

Wide-Bandgap Semiconductors for Next-Generation Power Electronics – Fraunhofer IISB in the WBG Pilot Line

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Fraunhofer IISB

»As Europe's leading center of excellence for wide bandgap-based power electronics, we ensure sustainable and economical mobility and energy supply, climate protection, resource conservation, and security.«

Power electronics along the entire value chain

The Fraunhofer Institute for Integrated Systems and Device Technology IISB, headquartered in Erlangen, is one of Europe's leading research institutions for **wide-bandgap (WBG) semiconductors and power electronics**. It covers the **entire value chain for next-generation power electronics**: from material to chip and from module to system. The spectrum ranges from semiconductor materials and processing technologies through packaging and module designs to complex electronic and energy systems, such as ultra-compact converters, modular multilevel converters, electric drive trains, battery storage systems, and decentralized energy grids. For silicon carbide (SiC), e.g., the institute operates the complete technological processing chain. The focus is on power and sensor devices based on wide and **ultra-wide bandgap (UWBG)** semiconductors for applications, e.g., in **mobility and transport, aerospace, or sustainable energy supply, as well as security and defense**. With its solutions, the institute keeps setting benchmarks in energy efficiency, performance, and reliability, even for extreme operating conditions in harsh environments. Within the **Research Fab Microelectronics Germany (FMD)**, the IISB coordinates the FMD Power Roadmap, involving all power-electronics-related institutes. The work, competencies, and offers of IISB include:

- **Material development** (crystal growth, epitaxy, test devices) of semiconductors (Si, SiC, GaN, AlN, diamond, III-V, II-VI), functional coatings (TaC, SiC, SiO₂, Si₃N₄), and energy materials (Al-ion batteries); WBG quantum materials
- Comprehensive **semiconductor technology lines, cleanroom infrastructure, and metrology** on Si and SiC; particle and thin-film systems, nanotechniques
- **Prototyping foundry** π-Fab for custom-tailored **power and sensor devices**, SiC high-T CMOS; EUROPRACTICE services
- New methods and materials for **packaging, cooling, lifetime and failure analysis, reliability; power modules**
- Highly efficient, compact, and robust **power electronic systems** (converters, e-machines) for all kinds of vehicles, comprising **electric drives, battery systems, and charging infrastructure** for cars, transport, aviation, and shipping; cryogenic power electronics
- **Intelligent energy systems** on all levels of the power grid, e.g., components for HVDC transport or local DC microgrids
- **Physical modeling and AI**, software and optimizers for processes, devices, or power electronic systems

