Power Electronics Conference

O. Pyper
Senior Manager Innovation Projects
Infineon Technologies Dresden GmbH, IFD, Dresden, Germany

Biography
Dr. Oliver Pyper holds a Diploma in chemistry and a PhD in natural science. After his studies at the Technical University of Berlin, he joined Infineon Technologies Dresden in 2000. Until 2005 he was responsible for a module of the DRAM-technology and managing several projects for optimising current technologies and fast ramp of new technologies. In 2005 he changed to production, managing several projects to improve the manufacturing landscape. Since 2007 he is also responsible for managing innovation projects within R&D- and pilotline-projects.

Silicon based devices for demanding high power applications

A. Kopta
Head of BiMOS R&D
ABB Switzerland Ltd, Semiconductors, R&D, Lenzburg, Switzerland

Abstract
This presentation gives an overview of future requirements and recent progress of silicon based semiconductor devices and packaging technologies for very high power applications. The first part provides an outline of future trends in the areas of power transmission and power consumption and the resulting requirements on device design and performance. The second part elaborates on the recent advances of power devices and the corresponding packaging technologies used in these high power applications.

Biography
Arnost Kopta is currently heading the BiMOS R&D Department at ABB Semiconductors in Lenzburg, Switzerland. In this position, he is responsible for development of high voltage IGBT and diode chips as well as the power modules where these chips are packaged. Arnost Kopta studied engineering physics at the University of Lund in Sweden and acquired a PhD dealing with IGBT short circuit ruggedness from the University of Bremen in Germany.

L. Di Cioccio
scientific director
CEA, LETI - Minatec, semiconductor components, Grenoble, France

Biography

Lea Di Cioccio received the degree in physics engineering from the Institut National des Sciences Appliquées, Rennes, France, the M. S. degree in metallurgy and material science from Paris VI university, Paris France, in 1985, and the Ph. D. degree in material and semiconductor physics from the Institut National Polytechnique de Grenoble, France in 1988.

In 1990, She joined the Commissariat à l'Energie Atomique /Laboratoire d'Electronique et de Technologie de l'Instrumentation , Grenoble where was first engaged in characterization such as Transmission and Electron Microscopy. She is currently a specialist in semiconductor heterostructures , 3D integration using various processes such as epitaxy , wafer bonding and thinning and power deivices SiC and GaN . She is author and co author of more than 180 publications and 30 patents.

200 mm G-FET GaN On Silicon power switch technology : a robust path to manufacturing

F. Letertre
COO
EXAGAN, GRENOBLE, France

Abstract
GaN on Silicon power devices are recognized as a key technology to sustain future power systems integration roadmaps in the field of IT electronics, renewable solar and emission free automotive applications. Despite significant efforts to develop cost effective, high performing and reliable devices, GaN on silicon devices still need R&D efforts to fulfill application requirements.
Besides these remaining technical challenges, such new emerging disruptive technology (compared to established silicon power devices) need to prove its economic model to bring end users new levels of performance at an affordable price, out of a robust supply chain as close as possible to silicon proven one.
Exagan as a new startup company is pushing the limits of its proprietary 200 mm GaN on Silicon G-FETTM technology to propose the advantage of its unique expertise in GaN on silicon material fabrication while leveraging on its attractive fab lite business model to meet future market performance, reliability and cost targets.
This paper will present the latest developments achieved.

Biography
Fabrice Letertre received engineering degree from INPG- ENSPG with specialization in semiconductor materials, technology and devices, Grenoble, France in 1995. He joined CEA-LETI in 1995 in the Silicon On Insulator (SOI) material department and Soitec in 1998 where he held various R&D management and project leader positions. From 2009 to 2003, he was responsible, as Soitec group VP R&D, of managing Soitec's strategic projects portfolio including GaN, III-V and advanced SOI activities. In 2014, he co-founded Exagan with the aim to develop a leading European source of GaN power switches based on Exagan proprietary 200 mm GaN on Silicon technology, for power conversion applications. He holds more than 60 patents and has co-authored more than 40 technical papers.

