

High Power Diode Laser Application Center Dresden



Fraunhofer Institut
Werkstoff- und
Strahltechnik

High power diode lasers - Visions turning real

Laser beam techniques underwent a tremendous boost in materials technology during this decade. Nevertheless, the light beam as a tool still offers vast fields of novel applications which have not been utilized so far because of high cost, low energetic efficiency, and bulky shape of conventional laser equipment. Presently we are witnessing the introduction of high power diode lasers into materials technology, which compares to the advent of the transistor in electronics some time ago.

The extraordinarily high energetic efficiency (more than 10 times that of the Nd:YAG-laser) and its compact shape (about 10 times smaller than comparable CO₂-lasers) enable the diode laser to be easily integrated into existing production lines and thus make it a favorite beam tool of the near future.

The future

The high power diode laser will not only serve as a favorable substitute heat source for processes as soldering, gluing, tempering, forming, welding of metals and polymers, hardening, surface cladding, eroding, labeling, etc. but also as a component of novel hybrid technologies. Examples for these are laser supported turning and milling, tooling and hardening in one clamp, and laser induction welding.

Equipment

2.5 kW high power diode laser

- cw-mode
- wave length 808 nm and 940 nm
- spot size 1.2 • 1.2 mm²
- different changeable optics up to a focal length of 300 mm

1.5 kW high power diode laser

- cw-mode
- wave length 940 nm
- spot size 1.8 • 3.8 mm²
- max. luminosity $2.2 \cdot 10^4$ W cm⁻²

4.0 kW high power diode laser

- cw-mode
- wave length 940 nm
- spot size 1.8 • 3.8 mm²

2.0 kW high power diode laser (in satellite station in USA, Plymouth, MI)

- cw-mode
- wave length 940 nm
- spot size 1.8 • 3.8 mm²



Fig. 1: Laser hardening plant with integrated high power diode laser (HPDL)

The application center - A quick way to the solution

The application center for high power diode lasers at IWS Dresden is engaged in the development of novel techniques and provides advice and assistance to our customers in all problems concerning diode laser application.

Based on long-time experience in the development and realization of „conventional“ laser technologies as well as on close cooperation with leading manufacturers of high power diode lasers, the application center is able to respond quickly and efficiently to your demands by applying the latest high power diode laser systems.



Fig. 2: Welding of large sheet metal components by a 2.5 kW HPDL

High power diode lasers - Applying the novel tool

Laser beam welding with diode lasers

The high power diode lasers are well suited for weld joining a large variety of small parts, as punched or cold formed parts, also thin metal sheets and polymer coated foils.



Fig. 3: Sintering sieve drum, welded by a HPDL, material: non-rusting high-grade steel, 2 mm

Laser beam hardening with diode lasers

A promising field of application of high power diode lasers is the surface hardening of small parts of hardenable steels, with absorption as high as 70 %. The hardening depth of optionally 0.1 - 1.5 mm predestines this technique to application to small tools and parts of textile machines, precision mechanics, medical devices, etc..

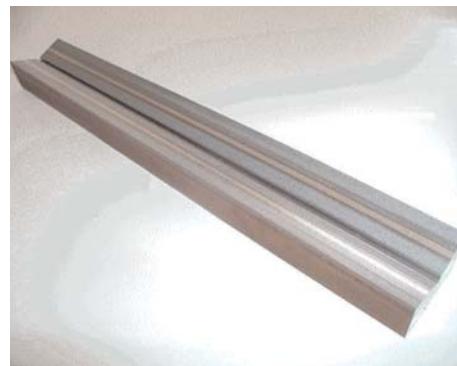


Fig. 4: Guide rail, partially hardened by a HPDL

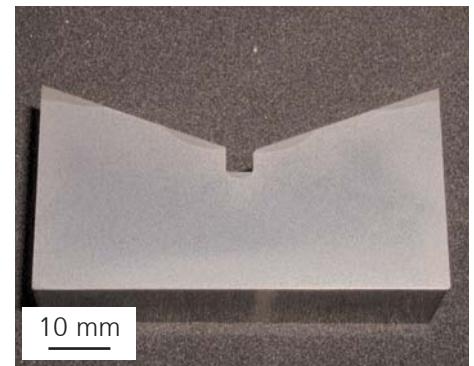


Abb. 5: Cross-section polish of a guide rail, hardened by a HPDL

Laser beam surface cladding with diode lasers

The availability of high power diode lasers up to 4 kW opens novel fields of application also to the proven technique of surface cladding. In addition to a more cost-efficient hardfacing of parts and tools, the newly developed portable laser systems enable repair work to be done in situ at the customer's.



