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Final publishable summary report

Grant Agreement number: 604057

Project acronym: SPEED

Project title: Silicon Carbide Power Technology for Energy Efficient Devices

Funding Scheme: Large Project

Date of latest version of Annex I against which the assessment will be made: Ref. Ares(2013)3341068 – 25/10/2013

Periodic report: **Final publishable summary report**

Period covered: **from** 01 January 2014 **to** 31 June 2016

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[2] The home page of the website should contain the generic European flag and the FP7 logo which are available in electronic format at the Europa website (logo of the European flag: http://europa.eu/abc/symbols/emblem/index_en.htm logo of the 7th FP: http://ec.europa.eu/research/fp7/index_en.cfm?pg=logos). The area of activity of the project should also be mentioned.

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1. Executive summary

Highly efficient Power Electronics (PE) applied in power generation, transmission, and distribution is a key element for the ambitious goals of renewable energy penetration in Europe. A new generation of power electronic devices will greatly improve the energy efficiency, increase power quality, and enable continuous voltage regulation, reactive power compensation and automated distribution. New power electronics devices will result in a better integration of distributed energy resources like local energy storage, photovoltaic generation, and plug-in electric vehicles.

The development of a new generation of high power semiconductor devices, highly efficient and able to operate at high voltages (even above 10kV), is crucial for reducing the cost of Power Electronics in grid related applications, hence enabling a breakthrough in the way we generate and distribute energy.

It´s been known for some time that the material properties of silicon carbice (SiC) are superior to those of silicon (Si) for these applications. The development of SiC power electronic devices with suitable characteristics will lead to new applications and markets in power generation and distribution and will insure that EU industry remains at the forefront of the fast developments in the field.

Funded by European Commission, Project SPEED aimed at a breakthrough in SiC technology along the whole supply chain:

- Growth of SiC substrates and epitaxial-layers.
- Fabrication of power devices in the 1.7/>10kV range.
- Packaging and reliability testing.
- SiC-based highly efficient power conversion cells.
- Real-life applications and field-tests in close cooperation with two market-leading manufacturers of high-voltage (HV) devices.

SPEED Project pooled seventeen world-leading manufacturers and researchers from nine different European countries, who will work together during 48 months, with a common goal: the development of the next generation of power semiconductors based on SiC with specific applications in wind converters and the new generation of Solid State Transformers (SSTs).

2. Description of the project context and the main objectives

Developments in high Power Electronics (PE) are currently being driven by Silicon (Si) power semiconductor devices, such as Insulated Gate Bipolar Transistors (IGBTs) and bipolar rectifiers. These devices have been developed during the past 30 years and are enjoying today a significant market success, with worldwide sales in the range of tens of billions of euro. These devices allowed the continuous improvement of power electronics, with immense implications in all the industries and large scale energy T&D.

The availability of Si power devices has made possible Power Electronics as it is currently. However, due to the specific requirements of new power electronics, especially in terms of switching frequency, electro-thermal, thermo-mechanical performances and electrical losses, Silicon is currently reaching its physical limits. Therefore, a next generation of power devices should be developed based on other semiconductor materials. In this sense, Wide Band Gap (WBG) semiconductors could extend the limits of Si technology.

Silicon Carbide (SiC), thanks to its outstanding electrical and thermal properties, is considered as the ultimate semiconductor for applications in High Voltage (HV)/Power Electronics. Its breakdown strength, thermal conductivity and saturation velocity surpasses that of Si, allowing the creation of novel and more energetically efficient applications, especially in high voltage and power applications, where Gallium Nitride (GaN), another relevant WBG semiconductor, is not competitive.

SiC has over 250 poly-types, among them the 4H-SiC has become preferred due to the more isotropic nature of its electrical properties. The 4H-SiC is the most promising material for power switching device applications also due to the quality of the crystal growth, and the maturity of the manufacturing process. Therefore, 4H-SiC is also our choice.