GaN-Si MOCVD advancements: Accelerating WBG materials adoption in new Power Electronics applications

S. Joshi
Sr. Director of Marketing
Veeco Instruments, Somerset, United States

Abstract
Emerging mid and high voltage applications in Automotive, Alternate Energy and Data centers are requiring improved power efficiency, higher operating temperatures and system size reduction. GaN delivers on these parameters over Si. With advancements in MOCVD of GaN on Si substrates, an economically viable alternative to Si has emerged. To meet the system level yield, reliability and cost targets , the industry requires MOCVD process to deliver superior film uniformity, run to run control, dopant control (Mg and C), low defectivity and high uptime. In response to these requirements, Veeco has developed the next generation MOCVD system that has demonstrated industry leading performance at multiple sites. In this paper we will discuss these results as relevant to system performance.

Biography
Somit Joshi is Senior Marketing Director in Veeco Instruments, where he is responsible for development of new applications and markets for MOCVD products. Prior to Veeco, he led new product development in KLA-Tencor for Wafer Inspection applications in advanced CMOS technologies. Somit also spent several years in Silicon technology development in Texas Instruments working on cutting edge Interconnect development. He holds MBA degree from SMU, Dallas and MS from UCF, Orlando. He is also author of several patents and publications

GaN Transistors for Power Electronics

A. Wachowiak
Senior Scientist
NaMLab gGmbH, Dresden, Germany

Abstract
Power semiconductor transistors are at the core of power electronics systems and, therefore, determine their potential efficiency by the device related performance. Next to SiC-devices, GaN based transistors are becoming a more serious competitor for the presently dominating Silicon power devices. The superior intrinsic material parameters of GaN (wide band gap, high breakdown field strength,...) compared to Silicon in combination with the ability to use heterojunction interfaces as transistor channels of very high mobility predict an out-performance of current Si-technologies and an extended operation regime at higher temperatures. However, GaN related technology hurdles have to be overcome in order to meet the requirements for a mature product. Main challenges start at the growth of high-quality substrate material, over specific characteristics of GaN devices up to final reliability in harsh environment. Solutions of some issues and different approaches to tackle the remaining tasks will be described and discussed. The activities of NaMLab within this context of technology development are presented.

Biography
Andre Wachowiak received his diploma degree in physics in 1998 from the University of Heidelberg, Heidelberg, Germany in and the P.h.D. degree in 2003 from University of Hamburg, Hamburg, Germany. After being a post-doctoral research fellow at the physics department of UC Berkley and Lawrence Berkeley National Laboratory, Berkeley, CA, USA for two years, he joined the DRAM division of Infineon Technologies Dresden (later Qimonda), Germany, in 2006. As device engineer, he was responsible for pre-development of CMOS periphery devices in up-coming technology nodes of DRAM chips until 2009. He has been a Senior Scientist with NaMLab gGmbH, Dresden, since 2010, where he is responsible for concept evaluation and device development in different areas of Silicon to GaN technology.

Efficient Energy Conversion using Power Electronics

M. Schulz
Principal, Application Engineering
Infineon Technologies, Warstein, Germany

Abstract
Growing energy consumption is a challenge for all nations around the world and there are two options to cope with this challenge.
Increasing the amount of available energy by setting up more power plants is the most obvious one. Though typically plants using fossil fuel or nuclear power have the higher power output, plants based on renewable energies have to be favored to reduce the impact to the environment. Power electronic systems to convert the energy harvested into grid-compatible form have to be used, directly influencing the plant's efficiency.
Complementary, an increase of efficiency in energy conversion, transmission & distribution and consumption can contribute a similar share.
On its way from generation to consumption, energy passes semiconductors for a multitude of times making this technology a true gateway to efficiency improvements.
The presentation will give an insight on what efficiency improvements mean in terms of saving energy and reducing greenhouse gases on a national and global scale along with the current developments in power electronic device technology.

