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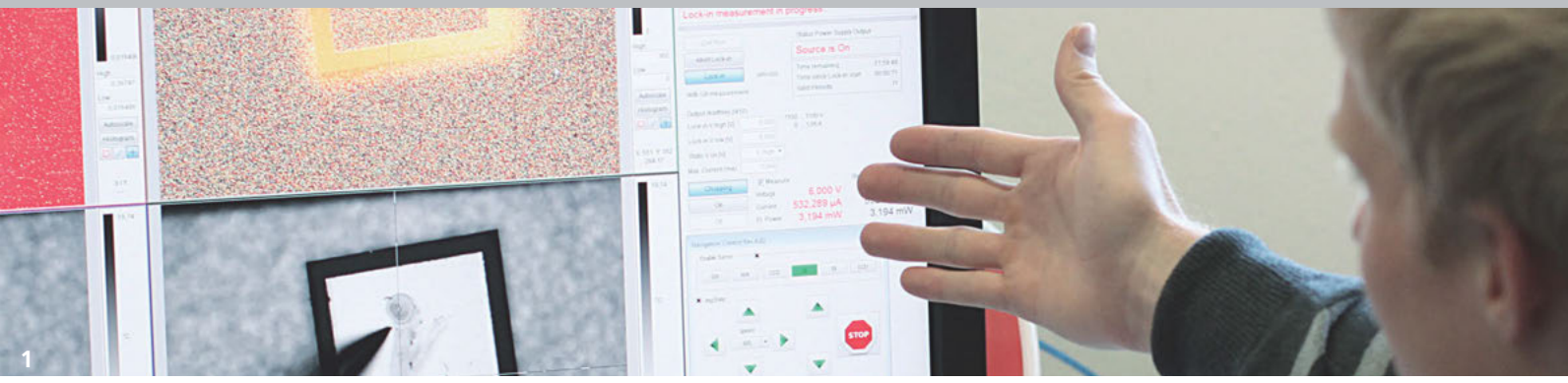

1 *Lock-In Thermography in action*

LOCK-IN THERMOGRAPHY

Non-destructive localization of electric active defects

Description of lock-in thermography analysis

- Detecting of failed power electronic devices such as IGBT, MosFETs, diodes and resistors
- Analysis of short circuits, ESD defects, oxide damages, edge termination defects, avalanche brake 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 as well as 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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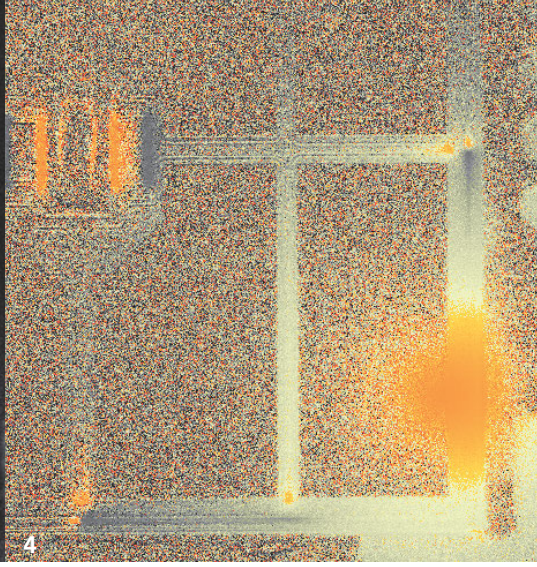


Analysis principle

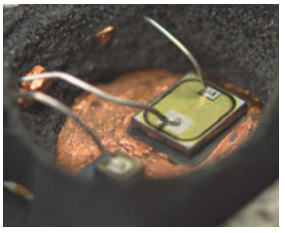
- The device under test is pulsed with the rectangular voltage by arbitrary lock-In frequency (typical: 1 to 25 Hz)
- Electrical defect dissipate thermal power
- Thermal power heats up the surface
- Measurement of infrared signal with infrared camera
- Acquisition of amplitude image as well as resulting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

Advantages

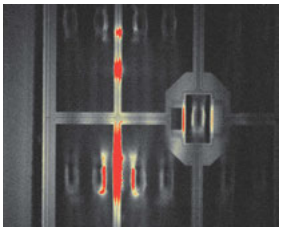
- Differential measurement principle
- Best suited for different emission coefficients of the device surface materials
- No influence of the ambient (temperature, reflections)
- Three different zoom lenses to investigate structures from complete power module to single IGBT cells

Application example

- After fabrication, a power module failed the final electrical quality test (e.g. gate-emitter leakage current)
- Lock-in thermography helps to detect which semiconductor is responsible for the leakage current and determinds the exact position of the defect on the device
- Next step consists of removing bond wires and aluminium-metalization of the semiconductor followed by a second lock-in thermography analysis to get the micro scale location of the defect
- An additional investigation can be a focused ion beam investigation with scanning electron microscopy to detect the cause of failure (e.g. damaged gate structure)

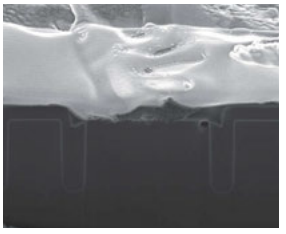


Demolded device

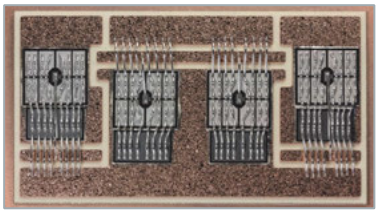


Topography

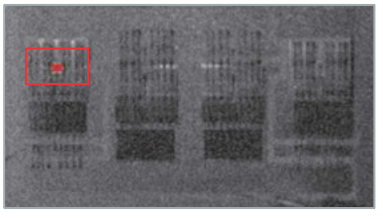
Cross section



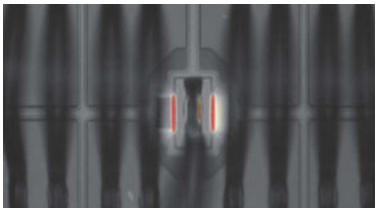
Focused ion beam



Power modul



Lock-in overview



Lock-in detail

2 *Optical Microscopy of IGBT*

3 *Lock-In Thermography Amplitude of IGBT*

4 *Lock-In Thermography Phase of IGBT*