



SEMIKRON ELEKTRONIK GMBH & CO. KG

Production of innovative power electronics for mobile drives and regenerative energies

SEMIKRON is a global supplier of power electronics components and systems in the medium power segment. The company employs over 3200 people in 25 subsidiaries worldwide. For more than 60 years, SEMIKRON has been establishing new standards for power electronics products. SEMIKRON develops and manufactures various chips, power modules, power electronic assemblies and systems as part of numerous product lines. These are primarily used for energy-efficient motor drives, industrial automation systems, renewable energies and in electric vehicles and for power supply.

Challenges

Future applications in the field of power electronics require innovative product solutions that have to be extremely powerful, reliable and cost-efficient. Power electronics modules play a key role in this: they form a technically sophisticated component in vehicle electrification, in the conversion and generation of electrical energy and in its control. In most of these

modules, semiconductor components are attached to the substrate via solder connections. However, these connections are at high risk of failure under the significant temperature fluctuations caused by the clocked, high current flow in the power module. Sintered connections are significantly more reliable than soldered connections, but cannot yet be manufactured on a large scale. The transfer and scaling of sintering technology to large-scale production therefore represents a considerable challenge.

Objective

In the long term, SEMIKRON would like to replace soldering technology by the sintering process for all products and thus make preparations for the first large-scale production in this project. The goal is to replace products based on the 40-year old soldering process and to introduce the sintering process as the basic process for all future products. This is a fundamental change for the assembly and connection technology in power

electronics. SEMIKRON is developing a uniform sintering concept for the various components, developing and optimising the corresponding processes and thus increasing the overall yield. The systems themselves are specified, evaluated and digitally networked. The company is also developing scalable methods for quality assurance. In an initial commercial application, sintered power semiconductor components and systems are to be manufactured with new plant chains. German and European partners can build on this and develop more energy-efficient and reliable products along the value chain. The new modules are initially to be used increasingly in electromobility for passenger cars and in wind energy. The project thus strengthens German and European industry in a special way and contributes to the successful implementation of the goals of the integrated European project as a whole.



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Nürnberg



Approaches

In the sintering process, a paste with silver particles is printed onto a ceramic substrate. The chips are then pressed on under high pressure as well as elevated temperature, causing the silver particles to condense and form a stable compound layer. In order to standardise production technology and reduce operating costs, the project will first develop plant specifications. Production is to be automated, networked and integrated into a comprehensive Manufacturing Execution System (MES): This will ensure reproducible quality standards and achieve higher throughput. The sintering process and the adjacent processes are to be coordinated for all available module variants in such a way that systems can be used variably and cost-optimised large-scale production processes can be realised. In order to meet the demanding production conditions, an existing building is being converted into a clean room and the necessary infrastructure installed. In addition, new test methods are being developed and test capabilities expanded in order to investigate and iteratively optimise the reliability of the power electronics components.

Perspectives

Sintered connections allow existing products to be significantly improved and new products with unique properties to be developed. Converters in wind turbines become significantly more reliable and the installation space is considerably reduced. By scaling up the sintering process to large-scale production, the products are also of great importance for the rapidly growing market for electric vehicles in the future. To ensure the further dissemination of the results, cooperation with universities and research institutions is planned in the form of scientific papers and publications. Within the framework

of doctoral theses, the training of young scientists is supported. In addition, SEMIKRON cooperates with numerous small and medium-sized enterprises. With the development of high-performance and energy-efficient power semiconductors, SEMIKRON's project contributes to advancing the key technology of micro- and nanoelectronics as a common European goal.

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