Biography
Martin Schulz
is with Infineon Technologies since 2005.
In 2011 he joined the application engineering group.
His responsibilities are in the area of industrial battery chargers and electrified commercial and agricultural vehicles (CAV).
Furthermore, thermal management is his field of expertise.
Martin Schulz holds a Dr.-degree in electrical engineering, gained at the University of Siegen at the Department of Power Electronics and Electrical Drives.
He is a Senior IEEE-Member.

Challenges in failure analysis of power and automotive microelectronics

G. Dallmann
Division Manager Microelectronics
SGS INSTITUT FRESENIUS GmbH, 01109 Dresden, Germany

Abstract
Semiconductor devices are rapidly entering new markets and applications. Power transistors are used in motor control applications like steering gears or in inverters for PV or wind power applications. To reduce volume and cost the transistors are combined with microcontrollers and new package types, requiring new technologies and material combinations and leading to additional failure and degradation mechanisms. On the other hand the automotive industry requires a zero failure policy and forces suppliers to understand every field failure in short time. The classical semiconductor device qualification procedure is very limited in statistics and is not capable to demonstrate and assure a zero failure level. Additional information has to be considered to understand reliability mechanisms and to improve quality. The talk shows some typical failure mechanisms found in a lab acting as a service provider for many different companies. Some weak spots are discussed with recommendations for improvements.

Biography
Division Manager at SGS Institut Fresenius GmbH in Dresden, Germany, since 2009.
Main focus on material and failure analysis of semiconductor devices of client companies.
1995 Director for technology development at Siemens, Infineon, Qimonda, responsible for process integration, yield enhancement and material and technology development of DRAMs.
1990 Product manager microelectronics at Institut Fresenius in Dresden. Main Focus on failure analysis of semiconductor devices.
1986 Department manager electron microscopy at Zentrum Mikroelektronik Dresden (ZMD).
1986 Diploma in Microelectronics Technology and Semiconductor Devices.

History and trend of Power electronics in automotive body systems

R. Letor
Technical marketing manager
STMicroelectronics, APG, Catania, Italy

Abstract
Year by year enhancement of passenger car comfort and safety that started in the 90's, requires a consequential constant increasing of installed electric power in the car.
Challenged by the weight of compulsory massive wire harness that is in contrast with CO2 reduction, the architecture of car electric distribution evolved with the introduction of solid state power actuators and with the multiplexing of commands/diagnostics. Also improved efficiency for minimizing the current rating of the alternator is made possible by the way of new technologies. From the many car body systems we can mention as examples:
*** Smart Junction Box using solid state relay in M0 vertical integrated power technology allowing wire harness optimization and ECU space/weight reduction.
*** Migration to solid state solution with power LED and dedicated drivers allow reducing drastically the current rating of the lighting systems.
*** System on Chip using technologies with high gate and high power densities allow implementation of small and cheap drivers for light and efficient brushless motor that substitute traditional brushed DC motors.
*** Audio amplifiers evolving with high efficiency power stage in class D.

This trend is stimulating from one side the system specification and on the other side the power technologies to be used. The presentation will show this evolution and the new challenges for the car body power devices.

Biography
Received Electrical engineer Degree from University of Naples (Italy) in 1985 and hired by STMicroelectronics in 1985. Its Main experiences are in Power electronics, Power management and automotive electronics. He has several patents and he wrote many papers for most important worldwide conferences. He is advisory board member in PCIM and ESRF. Actual Focus is on the definition of new Power and Integrated Smart Power devices dedicated to automotive emerging systems.

Human-centric lighting - requirements and opportunities for today's micro-(power) electronics!?

P. Ritter
Funktionsoberarzt
Universitätsklinikum Carl Gustav Carus, Dresden, Germany

Abstract
In the future, light sources with adjustable spectrum will be available at the cost of today's standard compact fluorescent lamps. You will be able to set your lamp at a spectrum for being awake and productive or going to sleep.
With the possibility of adjusting your home light to your needs, the question of what is best for the human biological rhythm arises.
In the talk we will gave a short overview of what is state of the art knowlege about human centric lighting and what we try to figure out in our projects. In the second part we look at todays lighting devices power- and control electronics and give a sort of wishlist for a good lighting design.

