Power Modules

Packaging & Prototyping

Reliability & Lifetime

Fraunhofer IISB

Fraunhofer Institute for Integrated Systems and Device Technology IISB

SiC MOSFETs embedded in DBC substrate with vias
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Future Power Electronics Solutions

High Temperature Packages for WBG Semiconductors

Features

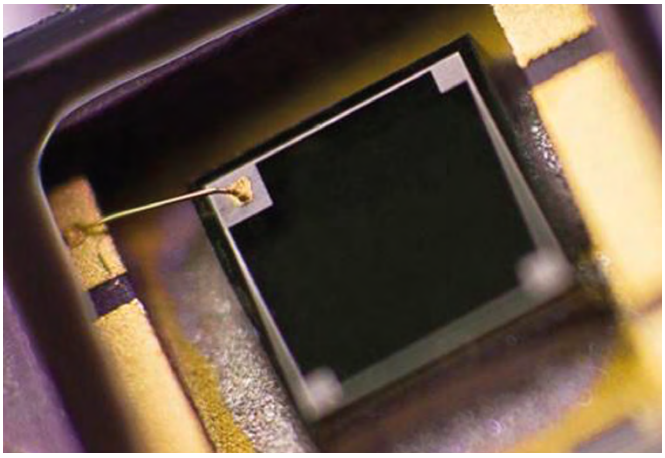
- High temperature capability ≥ 250 °C
- High active and passive cycling capability
- Double sided cooling
- Fast switching with WBG, high power density
- Flexible design of 3-dimensional integrated power modules
- High current carrying capability, thick copper metallizations

Packaging concept

- Embedding of WBG devices in ceramic substrates
- Double sided sintering of WBG devices in ceramic substrates
- Ceramic insulation, Al_2O_3 / AlN / Si_3N_4
- Thick aluminum and copper metallizations ≤ 800 µm
- Soldering and silver sintering technologies
- Vias in multilayer DBC stacks

Applications

- Electric vehicles
- Aerospace
- Railway & tramway
- Space and defense
- Solar inverters
- Down hole oil drilling
- Sensor technologies
- Geothermal instrumentation



Mounted 4H-SiC UV-sensor © Anja Grabinger / Fraunhofer IISB

Ceramic embedding

- Laser structuring of ceramic substrates
- Soldering or silver sintering of devices
- Filling of vias
- Sealing and stacking of embedded package

Double sided sintered power module

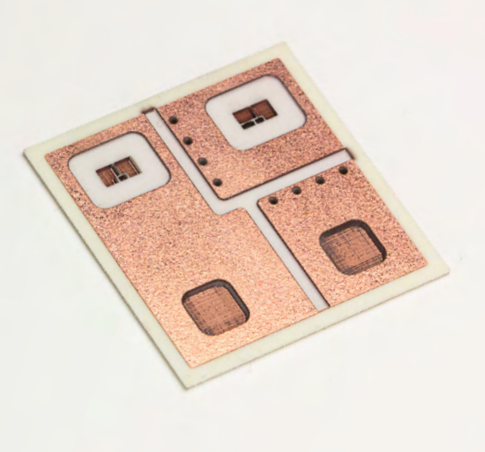
- DBC sandwich concept
- Two level etching of substrate metal
- SiC devices sinterable on both sides
- Laser welding of metal housing

Vias in DBC substrate

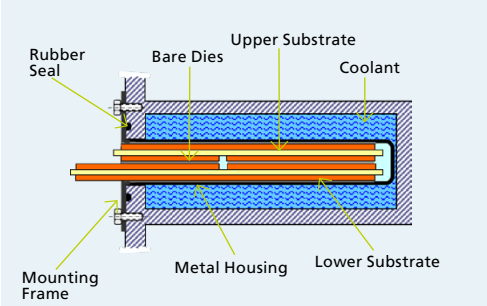
- Laser drilling of blind-holes or through-holes
- Via filling by stencil printing, dispensing or mechanical pressing
- Via materials as silver paste, copper paste or copper rivets

4H-SiC high temperature sensing & electronics

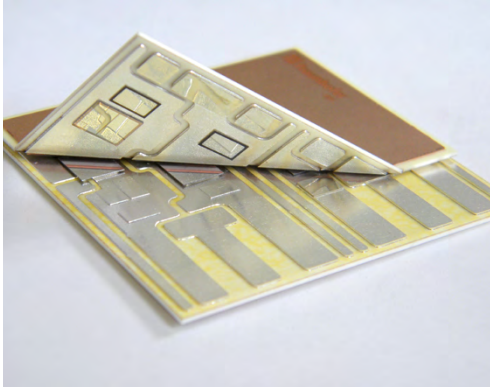
- Mixed-signal circuits operating at temperatures beyond 250 °C
- Combination of sensing function with on-chip amplification and Smart-Power IC for actuation
- Temperature-sensitive diodes operating in constant current forward bias mode (CCFB)
- High sensitivity (dV/dT) up to 4.5 mV/K
- High linearity up to 500 °C



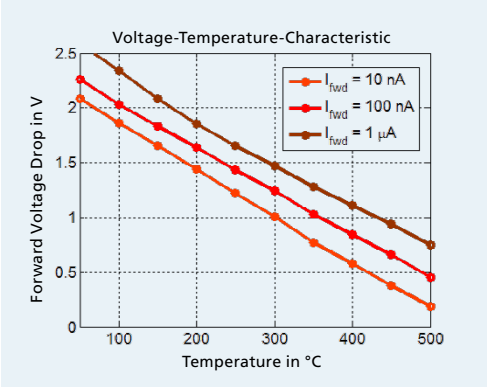
SiC devices embedded in a DBC substrate © Fraunhofer IISB



Concept of double-sided power module © Fraunhofer IISB



SiC devices double sided sintered in DBC substrates © Fraunhofer IISB



V-T-characteristic of a 1.3 mm² temperature sensor in CCFB mode © Fraunhofer IISB

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