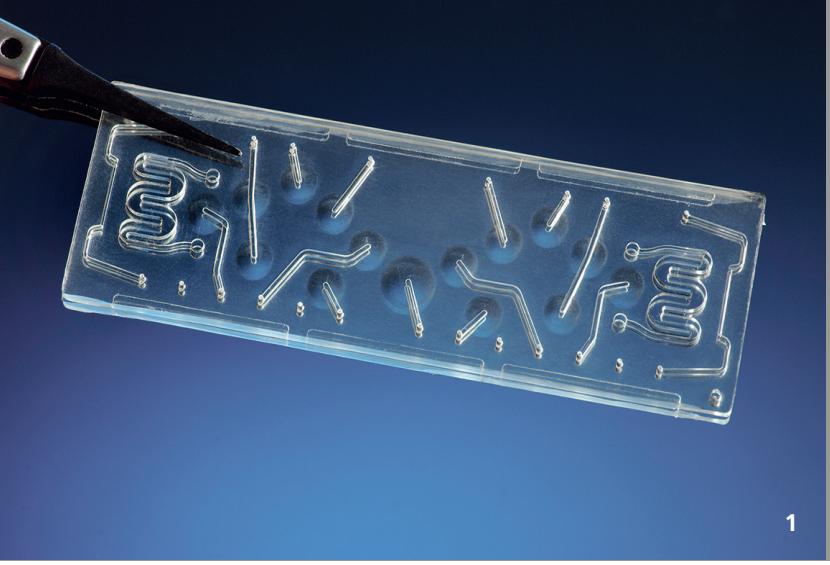

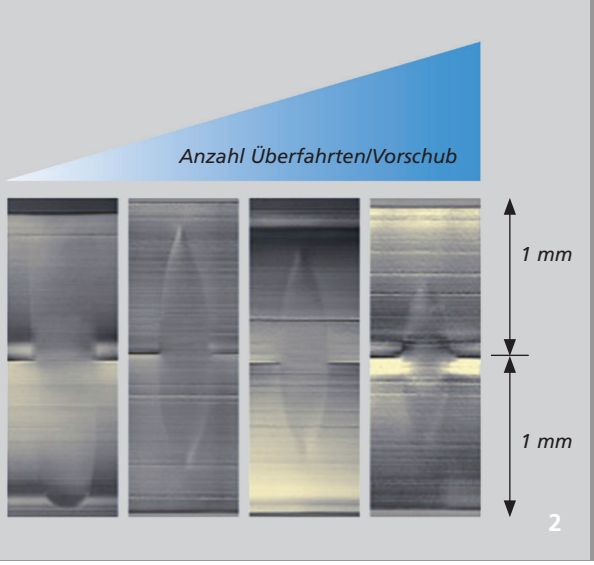

QUASI SIMULTANEOUS WELDING OF ABSORBER-FREE THERMOPLASTS

Task

Since thermoplastics are transparent in the wavelength range of classical beam sources used in laser beam welding (800 - 1100 nm), a joining partner usually requires a modification: an absorbent layer is needed so that the laser radiation is absorbed. However, when appropriate beam sources are used, intrinsic absorption properties of thermoplastics can be exploited so that two plastic parts can be welded together without requiring additional absorbers. Here, the challenge is to fuse both joining partners in the contact area as selectively as possible.

Method

So far, a selective melting of the contact region has not been achieved despite adjusted wavelength and strongly focusing optics. The heat affected zone (HAZ), which extends far along the beam axis, can lead to distortion in flat components, such as lab-on-a-chip applications (Figure 1), and, moreover, promote melt discharge and burns on the irradiated surface. A more compact HAZ can be achieved by quasi-simultaneous welding in which the laser beam is repeatedly guided along the weld contour in succession at very high feed rates (> 1 m/s). Due to the poor thermal conductivity of plastic materials, the heat in the joining zone is accumulated while it is discharged at the upper and lower sides by the elements of the clamping device (glass, aluminum), which have a much higher thermal conductivity.

Result

Compared to the contour method, this absorber-free welding process generates a substantially more compact HAZ in the beam direction because of the quasi-simultaneous irradiation (Figure 2). The almost uniform heating of the entire welding contour generates a joining path with which remaining gaps can be leveled out between the joining parts. Despite the radiation passing over the joint repeatedly, the welding time is comparable with the contour welding processes due to significantly higher feed rates.

Applications

The method presented here is primarily targeted for applications in medical technology (Figure 1) in which the use of absorbers may present a risk to biocompatibility. However, the method can be used in other applications where optical absorbers are inadmissible due to economic or functional reasons.

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1 Example of a microfluidic component.

2 HAZ with increasing number of pass-overs.

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