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FRAUNHOFER INSTITUTE FOR INTEGRATED SYSTEMS AND DEVICE TECHNOLOGY

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

PACKAGING FOR ELECTRONICS

High Lifetime and Reliability

Conceptional investigations

- Evaluation of cooling concepts, liquid and air, single and double sided cooling, heat spreading
- Lifetime improvement by matching and minimization of material's coefficients of thermal expansion (CTE)
- Designs with and without baseplate
- Design for electrical, thermal, mechanical and lifetime 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 75kN) process for small and large areas
- Single and double sided semiconductor devices
- Multichip power modules using pre attaching
- Selective sintering on populated circuit boards
- Sintering of active and passive components
- Sintering on DCB, PCB and leadframe
- Screening of different sinter material

Soldering

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

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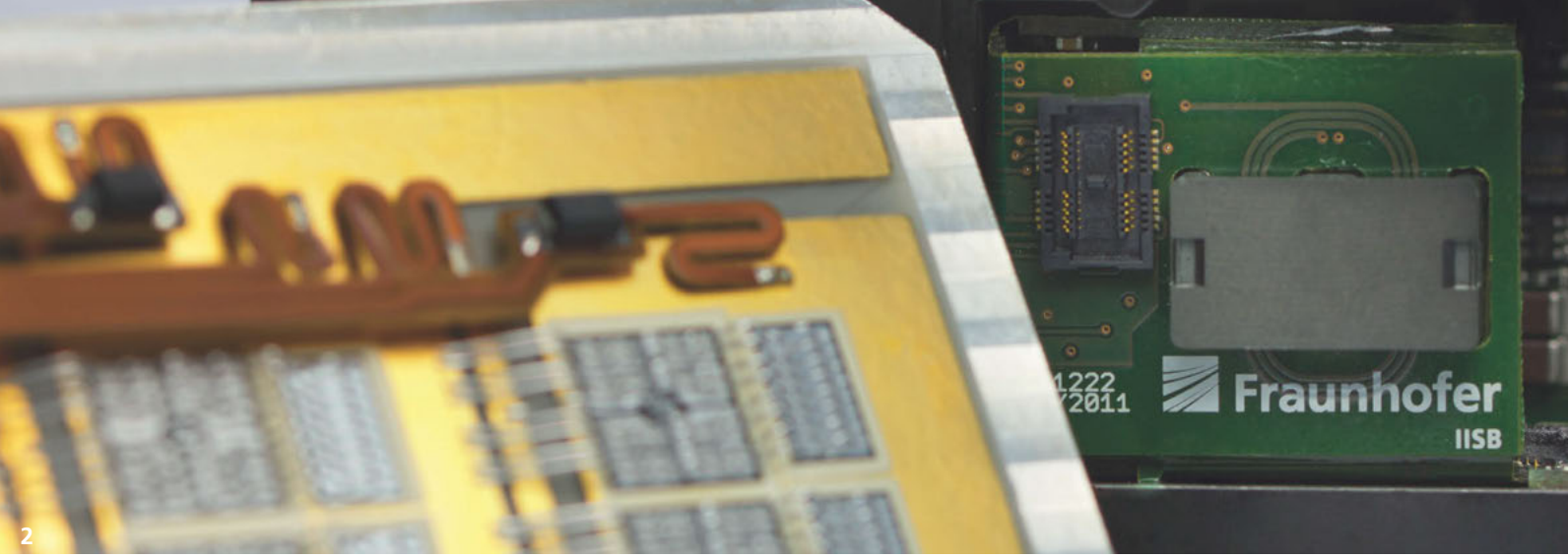


Wire and ribbond bonding

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

Prototyping

- Material selection including housing and potting
- procurement of material
- Small-scale production

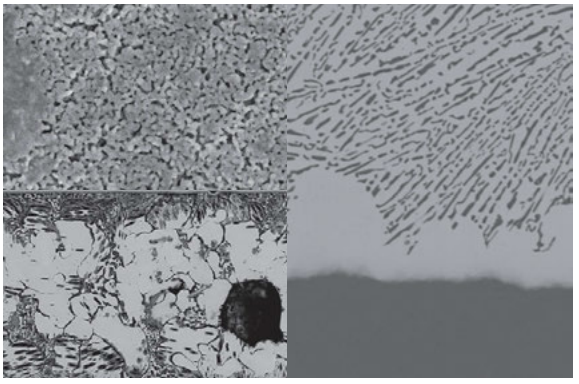
Testing

- Static thermal measurements from chip to coolant
- Dynamic thermal measurements
- Static electrical characterization
- Dynamic switching characterization
- Scanning acoustig microscopy
- Shear, pull, peel test
- Active power cycling
- Passive temperature cycling

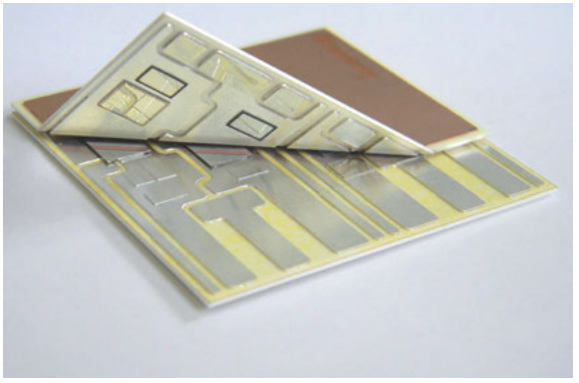
Equipment

- Multi-physics simulation tools (electro-thermo-mechanical), CAD
- Plasma cleaning
- Printer for paste material
- 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

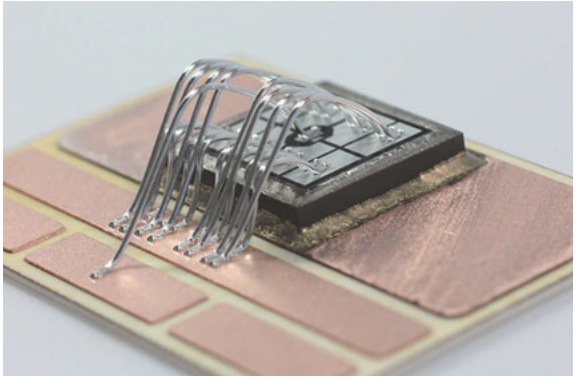
2 *Inverter Building Block for the IISB electric vehicle technology demonstrator; robust concept with direct cooled CTE matched baseplate, full aluminium approach, integrated gate driver, current sensor and DC link capacitor (600 V IGBT half bridge)*



Cross section of a silver sintered, gold-germanium, aluminium-zink and high lead soldered bond lines



Double sided cooled sintered power module



Head spreading and CTE matching by graphite