lightmotif OP2 / OP3

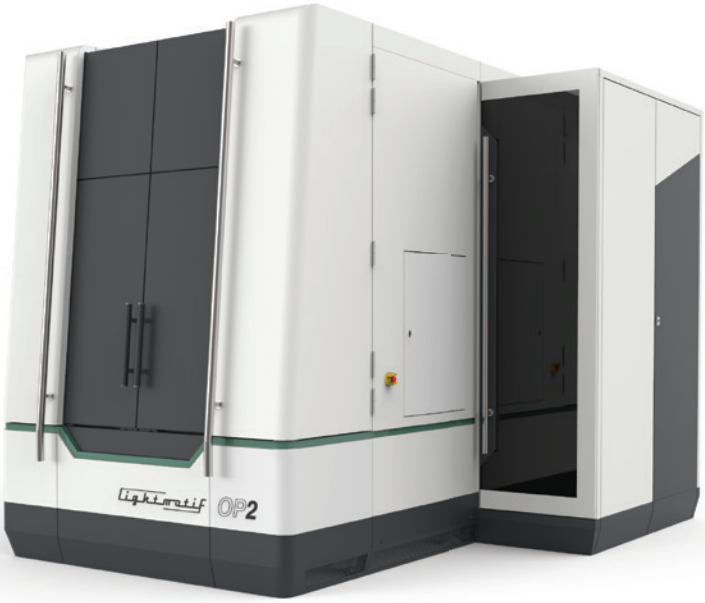
5-axis laser micromachining systems

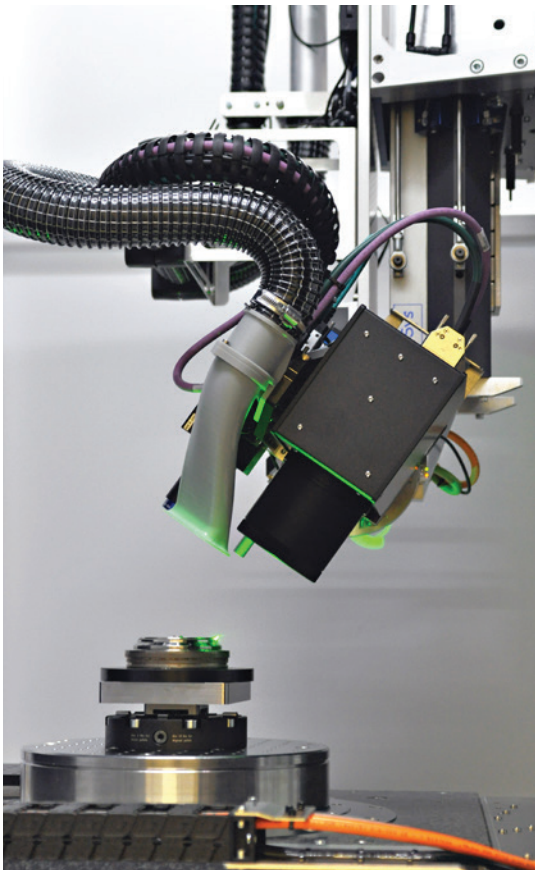
High accuracy step-and-scan micromachining
for fast and precise surface texturing and micro-milling in 2.5D and 3D

Flexible and modular machine concept
from single purpose production machine to all-round laboratory workstation

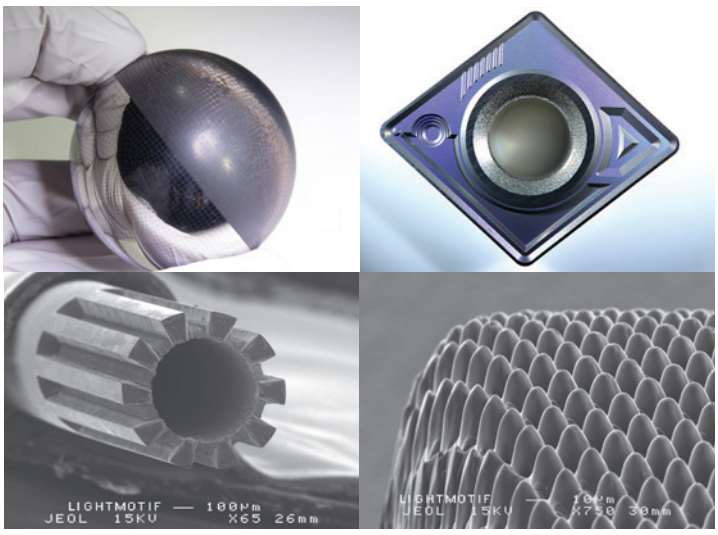
High level of automation and sensor integration
allows the user to focus on the application instead of on the machine

