New Dimensions in High-Performance Ceramics from Cars to Medical Engineering

Bosch is synonymous with quality and precision in the field of high-performance ceramics for the automotive sector. The Stuttgart-based group is now tapping into a new market and also offering functional components made of high-performance ceramics for the medical engineering market. Thanks to special properties such as extreme robustness, biocompatibility, as well as chemical and electric characteristics, the material opens up unimagined possibilities.

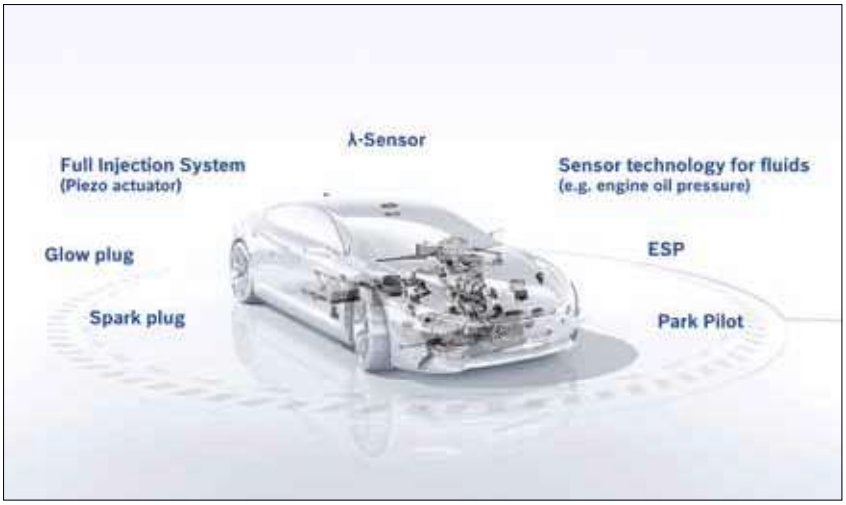

Fig. 1
Bosch ceramic components in cars

Based on a combination of innovative manufacturing technologies and Bosch's own material systems, Robert Bosch GmbH develops highly innovative, precise ceramics products for the medical engineering market. "We benefit from our many years of experience as a manufacturer of high-performance ceramics in the automotive industry and harness this know-how to make a valuable contribution in medical technology. This is how we translate technology "Invented for life," says Marc Meier, President of Bosch Healthcare Solutions GmbH.

Keywords
functional integration, additive manufacturing, ceramics, innovation, ceramic injection moulding

Tradition meets innovation

Bosch has specialized in providing high-quality, customized solutions made of high-performance ceramics for over 100 years. The company registered its first patent for Ceramic Injection Moulding back in 1939. Today, Bosch supplies many functional ceramics components for the automotive sector, ESP®, spark plugs, and exhaust-gas sensors (e.g. lambda sensors), as well as for the electronics and consumer market. Bosch produces nearly a million ceramics parts a day.

Over the past five years, production technologies such as Additive Manufacturing (3D-printing) have reached a high level of maturity that now also qualifies the technology for fields of application with particularly high demands. Bosch Healthcare Solutions GmbH draws on these technologies to produce highly advanced functional components made of technical ceramics for the medical technology industry, for example for use in surgical instruments.

Bosch expertise for increasing demands

The wholly owned subsidiary of Robert Bosch GmbH was established in early 2015 with the aim of developing products and services that improve people's health and quality of life. The developments for the healthcare and medical technology market

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draw on the Bosch Group's core competencies in the fields of sensors, software, and services. Together with strong partners from research, ceramics manufacturing, and the medical engineering expertise of Bosch Healthcare Solutions, the company creates solutions that not only meet the challenges in medical engineering, but redefine the state-of-the-art. As an innovative company with high quality standards, Bosch makes its resources available for application in individual and industrial production of high-performance ceramics.

Demands on ceramics products are continuously increasing: the maxim is to become even more complex, precise, and efficient. At the interface of automation capacity, precision, and complexity, Bosch is setting new benchmarks with innovative manufacturing technologies. Ceramic Injection Moulding in combination with Inmould Labeling for application of functional layers and Additive Manufacturing (3D-printing) make it possible to manufacture complex functional components with the highest degree of precision and almost unlimited geometrical design options for use in medical technology – from a lot size as small as one.

