HEIDELBERG INSTRUMENTS

MPO 100

3D LITHOGRAPHY AND 3D MICROPRINTING

heidelberg-instruments.com

MPO 100

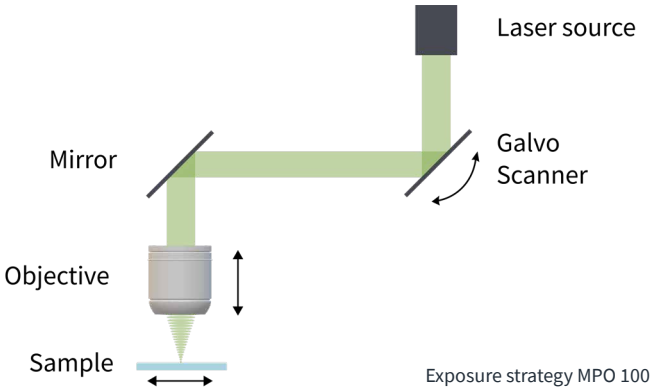
3D LITHOGRAPHY AND 3D MICROPRINTING

The MPO 100 is a Two-Photon Polymerization (TPP) multi-user tool for 3D Lithography and 3D Microprinting of microstructures with applications in Optics, Photonics, Mechanics, and Biomedical Engineering. The modular 3D printing platform MPO 100 offers high precision on demand for 3D Lithography as well as high print volume for 3D Microprinting and enables production of complex functional microstructures with high throughput in a single process step.

MPO 100 HIGHLIGHTS: 1 - 10 - 100 - 1000

- Printing height of over 1 cm
- Surface quality: Roughness down to 10 nm
- Resolution down to 100 nm
- Scan speeds over 1000 mm/s
- Flowbox with temperature control down to ± 0.1 °C
- Print area of 100 mm x 100 mm
- Stitching-free fabrication capability
- Synchronized scanning system
- Application-specific Write Modes
- Additive processing of organic and hybrid polymers (ORMOCER®s)
- Optional software modules for customer-specific print jobs
- Subtractive processing of metal layers (Au, Ag, Cr, …)

The MPO 100 includes a powerful femtosecond laser system operating at a wavelength of 522 nm, thereby enabling efficient and high-speed processing of many commercially available polymer systems. Among those is the industry-proven class of inorganic-organic hybrid polymers known as ORMOCER®. This class of materials provides unique optical, mechanical, and chemical properties. In addition, as many photoresists exhibit high sensitivity at the 522 nm TPP wavelength, the MPO 100 is an ideal tool for R&D to develop new material systems. Application-specific Write Modes enable fast and easy switching between 3D Lithography and 3D Microprinting. Macrostructures with a height of over 1 cm can be fabricated as well as microstructures with superior surface quality exhibiting a roughness of down to 10 nm. The achievable minimum feature size of down to 100 nm and the accessible scan speed of over 1000 mm/s provide full user benefit for tailored 3D nano-, micro- and macrofabrication processes.



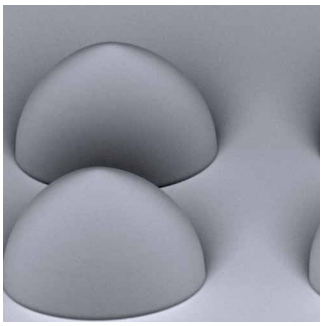
Exposure strategy MPO 100

1
Print height (cm)

Design by iba Heiligenstadt e.V.
Grant FKZ: 13XP5089D

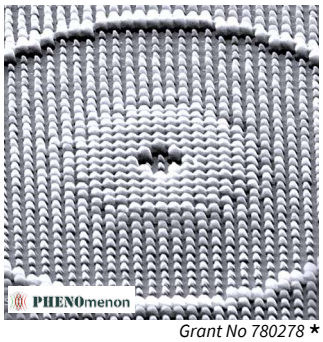
3D scaffold structures for biomedical applications such as implants in regenerative medicine.

10
Roughness (nm)



High quality microoptical elements with varying shapes (e.g. freeform) and sizes can be fabricated either on planar substrates or directly on active/passive devices.

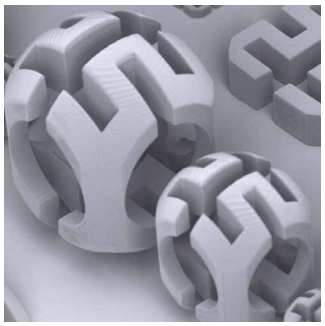
100
Resolution (nm)



Grant No 780278 ★

Metastructures with feature sizes below the diffraction limit can be fabricated in a single process step.

1000
Scan speed (mm/s)



3D structures for diverse applications such as optics, mechanics, and life science can be fabricated at high speed.

