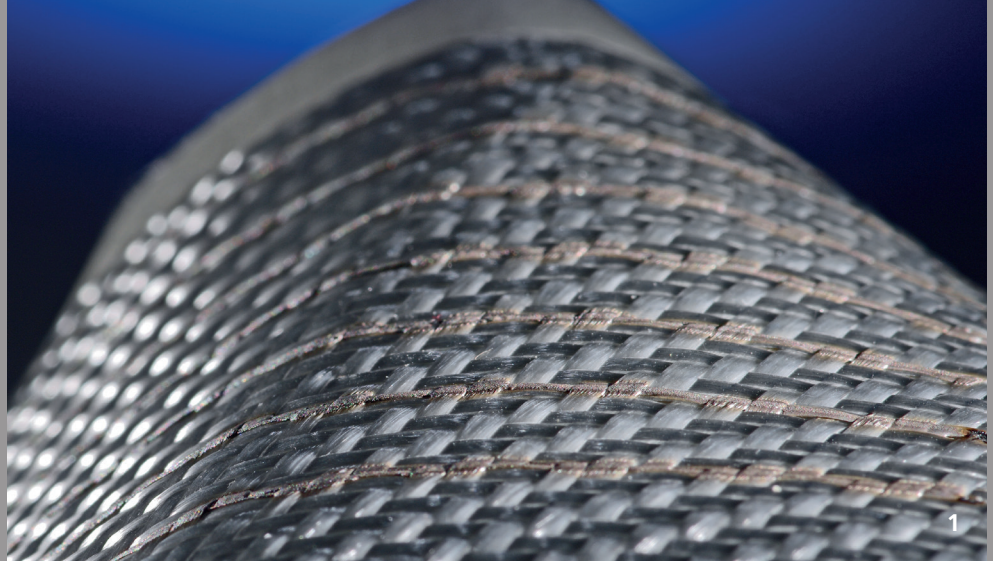

ADDITIVE MANUFACTURING OF ELECTRICAL FUNCTIONAL LAYERS IN FIBER COMPOSITES

Task

As the demand for fiber-reinforced composite materials (FRP) grows and functional integration in components (»Internet of Things«) advances, there is an increasing need for integrated sensors for this material class. To date this has been achieved, for example, by placing prefabricated sensors in the composite material or by manually attaching them to components. These processes represent a major cost factor, however, due to their poor automation and negative effects on mechanical properties; in consequence, critical components must be dimensioned larger. When such functions are integrated through automated, digital printing and laser processes, manufacturing can be accelerated and done cheaper. In addition, new features such as moisture measurement can be integrated into products.

Method

In order to integrate such functions into FRP, researchers of Fraunhofer ILT have developed laser processes that, in combination with digital printing processes (e.g. dispensing, aerosol jet), enable sensors, heating elements and the required electrical interconnects to be manufactured on semi-finished products (fiber fabrics) or finished FRP components. For this purpose, functional materials are first printed onto glass fiber fabrics and then thermally treated by means of laser radiation (hardened, sintered, etc.). These modified fiber fabrics are subsequently incorporated into a fiber composite by a partner, such as Fraunhofer IFAM. Alternatively or in combination, the finished FRP component's surface is laser pretreated, functional materials are then printed and finally post-treated by means of laser radiation.

Results

By combining digital printing and laser techniques, Fraunhofer ILT can apply electrical functions (heaters, interconnects, sensors for measuring strain, etc.) to and into fiber composites. Compared to layers made with furnace-based post-treatment processes, the laser-based manufactured layers show better electrical properties while the thermal impact on the component is reduced. The insertion of the electrical functional layers does not impair the component's mechanical properties.

Applications

The functions produced and integrated by means of digital printing and laser processes can be used in various fields of application (e.g. automotive, aerospace). The functional layers produced with this method are particularly relevant in the area of »Internet of Things« and »Structural Health Monitoring«. The »Go Beyond 4.0« lighthouse project is financially supported by the Fraunhofer-Gesellschaft.

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1 Printed electrical interconnects produced by means of printing and laser processes on a glass fiber semi-finished product.

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