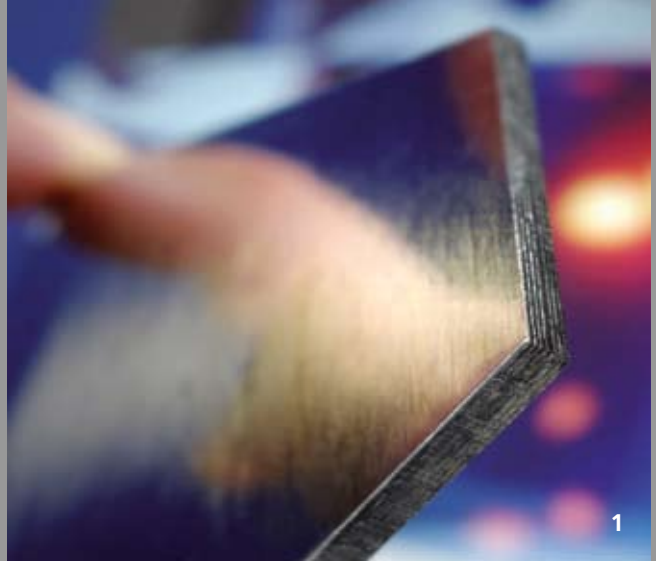

CUTTING OF CARBON FIBER REINFORCED POLYMERS (CFRP)

Task

Fiber reinforced polymers (FRP) are an important class of materials for putting lightweight concepts into practice, for example, within the material mix of lightweight vehicles. Additionally, as more and more consumers use electric and hybrid cars, manufacturers are seeing the need to promote efforts to develop such lightweight design. Mechanical processing of FRP is difficult because high tool wear reduces quality during the use of a tool and the tool's life time. These issues can be solved by contact and load-free laser cutting, which can provide constant quality. To accomplish this, however, laser cutting processes are needed with economic cycle times – commonly in the range of one minute in mass production – and low thermal influence on the cut edge.

Method

High quality cuts can be accomplished with ultra-short pulsed lasers, but at low feed rates. Nanosecond lasers with pulse durations from 10 nanoseconds to some 100 nanoseconds feature laser radiation with the high intensity needed for high cutting quality, combined with high average power to realize the required high cutting speed. To achieve high cutting quality and speed, good absorption of laser radiation is a prerequisite, which is reached with typical nanosecond lasers at a wavelength of 1 µm for the fiber, but not for the matrix material.

Result

With a CO_2-nanosecond laser having an average power of 1.5 kW, a heat affected zone of 100 µm width could be reached for cuts in CFRP. This is a process regime between fast processing with multi-kilowatt lasers and high quality processing with ultra-short pulsed lasers.

Applications

The development of efficient cutting processes for holes and trimming of carbon or glass fiber reinforced parts are being stimulated by the increasing use of FRP materials in aerospace and automotive applications. In addition, products in mechanical engineering, consumer goods and the sports equipment industry will profit from these new cutting processes.

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1 Cut edges of CFRP parts.

2 Cross section of a CFRP cut edge (thickness: 2.6 mm).

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