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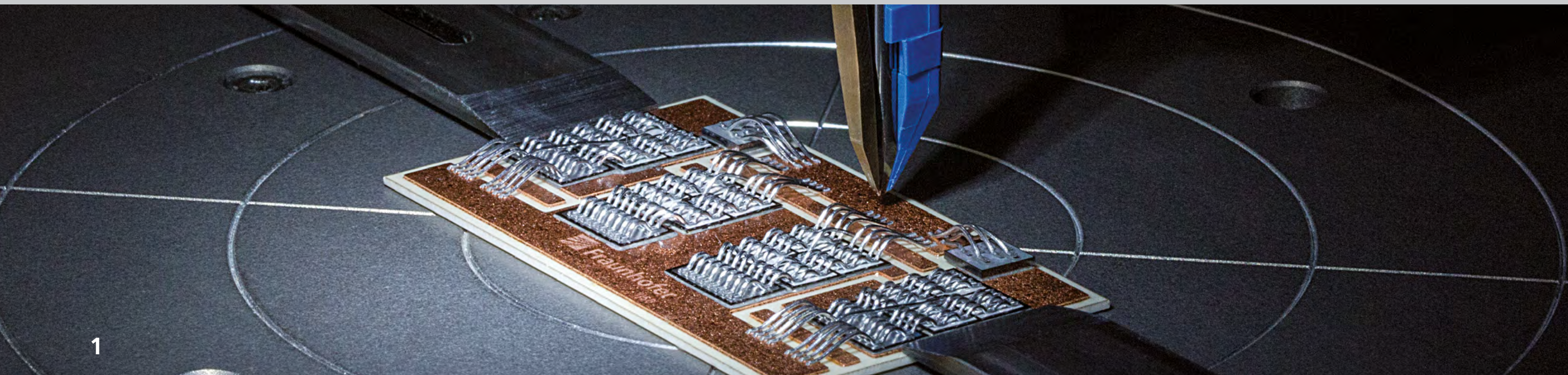
FRAUNHOFER INSTITUTE FOR INTEGRATED SYSTEMS AND DEVICE TECHNOLOGY



1 *Automated wire bonding of power electronic modules*

WIRE BONDING

TOPSIDE CONNECTION FOR SEMICONDUCTORS

Research fields

- New materials for bond wires, like copper, composites or alloys
- Influence of bonding parameters, geometry and materials on reliability and life-time optimization
- Metalization and surface optimization of semiconductors for bondability
- Cleaning processes to achieve reliable bond connections
- Correlation between bonding parameters and lifetime using power cycling tests

Our services

- Aluminum and copper wedge/wedge bonding with diameters from 100 µm to 500 µm
- Ribbon bonding
- Gold ball bonding with diameters from 25 µm to 75 µm
- Heatable chuck for bond process under temperature for up to 200 °C
- Quality assurance by pull and shear tests
- Control of reliability and life time by active power cycling test, passive temperature cycling and vibration tests
- Design of experiment techniques to optimize bonding parameters