Autoren:
Ritter, Philipp; Wieland, Falk

Biography
Ritter, Philipp

2001-2003 Assistenzarzt in der Gastroenterologie, Chirurgie und Notfallmedizin Exeter, Bath (beide England) & Adelaide (Australien)

2003-2005 Assistenzarzt in der Neurologie Hamburg

2005-2008 Assistenzarzt in der Allgemeinen- und Forensischen-Psychiatrie Hamburg

Seit 2008 Assistenzarzt und wiss. Mitarbeiter
Klinik und Poliklinik für Psychiatrie und Psychotherapie,
Universitätsklinikum Carl Gustav Carus an der TU Dresden, Dresden

2012 Facharzt für Psychiatrie und Psychotherapie

2012 Promotion zum Thema: Schlafcharakteristika von Patienten mit einer Bipolaren Störung
und Personen mit einem erhöhten Erkrankungsrisiko im Vergleich zu gesunden Kontrollpersonen

Seit 2015 Funktionsoberarzt

Wieland, Falk

2010 Abschluss als Dipl.-Ing. Elektrotechnik an der TU Dresden

seit 2010 Wissenschaftlicher Mitarbeiter der TU Dresden

Solar Storage: New approaches for Bidirectional Chargers

P. Haaf
Senior Field Application Engineer
Fairchild Semiconductor, Stuttgart, Germany

Abstract
For multiple reasons storage systems become more important: grid stability, storage units for UPS and Solar Island grids, and for increased self consumption of residential solar plants.

In this work, the most common isolated and non isolated topologies for storage systems are summarized. A clear trend to 48V batteries for the residential applications is identified.

A special focus of this paper is the optimization of the secondary side by reducing all parasitics significantly with the introduction of a new packaging technology.

Biography
Peter Haaf is a Field Application engineer at Fairchild Semiconductor. He studied electrical engineering at the technical University in Karlsruhe, Germany. Prior to Fairchild, Peter worked for 8 years in the R&D department at Vossloh-Schwabe GmbH developing standard and dimmable electronic ballasts for fluorescent lamps. Peter has been with Fairchild Semiconductor for 14 years as an expert for the industrial segment focusing on lighting and high power systems like UPS, Welding, Inductive heating and Solar Inverters.

T. Neyer
VP R&D
Fairchild Semiconductor, HV Device Development, Muenchen, Germany

Biography

Dr. Thomas Neyer has received his PhD from University of Technology in Vienna and Cambridge University in 1995. He joined Siemens HL to work on mixed signal Product design and Test. Over the years Dr. Neyer worked on HV and BCD Technologies at Siemens and Infineon Technologies and in 2003 he was entrusted to setup Technology Centers of Competence in Malaysia and China. During the PowerFab start and ramp-up in Kulim, Malaysia in 2005, Dr Neyer was building and leading the Fab engineering and manufacturing teams. Subsequently he was appointed as EVP for R&D and Fab Operation of Grace Semiconductors in Shanghai, China - an advanced Foundry for differentiated, analog Technologies.
In 2011, Fairchild Semiconductor founded a R&D center for High Voltage Technologies in Munich and assigned Dr Neyer to spearhead the effort and coordinate all related Silicon and SiC HV development activities covering device design, modeling and High Power package development.

The best ways to use the new GaN devices and technical challenges to solve

P. Perichon
Power electronic expert
CEA, Grenoble, France

Abstract
Power converters are essential for the management of energy especially in embedded applications. We are constantly looking to improve performances: better efficiency, lower size and lower mass, lower cost.
New large gaps components, including GaN, promise exceptional performance. But what are the best ways to use them and what are the technical obstacles to be overcome: at the component level, but also the system level. Some examples of potential uses will be shown including transport: aerospace and automotive.