MAXIMUM FLEXIBILITY

The scanning system of the MPO 100 consists of high-performance, frictionless air bearing stages that are synchronized with the high-speed galvoscanner. This enables a simultaneous movement of the sample and a deflection of the laser spot, thereby expanding the scan field (Field-of-View, FoV) of the microscope objective to the entire print area of 100 mm x 100 mm and thus provides the capability of stitching-free fabrication (infinite FoV). The ultrafast scanner facilitates high scan speeds based on the relation 10 m/s divided by the objective's magnification. Due to the high dynamic of the scanner, optimum scan speeds of over 1000 mm/s can be achieved.

★ *This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 780278. PHENOmenon project is an initiative of the Photonics Public Private Partnership. www.photonics21.org*

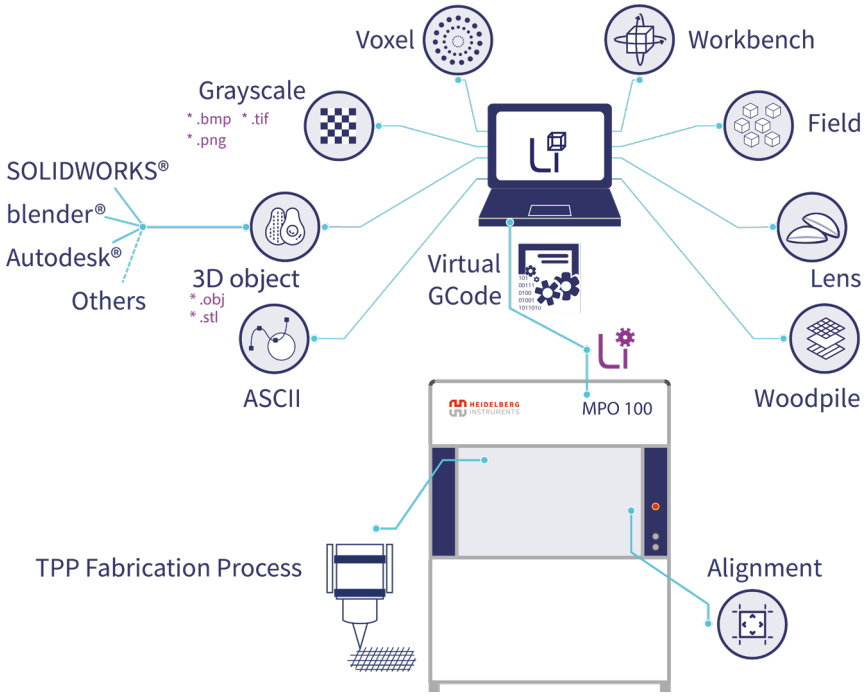
3D LITHOGRAPHY AND 3D MICROPRINTING WITH MPO 100

SOFTWARE

The MPO 100 includes the software package of LithoStream and LithoSoft3D as standard.

LithoStream is the MPO 100 control software. It provides unique features like printing time estimation, triangulation, process camera, alignment, print job creator, and application programming interface (API). Printing parameters can be saved into a data base and printing recipes can be loaded.

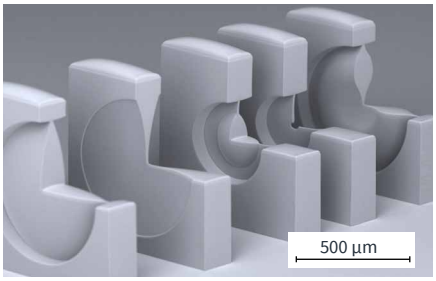
LithoSoft3D is the code preparation software. It includes powerful modules to handle and to process application-specific design formats such as stl- or bitmap files with advanced stitching options. Depending on the user's requirements, different trajectory modes can be chosen like full volume scan, contour scan, or the combined contour hatch scan as well as the unique LCON3D (real 3D Laser CONtouring). The interplay between LithoSoft3D and LithoStream is based on a vector based virtual GCode (VGC) architecture that allows for modifications of the printing parameters at the machine level (e.g. triangulation, laser power, scan speed).



The MPO 100 includes the software package LithoSoft3D and LithoStream with various options for advanced 3D nano-, micro-, and macro-processes.

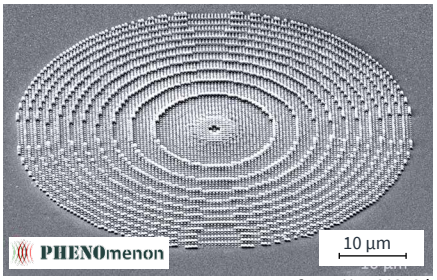
APPLICATIONS

OPTICS



Horizontal lens system: Entire optical systems can be fabricated in a single process step without the need for alignment.