Flexible and scalable control software
enabling large and complex machining programs





Lightmotif's OP2 and OP3 are 5-axis laser machine tools designed for surface texturing and micromachining on complex 3D curved workpieces. The combination of step-and-scan machining and a state-of-the-art picosecond laser provide the best combination of speed and accuracy for applying micro-features to relatively large parts. The systems can be used as flexible workstations for R&D or as a production system. Based on a modular machine concept the systems can be adapted to create a semi-custom machine that fits the requirements specific to your application.



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Feature Highlights

Large area laser surface micro-texturing

The OP2 is specifically designed for micro-texturing of large and heavy (up to 300 kg) workpieces, whereas the OP3 focuses on increased accuracy and accessibility for small to medium-sized parts (up to 10 kg). The step-and-scan machining method and built-in scan field calibration ensure accurate tile alignment (negligible stitching errors).

The use of a picosecond laser source enables machining of very small and detailed features. Dimple textures can be made with dimple diameters as small as just a few micrometers. Free-form pockets allow for example the machining of small pillars, and the typical material interaction of ultrashort laser pulses enables applying different types of micro-roughness.

By using control software developed by Lightmotif specifically for large and complex step-and-scan micromachining jobs the system allows programming textures which contain millions of small features.

Details handled automatically

Ideally the operator should never have to worry about machine-specific details, but instead focus on those directly relevant to the process. For example, to mark a line should not require thinking about scanner mirror acceleration or tracking errors. Lightmotif uses various sensor systems to allow the machine to handle these details automatically.

An automatic power calibration system allows programming in physical units (watt) instead of laser “relative” power, avoiding the need for manual power measurements, and ensuring a program will always yield reproducible results.

To achieve maximum accuracy from the scan head the system is equipped with a tool calibration system. This camera-based system automatically measures and corrects for scan head alignment errors, scan field distortion, scan system and laser pointing drift, and variations in the laser focus.

Specifications

Laser

- Lumentum PicoBlade® 2 industrial picosecond micromachining laser
- 10 ps pulse width
- 532 nm wavelength
- Fast modulation of pulse energy (up to 2 MHz)
- Optimized for high power and high repetition frequencies (up to 8 MHz)

Scan system and optical configuration

- High accuracy SCANLAB 2D scan system with digital encoders for low drift and dither
- 10 mm scan head aperture
- Telecentric objective with 100 mm focal length
- 35×35 mm scan field
- 20 μm spot size

Manipulator

- 5-axis motion platform with granite base body
- Separate stage for built-in calibration sensors (power, alignment)
- Air bearing direct-drive linear stages with repeatabilities better than 1 μm
- 400 mm Z axis travel
- Integrated workholding system (EROWA / System 3R)

OP2

- Tilting head configuration
- Workpiece weight up to 300 kg
- 600×600 mm working area

OP3

- Tilting table configuration
- Workpiece weight up to 10 kg
- Workpieces up to 250 mm diameter, 200 mm height

Exhaust system

- Integrated local fume extraction system moves with the scan head to ensure optimum capture efficiency for 3D machining

Enclosure

- Free standing laser safe enclosure with interlocked doors
- Easy access to work table and scan head
- Beam shaping area can be accessed from within the enclosure, allowing alignment / adjustment without requiring additional laser safety measures
- Enclosure ventilation using filter fan units to provide clean air downflow

Control

- Job definition using high-level programming language (Python) scales to large and complex jobs
- Programmable control of laser settings (repetition rate, burst)
- Graphical job preview and inspection
- Automatic power calibration, i.e., jobs are programmed in watt instead of percentage
- Graphical operator interface
- Support for system control by third-party software (C API, network protocol)
- Upgradable software

Calibration sensors

- High optical resolution (1.5 μm) off-axis camera allows precise position measurements in the image plane as well as in the focus direction
- Additional low-magnification camera system with larger field of view (> 10×10 mm), large depth of field (> 1 mm), and good optical resolution (< 10 μm)
- Integrated power calibration system measures the laser power and system transmission to ensure process repeatability
- Automated scan field calibration system measures and compensates field distortion and drift, and determines the exact scan field location (tool offsets)
- Automated calibration of five-axis kinematics using touch probe and reference ball
- Support for workpiece alignment using touch probe