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Press Information

Integrated SiC power module on ceramic heat sink from CeramTec

Test results confirm thermal characteristics of new ceramic power module for drive inverters

Southampton/Plochingen, 14 June 2021 – At the beginning of May, CeramTec launched a new ceramic power semiconductor module for drive inverters in e-mobility. The globally operating high-performance ceramics specialist is now presenting the test results, which demonstrate the importance of ceramic materials for innovative drive concepts.

Cooling the power electronics in powertrains is key when it comes to reliably regulating the electrical power in e-drives on an ongoing basis and over longer periods of time in the smallest possible space. Together with the Fraunhofer Institute for Integrated Systems and Device Technology (IISB) in Erlangen, CeramTec has developed an innovative cooling solution for power electronics in e-mobility powertrains.

The joint project, called FuCera, focused on the development of a module design using ceramic coolers that efficiently deheats the SiC

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semiconductor chips and makes the best possible use of the chip surface.

High-performance ceramics are extremely suitable for the use in e-mobility due to their properties, namely the resistance to temperature changes, chemical resistance, electrical insulation, corrosion and wear resistance combined with their thermal conductivity.

Ceramic heat sink with chip-on-heatsink technology

For efficient heat dissipation and thus better thermal management, CeramTec uses ceramic heat sinks with metallisation on both sides, which makes it possible to apply the semiconductor chips directly to the ceramic cooler (chip-on-heatsink). This design makes it possible to use both sides as circuit carriers and to cool them at the same time. The internal cooling structure can be individually adapted to the requirements and designed, for example, as a pin-fin structure. In a direct performance comparison between conventionally constructed cooling systems and heat sinks with CeramTecs chip-on-heatsink technology, the thermal resistance of the latter is only half the value.

The chip-on-heatsink design was also applied to the new SiC power module with integrated ceramic cooler. The cooler consists of a liquid-flow aluminium nitride cooler with copper metallisation on both sides

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and an optimised pin-fin structure. The very compact heat sink has a size of only 48 x 36 mm with a thickness of 3.6 mm (incl. metallisation) and a weight of ten grams.

Test measurements confirm thermal performance

The thermal performance of the module was impressively confirmed by thermal characterisation at the PowerCycling test station. At the design point, the thermal resistance of the power module with pin-fin ceramic cooler is 0.15 K*cm²/W from the chip to the cooling water. The small and lightweight design of the cooler and its internal pin-fin structures are ideally suited for mounting semiconductors using pressure sintering. This was proven in practice both by calculation and by means of the assembled power modules. Good sintering properties of the cooler metallisation were demonstrated by shear strengths of approximately 40 MPa.

"The test measurements have proven that the SiC power module with high-performance aluminium nitride ceramic cooler can withstand high loads. With low thermal resistance and high packing density, the power module for drive inverters becomes a high-performance cooler for e-mobility that can additionally be modified for specific customer requirements," says Richard Boulter, President Industrial of the CeramTec Group.

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For more information on CeramTec high-performance ceramics for e-mobility applications, please visit: <http://insights.ceramtec-group.com/demonstrator>.

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Notes to the editor

Image



Caption: Power module for Drive Inverter from CeramTec
Image Source: CeramTec GmbH

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About CeramTec GmbH

CeramTec is a world-leading manufacturer of technical ceramics and is specialised in the development, manufacturing and sale of parts, components and products made from ceramic materials. With over a century of developmental and production experience, CeramTec is a global leader in the manufacturing of advanced ceramics and engineers these materials for use in a wide variety of applications. Advanced ceramics from CeramTec are used in a range of industries, including medical engineering, the automotive industry, electronics, energy and environmental engineering, as well as equipment and mechanical engineering. The current portfolio comprises well over 10,000 products, components and parts made from technical ceramics, along with a wide variety of ceramic materials.

With production sites and subsidiaries in Europe, the UK, North and South America as well as Asia, CeramTec maintains its presence around the globe as a manufacturer and supplier. The company is headquartered in Plochingen, near Stuttgart. In 2020, CeramTec generated close to €553 million in revenues. CeramTec employs more than 3,500 staff worldwide, around 2,000 of which are in Germany.

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