SiC MODULES
DIE ATTACH TECHNOLOGIES AND RELIABILITY

Our objective

• From chip to power – research, development, and prototyping from one source

Features

• Conceptional investigations for SiC power modules
• Joining technology research like, e.g., silver sintering
• Various characterization equipment and know-how
• Wide lifetime testing capabilities like, e.g., power cycling
• Diverse analyzing of failure mechanisms like, e.g., µ-scale chip crack
• Lifetime modeling of power modules like, e.g., physics of failure method

Advantages

• Solutions from the system or application point of view
• Standing experience in power module research and development
• Complete process line from chip to package
• Complete process chain from package to lifetime model
• Short time from idea to prototype, always ready for any challenge

Benefits

• Innovative solutions and short response time
• Projects from small scale to complete technology investigations and transfer
FRAUNHOFER IISB OFFERS R&D SERVICES ON SiC FROM MATERIALS DEVELOPMENT AND PROTOTYPE DEVICES TO MODULE ASSEMBLY AND MECHATRONIC SYSTEMS.

Module assembly and die attach technologies

Module design
- Conceptional investigations
- Design for electrical, thermal, mechanical, and lifetime constraints
- Electrical and thermal simulations

Manufacturing and packaging including advanced joining technologies
- Soldering for standard and high-temperature applications
  (vapor-phase vacuum soldering system / formic-acid-activated IR vacuum reflow)
- Silver sintering with enhanced automatic die placer and servopress
  (single and double sided / multichip power modules)
- Wire bonding of different materials and diameters with automatic bonders

Characterization
- Dynamic switching / static device performance
- High speed imaging / infrared imaging
- Thermal resistance ($R_{th}$) / impedance ($Z_{th}$) measurement

Reliability and failure analysis

Accelerated aging
- Passive temperature cycling via air in two-chamber shock oven from -80 °C to +300 °C
- Passive temperature cycling tests for liquid cooled power electronic systems from -25 °C to +90 °C
- Active power cycling with up to 20 devices in one test and a wide range of parameter sets
- Environmental tests for power modules and passive components (like H3TRB and others) with temperature, humidity, AC and DC voltage

Analysis of failure mechanisms and modeling
- Package decapsulation / removal of soft gel
- Scanning Acoustic Microscopy (SAM), Scanning Electron Microscopy (SEM)
- Focused Ion Beam (FIB) with elementary analysis (EDX)
- Lock-in thermography (LIT)
- Partial discharge
- Electro-thermo-mechanical simulation of power modules including reliability prediction
- Physical and empirical lifetime modeling for, e.g., gate oxide reliability and electromigration