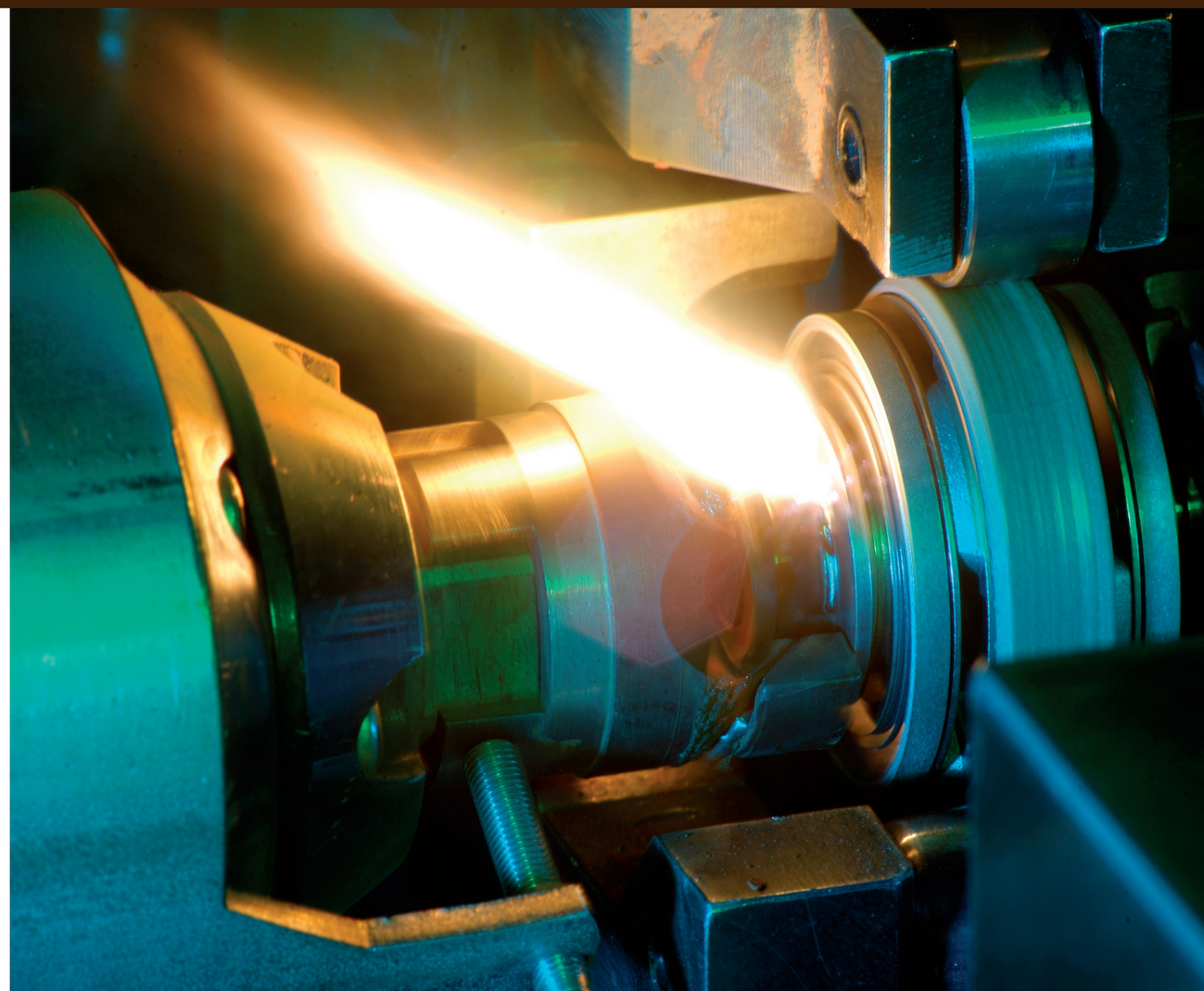
Fraunhofer
ILT

FRAUNHOFER INSTITUTE FOR LASER TECHNOLOGY ILT

LASER BEAM WELDING OF METALLIC MATERIALS



DQS certified by
DIN EN ISO 9001
Reg.-No.: DE-69572-01

Fraunhofer-Institut
für Lasertechnik ILT
Director
Prof. Dr. Reinhart Poprawe M.A.

Steinbachstraße 15
52074 Aachen, Germany
Phone +49 241 8906-0
Fax +49 241 8906-121

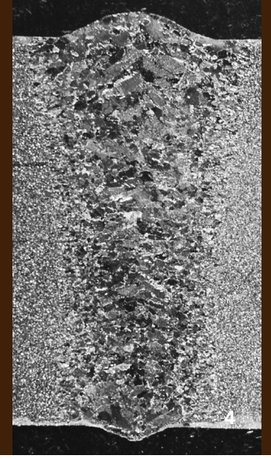
info@ilt.fraunhofer.de
www.ilt.fraunhofer.de

Fraunhofer ILT - Short Profile

With about 330 employees and more than 11,000 m² of usable floorspace the Fraunhofer Institute for Laser Technology ILT is worldwide one of the most important development and contract research institutes of its specific field. The activities cover a wide range of areas such as the development of new laser beam sources and components, precise laser based metrology, testing technology and industrial laser processes. This includes laser cutting, caving, drilling, welding and soldering as well as surface treatment, micro processing and rapid manufacturing.

