

SUNDAY

ORAL PRESENTATIONS

* Invited Paper

Tutorials

Session Chair: Victor Veliadis
Sunday Morning, September 17, 2017
Thurgood Marshall Ballroom, North Salon
9:45 am – 5:30 pm

Moving from Silicon to SiC: Learning to Think Differently!

SiC technology advancements show increasing commercial viability and SiC power devices are replacing a growing number of Si devices in power electronics systems. The tutorials will provide an overview of the state of SiC technology today and how advances in the various capabilities, ranging from growth to applications, are interrelated.

9:45 AM

Introduction

Victor Veliadis, PowerAmerica, North Carolina State University

Victor Veliadis received a PhD degree in electrical and computer engineering from Johns Hopkins University in 1995. From 1996 to 2000, he was with start-up Nanocrystals Imaging Corporation, where he developed quantum-dot phosphors for imaging applications. From 2000 to 2003, he was with Lucent Technologies, where he designed InP-based tunable photonic integrated circuits for telecommunication applications. In 2003, Veliadis served as adjunct physics professor at Ursinus College and St. Joseph's University. Veliadis joined Northrop Grumman Electronic Systems in 2004 where he designed, fabricated and tested SiC SITS, JFETs, MOSFETs, thyristors, and JBS, Schottky and PiN diodes in the 1-12kV range. In 2016, he was appointed chief technology officer (CTO), and in 2017, CTO/deputy director of PowerAmerica, a U.S Department of Energy wide bandgap device manufacturing institute managed by North Carolina State University (NCSU). At the time, Veliadis also became an electrical and computer engineering professor at NCSU. Veliadis has given over 60 invited talks and tutorials, authored and co-authored 106 peer-reviewed technical articles, authored three book chapters and has 24 issued patents to his credit.

SiC Material Properties—Advantages, Challenges and Solutions

10:00 AM

SiC Bulksubstrates

Elif Balkas, Wolfspeed, A Cree Company

Elif Balkas received her BS degree from the Department of Metallurgical and Materials Engineering at the Middle East Technical University of Turkey in 1999, followed by her MS degree in materials science from the same university in 2001. During her Master's studies, she designed and built a research laboratory to develop and test material systems for hydrogen sorption for energy-storage purposes. For her PhD degree, she studied GaN growth via physical vapor transport techniques in the Department of Materials Science and Engineering at North Carolina State University and received her degree in early 2005. Balkas joined Intrinsic Semiconductor in 2005, where she worked as an epitaxy scientist specializing in GaN and SiC epitaxy platforms. She joined Wolfspeed, A Cree Company, through acquisition in 2006. At Wolfspeed, she dedicated much of her time to developing SiC crystal growth and surrounding technologies that are scalable for manufacturing purposes. Balkas is currently driving the development efforts as the director of materials R&D at Wolfspeed, to create SiC substrates that enable power and radio frequency devices on wide bandgap materials.

10:30 AM

SiC Epitaxy

Al Burk, Wolfspeed, A Cree Company

Al Burk currently manages SiC and GaN-HEMT epitaxial growth R&D for electronic devices at Wolfspeed, A Cree Company. He received his BA degree from Western Maryland College, majoring in chemistry and physics. In 1985, he received a PhD degree from the University of Wisconsin–Madison in physical chemistry. Since graduation, Burk has accumulated over 30 years of experience in microelectronics materials, characterization and processing—focusing primarily on epitaxial growth. As an engineer and program manager at Westinghouse/Northrop Grumman Corporation, he developed chloride-VPE and MOCVD growth reactors and processes for GaAs MMIC production. Al began his research into high-temperature SiC epitaxy in 1992, leading to the development of 7×2-inch warm-wall planetary reactors for SiC MESFET and SIT device production. Since 1999, Burk has been at Wolfspeed, where he continues to develop epitaxial processes, most recently 8×150mm warm-wall planetary-VPE, 3×150mm hot-wall SiC reactors and 8×150mm MOCVD nitride epitaxial layers for both internal and external advanced wide bandgap electronic devices. Burk has authored numerous technical papers and presented contributed, invited and plenary ICSCRM conference presentations on the topic of SiC epitaxy.

