DEPARTMENT OF ENERGY TECHNOLOGY
AALBORG UNIVERSITY

PhD Public Defence

Title: Reliability of GaN-on-Si High-Electron-Mobility Transistors for Power Electronics Application

Location: Pontoppidanstræde 111, auditorium

Time: Wednesday 28 November 2018 at 13.00

PhD defendant: Sungyoung Song

Supervisor: Professor Stig Munk-Nielsen

Moderator: Associate Professor Szymon Michael Beczkowski

Opponents: Associate Professor Erik Schaltz, Dept. of Energy Technology, Aalborg University (Chairman)
Olayiwola Alatise, University of Warwick, UK
Yunzhong Chen, DTU, Denmark

All are welcome. The defence will be in English.

After the defence there will be an informal reception in Pontoppidanstræde 111 (coffee room).

DEPARTMENT OF ENERGY TECHNOLOGY
AALBORG UNIVERSITY

Abstract:

A Gallium nitride (GaN) power device is a promising candidate to replace silicon metal-oxide-semiconductor field-effect transistors (MOSFETs) at the market below a thousand volts. Several major companies have commercialized discrete GaN devices, and new products using the GaN devices are targeting mainly in various new markets. Despite this great interest, the reliability of the commercial power GaN devices is only being verified with the JEDEC standard designed for Si-based devices. Furthermore, we are being confronted with various failure phenomena uniquely related to GaN device technology. Therefore, it is significant to study the technology and the reliability of GaN devices to prepare for new defects that can occur in the field in the future and to verify the problem in advance.

The project focuses on understanding advanced commercial GaN device technologies and studying the reliability of a GaN device in power electronic application. The research had been conducted from three aspects; i) performance assessment using the figure of merits of commercial power GaN devices, ii) the reliability and failure mechanisms of the cutting-edge GaN device regarding thermal and thermo-mechanical stress, and iii) device design conditions to optimize the performance and the reliability of GaN devices. The outcomes of the Ph.D. project include i) the performance comparison results to their counterparts of representative commercial GaN devices and the development possibility of GaN power devices, ii) the failure mechanism analysis results and the new failure phenomenon of the cutting edge GaN power device under thermal and thermomechanical stresses, and iii) an experiment plan to find the best design condition for optimizing the performance and the reliability of GaN devices.