



# WIDE BANDGAP DEVICES & APPLICATIONS VIRTUAL SHORT COURSE

NOVEMBER 16-17, 2021

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

## COURSE BENEFITS

Enable power electronics engineers to incorporate SiC and GaN technology into products and systems, and fully utilize the benefits of this technology.

## COURSE OBJECTIVES

Provide the basics of SiC and GaN 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

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

**Elif Balkas, PhD**  
R&D Manager-Materials, Wolfspeed

**Tushar Dhayagude**  
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

**Iqbal Husain, PhD**  
Professor, North Carolina State University

**David Levett, PhD**  
Power Electronics Design and Applications  
Engineer, Infineon Technologies

**Alan Mantooh, PhD**  
Professor, University of Arkansas

**Michael MacMillan, PhD**  
Vice President of Worldwide Sales and  
Marketing, Epiluvac

**Burak Ozpineci, PhD**  
Section Head, Vehicle and Mobility Systems  
Research, Oak Ridge National Lab

**Victor Veliadis, PhD**  
Executive Director and CTO, PowerAmerica

**Fred Wang, PhD**  
Professor, University of Tennessee, Knoxville

For questions, contact Rogelio Sullivan at [rasulliv@ncsu.edu](mailto:rasulliv@ncsu.edu).

## COURSE FEE

\$100 Student  
\$300 PowerAmerica member  
\$500 PowerAmerica non-member

## LOCATION

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

REGISTRATION ONLINE AT:  
[PowerAmericaInstitute.org/shortcourse](https://PowerAmericaInstitute.org/shortcourse)

# SCHEDULE

NOV. 16, 11 a.m.–5:30 p.m. Eastern Time

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# WIDE BANDGAP DEVICES & APPLICATIONS VIRTUAL SHORT COURSE

## COURSE OUTLINE

### SiC Power Device Technology and System Benefits

- ▶ Low cost wafer technologies
- ▶ Designing reliable power transistors
- ▶ Chip packaging and smart driving ecosystem
- ▶ System benefits and value propositions

### SiC Power Devices: Volume Applications, Market Outlook and Introduction to Fabrication

- ▶ High volume applications
- ▶ Accelerating commercialization and the U.S. SiC foundry infrastructure
- ▶ Introduction to SiC power device fabrication

### SiC Bulk Substrate: Advantages, Challenges and Solutions

- ▶ Crystal Growth
- ▶ Defects in SiC
- ▶ Substrate Processing: Surface Quality, Flatness
- ▶ 200 mm R&D

### Silicon Carbide Epitaxy for Beginners

- ▶ SiC epitaxy – basics of growth
- ▶ Substrates
- ▶ Growth Parameters
- ▶ SiC epitaxy tools
- ▶ Types of tools currently in use
- ▶ Next generation tools and techniques
- ▶ Characterization techniques and requirements for commercial epi
- ▶ Thickness and Doping Accuracy and Uniformity
- ▶ Defect types and control

### 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

### Optimizing SiC MOSFET chip and package design to match specific application requirements

- ▶ 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

### Power Electronics for Electric Vehicles

- ▶ Electric Traction Drives for passenger Electric Vehicles
- ▶ Extremely fast wired and wireless chargers
- ▶ Gaps, challenges, and opportunities
- ▶ Capacitor, power module, and heat sinks
- ▶ Power Electronics Needs for medium and heavy duty vehicles

### WBG Power Electronics Driving High-Speed Electric Machines for Electric Vehicles

- ▶ Powertrain for electric vehicles
- ▶ WBG traction inverter for high-speed electric machines
- ▶ WBG circuit design for high frequency, high temperature operation and EMI suppression
- ▶ Interaction of WBG drives with machines
- ▶ System benefits of WBG insertion
- ▶ Inverter testing and e-motor emulation

### GaN Power Devices and Applications Reliability

- ▶ 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

### 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

### High Voltage SiC-Based Power Conditioning System

- ▶ Development for Grid Applications
- ▶ 10 kV Device Characterization
- ▶ Driving and Protection
- ▶ Isolated Power Supply Control
- ▶ PCS Design and Testing
- ▶ Grid Supporting Function Validation

### Application of 650V GaN in 45W to 10kW Power Levels

- ▶ 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 need
- ▶ Power levels and topologies and the pros and cons of GaN and Si MOSFETs in various applications.