



LASER DRILLING OF CFRP PREFORMS

Task

So that heavy-duty and simultaneously releasable connections of CFRP structural components can be produced, metallic threaded sleeves (inserts) are commonly introduced into the components. Classically, these are glued either to the consolidated component or into the drill hole after a mechanical drilling process. The preparation and application of an adhesive body is complicated, wherein the mechanical processing, with a drill or milling tool, can cause irreparable damage, such as delamination. Therefore, it makes sense to introduce a hole in the textile (preform), which has not yet been impregnated and then consolidate it subsequently. For this purpose, laser-based drilling can be used for textiles with a thickness of several millimeters or which require small drill hole geometries.

Method

To drill 10-layer bi-axial carbon fiber preforms, Fraunhofer ILT used an ultrashort pulsed laser beam source from the company AMPHOS with a pulse duration of 7.6 ps and an average power of 400 W. By means of a scanner, both round and stellate holes can be introduced into the preform. This makes it possible to use custom inserts for component-specific load cases.

Result

Due to the very small tolerances of the drill hole shape, $< 20 \mu\text{m}$, the insert can be fixed to the preform in a non-displaceable manner. In the subsequent matrix infusion process, a firmly bonded material connection is made. Thanks to the direct connection of the insert with, for example, an epoxy matrix, the extract torque of the insert from the CFRP component can be increased by 15 percent (to 29 Nm) and the extract force increased by 75 percent (to 13.5 kN) compared to conventionally produced CFRP components. At the same time the corrosion protection layer of the insert is not damaged.

Applications

This process, for generating heavy-duty and simultaneously releasable connections, can be used in particular for high-maintenance automotive and aircraft components as well as in the leisure sector.

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4 Laser-beam drilled CFRP preform.

5 SEM image of the drill hole wall.