Today, SiC devices are commercially available in the 600V-1200V range (since recently there are some 1700V devices in the market), demonstrating the viability of this technology for the power market. One of the SPEED partners was the first in releasing 600V SiC Schottky diodes on the market. However, in the higher voltage range, SiC can bring a real breakthrough by allowing the development of unipolar rectifiers and switches in the 2-3kV to 6kV range, which is now covered by Si bipolar devices with their inherent limitations, and also the feasibility to produce devices, either unipolar or bipolar, in a higher voltage range (6 to 15KV), which are not available in the market today.

SiC semiconductors could open the way to novel concepts and applications in the high voltage field such as renewable energies, traction, energy generation and distribution. European companies are world leading positioned in these fields and they need to access such novel devices in order to continue the innovation track.

However, most of the SiC material and devices production capabilities are located at this moment outside EU; i.e., United States and Japan. This is the reason why we strongly advocate an integrated European SiC industry supply chain. Such an integrated approach will support EU leading companies in the field to leverage the collaborative R&D effort and deliver SiC material and devices that fulfil the requirements of next generation applications were EU companies are strong. The supply chain must necessarily include bulk material production, epitaxial layer growth technology, devices processing lines, circuits and topology design and optimisation, and final system manufacturing. Moreover, since we deal with new semiconductor material, standard production equipment is not appropriate for an optimal processing of components. Therefore, there is a need for new process equipment concepts to be developed. In a similar way, the physical device models and the simulation tools used for optimisation of the design of devices and systems, as well as the characterization and reliability testing techniques must be adapted to this semiconductor material. Such activities must be considered if a full supply chain has to be set-up.

Moreover, high-power devices such as PiN diodes and switches (MOSFETs, JFETs and IGBTs) require SiC substrates and SiC epilayers that fulfil very demanding specifications. Defects that are of limited importance for current mainstream SiC devices, such as Schottky diodes, become critical. As high power devices have to be large in order to provide them with high current capability, the acceptable defect density needs to become lower. SPEED will develop and improve growth techniques for SiC crystals and epilayers in order to produce 100mm material with the properties suitable for high power SiC devices.

In this context, the **final objectives of SPEED project was to supply high voltage SiC devices with higher performances compared to existing Silicon technology** for:

- Higher power systems efficiency (increased efficiency, lower volume and weight, smaller and cheaper cooling systems ...)
- Reduction of electrical loss and consequently energy saving
- Novel systems topologies and applications based on availability of very high voltage (5-10kV) devices
- Higher reliability in strong power cycling and harsh environments.

Over the objectives defined above, the overarching objective was to establish a strong European industry value chain for SiC technology -wafers, epitaxy, device fabrication, packaging and standardization- able to successfully compete with non-EU companies. By this, few select applications in the megawatt-level energy area were proposed for in depth evaluation of the benefits delivered by the SiC technology.

To develop in depth previous objectives, SPEED Project defined serveral technical objectives which have been achieved during the 4 years Project lenght:

- High quality cost effective bulk SiC growth

- Very low defect density thick SiC epitaxial layers for high voltage large area devices
- Process optimisation for high reliability MOS gate control devices and adapted dielectric deposition equipment development
- Process optimisation for very high voltage capability: termination structures, passivation schemes, top metallisation, ...)
- To develop SiC diodes and switches of various ranges: 1700V, 3.3KV, 5KV, 6.5KV 10kV and 15kV
- Processing modules for trench devices for high integration density
- Novel Characterisation techniques and reliability analysis for these high voltage SiC devices
- Development of simulation modules and libraries for SiC devices and circuit modelling/optimisation
- New SiC power cells for wind applications and energy distribution
- Application proof of concepts, demonstration of scalability toward industrial needs and cost/efficiency analysis

To successfully complete these tasks, we have gathered highly skilled and complementary partners including European leading companies and research centres in each of the targeted topics. We took profit of the existing commercial technologies and prototypes already available at each consortium member site (100mm bulk SiC, thick epilayers, 1.7kV diodes and switches technologies in production, up to 10kV prototypes, ...) to improve each technological step of the value chain in order to reach the challenges fixed by the set-up of novel high voltage devices for energy application.

