Heterogeneous Integration Session

Recent Developments in Multifunctional Integration

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Abstract
New device technologies and applications with their ever increasing performance and functionality are driving the requirements and innovation for assembly and packaging. The technology boundaries between semiconductor technology, packaging and system design are becoming blurred. As a result chip, package and system designers will have to work closer together than ever before in order to drive the performance for future microelectronic systems. In addition heterogeneous integration will be an integral aspect for all future advanced electronic applications.

Biography
Dr.-Ing. Stephan Guttowski studied electrical engineering at TU Berlin, focusing on measuring and automation technology, and then went on to do a doctorate in electromechanical compatibility. He then did a post-doc at the Massachusetts Institute of Technology (M.I.T.) in Cambridge. After returning to Germany, Guttowski first worked in the electric drive research lab at DaimlerChrysler AG and, in 2001, moved to the Fraunhofer Institute for Reliability and Microintegration IZM. Here, he was initially chairman of the Advanced System Development group before taking over the System Design & Integration department. Since June 2017, Guttowski has been technology park manager in the FMD and, within this role, works towards cross-institute cooperation.

Versatile Silicon Photonic Platform for Datacom and Computercom Applications

B. Szelag
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Abstract

The explosive growth of information exchange requires scalable, high-yield and cost-effective integration of microsystems. Silicon photonics is becoming a technology of choice for optical communications.
Compatibility with cmos manufacturing process is one key of success since it allows taking advantage of the production capacities of foundries; i.e. big volume and low cost manufacturability [1-2]. Integration of high performances devices is the key of success for these platforms.
Today, many silicon platforms are available in foundry with similar device offer aiming to address at least 25 Gb/s applications. CEA-Leti has developed such base line silicon photonic technology with demonstrated results for 50 Gb/s data rate. New technological challenges are explored to improve the capacities of this platform by developing new integration schemes such as multilevel silicon, integration of a silicon nitride level on top of the silicon or heterogeneous materials and specific edge coupling processing.
We are presenting here results on 3 add-on developed on our silicon photonic platform:

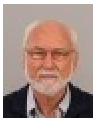
• silicon nitride and hybrid silicon nitride on silicon device
• Hybrid III-V on silicon laser
• 3D packaging

Biography

Dr Bertrand SZELAG received the Master degree in Physics from the University of Lille in 1994 and the PhD degree in Microelectronics from the University of Grenoble in 1999. He has been a visiting researcher in Tohoku University in 1997 working in the field of sub-100nm CMOS transistor properties. In 1999 he joint STMicroelectronics in Crolles, France to work on BiCMOS platfrom development for Analog/RF applications. Since 2013, he has been with the LETI, MINATEC Institute, Grenoble, France as a Project Manager and senior process integration researcher in the field of silicon photonic devices. His current research activities included high speed silicon modulator, germanium photodetectors and hybrid III-V laser integration in silicon.

He is the author or co-author of more than 50 papers in scientific journals and international conference proceedings in the field of CMOS, Bipolar and DMOS transistors and silicon photonic devices.

Towards Smart Integrated Photonic Building Blocks



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Technische Universiteit Eindhoven University of Technology
Where innovation starts

Abstract
Indium Phosphide is today's major technology platform for fabrication of Photonic ICs (PICs). InP foundries processes provide all the building blocks required in modern telecommunication and datacommunication systems, including lasers, modulators, detectors, and a variety of passive components. While telecommunication is the dominant market, InP PICs are increasingly finding application in many kinds of sensor systems, medical diagnostics, metrology and automotive. R&D efforts are directed towards improvement of building block performance and building block descriptions, in order to support accurate PIC design.
An important next step is integration and co-design of photonic and electronic functionality, e.g. lasers and modulators with their electronic driver circuits, and providing integrated photonic-electronic modules as building blocks in the library. This will release designers from the need to design complex drivers which match the specifications of the photonic circuits and enable them to use the components as smart black boxes. Integration of monitor diodes will extend the capabilities of the smart modules by integrating feed-back circuitry.
In the presentation progress in photonic-electronic integration will be described and its potential for Smart Integrated Photonic Building Blocks will be discussed.

