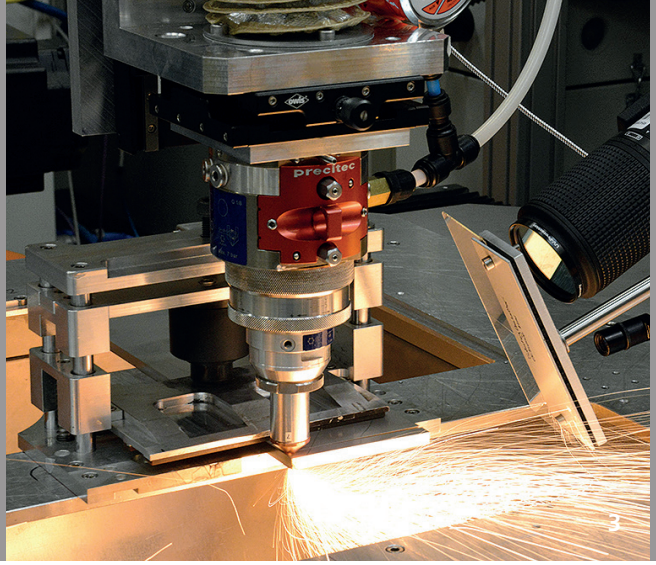

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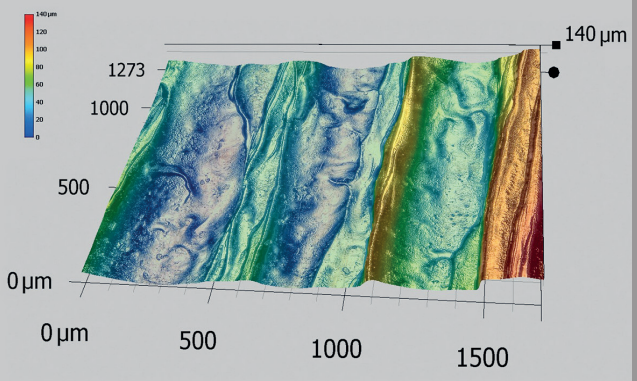

4

INFLUENCE OF BEAM SHAPING ON LASER-BEAM CUTTING

Task

Fiber and disk lasers offer numerous technological and economic benefits. Indeed, the number of fiber-coupled flatbed cutting plants sold annually will soon exceed that of CO_2 laser systems. In the thick plate industry, however, the average cutting quality CO_2 lasers generate is still unsurpassed. To increase the quality of fiber laser cuts, therefore, a basic study should analyze the extent to which elliptical beam shaping influences the process.

Method

The beam is shaped by means of several cylindrical lenses of different focal lengths. The optomechanical setup of the cutting head allows the beam ellipticity to be varied over a wide range. In parameter studies upon 8 mm thick stainless steel sheets, the effect of the beam shape on the cut edge quality and melt film dynamics has been analyzed. The melt flow is observed by means of a high-speed camera with more than 100,000 frames per second. The recordings are evaluated based on streak analyzes to identify key dynamic and statistical values of the melt flow.

Result

This investigation – on how elliptical beam shaping influences the melt film dynamics – has contributed significantly to understanding the way these physical sub-processes function in laser cutting. In the course of this work, a comprehensive cutting database has been created, which contains process parameters and measurements of the cutting quality of a few hundred cut samples. It also contains the respective high-speed shots of the melt flow and derived dynamic and statistical characteristics of the melt flow behavior.

Applications

The findings gained here have been included in the development of industry-standard beam forming concepts to increase the productivity and cutting quality of fiber-laser cutting systems. Furthermore, the measured experimental data can be used to calibrate numerical models and as meta-model data sets.

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3 Cutting process and diagnostics setup.
4 Macro image of the topology of a cut edge.