3. Description of the main S & T results/foregrounds

In the SPEED proposal, and later in the DoW of SPEED project, it is stated that "The overarching objective is to establish a strong European industry value chain for SiC technology - wafers, epitaxy, device fabrication, packaging and standardization - able to successfully compete with non-EU companies."

In addition to the general objective, in the DoW few applications in the megawatt-level energy area are proposed for in depth evaluation of the benefits delivered by the SiC technology.

The general objective defined before was to be accomplished through a series of ***specific objectives*** that cut transversally through several working packages.

The ***specific objectives*** are presented in the following table:

Objectives		Reached
1	High quality cost effective bulk SiC growth	✓
2	Very low defect density thick SiC epitaxial layers for high voltage large area devices	✓
3	Processoptimisation for high reliability MOS gate control devices and adapted dielectric deposition equipment development	✓
4	Process optimisation for very high voltage capability: termination structures, passivation schemes, top metallisation, …)	✓
5	To develop SiC diodes and switches of various ranges: 1700V, 3.3KV, 5KV, 6.5KV 10kV and 15kV	✓
6	Processing modules for trench devices for high	✓

	integration density	
7	Novel Characterisation techniques and reliability analysis for these high voltage SiC devices	✓
8	Development of simulation modules and libraries for SiC devices and circuit modelling/optimisation	✓
9	New SiC power cells for wind applications and energy distribution	✓
10	Application proof of concepts, demonstration of scalability toward industrial needs and cost/efficiency analysis	✓

Table 1. SPEED specific objectives

During the Period 1, the first steps on basic research on the elements or components were performed. In Period 2, basic research continued and also started the applied research and the development of the first components. During Period 3, SPEED consortium has continued investigating in materials and components. However, the greatest effort has been oriented to interconnect the results from previos periods to obtain the SST prototypes.

The main S & T results per WP are:

WP1. Advanced SiC Materials: Substrates and Epi

In P1 and P2, the work was focused on improved boule and seed quality improvements.

Based on the diameter expansion continued in P3 in small steps up to 150 mm, while maintaining the crystal quality. The most important quality properties such as the micropipe density (< 0.2 cm-2) threading screw dislocation density (< 500 cm-2) and basalplane dislocation (< 1700 cm-2) is close to the values for the 100 mm substrates.

The boule expansion and the demonstration of a 150 mm substrate is the final and most important achievement in WP1.

SPEED partners has made a proposal of standard for epitaxial wafers and discussed with representatives for the SEMI standard organization.

WP2. Medium-Voltage SiC Device & Packaging Technologies for Wind Power Applications

- JFET based power modules were re-designed and assembled with a module concept offering higher symmetry.
- Delivery of parts for the final demonstrator
- Successful formation of JEDEC committees

WP3. High-Voltage SiC Device & Packaging Technologies for Power Transmission Applications

WP3 was dedicated to the development of technologies for diodes and power MOSFETs having breakdown voltage ranging from 3.3kV to 10kV.

In this workpackage we have successfully developed and series of technologies for building SiC power devices from 3.3kV up to 10kV. Most of the objectives have been reached. We have been processing more devices batches than initially schedule to reach these objectives. However, this is usual when developing novel semiconductors technologies. Indeed the objectives were very ambitious. As a consequence, it has been done a great effort to delivery good devices to the other WP.

The main achievements of the workpackage are then:

1. An advanced pre-industrial JBS technology for the fabrication of 3.3kV to 10kV power diodes
2. An improved 6.5kV and 10kV PiN diodes technology with lifetime control process
3. Planar SiC MOSFET technology suitable for 3.3kV to 10kV power MOSFET
4. Advanced optimized power modules suitable for 3.3kV and 10kV MOSFETs

WP4. Advanced Characterization & Reliability

- Further High Humidity High Temperature Reverse Bias (H^3TRB) tests have been conducted with SiC devices from other WPs. The results indicate that SiC devices can have a significant higher robustness against humidity than expected. In particular, SiC Schottky diodes, similar to those which are already commercially available, show very promising results. On the other hand, novel high voltage devices such as 3.3kV SiC JBS Diodes show some shortcomings of humidity robustness. Tests are ongoing until the end of the project to verify and understand the physics of failure. Results have been fed back to related work packages in order to improve design and enhance device performance.