Biography
Meint K. Smit started research in photonic integration in 1981. He invented the Arrayed Waveguide Grating and he was closely involved in the introduction of MMI-couplers, both key components in Photonic ICs. In 2000 he became the leader of the Photonic Integration group at the COBRA Research Institute of TU Eindhoven. His current research interests are in InP-based Photonic Integration and integration of InP circuitry on Silicon. He is the founder of the JePPIX platform, the Joint European Platform for Photonic Integration of Components and Circuits and strongly involved in the development of the InP-based photonic foundry system in Europe. Meint Smit is an IEEE Fellow. In 2012 he received an ERC Advanced Grant and in 2016 the Rank Prize for Optoelectronics.

Energy efficient smart electronic systems: the role of heterogeneous integration to enable artificial intelligence at the edge

A. Ionescu
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ÉCOLE POLYTECHNIQUE FÉDÉRALE DE LAUSANNE

Abstract
We will present and discuss some of the great research challenges and application opportunities related to energy efficient computing and sensing devices and systems, in the context of the Internet of Things (IoT) and having heterogeneous integration as an a technology enabler.
3D heterogeneously integrated chips combining CMOS logic, memory, sensors, ADC and analog/RF circuits and 3D integrated energy harvesters, are currrently explored to build full IoT sensor nodes with fog and edge computation capability, supporting future Artificial Intelligence applications.

Biography
Adrian M. Ionescu is a Full Professor at Ecole Polytechnique Fédérale de Lausanne (EPFL), Switzerland. He is director of Nanoelectronic Devices Laboratory of EPFL, and he served as Director of Doctoral Program in Microsystems and Microelectronics of EPFL. His group pioneered steep slope devices and MEMS resonators with emphasis on low power nanoelectronics. Prof. Ionescu published more than 500 articles. He is recipient of IBM Faculty Award 2013 and of André Blondel Medal 2009, France. Since 2015 he is member of Swiss Academy of Technical Sciences. He is an IEEE Fellow and served for 6 years as Editor of IEEE TED and as member of PUB committee of IEEE –EDS. He is leading the ERC Advanced Grant Millitech dealing with development of energy efficient electronic and sensing functionsat 100 milliVolts. He is a co-coordinator of Health EU FET FLagship initiative for personalized, preventive and participatory healthcare.

Challenges of mounting magnetic materials in electronics

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Abstract

Automotive electronics will show an annual 2-digit growth until 2025. One driver of this development is the increasing number of sensors and actuators in vehicles. This is not only due to additional functions of driver assistance systems, but also due to the demand for lower-emission and more efficient drive systems.
New sensor functionalities also require new or diversified sensor designs with partly new components and materials. Here, magnetic materials also play an important role.
The results are heterogeneous systems, which require new manufacturing technologies. The classic back-end sensor packaging is facing new challenges.
The processing of magnetic materials creates several problems. These are among other things the clean feeding of magnets and a damage-free handling. Adhesive technologies must be adapted to different materials, including a desired short curing time. Despite the processing of roughly tolerated magnetic materials, a high accuracy in the placement must be achieved. Furthermore, the automation concept should enable a high production rate with short cycle times and continuous data tracking during the packaging process.
XENON has many years of experience in the development of product-specific equipment, especially for sensor and actuator mass production.
In the context of an EU-funded project "IoSense", preliminary studies were carried out for special technologies to produce magnetic sensors, how process safety can be realized together with high quality requirements. Some results will be presented.

Biography

Dr.rer.nat. Jens Müller
Studied Physics (including doctorate on CIGS thin film solar cells) in Germany and worked thereafter as postdoc in the field of X-Ray diffraction at NIST, Boulder USA. Work in the industrial sector included semiconductor reliability and reliability of thin film solar cells.
Actual position at XENON Automatisierungstechnik GmbH includes work as project coordinator for the funding acquisition and supervision of R&D projects.