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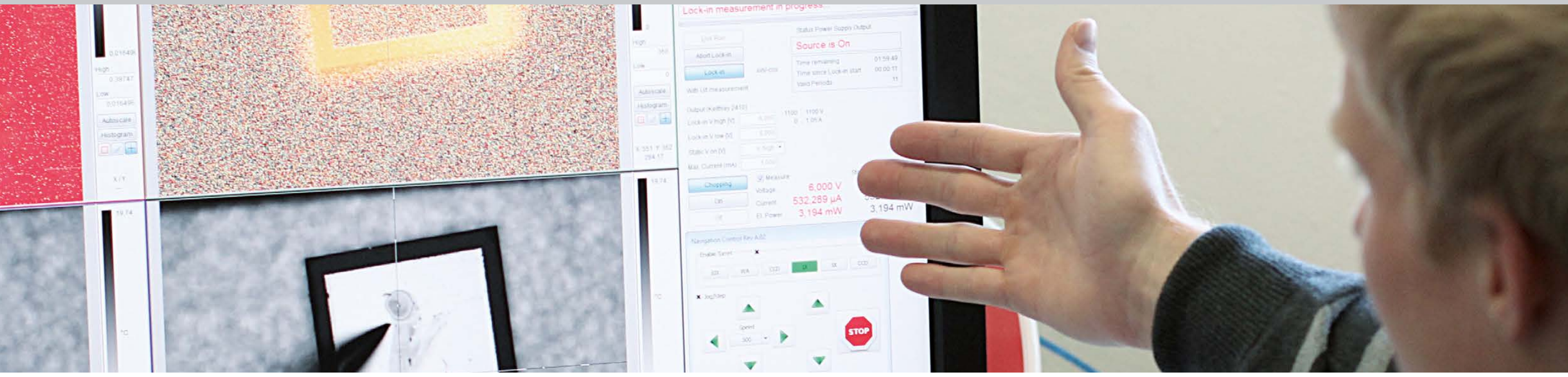

1 *Lock-In-Thermography in action*

LOCK-IN-THERMOGRAPHY

NON-DESTRUCTIVE LOCALIZATION OF ELECTRIC ACTIVE DEFECTS

Description of Lock-In-Thermography analysis

- Detection of failed power electronic devices such as IGBTs, MOSFETs, diodes and resistors
- Analysis of short circuits, ESD defects, oxide damages, edge termination defects, avalanche break down, whiskers and electrical conductive contamination
- High sensitivity for hot spot detection with a heat dissipation in the µW range
- 2D/3D defect localization for further destructive analysis to identify the failure mechanism

Special features

- Measurement voltage from mV up to 10 kV
- Decapsulation of mold compounds and silicone gels
- Chemical removal of chip topside metallization and contacts, for instance bond wires and ribbons out of different materials
- Follow-up investigations such as cross-sections, scanning electron microscopy, micro sections with focused ion beam
- Interpretation of test results and failure mechanisms
- Consultancy on the different investigated failure modes, for instance chip damage due to improper bond wire process parameters

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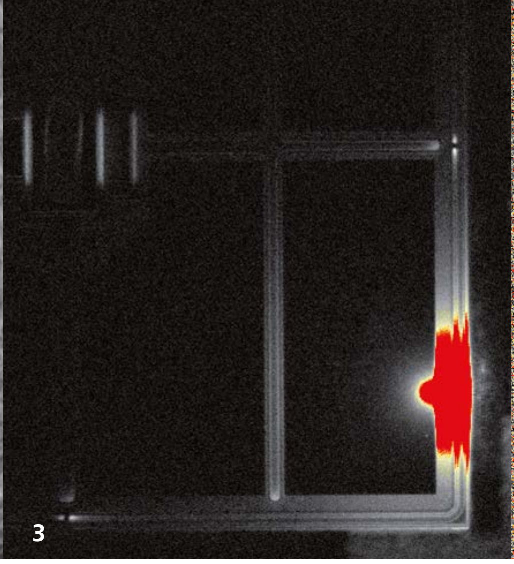


Analysis principle

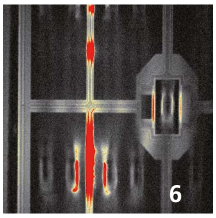
- The device under test is pulsed with the rectangular voltage by arbitrary Lock-In-Frequency (typical: 1 Hz to 25 Hz)
- Electrical defects dissipate thermal power
- Thermal power heats up the surface
- Measurement of infrared signal with infrared camera
- Acquisition of amplitude image as well as resulting time dependent step response (phase image)

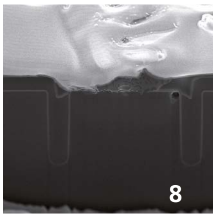
Advantages

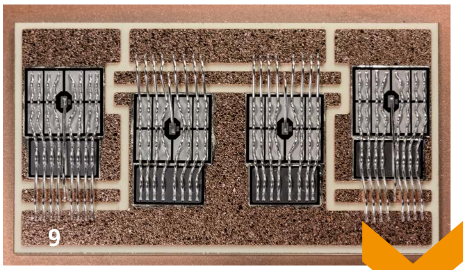
- Differential measurement principle
- Best suited for different emission coefficients of the device surface materials
- No influence of the ambient (temperature, reflections)
- Three different zoom lenses to investigate structures from complete power module to single IGBT cells

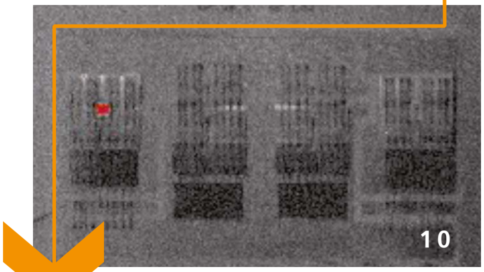
Application example

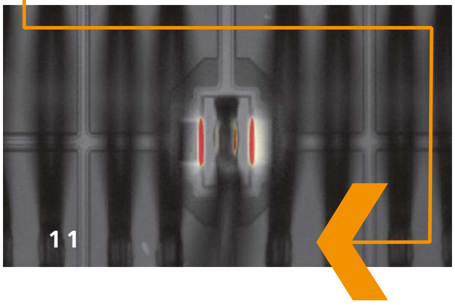
- After fabrication, a power module failed the final electrical quality test, for instance gate-emitter leakage current
- Lock-In-Thermography helps to detect which semiconductor is responsible for the leakage current and determines the exact position of the defect on the device
- The next step is to remove the bond wires and aluminum metallization from the semiconductor, followed by a second Lock-In-Thermography analysis to determine the location of the defect in the microscale
- An additional investigation could be a focused ion beam investigation with scanning electron microscopy to determine the cause of failure, such as a damaged gate structure











2 *Optical microscopy of IGBT*
3 *Lock-In-Thermography amplitude of IGBT*
4 *Lock-In-Thermography phase of IGBT*
5 *Demolded device*
6 *Topography*
7 *Cross-section*
8 *Focused ion beam*
9 *Power module*
10 *Lock-In overview*
11 *Lock-In detail*