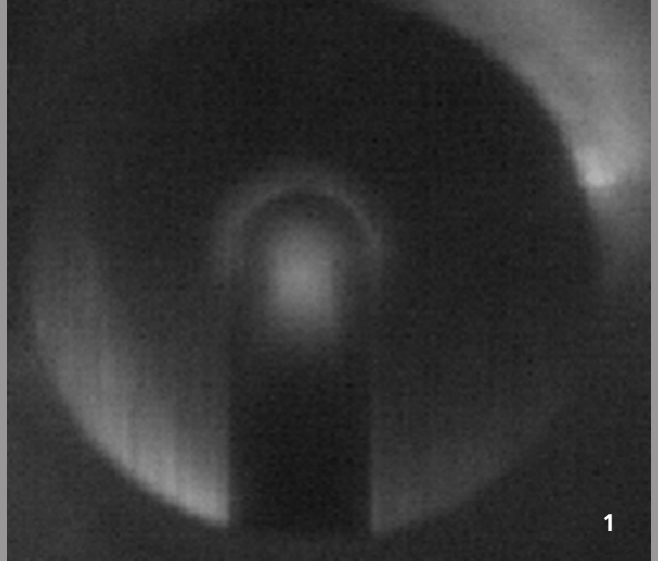

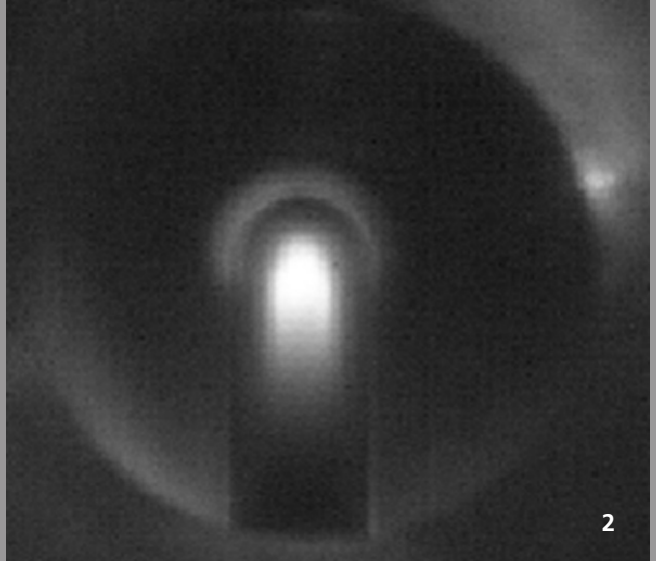

PROCESS DIAGNOSTICS IN LASER CUTTING

Task

A central question in the investigation and optimization of laser cutting processes is the exact visualization and the extraction of characteristic data of the process and its changes when process parameters are modified. Only with a precise analysis of melt dynamics, melt film thickness and the varying melt formation can the cutting efficiency be optimized.

Method

For the process diagnostics a monochrome high-speed camera and a fast photodiode were used. The optical paths of these two systems are connected to the machining beam path via a beam splitter. The combination of these two systems offers users the ability to interpret the process signals and the benefits of the extended temporal resolution of the photodiode. Today's laser cutting machines are often equipped with a photodiode, which is integrated in the beam path. Hence, the achieved results can be rapidly implemented into the industrial production process without having to significantly change system technology and machine setup.

Result

As result of this analysis, the dominant signal of the photodiode could be mapped. The largest contribution to the brightness results from the lower part of the cutting front. Due to the geometric and thermal properties of the cutting front, the upper part of the front is similarly dark as the cold sheet surface. The cutting speed showed a significant influence for the allocation of a specific process response to a process parameter. As seen in the figures, with an increase in speed, the brightness increases at the cutting front and in the kerf. From these developments, a control system can be implemented for achieving high cutting quality.

Applications

Current developments respond to specific questions in laser cutting processes of stainless steel sheets up to a thickness of 12 mm. In the medium term, the developments can be applied to other materials such as aluminum, or other processes such as oxygen cutting.

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1 Temporal averaged process recordings at 0.7 m/min.

2 Temporal averaged process recordings at 2.7 m/min.

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