



1 *Double sided silver sintering of power semiconductors; design study of various top side ribbons for extended life time and processability*

PACKAGING FOR ELECTRONICS

HIGH LIFE TIME, HIGH TEMPERATURE AND EXCELLENT RELIABILITY

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Conceptional investigations

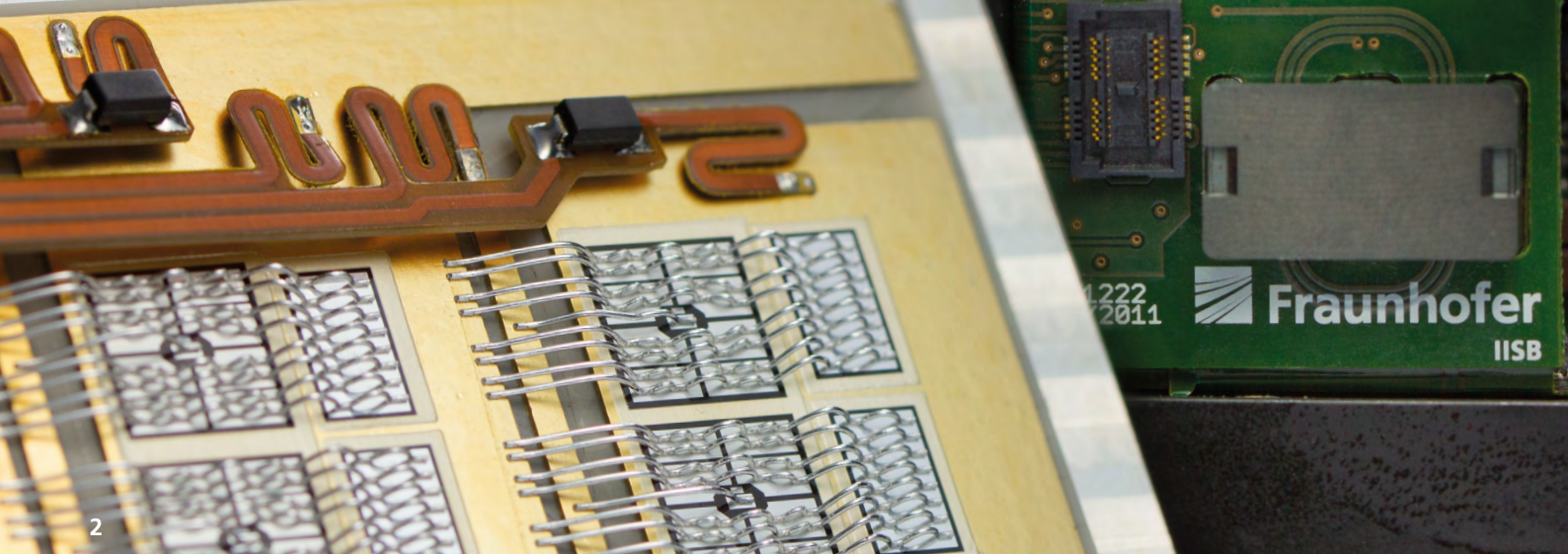
- Evaluation of cooling concepts, liquid and air, single and double sided cooling, heat spreading
- Life time improvement by matching and minimization of coefficients of thermal expansion (CTE) for different components and materials
- Designs with and without baseplate
- Design for electrical, thermal, mechanical and life time constraints
- Low parasitic inductance commutation cells especially for SiC and GaN
- High temperature applications up to 300 °C junction

Silver sintering

- Pressureless and pressure assisted (up to 75 kN) process for small and large areas
- Single and double sided semiconductor devices
- Multichip power modules using pre-attaching
- Selective sintering on populated circuit boards or in cavities of busbars
- Sintering of active and passive components
- Sintering on DBC, PCB and leadframe
- Screening of different sinter materials

Soldering

- Standard lead free tin-based and high-temperature alloys
- Void-free soldering with paste and preform material



Wire and ribbon bonding

- From 25 μm gold wire to 500 μm copper wire
- Different materials such as gold, aluminum, copper and composites

Prototyping

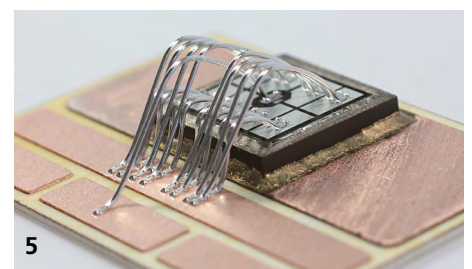
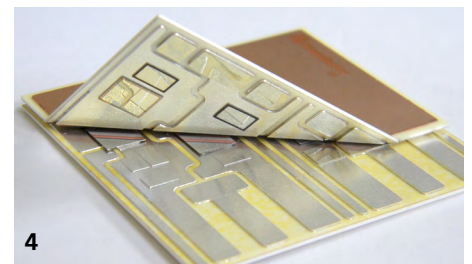
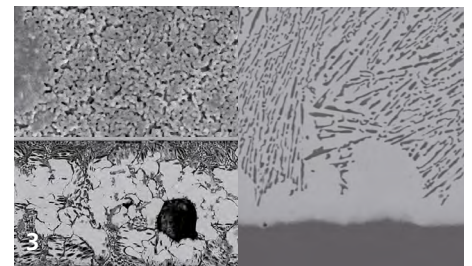
- Material selection including housing and potting
- Procurement of materials
- Small-scale production and qualification

Testing

- Static and dynamic thermal measurements from chip to coolant
- Thermal measurements with thermography
- Static electrical characterization
- Dynamic switching characterization
- Scanning acoustic microscopy
- Shear, pull, peel test
- Active power cycling
- Passive temperature cycling

Equipment

- Multi-physics simulation tools (electro-thermo-mechanical), CAD
- Plasma cleaning and activation of surfaces
- Printer for paste materials
- Vapor-phase vacuum soldering
- Formic acid-activated infrared vacuum reflow
- Hydrogen-activated infrared vacuum reflow
- Full automatic die placer with high temperature and extended tool force capability
- Automatic wire and ribbon bonders (aluminium, copper, composites, and gold)
- Servo press for sintering
- Ultrasonic and resistance welding machines for electric terminals



2 Inverter building block for the IISB electric vehicle technology demonstrator; robust concept with directly cooled CTE matched baseplate, full aluminum approach, integrated gate driver, current sensor and DC link capacitor (600 V IGBT half bridge)

3 Cross section of silver sintered, gold-germanium, aluminum-zinc and high lead-soldered bond lines

4 Double sided cooled sintered power module

5 Head spreading and CTE matching by graphite