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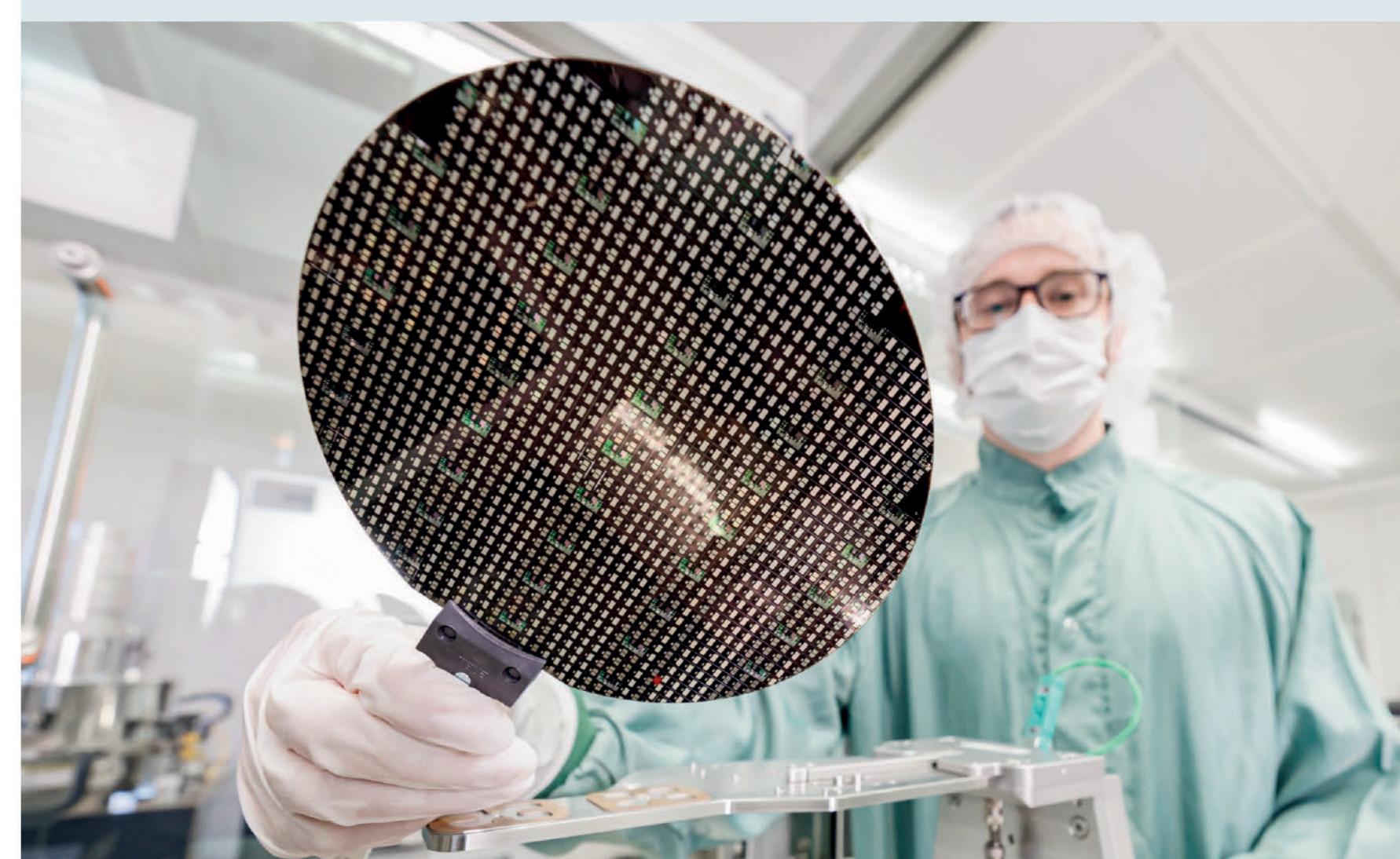
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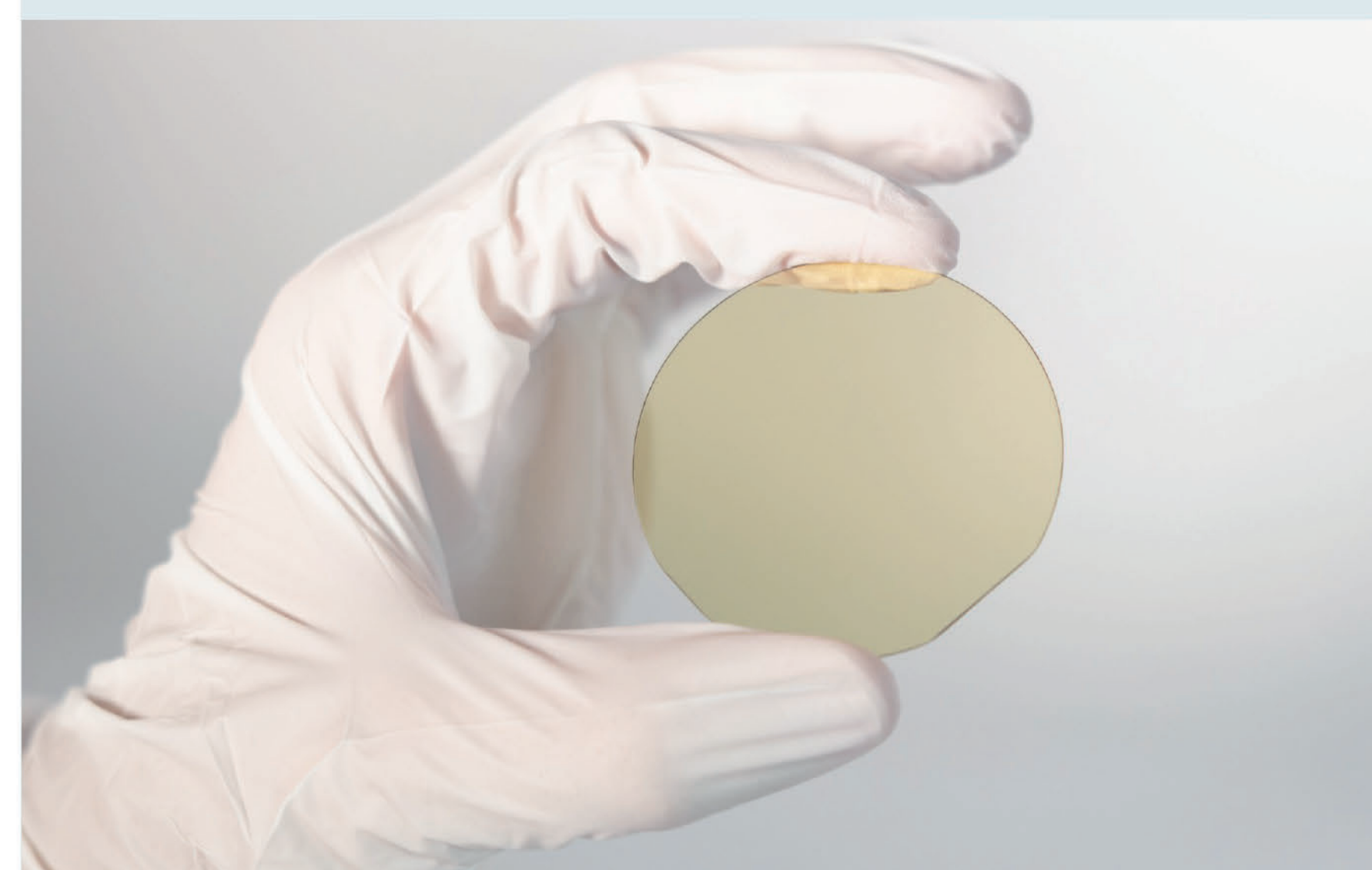
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