Biography
After an engineering degree in electronics and computer engineering from Central Lille, he has worked for 17 years in Schneider Electric France on electronic breakers and power converters for low-voltage grid. Since 2005, he belongs to the CEA organization and has worked for 5 years on photovoltaic systems (protection, power inverter, system), then on electric car and now on power electronic using GaN devices. He is an expert in power electronics, electrical system and protections systems for DC and AC network (arc detector, breakers, ground fault protection). He holds more than 40 patents.

Mechatronic Powerstage design of the COSIVU Drivetrain with parallelized SiC BJT Half-Bridge Modules and Drivers

F. Hilpert
Scientific Engineer
Fraunhofer Institute for Integrated Systems and Device Technology IISB, Erlangen, Germany

Abstract
The project 'COSIVU' aims at new system architectures for electric drive-trains by developing a smart, compact, modular and durable in-wheel drive unit with full SiC power electronics and a novel control, sensing and health monitoring system.
The main goals for the mechatronic integration concept of the COSIVU Inverter are to provide easy servicing of the complete Powerstage and a good manufacturability and flexibility due to the modular approach. This helps increasing the availability of hybrid/electric vehicles, which are even more demanding for commercial vehicles than for other types of vehicles. To show the flexibility of the system, the new architecture will also be adapted to other vehicle platforms such as passenger cars.
Main component of the modular integration approach is a newly designed Inverter Building Block (IBB). The IBB is a mechanically self-supporting structure with all necessary components to drive one Half Bridge of the Inverter. It consists of a Cooling Plate, three parallel Half-Bridge 1200V SiC BJT Power Modules each with its own Base Driver Module, an AC-Current-Sensor and a DC-link-Capacitor. This approach offers a low parasitic inductance design which supports a reduction of switching losses and allows higher switching frequencies of the SiC devices. The Base drivers can be extended with a thermal impedance board for health diagnostics on the power modules.
The current driven silicon carbide bipolar transistors exhibit the lowest on-state losses in comparison to IGBTs or SiC-MOSFETs. Extra driving losses due to a necessary dc-on-state base current are around 3% of the rated current. The drive unit features fast and parallel signaling, desaturation protection, high power flow-rate with compact design and an attachable PCB for monitoring the power semiconductors.
The COSIVU project brings SiC BJTs into real application and includes innovative diagnostic features that can be used and extended to any kind of electrical drive application.

Biography
2006-2011
University of Erlangen-Nuremberg, studies of Mechatronic with focus on Power electronics and Electric Drivetrains
2012
1st price winner "Drive-E Studienpreis 2012"
2012-today
Scientific Engineer at Fraunhofer Institute for Integrated Systems and Device Technology IISB, Group Drives and Mechatronics

Presentation-Related:
COSIVU Workpackage Leader System Integration

Modern robustness challenges in wind-scale power modules

F. Iannuzzo
Professor
Aalborg University, Energy Technology, Aalborg, Denmark

Abstract
Reliability challenges in power electronics for modern wind power generation system are pointed out, together with state-of-the-art testing and modelling techniques adopted for robustness assessment of IGBT and SiC power modules under abnormal conditions.

Biography
Francesco Iannuzzo earned his M.Sc. (laurea) degree cum laude in 1997 and his Ph.D. degree in Electronics and Information Engineering from the University of Naples, Italy, in 2001, with a study on the reliability of power MOSFETs during diode operations. He is primarily specialized in the field of power device modelling. He has been Researcher since 2000 with University of Cassino, Italy, where he became Aggregate professor in 2006 and he is currently Associate professor since 2012.
In 2014 he got a contract as professor in Reliable Power Electronics at the Aalborg University, Denmark, where he is also part of CORPE (Center Of Reliable Power Electronics, http://www.corpe.et.aau.dk). He is author or co-author of more than 90 publications on journals and international conferences. His research interests are in the field of reliability of power devices, including against cosmic rays, power device failure modelling and testing of power modules up to MW-scale under extreme conditions, like overvoltage, overcurrent and overtemperature.
Dr. Iannuzzo was the Technical Programme Committee co-Chair in two editions of ESREF, the European Symposium on REliability and Failure analysis. He is a senior member of the IEEE (Reliability Society, Industrial Electronic Society and recently Industrial Application Society) and a member of ECPE (European Center for Power Electronics) and AEIT (Italian Electric, Electronic and Telecommunication Association). He permanently serves as expert and peer reviewer for several conferences and journals in the field, like: APEC, ECCE, ESREF, IECON, Microelectronics Reliability, IEEE Transactions on Industrial Electronics, Transactions on Industrial Informatics and Transactions on Power Electronics.