SiC MOSFET Design

SiC Power Electronic Applications

11:00 AM

SiC MOSFET Design—Advantages, Challenges and Strategies

B. Jayant Baliga, North Carolina State University

B. Jayant Baliga is a distinguished professor in electrical and computer engineering at North Carolina State University. He is an internationally renowned scientist, author of 20 books, nearly 600 publications and 120 U.S. patents. His most widely commercialized invention is the Insulated Gate Bipolar Transistor (IGBT), extensively used for lighting (CFLs), air-conditioning, home appliance controls, robotics, automobile ignition systems, electric-cars and bullet-trains. In 2016, he was inducted into the National Inventors Hall of Fame as the sole inventor of the IGBT. He is regarded as the father of wide bandgap semiconductor-based power devices, having derived the Baliga high-frequency figure of merit in 1979. He received the National Medal of Technology and Innovation from President Obama in 2011 and the North Carolina Award for Science from Governor Beverly Eaves Perdue in 2012. He was awarded the highest IEEE recognition, the IEEE Medal of Honor, in 2014, and the 2015 Global Energy Prize in St. Petersburg, Russian Federation.

SiC Processing

1:00 PM

SiC Processing—It's Not the Same as Silicon!

Woongje Sung, SUNY Polytechnic Institute

Woongje Sung received his BS and MS degrees in electrical engineering from Korea University in 2000 and 2002, respectively. Sung received his PhD degree in electrical and computer engineering from North Carolina State University in 2011. His experience spans a number of industrial settings including a start-up company, a semiconductor foundry, Dongbu HiTek, and a mature multinational company, Samsung Advanced Institute of Technology (South Korea). He is a founding member of the U.S. Department of Energy (DOE)-funded PowerAmerica Institute, where he has been contributing to establishing the baseline process of SiC MOSFETs and diodes. In 2016, Sung joined the State University of New York Polytechnic Institute also known as Colleges of Nanoscale Science and Engineering (CNSE), as an associate professor. He is an author of 20 peer-reviewed publications and 12 U.S. patents.

2:00 PM

15 kV IGBT Converters and High Voltage Circuit Topologies

Subhashish Bhattacharya, North Carolina State University

Subhashish Bhattacharya received his BE, ME and PhD degrees in electrical engineering from the Indian Institute of Technology, Roorkee, in 1986, Indian Institute of Science (IISc) in 1988, and from the University of Wisconsin-Madison in 2003, respectively. He worked in the Flexible AC Transmission Systems (FACTS) group at Westinghouse R&D, which later became part of Siemens Power Transmission & Distribution, from 1998 to 2005. Bhattacharya joined the Department of Electrical and Computer Engineering at North Carolina State University in August 2005, where he is the ABB Term Professor and also a founding faculty member and co-PI of the National Science Foundation (NSF) Future Renewable Electric Energy Delivery and Management (FREEDM) Systems Engineering Research Center and the U.S. Department of Energy (DOE) initiative on WBG-based Manufacturing Innovation Institute—PowerAmerica. Bhattacharya has authored over 350 peer-reviewed technical articles, two book chapters, and has four issued patents. A part of his PhD research on active power filters was commercialized by York Corporation for its air-conditioner chiller application. His research interests include solid-state transformers, MV power converters, FACTS, utility applications of power electronics and power quality issues, high-frequency magnetics, active filters, and the application of new power semiconductor devices such as SiC for converter topologies.

2:30 PM

High-Performance MVA Magnetic Resonance Imaging Gradient Drivers with SiC

Juan Sabaté, GE Global Research Center

Juan A. Sabaté is a senior principal engineer at the GE Global Research Center. He joined GE in 2000 and has contributed to new concepts for power supplies and high-power switching amplifiers for energy and medical applications. From 1997 to 2000, Sabaté worked for Philips Electronics Research, where he conducted research and advanced development of high-power density power supplies for commercial and lighting applications. From 1994 to 1997, he worked for Hewlett-Packard R&D center in Barcelona, Spain, where he designed high-power density dc-dc converters and special purpose sensors. Additionally, from 1994 to 1997, Sabaté was a lecturer and adjunct professor at the Ramon Llull University, Spain. Sabaté holds 26 patents, has more than 65 peer-reviewed publications, and has presented four invited tutorials at conferences of the International Society for Magnetic Resonance in Medicine. He holds an electrical engineering diploma from the Polytechnic University of Catalunya in Barcelona, Spain, and MS and PhD degrees in electrical engineering from Virginia Polytechnic Institute and State University.