Furthermore, the Fraunhofer ILT is engaged in laser plant technology, process control, modeling as well as in the entire system technology. We offer feasibility studies, process qualification and laser integration in customer specific manufacturing lines. The Fraunhofer ILT is part of the Fraunhofer-Gesellschaft with more than 80 research units, 18,000 employees and an annual research budget of over 1.6 billion euros.



LASER BEAM WELDING OF METALLIC MATERIALS

For numerous seam and joint configurations, laser welding represents the most productive and reliable method for high-strength substance-to-substance bonds of metallic components. The Fraunhofer Institute for Laser Technology ILT develops tailor-made processes, tools and systems for laser beam welding applications.

Laser Welding

The spectrum of laser welding extends from heat conduction welding to deep-penetration welding, a keyhole process in which aspect ratios of up to 10:1 are attained. High power densities permit a concentrated energy input, achieving high welding speeds as well as significantly reduced heat influence and distortion. Compared with arc welding, it allows a much wider range of materials to be welded, and material thicknesses of up to approximately 20 mm can be welded in one pass.

Hybrid Welding

Hybrid welding efficiently combines the deep-penetration mode of laser beam welding with the advantages of arc welding. The laser beam and arc work together in one process zone. The welding speeds, that are characteristic of laser welding, are complemented by high gap-filling ability. Optimal adjustment of the process to the material being welded produces welds with excellent fatigue strength.

Combined Processes

The combi-head enables cutting and welding to be performed in one setup. The parameters are adapted for the change in process by numerical control. The use of auxiliary energy (heat, ultrasound, electric or magnetic fields) makes it possible to join materials which normally are presumed not to be suitable for welding and to produce weld seams with particular characteristics.

1 Drum made of AlMg5 (3.3555) with a wall thickness of 11.5 mm.
2 Hybrid welding of a C-pillar.
3 Work piece platforms made of stainless steel 1.4306 for plasma coating units.
4 Weld in titanium 3.7035 (thickness 15 mm) produced at a power output of 18 kW.
5 Dissimilar weld of nitinol and stainless steel with a thickness of 3 mm.
6 Hybrid welding of a cantilever beam for a construction vehicle.

Materials

Fraunhofer ILT conducts research not only into the behavior of steels and aluminum alloys but also into laser beam welding of titanium and titanium alloys. Our research scientists possess extensive experience in the laser welding of nickel-based alloys and advanced austenitic and martensitic high-temperature steels. Current research work is focused amongst others on chromium steels with martensitic microstructure, aluminide-based alloys and non-ferrous metals, as well as the welding of dissimilar materials.

Fault Analysis

To reduce the occurrence of defects in welds and failures in welding processes, we conduct damage investigations as well as fault tracing and examine production processes. If it is not possible to remedy defects on the customer's installation, the fault mechanisms are determined by experimental replication in our laboratory and the process is readjusted and optimized. A metallography laboratory, optical and interference microscopes and two scanning electron microscopes are available for ad hoc analyses. We undertake extensive materials testing in conjunction with specialist partners.

Our Range of Services

We provide our customers with comprehensive support in the procurement, installation and conversion of laser systems, with a particular emphasis on the development and optimization of processes and techniques. Our range of services in laser welding extends from the verification of weldability and the manufacture of test samples to prototype production.

Facilities

- CO_2 lasers up to 20 kW
- Disk lasers up to 10 kW
- Fiber lasers up to 4 kW
- MIG/MAG and TIG welding power sources from various manufacturers
- Lamp- and diode-pumped solid-state lasers up to 8 kW
- Trumpf Laser Cell TLC 105 with TLF2600t CO_2 laser
- High-power scanners up to 8 kW
- Reis RLP16 laser gantry robot
- Held Translas 2718 and 3325 5-axis gantry robots
- 6-axis articulated arm robots, Kuka and Reis
- Mobile 3-axis welding system
- Welding heads from leading manufacturers and in-house developments with lenses and mirror optics
- Laserfact combi-heads for welding and cutting
- High-power beam diagnosis (systems from Prometec and Primes)
- High-speed cameras up to 100.000 frames per second
- Metallography laboratory
- Hardness testing devices, manual and automatic
- Ultrasonic testing, DP testing
- Roughness and profile measurement devices
- Scanning electron microscope with EDS

Contact

Dipl.-Ing. Martin Dahmen
Phone +49 241 8906-307
martin.dahmen@ilt.fraunhofer.de

Dr. Dirk Petring
Phone +49 241 8906-210
dirk.petring@ilt.fraunhofer.de