



# Fraunhofer

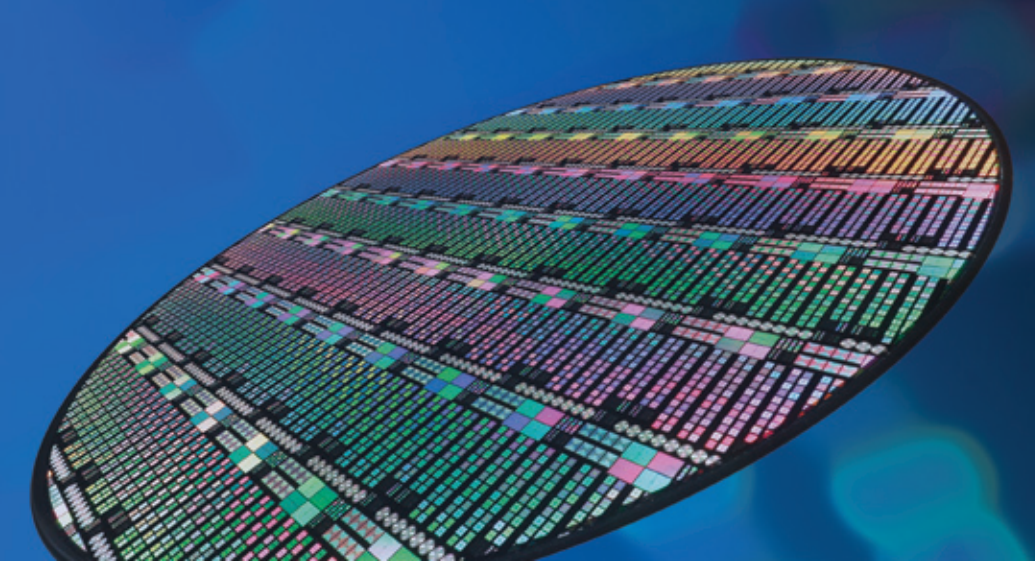
ISIT

FRAUNHOFER-INSTITUT FÜR SILIZIUMTECHNOLOGIE ISIT

## POWER ELECTRONICS

| RESEARCH | INNOVATION | PRODUCTION | QUALITY | RELIABILITY |





*PowerMOS wafer with  
R&D testchips*



*High voltage wafer probing*

## POWER ELECTRONICS AND IC TECHNOLOGY

The power electronics and IC technology department develops and manufactures active integrated circuits as well as discrete passive components based on a qualified production technology.

With regard to power devices the ISIT activities are focussed on smart power chips, IGBTs, PowerMOS circuits and diodes. In this context application specific power devices and new device architectures are special R&D areas. Application specific chip design and monolithic integration of e.g. sensor elements for temperature and current sensing are special items for customized power chip fabrication.

The development of new processes for advanced power device assembly on wafer level is a further important research topic. This comprises e. g. special chip metallization processes suitable for solder and sinter techniques and novel methods for backside processing of ultra thin Silicon substrates. Here, new carrier concepts for ultra thin wafer handling compatible with laser anneal technique are of special interest.

