

Tech Note: TN-002

LOCATING DEFECTS IN SUB-MICRON HIGH ELECTRON MOBILITY TRANSISTORS (HEMTs)

GaAs and GaN HEMTs with sub-micron dimensions are widely used for a wide variety of high frequency wireless communications applications, including smartphones and military electronics. These are applications requiring high reliability and long operating life. This Microsanj Technical Note illustrates how thermoreflectance thermal imaging can be used to analyze and detect small defects in a GaAs HEMT with sub-micron features.

The Microsanj NT220B Advanced High Resolution Thermal Imaging System with a 100x microscope objective and a white light illumination source is used for this example. Fig 1a shows the optical image of a failed die at 100x magnification and Fig 1b zooms in on the area where the HEMT defect is located. Fig 1c shows the thermal image of the hot spot caused by the defect with an applied bias to the device.

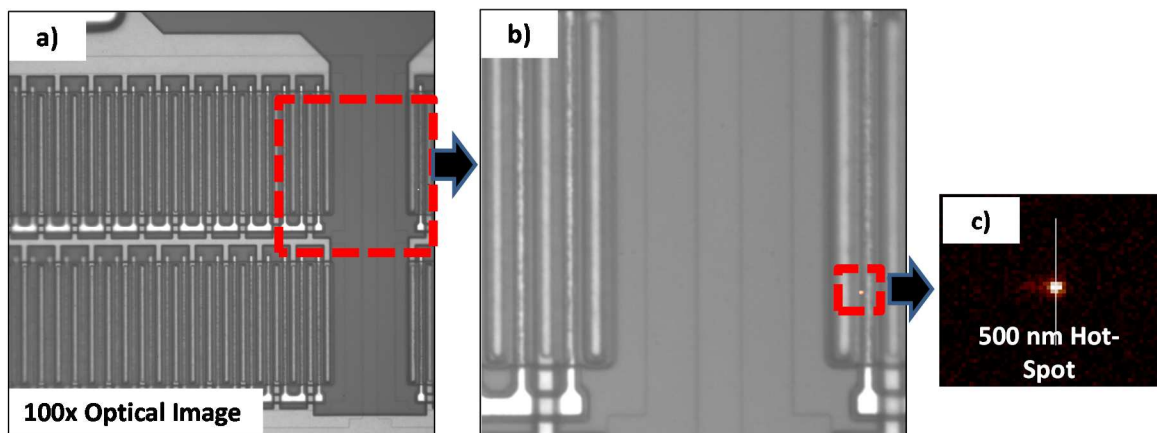


Figure 1: Optical and enlarged thermal image of the hot spot

Fig 2 shows the temperature profile through the hot spot, which has been determined to have a size of 500 nm at half the maximum temperature.

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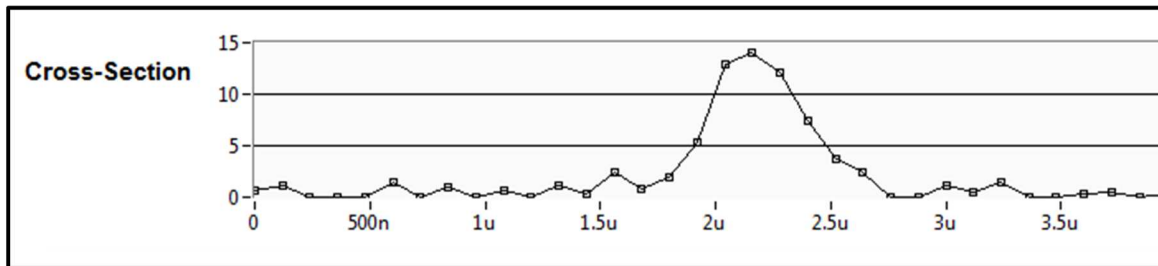


Figure 2: Temperature profile through the hot-spot shown in Fig 1c

Summary

Thermal imaging based on the thermorefectance principle has proven to be a valuable tool for detecting very small defects in HEMTs and other semiconductor devices with sub-micron features. Thermal imaging can be done quickly at the wafer level or at the device level to enable the screening of devices prior to shipment and help ensure that devices delivered to customers meet expectations for reliability and operating life.

References

- [1] AN-005: Detecting Hot-Spots and Other Thermal Defects on a Sub-Micron Scale in Electronic and Optoelectronic Devices
<http://www.microsanj.com/application-notes/detecting-hot-spots-and-other-thermal-defects-sub-micron-scale-electronic-and>
- [2] Understanding the Thermorefectance Coefficient for High Resolution Thermal Imaging of Microelectronic Devices
<http://www.electronics-cooling.com/2013/03/understanding-the-thermorefectance-coefficient-for-high-resolution-thermal-imaging-of-microelectronic-devices/>