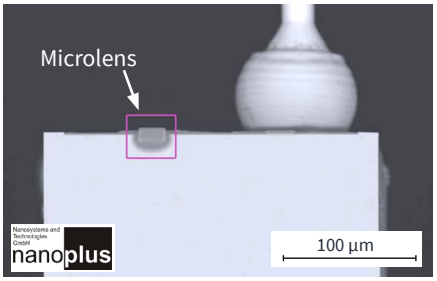
META-STRUCTURES



Grant No 780278 ★

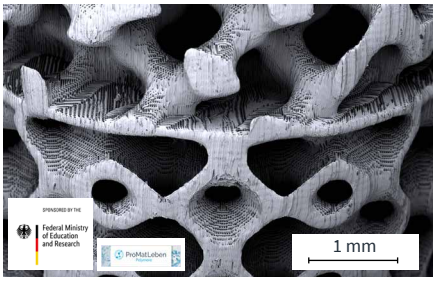
Metalens for visible light: One-step fabrication of a planar metalens with novel functionalities.

ON-DEVICE PRINTING



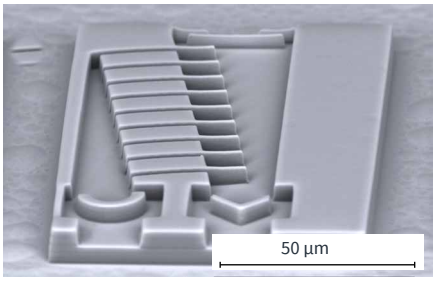
Microlens on EEL facet: Cylindrical microlens fabricated directly on the facet of a DFB laser to compensate the elliptical beam profile.

BIO-MEDICAL ENGINEERING



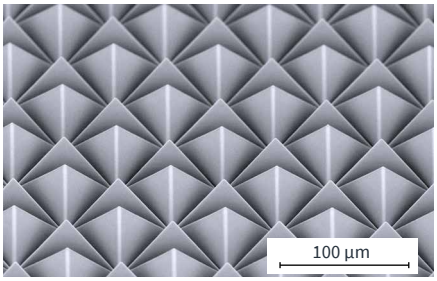
Design by iba Heiligenstadt e.V. *Grant FKZ: 13XP5089D*
Bone-cartilage scaffold: 3D scaffold structures with micro- and macroporosity for bone cartilage implants.

MICROFLUIDICS



Microfluidic reactor: Microfluidic structures with high complexity and with tunable channel width.

MASTERING



Retro-reflector: Fabrication of high-quality masters used in diverse replication technologies.

MPO 100

SYSTEM SPECIFICATIONS

Performance	
Print height (max.)	≥ 1 cm
Roughness (min.)	≤ 10 nm
Minimum feature size (min.)	≤ 100 nm (lateral)
Scan speed (max.)	10 m/s divided by magnification (e.g. 1000 mm/s for 10x)
Materials (additive or subtractive)	ORMOCER®s, SU-8, customer-specific resins, AZ-series, ma-P 1200, metal layers (e.g. Ag, Au, Cr, ...)
Structuring modes	Scan-and-Step with advanced stitching algorithms Stage only for stitching-free fabrication Synchronized Infinite Field-of-View (IFoV) for stitching-free fabrication
System features	
Laser	λ = (522 ± 3) nm τ_{pulse} ≤ 250 fs f_{rep} = (63 ± 0.6) MHz P_{mean} ≥ 600 mW E_{pulse} > 10 nJ
Laser power at focusing optics (max.)	≥ 200 mW
Focusing optics	Numerical aperture: 0.2 (air) to 1.4 (immersion) Magnification: 5x to 100x Field-of-View (FoV): up to 2 mm
Print area	100 mm x 100 mm
Autofocus	Optical detection of interfaces down to 20 nm
Substrate	Size: up to 6-inch (4-inch process area), Thickness: up to 4 cm
Software	LithoSoft3D (code generation software) LithoStream (system control software)
Scanning system	Synchronized 5 axes system of XYZ stage and galvoscanner XYZ stage: Electromagnetic direct drive, air bearing Accuracy: ± 0.2 µm per axis (over full travel range) Repeatability: down to ± 0.05 µm per axis (over full travel range) Positioning stability: ≥ 5 nm
Temperature controlled flowbox	Control down to ± 0.1 °C, ISO Class 4 cleanroom environment
System dimensions (TPP unit)	
Footprint	1300 mm x 1100 mm x 1950 mm
Weight	< 1000 kg
Installation requirements	
Electrical	115/230 V, 50/60 Hz, 16 A
Optimum lab conditions	Temperature: 21 °C ± 1 °C Humidity: 40 – 80 % non-condensing
Compressed air	6 – 8 bar, stability ± 0.5 bar
Room lighting	Yellow light

Please note: Specifications depend on individual process conditions and may vary according to equipment configuration. Scan speed depends on Write Mode. Design and specifications are subject to change without prior notice.

Visit product website for more information

To contact your local representative, please consult our website *heidelberg-instruments.com*

HEIDELBERG INSTRUMENTS
The power of direct writing

Heidelberg Instruments Mikrotechnik GmbH
Mittelgewannweg 27, D-69123 Heidelberg
Tel.: +49 6221 728899-0

HIMT 01 / 22