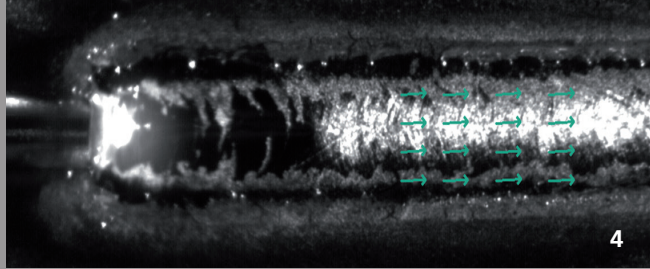
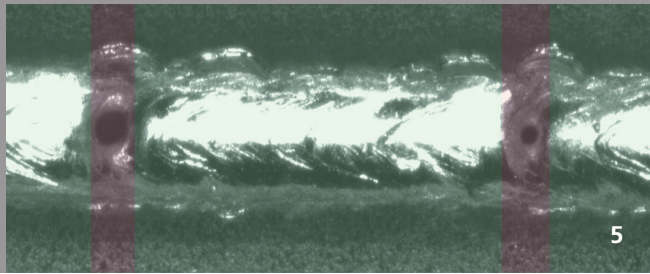


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## QUALITY ASSURANCE FOR LASER BRAZING

### Task

Laser brazing is an established joining process in the automotive industry. For example, two-piece tailgates, but also the roof seams are bonded together with this joining method. In addition, the resulting visible seam is often used as a stylistic element in exterior design. Accordingly, the demands on the optical appearance of the brazed joints are very high and make quality control necessary.

### Method

As part of the successful industrial project »SintALO - Sensor Integration in ALO3«, the Fraunhofer ILT and the company Scansonic MI GmbH have developed a real-time quality monitoring system that is fully integrated into the adaptive brazing head ALO3. Thanks to the coaxially integrated high-speed camera, the laser-beam brazing process can be visualized without impairing the component accessibility of the processing head. Furthermore, a powerful, multi-directional and fully integrated lighting module provides a uniform illumination of the entire field of view of the camera, allowing the use of robust image processing algorithms.

### Result

In addition to the visualization of the brazing process with up to 350 frames per second, the project partners have implemented real-time algorithms to assess the brazing quality and to monitor process parameters:

- Thanks to a classification algorithm, even the smallest pores with a diameter of 200 µm can be detected.
- The feed rate is determined by calculating a displacement vector between two successive images acquired by the coaxial camera.

Both evaluation methods can be used in real time thanks to the programming of a Field Programmable Gate Array (FPGA). Thus, the measured process parameters can be used in control applications.

### Applications

The fully integrated and, therefore, industrial-grade sensor system also offers deep insight into the laser material processing. Beyond laser brazing the sensor concept might also be used for other laser processes, such as laser soldering, welding or cutting. The imaging process monitoring continuously provides the basis to increase an understanding of the process as well as to document product quality completely.

### Contacts

Dipl.-Phys. Michael Ungers  
Telephone +49 241 8906-281  
michael.ungers@ilt.fraunhofer.de

Dipl.-Ing. Peter Abels  
Telephone +49 241 8906-428  
peter.abels@ilt.fraunhofer.de

3 ALO3 with fully integrated sensor system.

4 Visualization of laser brazing with measurement of feed rate in real time.

5 Pore recognition.