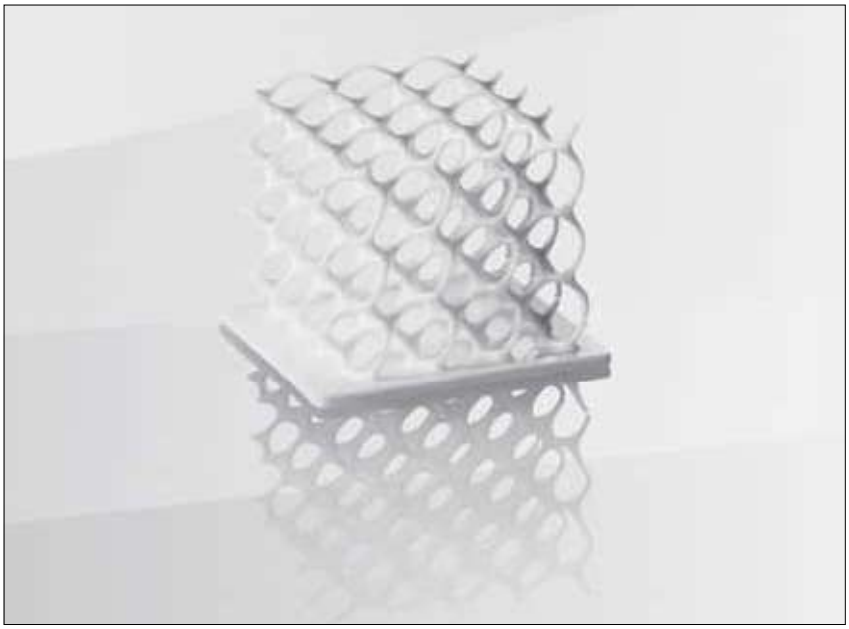

Fig. 2
Complex geometrical designs are possible with Additive Manufacturing

Researching new products

Bosch has its own research campus. Here, according to the guiding principle "Passion for Innovation", over EUR 20 billion has been invested in research in the past five years alone. "New products require a solid foundation in order to develop the material and production technology basis for series products in Bosch quality," Dr Jürgen Rapp, Department and Competence Field Manager for Functional Materials and Layer Technologies, explains.

"For the development of highly complex products, it is therefore essential to always think of components and subassemblies in the context of a system composed of mutually interacting parts. This approach to the development of new products allows researchers to draw on many different production technologies for material and system, which – combined in new ways – lead to genuine product innovations."

Functional integration as a future challenge

Components with a high degree of functional integration are absolutely fundamental to future innovations. To meet the demands of Industry 4.0, which will also become a reality in the medical sector, these components are additionally equipped with the necessary sensor technology. Robert Bosch GmbH already links a number of production processes, enabling machines to communicate with each other. Functional integration takes place in steps, whereby creating strong, permanent bonding of metallic and ceramic materials – known from the automotive sector – is a basic prerequisite. The method offers the possibility to combine electrically conductive and insulating systems in a single component. The metallization process can be realized as electric conducting tracks in track widths from 100 µm or as a two-dimensional area. It is gap-free and absolutely adhesive in use and during sterilization.

New semiconductor technologies for chip production (MEMS) also enable high-precision microstructuring of the ceramic or metallic surfaces to achieve tribological, optical, fluidic, or biomedical properties.

The special properties of technical ceramics are as impressive as the outlook on the future. Ceramic Injection Moulding, generative production processes, and innovative methods for integrating functions into components open.

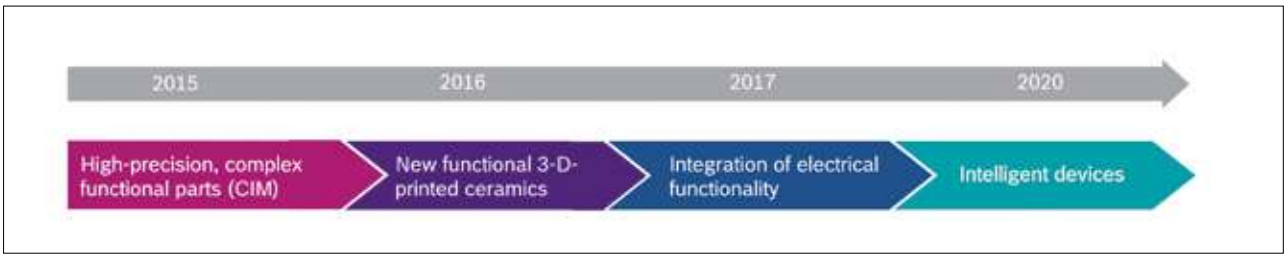

Fig. 3
Roadmap for functional integration