

Finalist of the Innovation Award Laser Technology 2012

3D-capable co-axial laser brazing head with integrated seam tracking



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Areas of application

Major sector of industry which is profiting from the innovation:

- Automotive industry, especially body-in-white applications

Technological impact

- Improved quality in existing products
- New product features
- Reduced manufacturing costs
- Shorter development lead time
- Improved quality assurance

Abstract

In industrial laser brazing applications processing heads are commonly used in which the wire is fed laterally usually ahead to the laser beam. Problems with this lateral wire feed are:

- Limited accessibility due to the comparatively large design
- Radii <10 mm difficult to handle or not feasible
- Time consuming programming of robot control due to frequent reorientation of the processing head, especially in demanding 3D seam geometries
- Lost productivity due to frequent rearrangement of the processing head, and thus low feed rates at the reorientation positions
- Variations in the weld width and lack of fusion by non-constant processing speeds, which are caused by frequent reorientations

For the above reasons a wire feed would be of great advantage in which the wire is transported coaxially to the laser beam into the joining zone. In combination with a ring shaped laser intensity distribution the brazing process could be carried out independent of direction without reorientation of the processing head. With this concept there is no need to keep the wire position ahead to the laser beam. By implementing a seam tracking system the seam position is automatically detected in order to keep the processing head in the desired position.

The main task in the realization of a coaxial wire feed unit with ring-shaped intensity distribution was the development of the necessary beam-shaping unit. One of the key features is the use of a multi-kW fiber coupled diode laser in order to stick with the beam sources standardly used for laser brazing applications, especially in terms of the brilliance of the laser beam. The essential requirements to the processing head were:

- Design for the usage of a fiber-coupled diode laser system with a core diameter of the fiber from 0.6 to 1.5 mm, laser power up to 4 kW and a NA of just 0.22
- Working distance (distance between the last optical element and the workpiece) > 100 mm
- Interfaces for the integration of a contactless optical seam tracking and quality assurance unit
- Efficiency of the optics (transmittance through the optical system) > 90%

All the features – propagation of the processing laser beam, propagation of the illumination, observation of the processing zone with a camera - are realized in one optical layout. Due to the optical concept there is no shadowing of the beam paths. Thus the coaxial wire support of the new laser brazing head enables direction independent processing, high stability of the process due to constant processing speed, less demanding programming of the robot path and processing of small seam radii. This leads to a speeding up of the process and the start-up time, less scraps and new work piece designs. Also the use of less expensive robots with reduced dynamics can contribute to a reduction of the overall system costs. With this new brazing head the first time a fully 3D processing of complex structures is possible. Potential customers from the automotive sector have tested the system and committed themselves to apply the new technology.

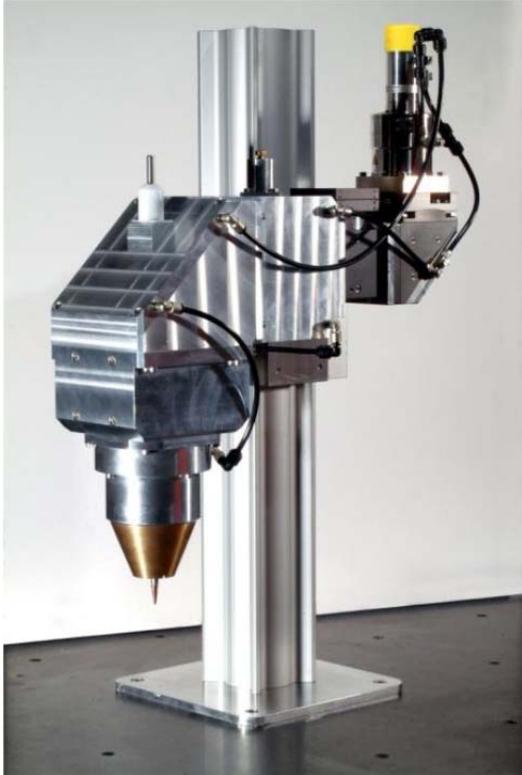


Figure 1: 3D Capable Co-axial Laser Brazing Head with Integrated Seam-tracking
(Photo: Fraunhofer ILT, Aachen)

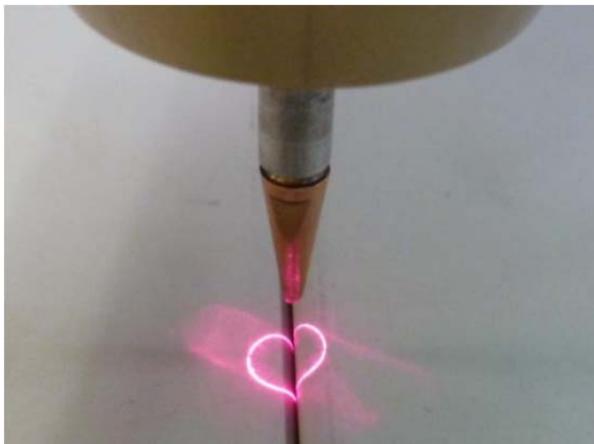


Figure 2: Illumination of the processing area for the optical seam tracking system
(Photo: Precitec Optronik GmbH, Rodgau)