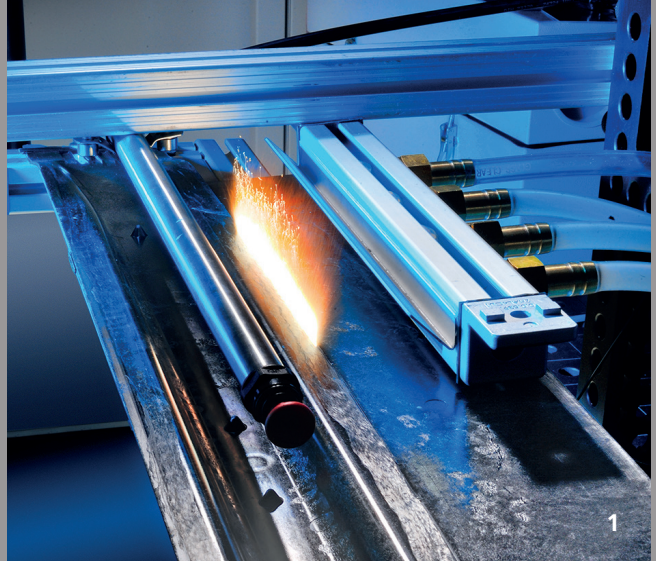

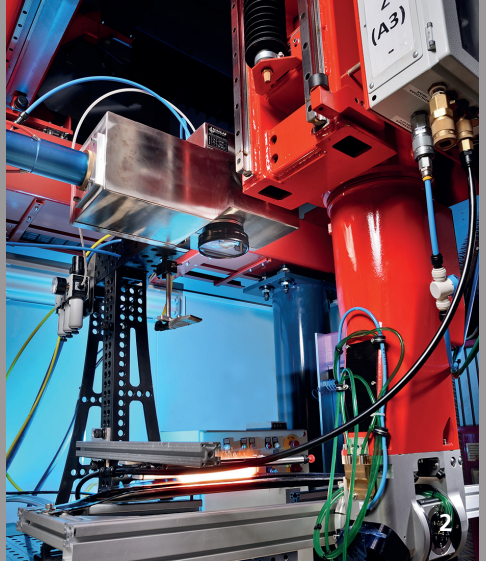

CUTTING FIBER-COMPOSITE HYBRID MATERIALS

Task

By combining different materials in one component and manufacturing process, the industry can not only optimize the weight of lightweight components, but also make the process more cost-effective. For example, structural components made of glass-fiber reinforced plastic (GFRP) can be reinforced by unidirectional carbon fiber tapes and thus tailored to specific loads.

Cutting such mixed materials is challenging because the inhomogeneity of the materials makes conventional mechanical separation processes difficult. A laser can be employed, however, to adapt the cutting process to the locally existing material structure. In the present case, 2 mm thick components were trimmed, consisting of CFRP in the upper half and GFRP in the lower half at the separation line.

Method

So that the CFRP layer could be separated with a minimum heat-affected zone, the material was removed with a continuous-wave single-mode (SM) laser in a multi-pass process. Although long-fiber-reinforced GFRP can be efficiently separated with a cutting-gas-assisted CO_2 laser, a fiber laser and the multi-pass method ablating on the beam entry side are also used here for the GFRP layer. Since the filling material has an absorption-increasing effect in the matrix, the fiber laser can ablate the material efficiently even at a wavelength of 1 µm.

Results

The parts can be cut with the SM laser in one operation. With a laser power of 5 kW and a scanning speed of 4.2 m/s, the parts can be completely separated after 13 passes. The heat-affected zone or geometric edge deviation amounts to a maximum of 150 µm.

Applications

Trimming or cutting contours and holes on CFRP or GFRP components are process steps required in all areas of lightweight construction, especially in the aerospace and automotive industries. As multi-material components are increasingly being used to fulfill lightweight construction goals, there is a great need for cutting methods that can be simply adapted to the material combination by employing laser processing.

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1 Remote laser-beam cutting of CFRP-GFRP hybrid material.
2 Continuous multi-pass cut with scanner and robot.