3:00 PM BREAK

3:30 PM

Heavy-Duty Vehicle Inverter

Brij Singh, John Deere Electronic Solutions

Brij N. Singh is a senior staff engineer at John Deere Electronic Solutions. He is leading the U.S. Department of Energy (DOE) PowerAmerica-funded project at John Deere to develop a 200kW SiC inverter for heavy-duty vehicle applications. Singh earned a BE degree in electrical engineering from the Madan Mohan Malaviya University of Technology in 1989, an ME degree in electrical engineering from the Indian Institute of Technology, Roorkee, in 1991, and in 1996, a PhD degree in electrical engineering from the Indian Institute of Technology, New Delhi. After earning his PhD, Singh joined the School of Advanced Technology, University of Quebec, Montreal, as a postdoctoral fellow. In 1999, he joined Concordia University, Montreal, as a research fellow, and in 2000, he joined the Department of Electrical Engineering and Computer Science, Tulane University, New Orleans, as an assistant professor. Singh joined John Deere Electronic Solutions in 2007. Singh has published over 90 research papers in various journals, such as IEEE Transactions and IET Journals. He has 12 U.S. patents and over 25 U.S. pending patents.

SiC Commercialization

4:00 PM

Strategies for Commercialization and Market Insertion

Anant Agarwal, The Ohio State University

Anant Agarwal joined the Electrical and Computer Engineering Department at The Ohio State University in August 2017. Previously, he was senior advisor for wide bandgap (WBG) semiconductors at the U.S. Department of Energy (DOE), where he helped create and manage four programs related to WBG technology and their applications including PowerAmerica, Next Generation of Electric Machines (I and II) and graduate traineeships. From 1999 to 2013, Agarwal was R&D manager for silicon carbide power devices at Wolfspeed, A Cree Company. From 1990 to 1999, he was a fellow at Northrop Grumman Science and Technology Center, Pittsburgh, Pennsylvania, where he led research activities on SiC power devices.

During 1984 and 1985, he was a member of the technical staff at AT&T Bell Laboratories, Murray Hill, New Jersey, where he was involved in the development of GaAs digital circuits. Agarwal received his PhD degree in electrical engineering from Lehigh University in 1984. He jointly holds more than 60 patents, has co-authored more than 300 research papers and was elected an IEEE Fellow in January 2012 for his lifetime contributions to WBG technologies.

4:30 PM

Student Q & A Session—Ask the Experts!

Sunday Program Reviews

Session Chair: Al Hefner

Sunday Afternoon, September 17, 2017

Thurgood Marshall Ballroom, West Salon

1:00 pm – 5:30 pm

1:00 PM *SU.PR.1.1

National Programs on SiC Power Devices in China—From Research to Applications

Fei Yang; State Grid Corporation of China, China.

1:45 PM *SU.PR.1.2

SiC Power Electronics Technology for Energy Efficient Devices (SPEED)—Introduction Overview; High Quality Substrate Material for High Power Application; High Voltage SiC Devices for Power Transmission Application; Solid State Transformers with Increased Functionalities and SiC in Future Wind Power Applications

Anton J. Bauer¹, Peter Friedrichs², Peder Bergman³, Adolf Schöner⁴, Andrei Mihaila⁵, Philippe Godignon⁶, Antonio de la Cruz⁷, Christian Sommer⁸, Itziar Kortazar⁹ and Jose Maria Cuartas Alonso¹⁰; ¹Frauhof IISB, Germany; ²Infineon Technologies, Germany; ³Norstel AB, Sweden; ⁴Ascatron, Sweden; ⁵ABB Corporate Research, Switzerland; ⁶CNM-CSIC, Spain; ⁷INAEL, Spain; ⁸University of Hannover, Germany; ⁹Ingeteam, Spain; ¹⁰University of Oviedo, Spain.

2:45 PM *SU.PR.1.3

Manufacturing Job Creation through Accelerated Large-Scale Adoption of SiC Semiconductor Devices

Victor Veliadis; PowerAmerica, United States.

3:30 PM BREAK

3:45 PM *SU.PR.1.4

Genealogy of National Projects on SiC Power Electronics and Related Current Research and Development Activities in Japan

Hajime Okumura¹ and Tsunenobu Kimoto²; ¹National Institute of Advanced Industrial Science and Technology (AIST), Japan; ²Kyoto University, Japan.

4:45 PM *SU.PR.1.5

The New York Power Electronics Manufacturing Consortium—Enabling the Power Electronics Revolution

Brian Sapp, Jeffrey C. Hedrick, Lindsay M. Bessette, Alexander Bialy, Matthew Bosco, Michael Bryant, Wenli Collison, Shannon Dunn, Daniel Franca, Thomas Gorczyca, Pui Yee Hung, Anne-Sophie Larrea, Vincent Pedone, Joseph Piccirillo, Jamie Prudhomme, Susan Rogers, Gerard Stapf, Vlad Stolkarts, Sean Valente and Paul Woodin; SUNY Polytechnic Institute, United States.