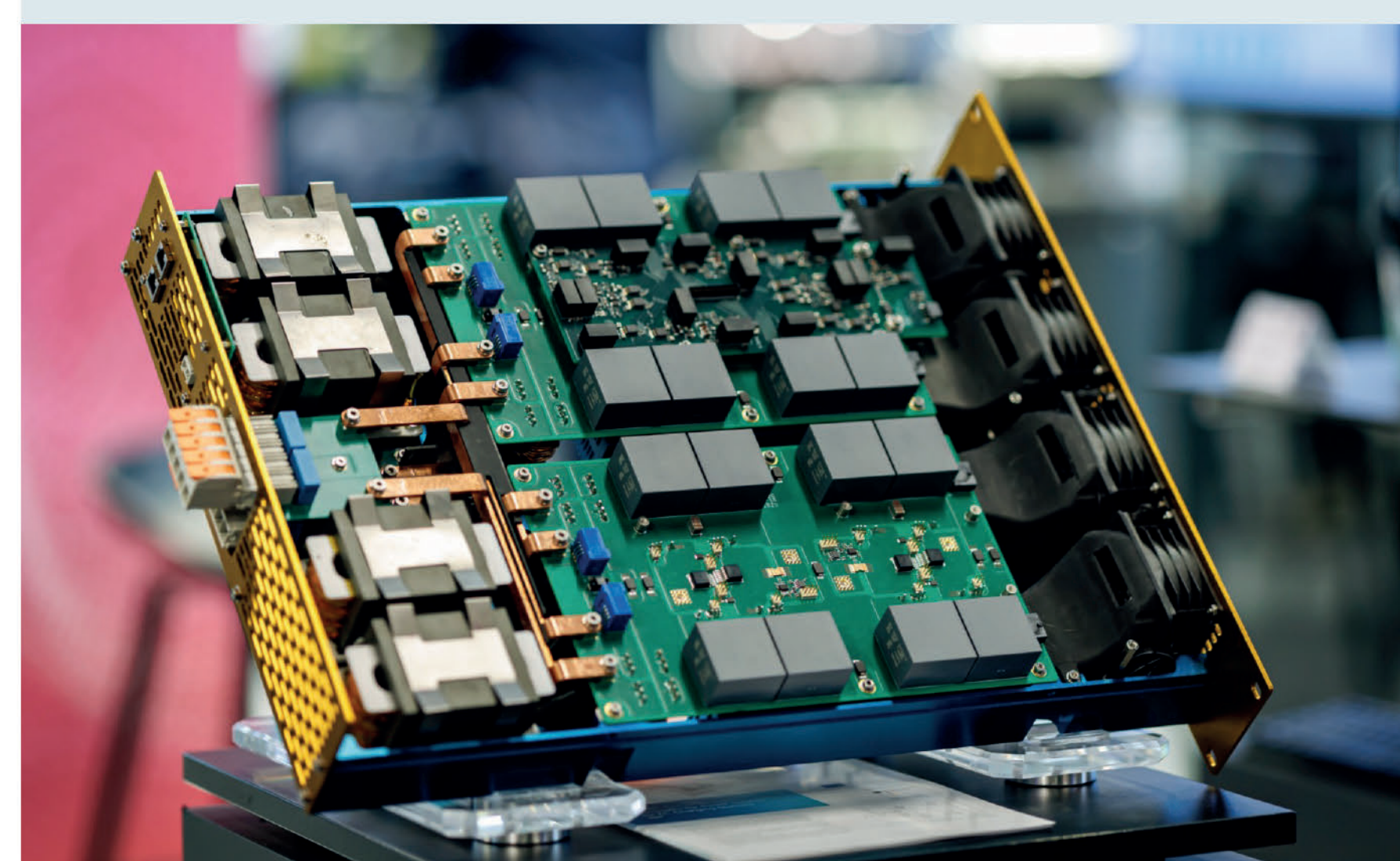
SiC power devices and high-temperature CMOS from the Fraunhofer IISB prototyping foundry
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2-inch aluminum nitride (AlN) wafer by Fraunhofer IISB