- Further SiC devices for Power Cycling (IOL) tests have been provided by WP2. Discrete devices in Epoxy Moulding Compound (EMC) package from WP2 indicate robustness against thermo-mechanical stress comparable to Silicon devices whereas first results with devices in module packages show significantly less power cycling capability in accordance with various publications.

- Bipolar degradation tests were performed with substrates. Even though no explicit degradation of forward voltage was observed, optical analysis shows an uneven plasma distribution. This might indicate an already occurred degradation which happend already during wafer level measurements or, more likely, an uneven doping in the production process.

- Time dependent dielectric breakdown (TDDB) tests were performed in order to obtain information about the stability of Silicon Oxide on Silicon Carbide. For this measurements MOS capacitors provided were used. The results show a huge variation of oxide quality manifested in a wide range of time to failures from nearly instant failure to several thousand seconds of test duration. The results were fed back and are used to optimize manufacturing processes and obtain improved quality.

- Additional High-fidelity semiconductor simulations were conducted with the test setup of ST4.1.3 to further calibrate models. Different SiC semiconductor devices from SPEED partners have been tested and results indicate that existing models are suitable for SiC device simulations.

- First thermo-mechanical characterisation and reliability tests have been conducted with different stacked substrates, which are candidates for novel package forms optimized for Silicon Carbide. Results show that silicon nitride based substrates obtain supreme performance in terms of thermal cycling ruggedness and are a promising candidate for stacked DBC substrates.

WP5. SiC – based Power Cells

- The gate driver for the semiconductors 1.7kV Easy 2B Package has been designed and the functional validation of the driver it-self has been already done.
- Two "Buck" regulators have been used, where modifying some components the required voltages can be selected.
- In the static characterization of the 3.3kV SiC MOSFETs, the results obtained are consistent both among all the devices under test, and also compared to commercial devices of a similar order of magnitude.
- The good static characteristics observed confirm that high voltage SiC MOSFETs have been developed.
- During the tests of the top side switch the gate to source voltage of the bottom switch is influenced.
- Actually, several solutions such us gate resistor values variation in order to increase the damping factor of the circuit.
- A prototype of a small scale DC/DC converter was developed to validate the analytical results. It consists of a three-phase inverter with 1700 V SiC MOSFETs by WOLFSPEED, three single phase transformers, a rectifier and appropriate control logic.
- Introducing hybrid SiC devices in an existing Wind Power converter, allows reducing by almost 50% the size and weight of the output filter without penalizing any other aspect in the design or operation of the power converter, which suppose a notably reduction of the total cabinet.
- DCDC converter's switching frequency definition: between 15 and 25kHz.
- Output diodes test results: the influence of the transformer and parasitic components analysis, impact on operating conditions of the PEBB.
- Operation points specification for each PEBB (DC Bus level, rated power, redundancy, …)
- Mechanical 3D development
- Multiport functionalities of the MMC have been defined and confirmed by means of simulation. A fault tolerant cell has been designed and teste experimentally.

WP6. Wind Converters and Solid State Transformers

- Solid starte transformer has been developed and successfully tested.
- A demonstrator to simulate the operation of a DC Output Wind Turbine has been developed and tested.

4. Description of the potential impact (including the socio-economic impact and the wider societal implications of the project so far) and the main dissemination activities and the exploitation of results

The SPEED project aims to significantly contribute to European technological progress in competition with non-EU countries by means of establishing a strong European research and industry value chain for SiC technology in power electronics, especially for SiC substrates, thick SiC epitaxies, high voltage devices, novel packaging strategies and also standardization for energy-efficient applications. The objective of dissemination is to maximize the project visibility, attract potential users of the results and to enable a quick take-up of the project results. To achieve this, a set of dissemination actions have been implemented.

