PROCESSING CFRP WITH ULTRA-SHORT PULSED LASER RADIATION OF HIGH AVERAGE POWER

Task

On account of their extraordinary mechanical stability-to-weight ratio, carbon fiber reinforced plastics (CFRP) have found a wide range of applications in lightweight construction for the automotive and aerospace industries. Due to the inhomogeneous mechanical and thermal properties of carbon fiber and matrix materials, processing them is, however, comparatively difficult. The difficulties arising are the delamination of fibers from the matrix, the thermal load upon it, which has a negative effect upon the mechanical strength, as well as high tool wear originating from the hard carbon fibers. For these reasons, laser radiation as a contact- and wear-free tool exhibits great potential to realize a quicker and more efficient CFRP processing.

Method

To keep the thermal influence on the workpiece as small as possible, the use of ultra-short pulsed (USP) laser radiation with pulse durations < 10 ps is evaluated. Through the use of high-power USP lasers with an average output power up to 400 W, great productivity should be reached, in comparison to the use of established USP lasers.

Result

Ultra-short pulsed laser radiation with an average power of 30 W is used to process CFRP with a heat-affected zone of under 5 µm at ablation rates of 30 mm^3/min (Figure 3). When the average output power is increased to 400 W, however, maximum ablation rates rise to 380 mm^3/min with a heat-affected zone of approx. 65 µm.

Applications

A potential application is the manufacture of CFRP components for use in lightweight construction. The process could also be used for the targeted ablation of defective sectors on lightweight parts during a repair process.

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3 Microscopic picture of a cutting edge.
4 Holes drilled in CFRP by means of USP laser radiation.