Hardening
with Diode Lasers

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Hardening with Diode Laser

Advantages of Diode Lasers
- Spot dimensions adapted to parts
- Local hardening only where required
- Adaptive temperature control
- High processing speed, very high productivity
- Low heat input and thus low distortion
- Short wavelength, therefore very good absorption

Applications
- Work pieces of batch size 1 (local hardening of injection moulding and forming tools), series production of components

Photo: Erlas

Hardening of forming tools with direct diode laser.
Hardening: Typical Data

- **Laser**
  - Direct diode laser, Twin- or Multi lasers

- **Power**
  - 1000 W to 6000 W

- **Beam quality**
  - 85 - 400 mm mrad

- **Spot dimensions**
  - 3 x 3 mm² to 15 x 15 mm², 19 x 9 mm² or up to 40 mm length, adapted to specific part to be hardened

- **Material**
  - steel and cast iron

*Hardening of cylindrical component*
Diode Laser Types for Hardening

Direct diode laser on robot.

Twin spot diode laser

Multi kW twin diode laser on 7 axis gantry system.

Photo: Reis Robotics

Photo: Stiefelmayer
Hardening: Principle

- Local heating of zone to be hardened
- Pyrometer control to avoid melting
- Self-quenching because of cold bulk material
- Formation of fine-grained microstructure of great hardness
- Low overall heat input, low distortion
Optimized beam geometry for every application
  e.g. 40 x 8 mm², 30 x 10 mm², 15 x 15 mm²
Integrated pyrometer for temperature control
Mechanical shutter, stack management
Interfaces: Profibus-DP, Interbus, Ethernet, PC-based control
Vario optics
Twin-laser or twin-spot solutions

Hardening: Options
Hardening: Comparison of Lasers
Hardening: Comparison of Results

Nd:Yag-Laser

Diode-Laser

Diode-Laser

20 mm
Hardening: Simulation and Reality

Offline-Programming with TopLas3D® of forming tool
- Simulation of process
- Generation of robot NC programm
- Collision control

Hardening of the same forming tool
- Weight: 1.5 tons
- Material: 1.2738
- $T_{\text{Hardening}}$: 1100 °C
- Speed: 5 mm/s
Hardening of Forming Tools

- Here: deep drawing tool for back door of VW Passat
- Material: GGG 70 (0.7070)
- $T_{\text{Hardness}}$: 1000°C
- Length: 35 m
- Width: 20 mm (single track)
Hardening of Forming Tools

- Automotive industry
- Tools for body-in-white sheets

Foto: Erlas
**Material:** 1.2379

**Hardening:** 1100 °C

**Speed:** 5 mm/s

**Laser system:** ERLASER® 4000 TCH

**\( P_{\text{Laser, max.}} \):** 4000 W

**Wavelength:** 808 + 940 nm
Hardening of Bending Tools

LDL 160-4000
- Optical power: 4000 W
- Temperature controlled spot: 17 x 17 mm²
Hardening of Cutting Tools

- Automotive industry
- Cutting tools for body in white sheets

Photo: Erlas
Hardening: Industrial Applications

Spring from automotive door

Hardening System: Robot and Diode Laser

Photo ERLAS
Hardening of Mass Production Parts

- Local hardening of
  - Cutting edges
  - Car door spring
  - Springs
  - Saw blades
- Laser power approx. 1.000 W
- Spot geometry adapted to hardening zone
Hardening with Diode Laser

Material: 40 CrMnMo 7
Temperature: 1050 °C
Spot: 17 x 17 mm
Power: 2500 W
Speed: 5 mm/s

Material: 42 CrMo 4
Temperature: 1050 °C
Spot: 25 x 8 mm
Power: 2500 W
Speed 5 mm/s
Hardening with TWIN- Diode Laser

- Two multi-kW diode lasers combined
- 7 axis handling station
- Operation from both sides possible for reduction of heat induced bending
Hardening with Diode Laser

- Hardening of different geometries
- Hardening in edges
- Temperature controlled hardening