Dissemination activities include the following points:

- Definition of the dissemination strategy
- Project website
- Workshops
- Training Activity
- European Commission Dissemination Action
- Publications
- Conferences
- Presence in Media

The SPEED project has been introduced to the industrial and scientific community at the following international conferences and workshops organized by external groups:

- ISiCPEAW 2014 in Stockholm, 25-27 May 2014.
- CWIEME in Berlin, 24-26 June 2014.
- ESSDERC 2014 in Venice, 22-26 September 2014.
- Darnell´s Energy Summit in Richmond, VA, 23-24 September 2014.
- CWIEME Chicago, Il, 1-2 October 2014.
- ISiCPEAW 2015 in Stockholm, 26-28 May 2015.
- ECPE SiC & GaN User Forum, 20-21 April 2015, Coventry, UK (with SPEED satellite workshop).
- ISPSD 2015, IEEE International Symposium on Power Semiconductor Devices and ICs, 10-14 May 2015, Hong Kong.

- WOCSDICE, Workshop on Compound Semiconductor Devices and Integrated Circuits, 8-10. June 2015, Smolenice, Slovakia (with SPEED satellite workshop).
- PCIM 2015, Power Conversion Intelligent Motion, 19-21 May 2015, Nuremberg, Germany.
- MIXDES 2015, Mixed Design of Integrated Circuits and Systems, 25-27 June 2015, Toruń, Poland.
- GADEST 2015, Gettering and Defect Engineering in Semiconductor Technology, 20-25 September 2015, Bad Staffelstein, Germany.
- EPE 2015, European Conference on Power Electronics and Applications, 8-10 September 2015, Geneva, Switzerland.
- ICSCRM 2015, International Conference on Silicon Carbide and Related Materials, 4-9 October 2015, Giardini Naxos, Italy.
- SSDM 2015, International Conference on Solid Stated Devices and Materials, 27-30 September 2015, Sapporo, Japan.
- CIPS 2016, International Conference on Integrated Power Electronics, 8-10 March 2016, Nuremberg, Germany.
- PCIM 2016, 10-12 May 2015, Nuremberg, Germany.
- EPE 2016, European Conference on Power Electronics and Applications, 5-9 September 2016, Karlsruhe, Germany.
- WODiM 2016, Workshop on Dielectrics in Microelectronics, Catania, Italy.
- E-MRS 2016: European-Materials Research Society Spring Meeting, 2-5 May 2016, Lille, France.
- ISPSD 2016, 28th IEEE International Symposium on Power Semiconductor Devices and ICs, 12-16 June 2016, Prague, Czech Republic.
- 13th International Seminar on Power Semiconductors, August 2016, Prague, Czech Republic.
- ECCE 2016, IEEE Energy Conversion Congress and Exposition, September 2016, Milwaukee, IL, USA.
- ECSCRM 2016, European Conference on Silicon Carbide and Related Materials, 25-29 September 2016, Halkidiki (Greece) .

- ESSDERC 2016: 12-15 September 2016, Lausanne (Switzerland)
- ESREF 2016: 27th European Symposium on Reliability of Electron Devices, Failure Physics and analysis, September 19-22, 2016 - Händel-Halle, Halle (Saale)
- IEEE Energy Conversion Congress & Exposition, ECCE (US & Canada).
- IEEE Applied Power Electronics Conference and Exposition, APEC (US & Canada). APEC 2016 will be in Long Beach, CA - March 20-24, 2016.
- ISPSD 2017 (in Japan).
- EPE 2017 in Europe.
- ICSCRM 2017, Washington D,C, USA

For the ECSCRM 2016 conference in Chalkidiki, Greece and the ICSCRM 2017 conference in Washington, D.C. USA, several partners of the SPEED consortium were part of the an exhibition organized in the frame of the conference.