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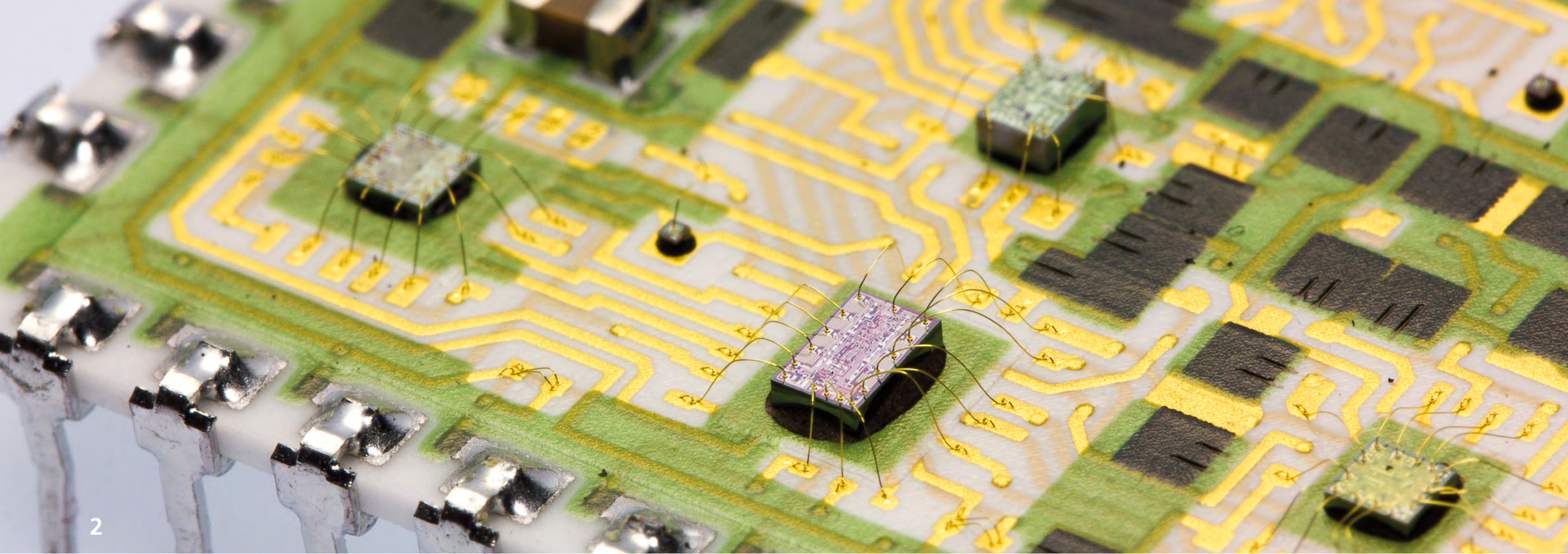


Functional principle

- Ultrasonic bonding works with high-frequency acoustic vibrations under pressure creating solid-state welded joints
- For aluminum wedge/wedge-wire bonding ultrasonic energy is applied to the wire for a specific duration while being held down by a bond force
- Thermosonic gold bonding includes heat treatment and can be used to form solid-state bonds below the melting points of the mating metals
- For ball bonding, a gold ball is formed before the bonding process by melting the end of the wire applying a high voltage

Devices and packaging

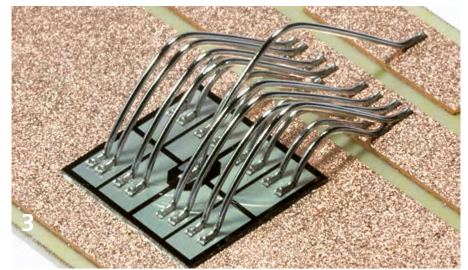
- Power electronic modules
- Discrete semiconductors
- Si, SiC, and GaN devices
- Surfaces providing best weld solutions: aluminum, copper, gold, and silver
- Various material combinations of wires and surfaces - please refer to table below

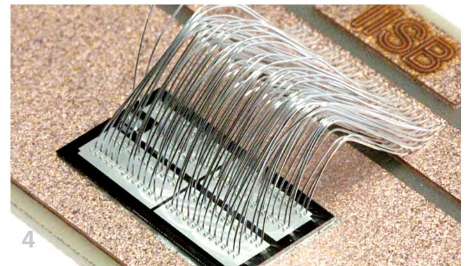
Bonder features

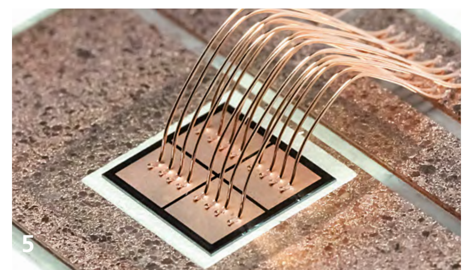
- Semi-automatic bonding process
- Programmable bond layouts
- Deformation limit control
- Image recognition of semiconductors and substrates
- Large area modules as well as small microelectronic devices bondable
- Fast changing/mounting of bond heads and pull or shear heads

Table of materials combinations

Wires	Surfaces						
	Al	Cu	Au	Ni	Pd	Ag	Sn
Al	✓	✓	✓	✓	✓	✓	✓
Cu	✓	✓	✓	✓	x	✓	x
Au	✓	x	✓	✓	x	✓	x
Pd	✓	x	x	x	x	✓	x
Ag	✓	✓	✓	✓	✓	✓	x
Sn	✓	x	x	x	x	x	✓







2 *Gold wire (25 µm)*
3 *Aluminum wire (125 µm)*
4 *Aluminum wire (375 µm)*
5 *Copper wire (250 µm)*