How can we help you?

Our customers benefit from our know-how in GaN-specialized cutting-edge high resolution microstructural characterization and failure analysis know-how combined with long term experiences of HEMT device technologies and industrial manufacturing processes. By helping our customers to understand the physics of defect formation and degradation mechanisms, we support an accelarated market integration for GaN-based RF and power devices.

Our research competences

- HEMT-technology and process characterization
- High-resolution device characterisation and failure analysis
- Enhanced defect localisation methods

We support our partners with

- identification and root cause analysis of electrical defects of HEMT transistors
- analysis of process-related structural defects and impurities
- exploration of degradation mechanisms
- the development and application of suitable analysis methods

Further information can be found here:

www.imws.fraunhofer.de

Fraunhofer IMWS

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We make wide bandgap semiconductors more robust.

Diagnostics for GaN technologies

09/2022

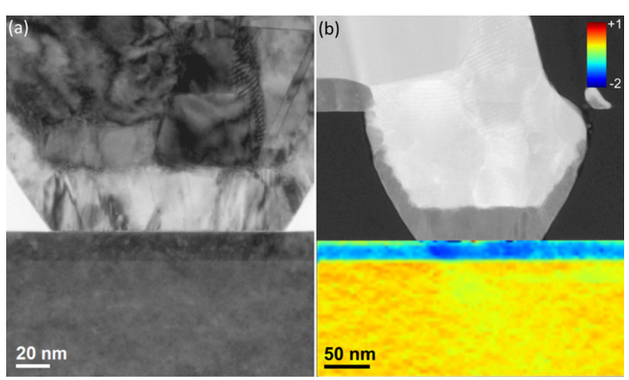
Diagnostics for GaN technologies

We can draw on many years of experience in high resolution microstructural characterization and advanced failure analysis of GaN HEMT technologies for RF and power electronic components.

The topics of saving global resources by increasing energy efficiency, mastering the problems of future digitalization and transforming the mobility systems are among the most significant problems society has to address today. A major target consists in developing powerful, efficient and reliable electronic devices for providing the required high-performing hardware components.

In this context, a huge potential for GaN-based semiconductor devices is currently arising, complementing traditional Si-based electronics. However, many questions with respect to lacking robustness and reliability causing significant failure risks during manufacturing and use, remain to be answered, thus forming road-blocking obstacles on the way to the mass market.

We work with our customers in researching and applying new tools and innovative solutions for identifying and understanding technology weaknesses, failure risks and degradation mechanisms limiting the lifetime of GaN devices.



(a) HRTEM image of the gate contact and (b) dark field STEM with overlaid strain map in the [002] direction.

HEMT-technology and process characterization

- High-resolution electron microscopy analysis of GaN EPI-substrates to identify and quantify crystal defects by means of atomic resolved (S)TEM / EDX / EELS
- Analysis of lattice matching and residual stresses in GaN-EPI layers by electron beam diffraction (NBED)
- Detection of process-related impurities within the GaN-EPI layers, substrates and interfaces to gate and ohm metal contacts and passivations by analytical HRTEM and TOFSIMS

High-resolution device characterisation and failure analysis

- Electron beam based current imaging (EBAC, EBIC) for the localisation of leakage paths and visualisations of pn-junctions in GaN EPI
- Localisation of electrically active defects in GaN-HEMT devices by using electroluminescence microscopy and high-resolution Lock-in Thermography
- Target preparation of local defects by using focused ion beam technology and analytical HRTEM to determine failure mechanisms and to understand the cause of stress-related degradation mechanisms in HEMT structures

Enhanced failure analysis methods

- Front and back side localisation using Lock-in Thermography on wafer and device level and spectrally resolved electroluminescence spectroscopy
- Electron beam-based imaging techniques (EBAC, EBIC, ECCI)
- Advanced FIB sample preparation and electron microscopy and TOFSIMS analysis

»Any defects that occur compromise quality as well as reliability and limit customer acceptance, cost efficiency and market potential. We support our customers in overcoming open issues concerning failure mechanisms and defect formation.«

Frank Altmann,
Head of Business Unit