Some of the dissemination activities are:

Conference Papers

- P. Hazdra, S. Popelka, V. Záhlava, J. Vobecký, Radiation Damage in 4H-SiC and Its Effect on Power Device Characteristics, Solid State Phenomena Vol. 242 (2016) pp 421-426, doi:10.4028/www.scientific.net/SSP.242.421
- R.K. Sharma, P. Hazdra, S. Popelka, A. Mihaila, H. Bartolf, Optimization of 1700V 4H-SiC JBS Diode Parameters, Materials Science Forum Vol. 858 (2016) pp 782-785, doi: 10.4028/www.scientific.net/MSF.858.782
- S. Popelka, P. Hazdra, Effect of Electron Irradiation on 1700V 4H-SiC MOSFET Characteristics, Materials Science Forum Vol. 858 (2016) pp 856-859, doi: 10.4028/www.scientific.net/MSF.858.856
- C. Bödeker, T. Vogt, and N. Kaminski, "Stability of Silicon Carbide Schottky Diodes against Leakage Current Thermal Runaway," in Proceedings of the 27th International Symposium on Power Semiconductor Devices & IC's (ISPSD), Hong Kong, China, 2015, pp. 245–248.
- C. Bödeker, T. Vogt, and N. Kaminski, "Thermal Limits of the Blocking Stability of Silicon Carbide Schottky Diodes," in Proceedings of the International Exhibition and Conference for Power Electronics, Intelligent Motion, Renewable Energy and Energy Management (PCIM), Nuremberg, Germany, 2015, pp. 1061–1067.
- C. Bödeker, T. Vogt, and N. Kaminski, "Investigation of the Thermal Runaway of Silicon Carbide Diodes during Blocking Operation," in proceedings of 15th European Conference on Power Electronics and Applications (EPE), Geneva, Switzerland, 2015.
- Fernando Briz, Mario Lopez, Alberto Zapico, Alberto Rodriguez, David Diaz-Reigosa, "Operation and Control of MMCs Using Cells with Power Transfer

Capability," 30th Annual IEEE Applied Power Electronics Conference & Exposition (APEC), 15-19 March 2015, Charlotte, NC, USA.
- Fernando Briz, Mario López, Alberto Rodríguez, Alberto Zapico, Manuel Arias, David Díaz-Reigosa, "MMC based SST", INDIN 2015 IEEE International Conference on Industrial Informatics, Special Session on Solid State Transformers, 22-24 July 2015, Cambridge, UK
- Mario López, Alberto Rodríguez, Enrique Blanco, Mariam Saeed, Ángel Martínez, Fernando Briz, "Design and Implementation of the Control of an MMC-Based Solid State Transformer", INDIN 2015 IEEE International Conference on Industrial Informatics, Special Session on Solid State Transformers, 22-24 July 2015, Cambridge, UK
- Mario López, Fernando Briz, Alberto Zapico, David Díaz-Reigosa, "Comparative Analysis of Control and Modulation Strategies for Modular Multilevel Converters", Annual Seminar on Automatic Control, Industrial Electronics and Instrumentation SAAEI, 8-10 July 2015, Zaragoza, Spain.
- A. Rodríguez, M. Arias, J. Sebastián, M. López, A. Zapico, F. Briz, "Retos tecnológicos en el desarrollo de un transformador de estado sólido basado en un convertidor modular multinivel con inyección de potencia a nivel de celda", Annual Seminar on Automatic Control, Industrial Electronics and Instrumentation SAAEI, 8-10 July 2015, Zaragoza, Spain.
- V. Soler, M. Berthou, M. Florentin, J. Montserrat, P. Godignon, J. Rebollo and J. Millán, "Design and Fabrication of High Voltage 4H-SiC MOS Transistors". Annual Seminar on Automatic Control, Industrial Electronics and Instrumentation SAAEI, 8-10 July 2015, Zaragoza, Spain.
- V. Soler, M. Berthou, M. Florentin, J. Montserrat, P. Godignon, J. Rebollo and J. Millán, "Experimental Analysis of Planar Edge Terminations for High Voltage 4H-SiC Devices". In proceeding of ESSDERC 2015, 14-18 september 2015, Graz (Austria).
- M. Florentin, M.Cabello, M.Alexandru, J.Montserrat, B.Schmidt and P.Godignon, "4H-SiC nMOSFETs Gate Oxide Designed for Irradiation Robustness under Time and Temperature Bias Stress Conditions". WOCSDICE 2015, Smolenice Castle, Slovakia (8-10 June), Proceedings book, pp 75-78.
- P. Friedrichs, "Silicon Carbide Devices for Wind Power Applications". WOCSDICE 2015, Smolenice Castle, Slovakia (8-10 June), Proceedings book, pp. 81-82.
- M. Cabello, M. Florentin, M. Alexandru, B. Schmidt, J. Rebollo, J. Montserrat, J. Millàn and P. Godignon "Irradiation and Post-Annealed nMOSFETs with Al implanted p-well: Limit of Robustness", in proceedings of ICSCRM2015, Giadini Naxos, 4-9 October 2015
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- R.K.Sharma, P. Hazdra, S.Popelka, Simulation and Characterization of Ion Irradiated 4H-SiC JBS Diode, Proceedings of the 22nd International

