



IDENTIFICATION AND UTILIZATION OF ACOUSTIC RESONANCES IN LASER BEAM CUTTING

Task

Using high-speed video analysis of the melt film on the cutting front, research has recognized that the cut edges have the lowest roughness depth precisely in the areas where the melt film exhibits high-frequency waves directed downwards. The associated frequencies decrease with the sheet thickness to be cut and are believed to be in the vicinity of acoustic resonances of the gas column in the kerf. An innovative approach aims to amplify and exploit this positive effect. To this end, Fraunhofer ILT is developing an acoustically tuned cutting nozzle design that causes a resonant »cutting whistle« to form, thus improving the achievable cutting edge quality.

Method

The cylindrical part of the nozzle outlet is adapted in the first step of developing a cutting whistle. Its geometry was dimensioned according to the known physical laws of acoustics, and its effect was then compared with that of a standard nozzle. An optical microphone was used to verify the acoustic signal when the gas stream exits the nozzle into free space. Furthermore, a fiber laser with 4 kW output power was used to cut stainless steel sheets with a thickness of 6 mm, while the gas pressure was varied.

Results

The investigations confirm that the acoustic waves can be adjusted specifically by adapting the nozzle geometry. Even without taking into account the total resonance system nozzle-joint, which is planned in the next step, the institute was able to reduce the maximum value of the roughness depth R_z by 15 percent. The aim is to halve the roughness depth in the future.

Applications

In laser-beam fusion cutting, acoustic resonances can open up great potential and provide an example of how taking acoustic effects into account – in a simulative, diagnostic and practical manner – can improve laser material processing in general.

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2 High-speed videography of the cutting process provides new insights.