



POSITIVE AND DIRECT JOINING OF CFRP AND GFRP

Task

The industry faces an increasingly important challenge: to save raw materials and energy both in manufacturing and in the use of products. And yet the performance of the components needs to be preserved, if not even increased. This applies particularly to the automotive and aerospace industry, where innovative lightweight designs are increasingly being used to reduce dead weight, thereby contributing to a reduction in fuel consumption and environmental emissions. Here, components of thermoplastic fiber-reinforced plastics (TP-FRP) are increasingly being produced, which can have both carbon- and glass-fiber reinforcement.

Method

With a new laser-based approach, Fraunhofer is pursuing an innovative joining concept, which is based on a combined positive locking and direct bond. First, in a multi-pass laser cutting process, the interlocking components are manufactured out of CFRP. This process makes it possible to produce a high quality cut edge with the required high accuracy for the positive connection thanks to short interaction times between laser radiation and material. Subsequently, the cut components are inserted into each other and fixed together with a laser welding process. For this purpose, a laser-transparent glass-fiber reinforced material is used, which has the same matrix material of the CFRP components. The GFRP material is overlapped on the positive sector, connected cohesively in a laser transmission welding process and, hence, the positive fit is fixed transverse to the loading direction.

Result

Initial test samples were manufactured with the bonding concept described here. By scaling and arranging the form-locking elements, the institute can adapt the design of the connection to the loading conditions. Investigations on the size and shape of the elements and on the transmission joined surfaces will offer potential to further optimize the processes.

Applications

The processes demonstrated in this bonding approach for welding and cutting thermoplastic FRP components provide an alternative to mechanical processing and to joining by screw, riveting and adhesive bonding for the bonding technology of different components and material options. These processes may also be used to repair fiber-reinforced composite components.

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- 3 Workpiece edge with positive locking geometry.
- 4 Laser transmission joining of the cover layers.
- 5 Connection generated by form and material closure.