Conference "Mixed Design of Integrated Circuits and Systems", June 25-27, 2015, Torun, Poland, ISBN 978-83-63578-06-0, pp. 567-570.

- R.K.Sharma, P. Hazdra, S.Popelka, Simulation and Characterization of 4H-SiC JBS Diodes Irradiated by Hydrogen and Carbon Ions, International Journal of Microelectronics and Computer Science, vol 6, 2015, pp.59 - 63.
- A. Ellison, E. Sörman, B. Sundqvist, B. Magnusson, B. Raghothamachara, J. Guo, Y. Yang, M. Dudley. “Mapping of Threading Screw Dislocations in 4HN SiC wafers”. ECSCRM, Giardini Naxos, Sicily October 4th-5th 2015
- M. Florentin, M. Alexandru, A. Constant, P. Michel, J. Montserrat, J. Millan and P. Godignon. “Proton and Electron Irradiation in Oxynitrided Gate 4H-SiC MOSFET: A Recent Open Issue”. Invited Poster. ESCSCRM 2014, September 21-25, 2014, Grenoble, France.
- M. Florentin, J. Millán, P. Godignon, A. Constant, M. Alexandru and B. Schmidt. “A Positive Impact of Low Proton Irradiation Energy On Oxynitride Gate 4H-SiC MOSFETs”. ESSDERC 2014.
- A. I. Mikhaylov, A. V. Afanasyev, V. V. Luchinin, S. A. Reshanov, A. Schöner, L. Knoll, R. A. Minamisawa, G. Alfieri, H. Bartolf, “Passivation of 4H-SiC/SiO2 Interface Traps by Oxidation of a Thin Silicon Nitride Layer”, ECSCRM 2014, Grenoble, France
- A. I. Mikhaylov, A. V. Afanasyev, V. V. Luchinin, S. A. Reshanov, A. Schöner, L. Knoll, R. A. Minamisawa, G. Alfieri, H. Bartolf, “Inversion-Channel MOS Devices for Characterization of 4H-SiC/SiO2 Interfaces”, ECSCRM 2014, Grenoble, France
- M. Florentin, J.M. Rafí, F. Chevalier, L.Konczewicz, S. Contreras, S. Juillaguet, J. Montserrat and P. Godignon Study of Geometrical Effects in Charge Pumping Current for Lateral SiC nMOSFETs Electrical Characterization. European Conference on Silicon Carbide & Related Materials (ECSCRM), Grenoble (France), 21-25 September, 2014.
- M.Florentin, M.Alexandru, A. Constant, B.Schmidt, J.Millán, P.Godignon. A positive impact of low irradiation energy on oxynitride gate 4H-SiC MOSFETs. 44th European Solid-State Device Conference (ESSDERC), Venice (Italy), 22-26 September, 2014. Oral Presentation.
- J. León, X. Perpiñà, V. Banu, J. Montserrat, M. Berthou, M. Vellvehi, P. Godignon, X. Jordà. Temperature effects on the ruggedness of SiC Schottky diodes under surge current. 25th European Symposium on Reliability of Electron Devices, Failure Physics and Analysis (ESREF), Berlin (Germany), 29 September – 2 October 2014.
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- V. Banu, P. Godignon, M. Alexandru, M. Vellvehi, X. Jordà, J. Millán. Demonstration of Temperature Compensated Voltage Reference Integrated Circuit Designed with 4H-SiC MESFETs. Semiconductor Conference (CAS), 2014 International, pp 359-362, Sinaia (Romania), 13-15 Oct, 2014

