PowerAmerica

WIDE BANDGAP DEVICES & APPLICATIONS VIRTUAL SHORT COURSE

NOVEMBER 7–9, 2023

The course will be presented online in real-time with opportunity for Q&A with the instructors.

COURSE BENEFITS

Attendees will gain comprehensive insight into power SiC and GaN materials, devices, and insertion of these technologies into power electronics systems.

COURSE OBJECTIVES

Provide fundamentals of SiC and GaN material, device, and power electronics technology. Participants will gain proficiency through instruction on WBG fundamentals and application-specific case studies.

WHO SHOULD ATTEND

- POWER ELECTRONICS APPLICATIONS ENGINEERS
- POWER DEVICE ENGINEERS
- SiC & GaN TECHNICAL MARKETING PROFESSIONALS
- POWER ELECTRONICS BUSINESS & PRODUCT LINE MANAGERS

INSTRUCTORS

Taha Ayari, PhD
Technology and Market Analyst, Yole

Sandeep Bahl, PhD
Distinguished Member of Technical Staff, Texas Instruments

Subhashish Bhattacharya, PhD
North Carolina State University

Peter Friedrichs, PhD
Vice President, SiC, Infineon

Don Gajewski, PhD
Manager of Reliability and Failure Analysis, Wolfspeed

Yuri Khlebnikov, PhD
R&D Manager-Materials, Wolfspeed

David Levett, PhD
Power Electronics Architect, Rockwell Automation

Peter Losee, PhD
Director of Technology Development, Qorvo/USiC

Srdjan Lukic, PhD
North Carolina State University

Christina DiMarino, PhD
Virginia Tech

Matteo Meneghini, PhD
University of Padova

Bulent Sarlioglu, PhD
University of Wisconsin-Madison

Michael MacMillan, PhD
Technical Director, Veeco

Victor Veliadis, PhD
Executive Director & CTO, PowerAmerica

For questions, contact *poweramerica@ncsu.edu*

COURSE FEE

$50 Student
$300 PowerAmerica member
$600 PowerAmerica non-member

LOCATION

Link to join the live course will be sent to registered attendees.

REGISTRATION ONLINE AT:

PowerAmericaInstitute.org/shortcourse

SiC and GaN Power Electronic Markets

- Application trends
- Market analysis and forecasts
- Eco-system and supply chains

SiC Substrate Technology Status

- Motivation for SiC
- SiC substrate technology maturation
- SiC substrate processing
- Crystal growth
- Chemical mechanical planarization
- SiC defects, surface quality, flatness
- 200 mm status

Silicon Carbide Epitaxy Technology

- SiC epitaxy – basics of growth
- Substrates and growth parameters
- SiC epitaxy tools
- Next generation tools and techniques
- Characterization techniques and requirements for commercial epitaxy
- Thickness and doping accuracy and uniformity
- Defect types and control

SiC Fabrication in a Silicon Fab

- Introduction to SiC material properties and key applications
- SiC process technology: etch, metallization and Ohmic contact formation, doping, gate oxide, edge termination
- SiC fab infrastructure
- Last barriers to mass commercialization and PowerAmerica's catalytic impact

Introduction to SiC Power Devices

- Impact of SiC material and processing constraints on device design
- Understanding the nuance of SiC datasheet characteristics
- Strengths and challenges with state of the art SiC power devices
- Considering cosmic ray reliability in SiC design
- Future directions of SiC devices

Packaging and Integration of Wide-Bandgap Power Semiconductors

- Introduction and background on power semiconductor packages
- Packaging considerations for WBG semiconductors
- Thermal, electromagnetic, and electrostatic challenges
- Industry tends
- New integration strategies

Si, SiC, and GaN applications in Mobility and Renewable Energy

- Global megatrends in power distribution
- UPS and Data Center operations
- Renewables integration
- E-mobility and charging

Reliable GaN FETs for Power Supply Applications

- Motivation for the GaN FET
- The meaning of traditional qualification—what does and does not carry over from Si reliability
- Intrinsic reliability of the GaN FET—dynamic Ron & TDDB
- Achieving application-reliable GaN—standardizing the approach (JEDEC JEP180)
- Surge robustness without avalanche

GaN Power Devices: Technology and Reliability-limiting Processes

- Overview of GaN Technology and advantages
- Charge trapping phenomena in GaN Devices
- Advanced methodology for stability investigations of GaN FETs

SiC Power Device Reliability

- Intrinsic reliability failure mechanisms and models
- FIT rate based on field failure data and terrestrial neutron radiation
- Product level reliability
- Reliability for high voltage and high humidity environments
- Product qualification
- Industry consortia qualification standards development

Matching Chip Requirements to the Application

- Motor drives
- Solar inverters
- EV chargers
- Traction drives

How WBG Switches are Reshaping Motor Drives

- Adjustable speed drives
- Integrated motor drives
- Design space and variables
- Efficiency, lifetime, and short circuit considerations

MV EV Fast Charger System

- Converter topology selection
- Device selection and characterization
- System modeling, simulations, and controls specification
- Prototype development and testing
- Schematics and PCB design, hardware assembly and testing
- Control code development and debugging
- System optimization to meet the design requirements

SiC and GaN High-Voltage Power Device Characterization for Converter Applications

- SiC device characterization for MV converters
- Commercial GaN device characterization for EV applications
- Gate drive isolation, short circuit protection and switching performance
- Solid state transformers and MV motor drives
- Autonomous grid connector—for grid interconnection of microgrid to grid/microgrid

Bidirectional SiC and GaN Switch Technology

- SiC and GaN bidirectional power flow applications
- GaN bidirectional switch with dual-gate configuration
- SiC bidirectional power transistor concepts
- Bidirectional circuit breakers and common-source-inverters

SCHEDULE

Tues., Nov. 7, 10:50 AM – 5:30 PM Eastern Daylight Time
Wed., Nov. 8, 11:00 AM – 5:30 PM Eastern Daylight Time
Thurs., Nov. 9, 11:00 AM – 5:30 PM Eastern Daylight Time