characterization of biocompatible materials. She has a PhD in electrical engineering from KU Leuven and she holds more than 500 publications and more than 15 patents in the field of device design and process technology.

12:15 Beyond Von Neumann computing architectures and Heterogeneous integration

With the recent COVID-19 crisis, the importance of Semiconductor technologies has been evidenced, increasing significantly the interest of all the countries due to its impact on sovereignty. Each country launched its own initiative to strengthen its position in Semiconductor. Many organizations all around the world are proposing new solutions for advanced computing. Many options, including disruptive

approaches, are investigated in order to provide new solutions for competitive technologies. This talk will detail the main actors and the main solutions that are developed for the next generations of Advanced Computing technologies. Details of the main leading actors (research organizations, universities, industries) will be provided, as well as details on the main technological approaches that are developed. Strengths and weaknesses will also be detailed.

Olivier FAYNOT, CEA-LETI

Olivier Faynot received his Ph.D. degree from the Institut National Polytechnique de Grenoble in 1995. He joined CEA-LETI in 1995. Since 2019, he is managing the whole Silicon Component division at CEA-LETI. He is author and co-author of more than 300 scientific publications in journals and international conferences, and was successively in the committees of the main international Semiconductors conferences like IEDM, the symposium on VLSI Technology, the IEEE International SOI conference, the EUROSOI network, SSDM conference and the International S3S conference. He received the 'Général Férié' award in 2012 and the 'Electron d'Or' award with CEA-Leti, ST Microelectronics and SOITEC in 2017.

12:35 Emerging Material Integration for Advanced Functionality of Semiconductor Devices and Systems

In my presentation, integration technologies of emerging materials bringing advanced and diversified functionalities to semiconductor devices and systems are reviewed. As specific examples, in the field of Beyond CMOS, I will introduce case studies of nonvolatile memory incorporating functional oxides and reservoir computing using ionic liquids. In the More-than-Moore field, the advances of energy harvesting technologies are shown. In order to implement emerging materials with novel functions into society, it is essential to create a healthy development competitive environment and market environment through international standardization. I will introduce examples of international standardization in the field of nanoelectronics.

Hiroyuki AKINAGA, AIST, Japan

Hiroyuki Akinaga (Senior Member, IEEE) received the B.E., M.E., and Ph.D. degrees from the University of Tsukuba, Ibaraki, Japan, in 1987, 1989, and 1992, respectively. Currently, he is the Principal Research Manager, Device Technology Research Institute, National Institute of Advanced Industrial Science and Technology (AIST). He is co-leader of the Beyond CMOS Working Group (WG) at International Roadmap for Devices and Systems (IRDS), Japanese leader of the research field of energy harvesting at More-than-Moore WG, and a strategic committee member at WG of Environment, Health, Safety and Sustainability (ESHS). He has been serving as a convenor at International Electrotechnical Commission (IEC), TC113 (Nanotechnology for electrotechnical products and systems), WG7 (Reliability) and WG13 (Wafer-Scale System Integration). He is a fellow of Japan Society of Applied Physics. His current interests include nanoelectronics and open innovation platform