



WIDE BANDGAP DEVICES & APPLICATIONS VIRTUAL SHORT COURSE

OCTOBER 25-27, 2022

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

Elif Balkas, PhD

R&D Manager-Materials, Wolfspeed

Subhashish Bhattacharya, PhD

North Carolina State University

Tushar Dhayagude, PhD

VP of Field Applications and Technical Sales,
Transphorm

Peter Friedrichs, PhD

Vice President, SiC, Infineon

Don Gajewski, PhD

Manager of Reliability and Failure Analysis,
Wolfspeed

Thomas Jahns, PhD

University of Wisconsin-Madison

David Levett, PhD

Power Electronics Architect,
Rockwell Automation

Peter Losee, PhD

Director of Technology Development,
Qorvo/USiC

Srdjan Lukic, PhD

North Carolina State University

Michael MacMillan, PhD

Vice President of Worldwide Sales and
Marketing, Epiluvac

Alan Mantooth, PhD

University of Arkansas

Matteo Meneghini, PhD

University of Padova

Ramanan Natarajan, PhD

Marketing & Applications Manager,
Texas Instruments

Victor Veliadis, PhD

Executive Director & CTO,
PowerAmerica

For questions, contact Rogelio Sullivan at rasulliv@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.

SiC and GaN for Power Electronics: Two Markets Driven by Different Growth Engines

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

Electronic Packaging of Wide Bandgap Devices

- ▶ Basics of WBG power module packaging
- ▶ System level considerations for WBG power modules
- ▶ Advanced packaging technologies
- ▶ Power module design flow
- ▶ Case study of an integrated power module

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

Non CMOS Compatible SiC Fabrication

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

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

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

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

Matching Chip Requirements to the Application

- ▶ Tradeoffs and compromises for chip designers
- ▶ Design considerations for different applications
- ▶ Applications to be discussed: aviation, solar, servo drives, traction, energy storage/chargers and automotive

How WBG Switches are Reshaping Motor Drives

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

MV Fast Charger System Specifications and Design Requirements

- ▶ 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 High-Voltage and GaN 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

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

Topologies for High Voltage GaN Applications

- ▶ GaN advancements and new applications in the past 5 years
- ▶ Applications in the 45W to 10kW range
- ▶ Approaches and topologies for each power segment and market needs
- ▶ Power levels and topologies and the pros and cons of GaN, SiC and Si MOSFETs in various applications.

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

SCHEDULE

Tues., Oct. 25, 10:50 AM – 5:15 PM Eastern Daylight Time

Wed., Oct. 26, 11:00 AM – 5:15 PM Eastern Daylight Time

Thurs., Oct. 27, 11:00 AM – 5:15 PM Eastern Daylight Time