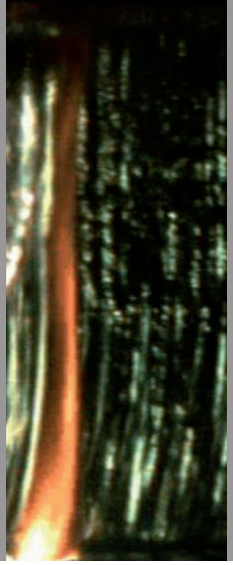

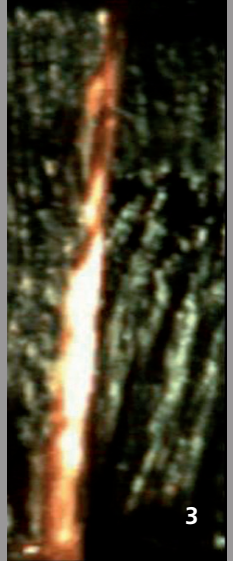

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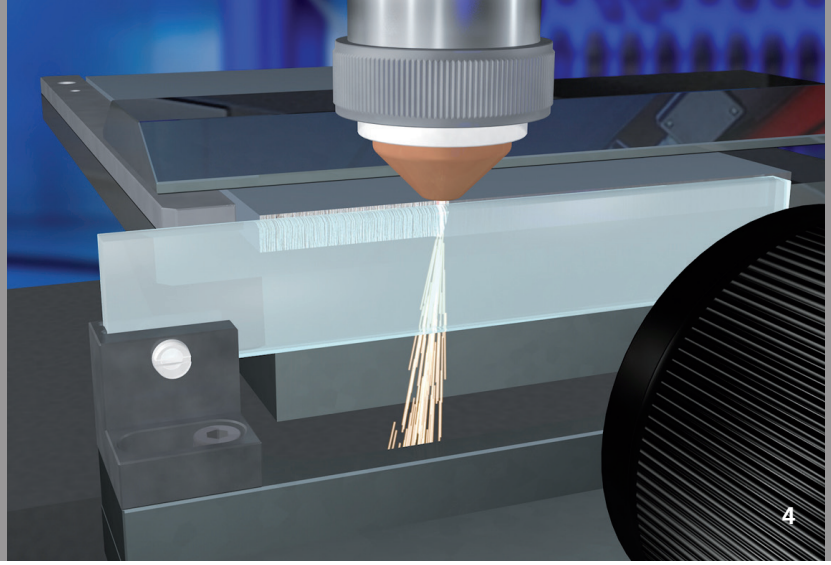

4

IN-SITU DIAGNOSTICS DURING LASER CUTTING

Task

Instabilities of the laser cutting front cause unwanted loss of quality in the form of material removal and solidification striations during laser cutting. They can also lead to the generation of dross. For in-situ diagnosis of the melting and solidification dynamics in laser fusion cutting, a trimming test bench was created in order to allow the cutting kerf to be observed optically during the process.

Method

During trimming, a cut is generated along an existing straight workpiece edge. The laser beam is displaced, relative to this cut edge, by less than a kerf width in the direction of the sheet metal. This process creates a half-cylinder shell-shaped cutting front as well as a new cut edge. Without additional measures, the cutting gas jet expands during trimming in the half space freed by the lack of a second cutting edge. To maintain a guided supersonic gas beam path along the melt film, the missing cut flank is simulated by a transparent replacement edge out of quartz glass. As the protective glass moves parallel to the cutting edge and a gap is clearly defined between the protective glass and cutting edge, both the thermal and the material impact of the protective glass can be reduced.

Result

The mobile trimming test bench can be used in different laser systems. Automatic linear axes are used to make it possible to vary the cutting speed for different material thicknesses, to move the protective window, to automatically adjust the beam displacement and, thus, the trimming width. During cutting, the normally inaccessible dynamic processes at the cutting front can be recorded with a high-speed video camera through the transparent protective glass.

Applications

The in-situ diagnosis of the processes involved in formation of the cutting edge serves as the basis for developing customized process parameters to reduce cut edge roughness while avoiding dross formation. In addition to improving the understanding of the cutting process, the collective findings will also benefit other melt-prone processes such as laser welding.

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3 Photographs of trimming created with provisional test bench.
4 Design of a new automated trimming test bench.