Fraunhofer IISB

FRAUNHOFER INSTITUTE FOR INTEGRATED SYSTEMS AND DEVICE TECHNOLOGY

1 *Analysis and discussion of sinter layers by optical microscopy*

FAILURE-ANALYSIS OF ELECTRONIC DEVICES AND SYSTEMS

Destructive and non-destructive analysis for power electronics

Fields of research and service

- Investigation of field returns
- Characterization of samples accompanying in-house and external lifetime tests such as active power cycling
- Analysis of new packaging concepts and joining technologies, for instance sinter technology versus soldering
- Competitive analysis of power electronic systems, modules and devices like power electronics of hybrid vehicles
- Physics of failure analysis, material characterization for parameterization of existing lifetime models or enhanced ones
- Interpretation of test results and failure mechanisms such as edge termination break down of semiconductor devices
- Consultancy on the different investigated failure modes for instance chip damage due to improper bond wire process parameters

Analyzing methodes

- Non destructive techniques, for instance scanning acoustic microscopy
- Destructive techniques such as cross sections, focused ion beam or sheer tests

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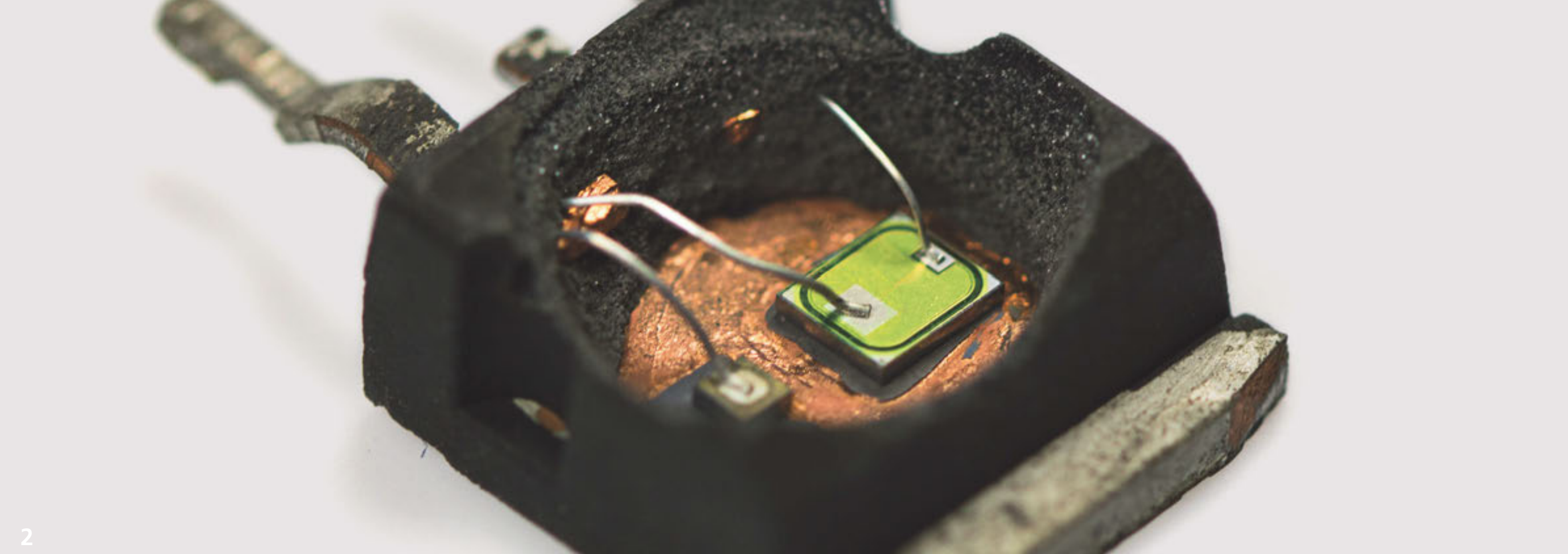


Destructive analysis

- Cross sectioning
- Optical microscopy (magnification up to 5000x)
- Scanning electron microscopy (SEM)
- Element analysis (EDX, distribution and quantity)
- Focused ion beam (FIB)
- 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
- Nano indentation, tensile tests under extended temperatures
- Shear, pull and peel tests

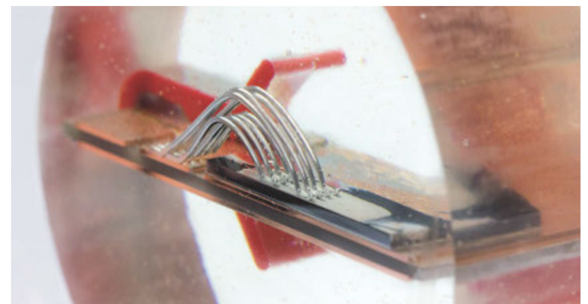
Non-Destructive analysis

- Scanning acoustic microscopy (investigation of voids, cracks, delamination)
- Partial discharge measurement for isolation quality investigations
- Ultra-violet imaging of discharge effects
- Infrared imaging, thermography for thermal resistance measurements
- Lock-In thermography for localizing of defects
- Eigenfrequeny measurement to determine cracks inside the material
- Static and dynamic electrical characterization

„Physics of Failure“ method

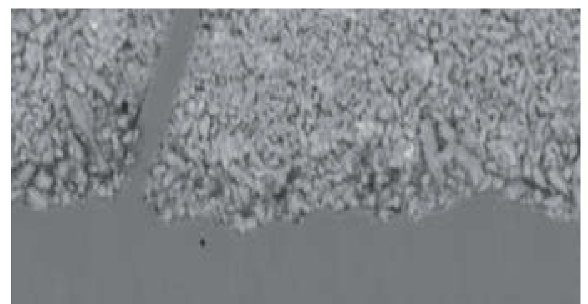
- The „physics of failure“ method asissts to get a better understanding of the reasons behind the symptom
- Fraunhofer IISB helps to ask the right questions for the interpretation of failure analysis
- Failure-Mode: What kind of failure effect? Short/ open circuit, heating, etc.
- Failure-Cause: What kind of process? Crack formation and growth, migration, corrosion, etc.
- Failure-Mechanism: What triggers the failure? Bond wires, solder layer, cooling, etc.
- Failure-Model: How can the failure be described? Mathematical/ statistical model, FEM simulation, etc.

2 *Demolded IGBT and diode of an D²Pack device*

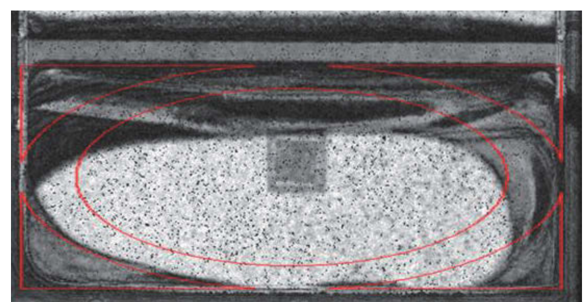


Cross section of IGBT power module

Focused ion beam analysis of an IGBT



Scanning electron microscopy



Scanning acoustic microscopy of an DBC substrate