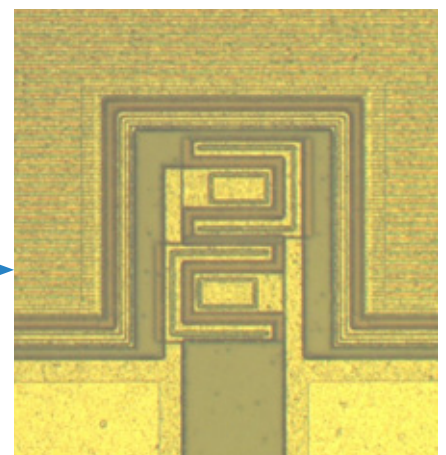
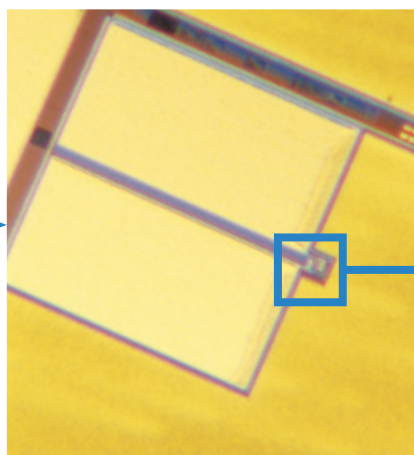
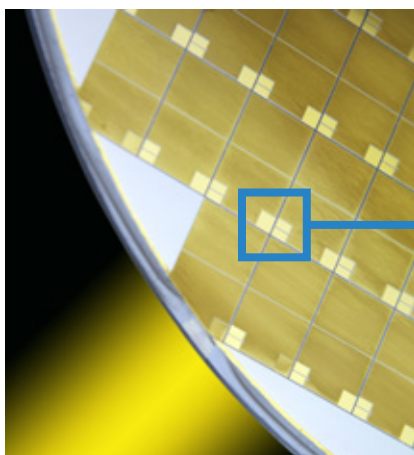
The electrical device characterisation is available for static and dynamic measurements on wafer and module level. Moreover the lock-in thermography enables failure analysis with high spatial resolution.

All activities are supported by simulation, tests, and design capabilities.

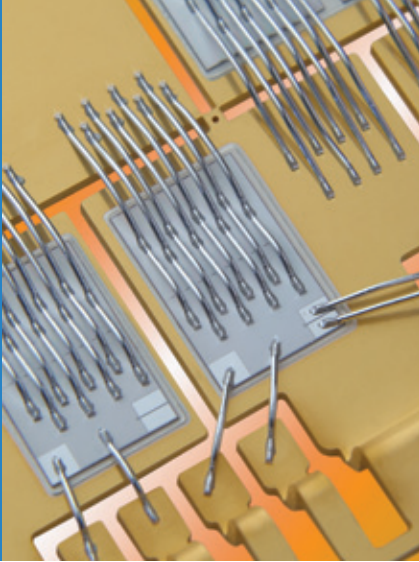
In the field of passive components ISIT is focussed on capacitors, precision resistors and inductors fabricated on wafer level. This includes development of new materials and its integration into existing manufacturing processes.

Based on a qualified production technology ISIT offers the development of individual processes, process modules and complete process sequences for customer specific applications in small and medium sized quantities.

*Application specific PowerMOS device with temperature sense and Ni-Au metallisation*



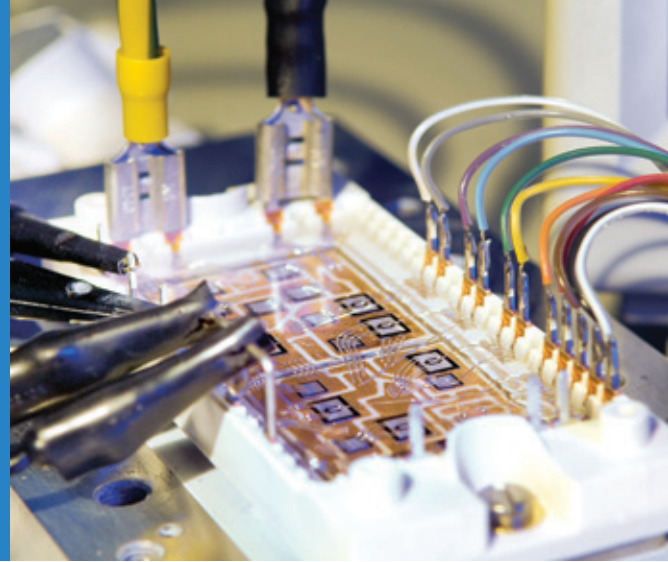




*Lead frame for mould module  
with PowerMOS devices*



*Ultrathin (20 µm) wafer with  
PowerMOS devices*



*Test of a power module  
(Danfoss Silicon Power)*

## QUALITY AND RELIABILITY IN POWER ELECTRONICS

Since many years, the department Module Integration has dealt with the examination, assessment, and quality evaluation of components, component parts, modules, microsystems, and discrete components both in electronics and in power electronics. ISIT can evaluate modules and processes following industrial standards and can advise improvements concerning assembly and joining methods. Test and qualifying possibilities range from electrotechnical techniques to destroying metallurgical examination methods.