Journal Papers

- P. Hazdra, S. Popelka, V. Záhlava, "The Influence of Neutron Irradiation on Electrical Characteristics of 4H-SiC Power Devices", Materials Science Forum, Vols 821-823 (2015), pp 785-788, doi:10.4028/www.scientific.net/MSF.821-823.785.
- M. Florentin, M. Alexandru, A. Constant, P. Michel, J. Montserrat, J. Millan and P. Godignon. "Proton and Electron Irradiation in Oxynitrided Gate 4H-SiC MOSFET: A Recent Open Issue". Material Science Forum, Vols 521-823 (2015), pp 667-672, doi:10.4028/www.scientific.net/MSF.821-823.785.
- P. Hazdra, S. Popelka, V. Záhlava, J. Vobecký, Radiation Damage in 4H-SiC and Its Effect on Power Device Characteristics, Solid State Phenomena, accepted.
- T. Christen, A. Ioannidis and C. Winkelmann, "A Model for Thermal Oxidation of Si and SiC including Material Expansion"– accepted, to be published in J. Appl. Phys.

Workshops

- E-MRS 2016. European-Materials Research Society Spring Meeting
  Lille, France, May 2-5, 2016
- P. Hazdra, S. Popelka, Radiation Resistance of Wide-Bandgap Semiconductor Power Transistors
- ECSCRM 2016. European Conference on Silicon Carbide and Related Materials 2016
  Greece, September 2016
- P. Hazdra, S. Popelka, Lifetime Control in SiC PiN Diodes Using Radiation Defects (submitted)
- ECPE SiC and GaN user forum in Warwick (April 2015). University of Warwick, Conference Centre "Scarman" House, Coventry, England.

Special Session: European FP7 Project SPEED

  - Challenges in Epitaxial Growth for High Voltage SiC Devices. Dr. Sergey Reshanov, Ascatron AB, Kista-Stockholm, Sweden
  - Design and fabrication of HV SiC JBS diodes for Power Transmission applications Dr. Andrei Mihaila, ABB Schweiz AG, Corporate Research Center, Baden-Dättwil, Switzerland.
  - Development of SiC based solutions for wind power.

Dr. Peter Friedrichs, Infineon Technologies AG, Erlangen, Germany.

  - Value chain management: the key for successful final applications in SiC-based power electronics for energy applications.

Dr. Daniel Fernández Hevia, INAEL Electrical Systems S.A., Toled0, Spain.
General Application Aspects of WBG Devices Session

  - Status and Trends of SiC Power MOSFET Technology Development, A. Castellazzi, University of Nottingham (UK).

- International SiC Power Electronics Applications Workshop, ISiCPEAW 2015, in Stockholm (May 2015) – invited speaker in the "Grid & HV" session, presented SPEED and some WP3 highlights. A. Mihaila.
- The European Workshop on Compound Semiconductor Devices and Integrated Circuits (WOCSDICE), Smolenice (June 2015), Slovak Republic. http://uef.fei.stuba.sk/wocsdice/index.php

Session for SiC Based Devices

  - Silicon Carbide Devices for Wind Power Applications, Dr. Peter Friedrichs, Infineon Technologies AG, Erlangen, Germany.
  - Requirements and Design of 4.5 kV 4H-SiC Merged pin/Schottky Diodes for Wind Power, Dr. Tobias Erlbacher, Fraunhofer, Erlangen, Germany.
  - High voltage power electronics and integrated circuits in Project SPEED: needs, synergies, and potential business strategies, Dr. Daniel Fernández Hevia, INAEL Electrical Systems S.A., Toledo, Spain.
  - SiC Substrates and Epitaxial Layers for High Voltage Power Device Applications, Prof. Peder Bergman, Norstel AB, Norrköping, Sweden.