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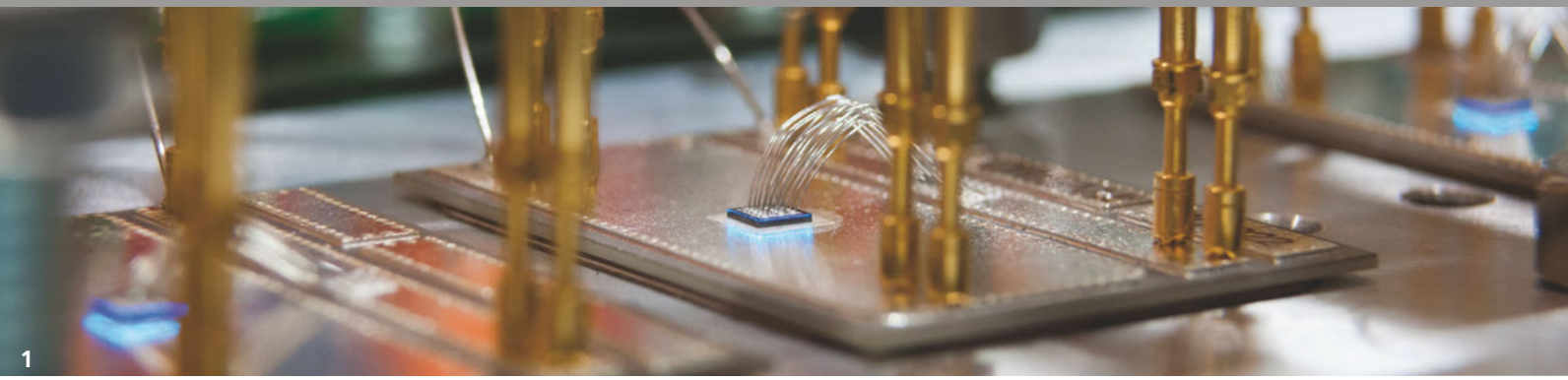

1 *Silicon Carbide merged PiN Schottky diodes emitting blue light during power cycling test.*
Image: Fraunhofer IISB

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

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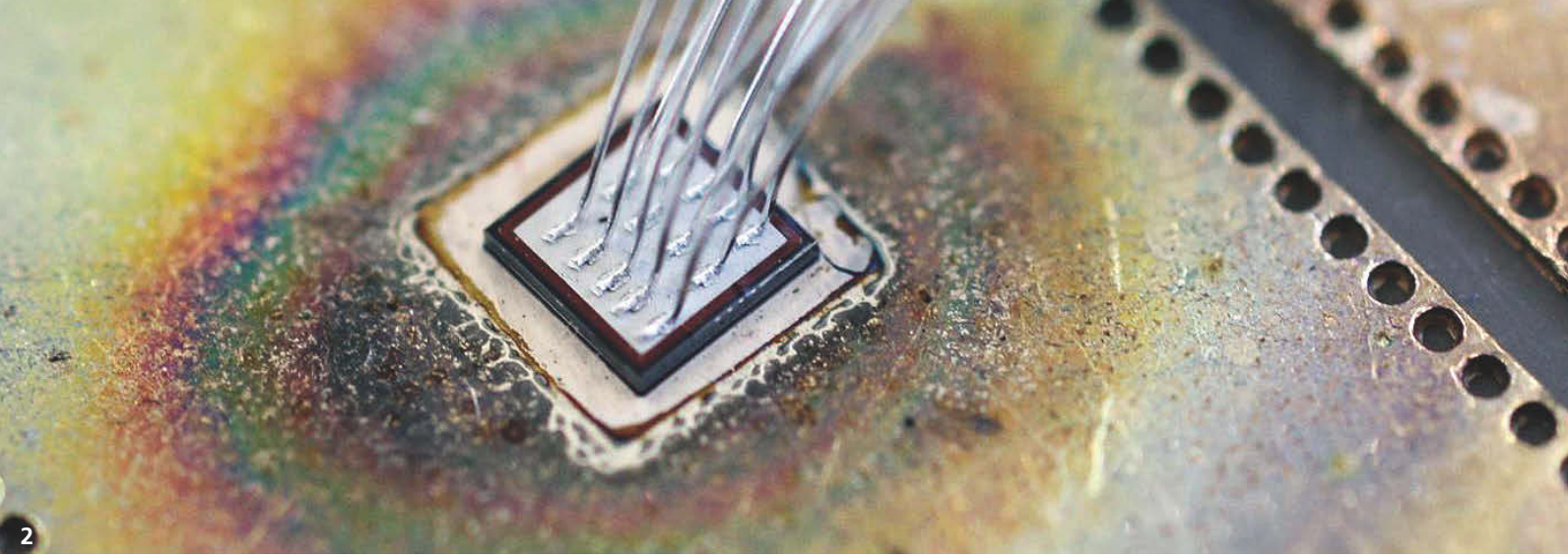

FRAUNHOFER IISB OFFERS R&D SERVICES ON SiC FROM MATERIALS DEVELOPMENT AND PROTOTYPE DEVICES TO MODULE ASSEMBLY AND MECHATRONIC SYSTEMS.

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

2 *Silver-sintered SiC device on insulating substrate operated at high temperature.*
Image: Fraunhofer IISB

3 *Simulated temperature distribution in SiC power module consisting of 96 SiC PiN diodes.*
Image: Fraunhofer IISB