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Ceramic Printed Circuit Boards for Electronic Cars

Siemens and its partners are developing a new type of ceramic printed circuit board for highly robust integrated power converters used in electric vehicles.



The converters' modular design and physical proximity to control and power electronics in the vehicles' transmissions will make them more reliable and allow them to take on new functions. The Kairos project (a German acronym for ceramic design and integration technology for robust signal and power electronics) is being funded by Germany's Ministry of Education and Research (BMBF). The first step in the project will be to develop a high-voltage electricity and signal transmission system between the circuit boards.

Electric vehicles need to have a range of different power electronics converters in order to ensure low-loss control of energy flows between the charging grid, the battery, and the drive unit. The project team will integrate the power electronics exactly at the location where they're needed—for example near the converter for adjusting current, voltage, and frequency in the drive system. This eliminates the need for several expensive connecting elements, cables, and housings, all of which are susceptible to defects. The resulting savings in terms of costs, weight, and volume also increase system efficiency.

The partners are working to combine ceramic power electronics printed circuit boards featuring high-temperature co-fired ceramics (HTCC) with control electronics that use low-temperature co-fired ceramics (LTCC). Using ceramics and a cooling system integrated into the boards will increase the thermal stability of the electronic systems. The new system will also be more compact because the components are printed on both sides. System performance capability will be demonstrated in a vehicle with a ten-kilowatt converter assembly made of performance components (IGBT, MOSFET, diodes).

The Kairos project members are Siemens, ContiTemic, Curamik Electronics, Via electronic, the Fraunhofer Institute for Ceramic Technologies and Systems, and the Department of Electronic Devices at the University of Erlangen. The project is receiving 2.5 million from the BMBF as part of the ministry's Key Technologies for Electric Mobility funding program. Project results will serve the further development of new types of electrical integration and design technologies for compact and robust electric modules in electric cars. These technologies will help solve problems associated with the electrical architecture of such vehicles.