Bipolar SiC diodes for high-power medium-voltage drives

F. Filsecker
Research assistant
Technische Universität Dresden, Chair of Power Electronics, Dresden, Germany

Abstract
A 6.5-kV, 1-kA SiC bipolar diode module for megawatt-range medium voltage converters is presented. This comprises a short description of the die and module technology and a device characterization. The results are compared to a commercial diode module. With the electro-thermal models of the devices, an estimation of the maximum converter output power, maximum switching frequency, losses and efficiency in a 4.16-kV three-level neutral-point-clamped converter operating with SiC and Si diodes is presented.

Biography
Felipe Filsecker was born in Viña del Mar, Chile. He received the Electrical Engineering degree from the Pontificia Universidad Católica de Valparaíso, Chile, in 2009. He is currently working as a research assistant at the Chair of Power Electronics at Technische Universität Dresden, Germany, and finishing his doctoral studies. He has worked mainly in the field of device characterization for high-power, medium-voltage applications. Currently, he is working on reliability and life-time monitoring of IGBTs.

Medium Voltage SiC Transistor Development at Cree in 2015

J. Casady
Business Development & Program Manager
Cree, Inc., Durham, United States

Abstract
From 2.5kV to 15kV, SiC has long been known since the 1950's, if not earlier, to have inherent advantages for simpler, more efficient, more compact, and more reliabile solid-state power electronics. Today, after nearly five years of SiC MOSFETs in the commercial market at voltages up to 1700V, the time is now rapidly approaching to discuss the development status of medium voltage SiC power transistors.

In this presentation, development status of SiC MOSFETs from 2.5 to 15kV will be presented, including on-state and switching performance, reliability data to date, and expected relationship of this class of SiC MOSFETs with the commercially available lower voltage SiC MOSFETs.

Additionally, a brief summary of SiC bipolar development will be offered, in particular GTO and IGBT type power transistors.

Biography
Dr. Casady is a Business Development and Program Manager for Cree, Inc. Power & RF. Dr. Casady has worked in SiC power devices and electronics since 1994. He received his PhD in Electrical Engineering in 1996, and has served a variety of roles in industry (Northrop Grumman, SemiSouth, and Cree), and academia (Auburn University, Mississippi State University). Prior roles included CEO, CTO, VP Business Development, and Senior Engineer. He has served with Cree since 2012, and has cumulatively over 80 technical publications, and three book chapters. He also co-authored numerous business articles, technical articles, book chapters, and patents.

H. Gueldner
Professor
TU Dresden, ETI-Leistungselektronik, Dresden, Germany

Biography

Henry Güldner received the Dipl.-Ing., Dr.-Ing., and Dr.-Ing.habil. degrees in electrical engineering from Technische Universität Dresden (TU Dresden), Germany, in 1967, 1971, and 1979, respectively.

He was a Research Assistant (1967-1971) and an Assistant Professor (1971-1976) at TU Dresden. From 1976 to 1982 he worked in the Institut für Mikroelektronik, Dresden, Germany. From 1982 to 1989 he was an Associate Professor of Electrical Engineering at TU Dresden. He was a Full Professor of Power Electronics at the Hochschule für Verkehrswesen, Dresden, Germany from 1989 to 1993. From 1993 to 2007 he was University Professor of Power Electronics at TU Dresden. He is currently with the chair of Power Electronics at TU Dresden as Professor Emeritus. His main research interests are in power electronics, modeling of power-electronic devices and systems, ac drives, and electronic ballast.