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Semiconductor-based isolation DC/DC converter for DC charging infrastructure
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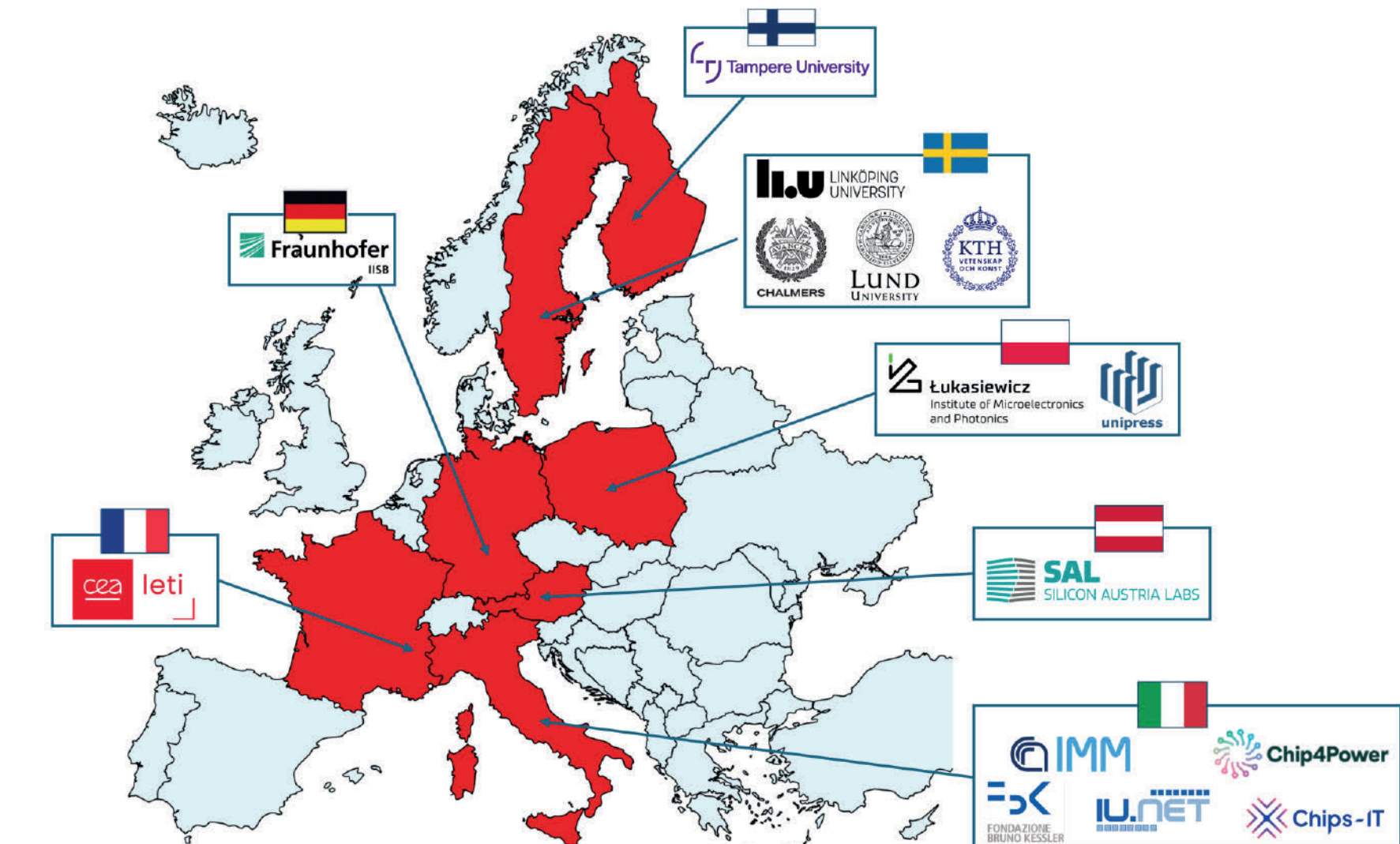


