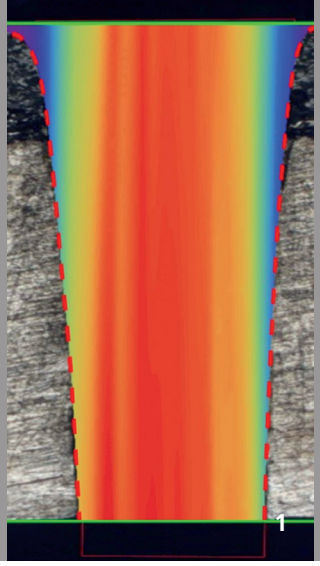

SIMULATION OF ASYMPTOTIC DRILL HOLE CONTOUR WHEN DRILLING WITH LASER RADIATION

Task

When long pulsed laser radiation is used for drilling, a so-called asymptotic ablation contour can be observed after a certain number of pulses. This contour is characterized by the fact that it changes only very little or not at all with irradiation by further pulses. Already well known from USP ablation of dielectric and semiconducting materials, this finding has been explained by Fraunhofer ILT when beam intensity falls below a threshold value.

Method

The aim of modeling and simulation is to describe and predict the final asymptotic drill hole contour, i.e., the hole shape, which no longer changes with further irradiation. In addition, the mechanism which leads to such asymptotics in the drill hole form should be identified and explained. This explanation cannot be extracted from the experimental results alone by mere observation.

Result

The explanation for why an asymptotic drill hole shape occurs has been developed, its underlying mechanism numerically implemented, tested and confirmed in comparison to experimental results (Figure 1). Fraunhofer ILT has implemented an interactive numerical tool that can illustrate – in real time – the impact on the resulting hole shape when process parameters are changed. This tool was especially designed for direct use by the customer and is offered by Fraunhofer ILT via a software license.

Applications

Originally, the basis for the observation of an asymptotic drill hole form comes from considerations on USP ablation, in which an asymptotic ablation contour occurs in the same way and was observed first. That this principle has proven to be valid also for ablation with long pulses seems to suggest that the same or similar principles can be applied to other laser manufacturing processes.

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1 Comparison between simulated asymptotic drill hole contour and experimental results. The color scale describes the beam distribution.

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