Prof. Güldner is member of Verein Deutscher Ingenieure (VDI), Germany, EPE and IEEE.

Silicon for Power Electronic and Detector application

L. Jensen
Senior Silicon Specialist
Topsil Semiconductor Materials A/S, Frederikssund, Denmark

Abstract
High quality silicon substrates are used for many types of discrete devices. The Topsil Group is a leading manufacturer of high performance silicon wafers for the power market and for niche applications in the semiconductor and the photo voltaic industries.
Utilizing proprietary Float Zone and CZ Epi technology to manufacture customized wafers for the most demanding applications, the high quality wafers are manufactured under strict quality standards.
Market segments like energy saving devices IGBTs, lightening devices like LEDs, infra-red detectors and wireless communication require a special set of optimized silicon parameters. Even scientific instruments require high quality silicon for detectors to meet today's requirements for high sensitivity when measuring high energy particles and radiation.
New application areas require a higher level of quality and improved material parameters for Gallium Nitride, GaN film growth for improved LEDs and power devices.
The Topsil Group covers a wide range of products by offering Neutron Transmutation Doped, NTD silicon for very high power devices. Preferred Float Zone, PFZ for Power applications. High Resistivity Silicon, HPS for Detector applications, High Resistivity silicon, HiRes® for communication devices. High Transparency silicon, HiTran® for Infra-Red applications. Photo Voltaic Float Zone, PV-FZ® for high efficiency solar cells. CZ Epi Medium and low power devices.

Biography
Leif Jensen, MMT eMBA, Senior Silicon Scientist at Topsil Semiconductor Materials A/S, Denmark.

More than 25 years of experience in developing silicon wafer products for the semiconductor industry, and background in electronic engineering.

Current position is to find emerging new technologies and create new business.

ECSEL-project PowerBase

H. Pairitsch
Senior Manager Technology & Innovation
Infineon Technologies Austria AG, IFAT PMM RDF, Villach, Austria

Abstract
PowerBase stands for "Enhanced substrates and GaN pilot lines enabling compact power applications". After years of research and first products on the market GaN on silicon devices still need R&D efforts to address application requirements in a broader range. Especially when high power density is a value, the performance of GaN-devices will generate a steadily growing market. Nevertheless the price performance ratio will determine the growth rate of this market. Therefore the ECSEL Pilot line project PowerBase targets to lay the foundation for a stable and achievable high volume production of GaN-devices.
The bullet-points below give an impression on the holistic approach along the entire value chain ranging from base-materials to high performance applications.
* GaN on carrier (Si and other advanced materials) technologies will provide major enhancements and cost competitiveness for novel power semiconductors focused on e-mode (= normally off) devices
* Expanding the limits of silicon based power technologies in leading 300mm wafer diameter will improve the current limitations in on-resistance of Trench-Power-MOSFET and IGBT devices and extend the capabilities of already installed 300mm pilot lines
* Pushing GaN power device technology and its superior performance towards the absolute GaN limit compared to current approaches taken
* Setup pilot production line for fully processed GaN on carrier power semiconductors in leading 200mm wafer diameter coexisting and compatible with high volume CMOS power manufacturing facilities
* Setup pilot production line for chip embedding (packaging) for advanced GaN based power products
* Prove target achievements in key demonstrators applications in the "smart energy" domain addressing compact power advancements together with leading European systems suppliers
* Reliability and quality as key enabler to gain market acceptance for these new technologies.

Biography
DI Herbert Pairitsch holds a degree in electrical engineering from the Graz University of Technology, from where he graduated in the year 1985. In 1986 he started his career at Infineon Technologies Austria AG (former Siemens HL) and held leading positions at various manufacturing and development departments. Since 2014 he serves as divisional Head of R&D Funding PMM (Power Management & Multimarket). His responsibilities include the coordination of national and international research projects in the context of energy efficient electronics like PowerBase (ECSEL Pilot line project).