Fig. 6: Cladding with diode laser and cyclon powder feeder head

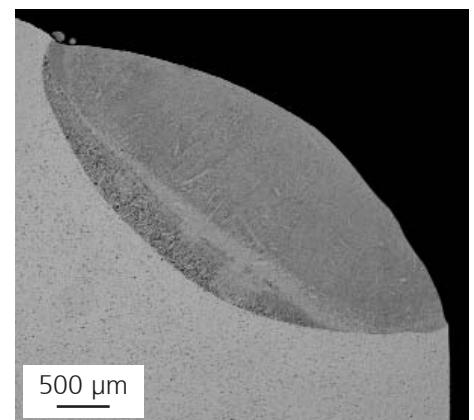


Abb. 7: Valve lined with stellite

High power diode lasers - Applying the novel tool

External beam shaping systems

A number of applications require a flexible beam shaping or a beam splitting for an optimal process control. The internal optics of the laser devices do not fulfil these demands. Thus external beam shaping systems such as scanners or beam splitters extend the application of the high power diode laser.



Fig. 8: Lab construction
- scanner system for 2.5 kW high power diode laser,
- maximum with a homogene power splitting 100 mm

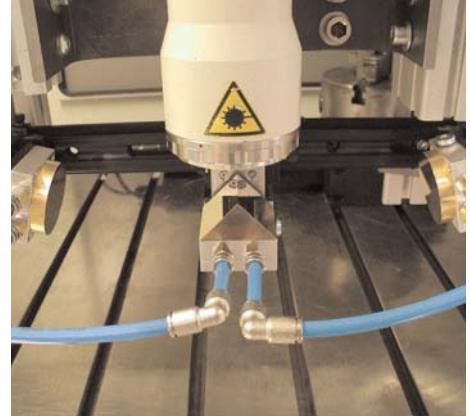


Fig. 9: Lab construction
Beam splitter for a 2.5 kW high power diode laser for simultaneous treatments

Control system LompocPro® for hardening, heat treatment and cladding LompocPro®

More and more industrial laser users demand controlled and monitored processes. The system LompocPro (laser online monitoring and power control program) applies pyrometers for a contact less temperature

measurement and it quickly and reliably controls the laser power to ensure a constant surface temperature.

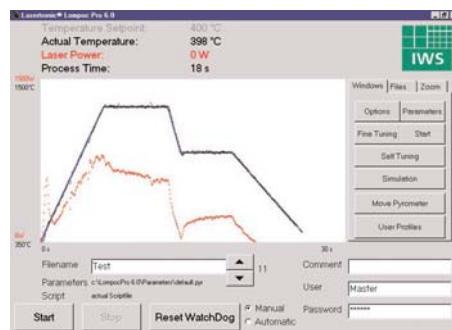


Fig. 10: PC operator interface of the temperature controlling system lasertronic® LompocPro

Offer

- feasibility studies on all problems concerning application of high power diode lasers
- developing technologies of welding, surface modification, milling, combining technologies into hybrid technologies
- setting up plant conceptions
- building and running of pilot plants
- series production checks
- developing complex technological systems in cooperation with renowned manufacturers of lasers and production plants

Title figure

Beam splitter for high power diode lasers for a simultaneous treatment from two sides

Fraunhofer Institute for Material and Beam Technology IWS
Fraunhofer-Institut für Werkstoff- und Strahltechnik IWS

Winterbergstr. 28
01277 Dresden / Germany

Contact
Prof. Dr. Berndt Brenner
Phone +49 (0) 351 / 2583 207
E-mail berndt.brenner@iws.fraunhofer.de

Dr. Steffen Bonß
Phone +49 (0) 351 / 2583 201
E-mail steffen.bonss@iws.fraunhofer.de

Fax +49 (0) 351 / 2583 300
Internet <http://www.iws.fraunhofer.de>