



LASER DRILLING OF CFRP-PREFORMS

Task

Threaded sleeves are often inserted into components to produce a heavy-duty and simultaneously detachable connection in structural elements made of CFRP. Classically, these inserts are glued either onto the consolidated component or into the borehole after a mechanical drilling process. The preparation and application of an adhesive body is complicated, however, since the mechanical processing – by means of drilling or milling – can cause irreparable damage, such as delamination. Therefore, it makes sense to introduce the hole in the textile (preform) before impregnation with subsequent consolidation. For this purpose the laser-based drilling can be used for textiles having several millimeters thickness or for generating small hole geometries.

Method

An ultrashort-pulsed laser beam source from AMPHOS with a pulse duration of 2 ps and an average power up to 400 W at a repetition rate of 400 kHz has been used to drill ten-layer bi-axial carbon fiber preforms. By means of a scanner both round and star-shaped holes can be drilled into the preform. This makes it possible to use custom inserts for component-specific mechanical loads.

Result

Thanks to very small tolerances of the hole shape, the insert is fixed in the preform so that it cannot shift. Subsequently, a positive connection is made in the matrix infusion process. Thanks to the direct connection of innovative inserts with e. g. an epoxy matrix, the pull-out force of the inserts can be increased by 36 percent up to 4.5 kN resp. the tensile strength to 71 MPa compared to those of conventionally produced CFRP-components. At the same time, the corrosion protection layer of the insert is not damaged.

Applications

The process for the production of heavy-duty and simultaneously detachable connections can be used, in particular, for high-maintenance automotive and aircraft components as well as in tool machines and in the leisure sector.

This project has been funded by grants from the state of North-Rhine Westphalia using the funds from the European Regional Development Fund ERDF as part of the project »CarboLase« under grant number EFRE-0800793.

Contact

Dr. Stefan Janssen
Telephone +49 241 8906-8076
stefan.janssen@ilt.fraunhofer.de

Dr. Arnold Gillner
Telephone +49 241 8906-148
arnold.gillner@ilt.fraunhofer.de

1 Laser drilled CFRP-preform.

2 SEM-image of the drill hole wall.