Reliability of SiC Power Devices

P. Brosselard
CEO
CALYTechnologies, Villeurbanne, France

Abstract
Silicon Carbide is a very attractive Semiconductor for Power Electronics. Today, diodes and transistors in the range of 1200V-1700V are commercially available. Among them, SiC MOSFETs are very interesting as they are normally off devices and requires small modification of their driving circuit. However, this type of device can presents some problems regarding the reliability aspects. Today, applying the standard HTGB test like, the electrical characteristics of the SiC MOSFET changes. As an example, the driving voltage VGS must be adjust to avoid any drift of the threshold voltage VTH, possibly resulting in short-circuits in a standard power inverter. Furthermore, devices characteristics can be strongly affected while operating in hard conditions (inductive clamping switching, overloads, reverse conduction trough the body diode, short circuits ...).
More over, the SiC MOSFET is also very attractive to increase the frequency of the different converters. For that, the implementation of SiC device in applications must be optimized.

CALYTechnologies is a spin-off from AMPERE Laboratory in Lyon, France, offering services on reliability stress and analysis. CALYTechnologies is a key partner for custom development of new generations power converters implementing SiC transistors.

In a first part of this presentation, we will present you the state of the art of SiC-MOSFET technology, the performances of those devices, and finally some problems that anyone could face and solutions to avoid or bypass them.
In a second part, we will presents latest results obtained on SiC MOSFET, focusing on stress analysis performed on commercial devices.
We will conclude this review with lifetime estimation of such device depending on their application and operating condition.

Biography
P. Brosselard today is CEO co-founder of CALYTechnologies. Pierre has presented his PhD on "5kV SiC JFET and thyristor" at the end of 2004 in Ampere Lab. After, he joined the Power electronic Group at CNM in Barcelone up to 2008 when he came back to AMPERE Lab. as Assistant Professor. During the 13 years, he has worked on high voltage SiC devices (diodes, JFET, MOSFET, Bipolar Junction Transistor and thyristors). Since october 2014, he has co-founded CALYTechnologies. CALYTechnologies is an innovative Wide Band Gap (WBG) specialist company, dedicated to support customers in their development of WBG power electronics activities.
CALYTechnologies, founded in 2014, is a spin-off from Ampere-Lab at INSA de Lyon, France.

Market and technology trends in Wide Band Gap materials for Power Electronics

P. Gueguen
Business Unit Manager
Yole Développement, Lyon, France

Abstract
With global drivers such as better energy consumption, energy efficiency and reduction of greenhouse gases, CO2 emission reduction has become key in every layer of the value chain. Power Electronics has definitely a role to play in these thrilling challenges as power conversion requires lighter/smaller, cheaper and more efficient systems. This evolution starts with improvements at the semiconductor level, and there are four technologies which are best suited to handle new system requirements: silicon IGBT, Super Junction (SJ) MOSFETs, Gallium Nitride (GaN) and Silicon Carbide (SiC)-based devices.
Speaking about compound semiconductor that can tomorrow enter the power electronics market, there are some challengers like Aluminium Nitride (AlN), Gallium oxide (Ga2O3) and Diamond. Even if today maturity and cost for these materials induce natural limitation to their adoption, in term of capabilities, intrinsic properties, performances, we can assume more and more interest will be given to their development. In this presentation, we will highlight the status of their development to show how these wide bandgap could impact tomorrow power electronics industry.

Biography
Dr Pierric GUEGUEN is Business Unit Manager for Power Electronics and Compound Semiconductor activities at Yole Développement. He has a PhD in Micro and Nano Electronics and an master degree in Micro and Nanotechnologies for Integrated Circuits. He worked as PhD student at CEA-Leti in the field of 3D Integration for Integrated Circuits and Advanced Packaging. He then joined Renault SAS, and worked for 4 years as technical project manager in R&D division. During this time, he oversaw power electronic converters and integration of Wide Band Gap devices in Electric Vehicles. He is author and co-author of more than 20 technical papers and 15 patents.