



Fraunhofer

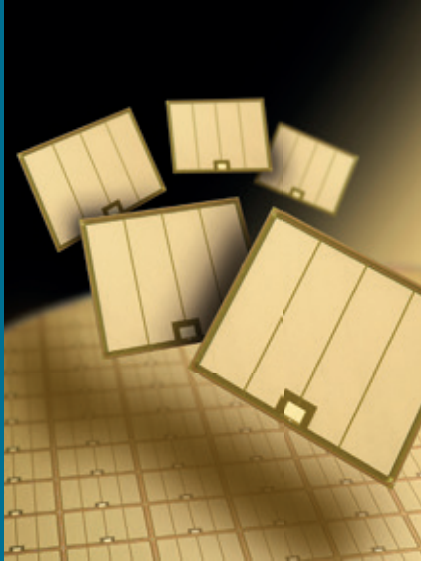
ISIT

FRAUNHOFER-INSTITUT FÜR SILIZIUMTECHNOLOGIE ISIT

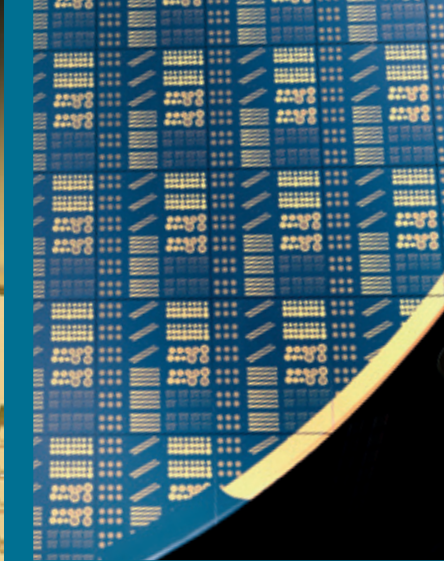
POWER ELECTRONICS

| RESEARCH | INNOVATION | PRODUCTION |





1200 V IGBTs with NiAu surfaces



8" GaN wafer with test structures



1 MW power stack

ADVANCED POWER TRANSISTORS

Silicon

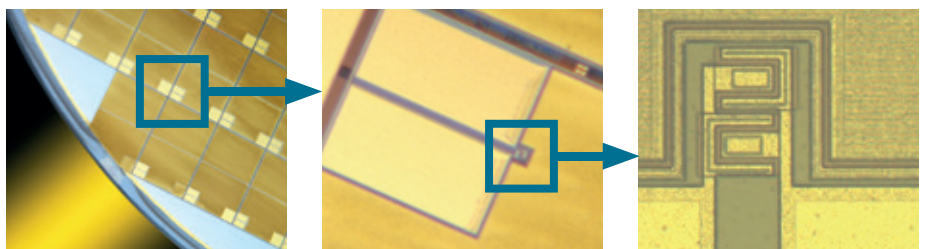
The Fraunhofer ISIT offers the development of semiconductor components such as application-specific silicon-based PowerMOS transistors, IGBTs and diodes with blocking voltages up to 1200 V. A particular R&D focus is the application-specific design of power semiconductors and the development of new device architectures. Based on a qualified 8" production technology the ISIT has a large number of CMOS-compatible semiconductor processes available which are used for a variety of development activities. Highlights are the wafer-handling and wafer-processing of ultra-thin substrates (<50 μm) and the dopant activation by laser annealing. The Fraunhofer ISIT develops customer-oriented device structures with special pad configurations and special metallizations, such as Ni/Au and Ni/Pd/Au for improved integration concepts. For the system integration of passive components the ISIT offers the development of chip capacitors, precision resistors and inductors as well as corresponding chip-level circuits. The Fraunhofer ISIT operates a professional lab for electrical characterization of power semiconductors on wafer-, PCB- and module-level. Highly-sensitive lock-in infrared (IR-) thermography is used for failure analysis and the location of defects.

Gallium nitride

The excellent physical properties of Gallium Nitride based power semiconductor devices allow to break the limitations of silicon based power semiconductor devices. The Fraunhofer ISIT is focusing on vertical GaN power devices, especially on advanced transistor and diode concepts with blocking voltages of some 100 V and switching speeds down to the ns range. The application specific chip designs and processes are facilitated by professional simulation software. The dedicated wafer equipment at the ISIT allows the processing of bulk-GaN material with low wafer diameter as well as 8" GaN-on-Si EPI wafers and the following electrical characterization within a professional lab. The design and process development is supported by modern simulation toolsets.