Also customized assemblies can be realized. Static and dynamic measurements and the assessment of switching behaviour can be offered as well as the measurement of minimal leaking currents and resistances for e.g. verifying data sheets or ensure quality requirements. Systematic test methods enable an examination of wire bond or solder joint reliability. Herewith it is possible to simulate different environment conditions and implicate them into the

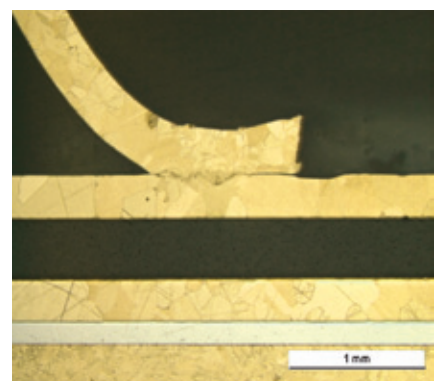
examinations. Another focus is laid on the thermal assessment of components and microsystems. Special testing methods allow the thermal characterization of particular components or assemblies in modules. Measurements of the thermal resistance or the thermal conductivity also can be conducted. Thermal simulations help to define the necessary cooling capacities and show particular weak sites in the interior of modules. Evaluations for the identification of material induced problems in joints are accomplished and, when indicated, matched with data from experiments.

Another field of work is the failure analysis. ISIT has a long-term experience in the field of detecting causes of assembly failure. The assessment is carried out with optical, electrical, and mechanical methods. With these methods unusual or very complex defects can be detected and analysed. The investigations at ISIT are helpful for a continuous improvement of safeness and reliability of assemblies, modules, and systems. In the laboratories of

module integration currents in the range of kA can be generated, the measurement range starts at a few femto ampere and reaches up to several kA.

In the field of power electronics ISIT coordinates the competence center KLSH (Kompetenzzentrum Leistungselektronik Schleswig-Holstein) which was founded in close cooperation with universities and companies of the federal country Schleswig-Holstein. Fraunhofer ISIT is a competence center within the European Center for Power Electronics (ECPE).

*Metallographic cross section of  
a Cu wire bond*





*Electrical characterization of power modules*



*IC production in the ISIT cleanroom*

## SERVICE OFFERS IN FRAUNHOFER ISIT

### IC and Power Device Development

- Process, device and circuit simulation
- Design of ICs and power devices
- Electrical characterisation on wafer and module level
- Lock-In thermography for failure analysis of semiconductor devices
- R&D for ICs and power devices
- Development and fabrication of customer specific power devices and components
- Fabrication of semiconductor devices in small and medium quantities

### New Assembly Techniques

- Metallisation for new packaging methods (e.g. Cu galvanic, e-less Ni-Au)
- Wafer Level Chip Size Packaging for power devices (WLCSP)
- Advanced wire bond-, soldering- and sintering methods
- Power balling
- Thermo-mechanic simulation
- Prototyp fabrication

### Reliability and Qualification

- Qualification of modules, assemblies and components
- Active and passive power cycle test
- Lifetime examinations

- Failure and damage analysis
- Electrical measurements
  - Leakage current
  - Electric strength
  - Dynamic behaviour
- Thermal measurements
  - Heat conductivity
  - Static and dynamic thermal resistance ( $R_{th}$  and  $Z_{th}$ )
- Climate chamber / accelerated ageing
  - Online data logging
  - Customized electrical and hydraulic wiring
- Non-destructive measurements (X-ray, Thermography, Sonography)
- Metallographic analyses

## CONTACT



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