WBG Pilot Line

The Wide-Bandgap (WBG) Pilot Line is one of the five pilot lines launched under the Chips for Europe Initiative, a key pillar of the European Chips Act. The project, officially started in June 2025, aims to establish a cutting-edge infrastructure dedicated to the development and industrialization of **wide-bandgap semiconductors** such as silicon carbide (SiC), gallium nitride (GaN), or aluminum nitride (AlN).

With a **budget of €360 million** involving seven EU countries, the WBG Pilot Line represents a strategic investment to strengthen Europe's autonomy in semiconductor technologies and to bridge the gap between laboratory research and industrial-scale manufacturing. It is coordinated by the National Research Council of Italy (CNR-IMM).

Wide-Bandgap Pilot Line consortium
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The WBG Pilot Line will build on the current facilities operating in **Italy, Sweden, Poland, Finland, Austria, France, and Germany**, where industrial processes will be defined and optimized, and demonstrators will be qualified to be then tested on the market. The WBG Pilot Line will be characterized by the implementation of new manufacturing techniques that enable the integration of different materials to achieve new devices and systems based on WBG semiconductor materials. Within the WBG Pilot Line, **Fraunhofer IISB as the sole German partner** serves as the national bridge for partners and industry to this powerful network and infrastructure. The institute coordinates Work Package 4 on **»Ultra-Wide-Bandgap (UWBG) Semiconductors for Next-Generation Power Electronics«**, which aims to increase the availability of UWBG materials in Europe and to establish know-how especially on the emerging **AlN-based technology for power devices**:

- AlN crystal growth for diameters of 2" up to 100 mm
- Optimization of wafering technology
- Processing of AlN wafers on state-of-the-art equipment by implementation of a shuttle technology
- Development towards complex technological schemes of device concepts and architectures on AlN
- Concepts for higher degrees of integration

www.wbg-pilot-line.eu

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