Fraunhofer Institut Werkstoff- und Strahltechnik

Laser Welding and Hybrid Welding Processes

Motivation

In the past years laser welding has been established as an efficient joining technology in manufacturing.
It offers wide application possibilities with regard to the welding materials as well as the variety of parts and loading conditions.

Driven by requirements to manufacture at lower costs, more effectively, faster, and more reliably, the industrial need for very sophisticated and refined welding solutions increases. The goal is therefore, to expand the material and manufacturing related limitations of today's welding processes. This can only be achieved with comprehensive solution approaches and innovative welding processes.

Passenger car drive shaft, laser welded with inductive preheating (Visteon)

Solution

Based on a large palette of established laser welding processes as well as a number of new or improved laser combination or laser hybrid welding processes, Fraunhofer IWS is capable of developing adapted, customer-oriented solution strategies. These, together with system integration, are then transferred to industry. The many years of experience in the area of material and laser technology guarantees the smooth control of the entire process from the initial material selection through the manufacturing process up to the final component performance. IWS is especially focusing on the component- and material-adapted process development.

The combination with additional process adapted energy sources enables the exploration of so far not accessible application fields for high strength or hard-to-weld materials, and for lightweight component designs. The process development is concentrated on the laser welding of steel with increased carbon content (e. g. heat treatable, spring and tool steel) and of other hard-to-weld materials (e. g. free machining steel, hot crack sensitive austenitic steel, cast iron). Laser induction welding as well as other hybrid processes are applied for the efficient material and load adapted joining especially for lightweight constructions (e. g. Al, Ti, Mg alloys).

Aluminum windshield wiper linkage, laser welded (Sander / Erdrich Forming Technology)

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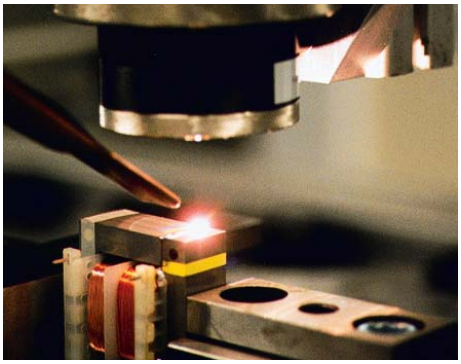
Process diagnosis during development and material testing according to application-oriented test strategies guarantee high process stability and production quality. The cooperation with laser, machining equipment and system manufacturers ensures the rapid transfer of new laser welding technologies into industrial production.

Processes Variants

- Laser beam deep-welding with CO_2 and Nd:YAG-lasers (Power range: CO_2: 2,0 - 20 kW; Nd:YAG: 0,8 - 3,0 kW)
- Heat conduction welding with high power diode lasers (HLDL to 2,5 kW)
- Laser beam welding with additional wire
- Induction assisted laser welding (induction generators: 4-20 kHz, power up to 80 kW)
- TIG assisted laser welding (choices are: CO_2 or Nd:YAG-laser)
- Plasma assisted laser welding (CO_2 or Nd:YAG-laser)
- MIG assisted laser welding (CO_2 or Nd:YAG-laser)
- HLDL assisted laser welding (CO_2 or Nd:YAG-laser)

Induction assisted laser welding of starter gears

Laser hybrid welding of steel sheets



Heat conduction welding of a sheet metal stack for a transformer with a high power diode laser (HLDL)

Performance Offer

- Development and optimization of material and stress tailored laser welding technologies
- Technology development for laser welding of hard-to-weld materials
- Process development for induction assisted laser welding
- Process development for hybrid welding technologies (Laser + Plasma/TIG/MIG, high power diode lasers)
- Process development of heat conduction welding with a high power diode laser
- Feasibility studies
- Welding of test patterns and prototypes, pilot production
- System conception and process integration
- Process technical equipment start-up and applications training
- Application oriented test strategies and continual materials testing during development