FRAUNHOFER IISB OFFERS INNOVATIVE POWER ELECTRONIC SOLUTIONS THAT ARE USED IN CONVERSION, SUPPLY, AND STORAGE OF ELECTRICAL ENERGY.

Fraunhofer IISB conducts applied research and development in the field of electronic systems for application in, e.g., aerospace, transportation, industry 4.0, energy, and future energy technologies. In this connection, the institute uniquely covers the entire value chain from basic materials and semiconductor technologies to entire power electronic systems.

Being part of the Fraunhofer-Gesellschaft, the IISB has contract research for industry as well as public authorities. On that note IISB conducts applied research to provide excellent research to its industrial partners and to set technological benchmarks as one of the leading research institutions in electronic systems.

- Branches in Nuremberg and Freiberg
- Close cooperation with Friedrich-Alexander-Universität Erlangen-Nürnberg (FAU), with its Chair of Electronics Systems (LEB) and Chair of Energy Electronics (LEE) being held by the directors of the IISB
- Member of Leistungszentrum Elektroniksysteme (LZES) and Energie Campus Nürnberg (ENCN)

SEMICONDUCTORS AND POWER ELECTRONICS

With its two business areas, semiconductors and power electronics, the IISB offers services in various specialized fields. These services are supplemented by broad activities in test and characterization, simulation, design, modeling, and metrology.

In addition to silicon technology, the IISB has a strong focus on wide-bandgap semiconductors, especially silicon carbide (SiC). For SiC, the institute offers a complete technology backbone, including materials science, devices, modules, and their integration in highly efficient power electronic systems.
### OUTSTANDING FACILITIES AND EQUIPMENT

1. End simulator test setup with a three-phase modular multilevel converter using 12 kV IGBTs

2. Air-cooled silicon carbide inverter for automotive and aircraft applications.

### ELECTRIC VEHICLE TEST CENTER

- Vehicles with an electrical power train can be tested completely new demands on test systems. The vehicle test center at IISB is dedicated to electric vehicles and allows for the testing and characterization of all components of an electrical power train, as well as complete electric vehicles. The test center includes test beds for electric drives, traction batteries, system reliability, and electric-vehicle magnetic compatibility (EMC). Overall electric vehicle testing is possible in an air-conditioned dynamometer, including fully automated road and driving cycle simulations. All labs of the test center include a powerful highly dynamic DC source (150 kW), a 960-kW dynamometer, and a coolant conditioning system (-40 °C to +115 °C) for the operation of the system under test (SUT).

### POWER ELECTRONIC SYSTEMS AND TECHNOLOGIES

1. Power electronics for stationary grid applications, data analyzers
2. Highly reliable SiC/MOSFET transistors
3. Multi-level converters for MVDC and high-power drives
4. LVDC inverters
5. Mobile and stationary battery systems, EMS
6. Increasing efficiency, availability, and responsiveness

### ENERGY TECHNOLOGIES

- Efficient energy production, storage, use, and supply
- Coupling of electrical and non-electrical energy
- Power electronic interfaces, grid connection
- Conversion of electricity into mechanical energy and vice versa
- Future vehicle electrification
- Energy storage
- Energy monitoring, peak load shift
- Gas-to-power coupling, non-electrical power
- Coupling of electrical and non-electrical energy

### VEHICLE POWER ELECTRICALS

- Extremely compact, robust power-electronic systems
- High-efficiency AC/DC and DC/AC converters
- Integration of latest SiC and GaN technologies
- High-frequency power converter and EMC development
- For electric vehicles, motors, and aerospace

### MATERIALS

- GaN and SiC technology lines, large silicon wafers
- For prototype device fabrication
- Custom-tailored SiC wafers, metrology
- Correlation of material and device properties
- Development of physical models and soft-core simulation
- Device characterization, statistical analysis
- Lifetime modeling

### PACKAGING & RELIABILITY

- New concepts and materials for packaging
- High-performance joining technologies, brazing
- Thermo, electrical, and mechanical characterization
- Lifetime characterization, statistical analysis
- Failure mechanisms analysis

### TECHNOLOGY & MANUFACTURING

- Silicon and compound semiconductors
- Silicon crystal growth and epitaxy
- Advanced mechatronic system integration
- High-performance joining technologies
- New concepts and materials for packaging
- Custom-tailored SiC services, metrology
- Development of physical models and software-assisted simulation
- Topography and doping process simulation
- Simulation of equipment and crystal growth processes
- Optimisation of equipment, processes, and devices
- Microsystems simulation, esp. for power electronics

### DEVICES

- Customer-specific active and passive devices
- Using silicon and silicon carbide processing technology
- For application in power electronics, microelectronics
- Semiconductor technology
- Novel device concepts and cost-efficient processes
- Ultra-wide and large-area applications

### MOLDING AND ARTIFICIAL INTELLIGENCE

- Development of physical models and software-assisted simulation
- Computational thermography and optics
- Topography and doping process simulation
- Simulation of equipment and crystal growth processes
- Optimisation of equipment, processes, and devices
- Microsystems simulation, esp. for power electronics

### ELECTRONIC DEVICE PROTOTYPE FABRICATION

The IISB is equipped with high-class laboratories, such as a test center for electric cars and an application center for DC grid technology. While the IISB institute building itself serves as a research and demonstration platform for advanced electronic technologies to be used in industrial production environments, linking electrical energy and non-electrical forms of energy by providing the necessary interfaces. Furthermore, the institute runs 1500 m² of cleanroom area for semiconductor technology on silicon and silicon carbide together with University of Erlangen-Nuremberg.

The IISB runs 1500 m² of cleanroom facilities (SiC) homoepitaxy on SiC substrates. The VPE runs 1500 m² of cleanroom facilities for SiC power device processing. Most important process steps on silicon wafers with diameters of up to 200 mm and on SiC wafers with diameters of up to 200 mm. An industrial CMOS process line is used as a reference and as the basis for development. The IISB has increased its commitment especially to SiC by implementing new equipment and processes to meet special and additional requirements for SiC power device processing. Most of the IISB’s silicon carbide devices are for high-temperature applications, including fully automated road and driving cycle simulations. All labs of the test center include a powerful highly dynamic DC source (150 kW), a 960-kW dynamometer, and a coolant conditioning system (-40 °C to +115 °C) for the operation of the system under test (SUT).