POWER ELECTRONIC FOR RE

We offer support to our customers for a wide range of technologies and topologies, within the development of power electronic systems. The main focus is on design, simulation and implementation of innovative concepts in circuit topology like resonant converter concepts and control to realize high efficient and reliable systems, in addition with integrated condition monitoring and lifetime prediction. Our resonant DC/DC- and DC/AC-converter systems reach an efficiency of more than 99 % by realizing a soft-switching operation over nearly the entire output power range. In the area of reliability analysis the ISIT is working on e.g. the evaluation and prediction of the lifetime of power converters. A broad spectrum of methods for fault analysis extends our services. In order to increase the integration of renewable energies within the energy supply system the ISIT researches e.g.



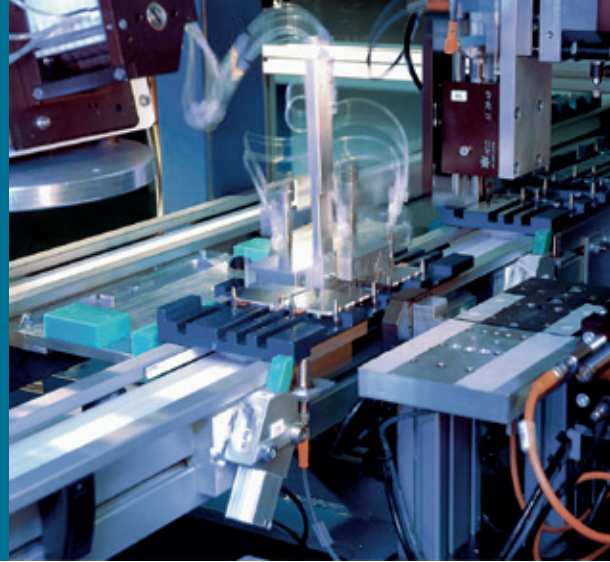
Application specific PowerMOS device with temperature sense and Ni-Au metallization



DC/DC converter



High performance battery storage system



Battery manufacturing platform

RENEWABLE ENERGY SYSTEMS

in the application of high-performance energy storage systems, how new control algorithms for ancillary services can be used to improve power quality and grid stability in the area of balancing energy and virtual / synthetic inertia.

The ISIT supports further co-simulations to map complex energy systems.

The field of application is mainly in the area of renewable energy systems, grid integration, e-mobility and electric aviation. The cooperation with thematic adjacent teams e.g. the Battery Systems for Special Applications team and the Advanced Power Transistors team allows us to offer a holistic customer-tailored solution.

BATTERY SYSTEMS FOR SPECIAL APPLICATIONS

For a long time the topic of energy storage has been one of the key research areas at Fraunhofer ISIT. The Fraunhofer ISIT offers customer specific battery development based on Li-polymer-technology with a broad range of characteristics, e.g. in terms of rapid charging / discharging ability, load capacity and longevity. By this, the ISIT has the opportunity to realize battery systems for special applications, where for instance stability at high temperatures or a particularly high power density is necessary. The latter is of high importance, for example, in the storage of wind energy for grid stabilization.

The ISIT's own production technology is characterized by a very high degree of flexibility and is thus an ideal technological platform for the production of prototypes and small batches. The complete process

chain from material preparation and electrode production to packaging and electrical and thermomechanical characterization of cells regarding different chemistries and design is available. These competencies enable the development of even complete, tailor-made storage solutions.

Our current focus is on the development of special high-performance batteries that can be charged in less than four minutes and deliver all their energy when needed in one minute. In addition, the Fraunhofer ISIT takes research on next generation energy storage systems, e.g. the lithium-sulfur battery, which can be expected in the future to utilize significant increase in energy density and allowing at the same time a considerably cost reduction.



Coated electrode foil



IC production in the ISIT cleanroom

SERVICES OFFERED BY THE BUSINESS UNIT POWER ELECTRONICS AT FRAUNHOFER ISIT

Advanced

Power Transistors

- Semiconductor components based on silicon and gallium nitride
- Process, device and circuit simulation
- Design and manufacturing of application specific power semiconductor components, ICs and passive devices
- Performing of electrical static- and dynamic characteristics on wafer- or modul level
- Highly-sensitive lock-in infrared (IR-) thermography and FIB- analysis
- Pilot processing of wafers up to 8" in low und medium volume

Power Electronic for

Renewable Energy Systems

- Conception design and design of resonant converter topology
- FEM (Finite element method) simulation
- Hardware and software development
- Double Pulse Test Bench for Si, SiC & GaN
- Power Converter Test Bench with measurement of efficiency +/-0,02 %
- Thermal Imaging
- Rapid Control Prototyping & Hardware-in-the-Loop
- Development of ancillary services for power networks
- Modelling of renewable energy sources and power networks

Battery Systems for

Special Applications

- Cell conception and design (electrochemistry and interpretation)
- Slurry preparation
- Coating technology
- Cell assembly and cell characterization
- Electronic cell integration into suitable modules
- Material characterization and cell tests
- Pilot manufacturing line

Fraunhofer ISIT
is participant of the



**Forschungsfabrik
Mikroelektronik**
Deutschland



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