

LithoProf3D[®] —GSII

3D Lithography Equipment Made in Germany



Always a Step Ahead.

Shape the Lithography Future.



- ✓ Fastest 3D Lithography equipment worldwide for sustainable production with tunable dimensionality of structures from 1D via 2D and 2.5D to 3D.
- ✓ Compatible to standard workflows in microoptics, microelectronics, and microfabrication.
- ✓ Direct Laser Writing system with 5 axes position-synchronized movements enabling stitching-free processing.
- ✓ Ultra-fast fabrication with tunable resolution down to sub- μm .
- ✓ Automated and individual process control for additive, subtractive, and ablative processing.
- ✓ Virtual Machine Code Creator with numerous implemented and combinable fabrication strategies.
- ✓ No limitation in materials and substrate choices.
- ✓ Touch screen with user-friendly GUI. Remote control.
- ✓ LCON and FALCON technology implemented.*

LithoProf3D[®] is the worldwide first modularly built lithography system which satisfies academic needs and industrial requirements at the same time. It is a 3D Lithography Platform available in a standard and customized versions. The equipment combines excellent performance of structure fabrication compatible to standard microelectronics and photonics packaging technology. It uniquely combines conventional lithography with direct laser writing and patented technology for a variety of CAD and design files. Automation allows to run the system 24/7 as well as with individual jobs in a batch mode for academic purposes. The LithoProf3D[®] system fulfills the highest standards with its modularity in hardware and software for a large variety of different markets and branches. Simplicity in operations inspires our customers to create noteworthy benefit using Multiphoton Optics' technology.

LithoProf3D[®] is the first 3D Lithography system worldwide which has demonstrated waferscale 3D Lithography on Silicon and Glass Wafers up to 6", aspect ratios of 43:1 to date, and metaoptics fabrication in one step. Maximum of three processes are necessary to create structures with tunable dimensionality (1D—2D—2.5D—3D). Additive, subtractive, and ablative processes are implemented for structure fabrication. LithoProf3D[®] features scalability of structure sizes, substrate formats, automation of processes, large-scale fabrication, and high precision positioning capabilities with a 5-axes system with position-synchronized outputs for **stitching-free** structure fabrication. All control units and electronics are included in the multifunctional integrated housing of LithoProf3D[®]. Substrates of any shape, kind, and format can be easily used with substrate thicknesses up to 48 mm. The equipment works on flat and shaped substrates as well as on assemblies.

The software consists of a Virtual Machine Code Creator LithoSoft3D which uses a proprietary compressed file format with embedded modules and editors. The control software LithoStream3D is used to fabricate the structures using the Virtual Machine Code files. This enables to spool large machine code files without losing details.

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Data Sheet



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LithoProf3D [®] with integrated vibration damping system		Reference
Fabrication		
Max average power for fabrication	≤ 200 mW	
Min feature size	≈ 100 nm (lateral), ≈ 270 nm (vertical)	1,2,3,4
Optical resolution	≤ 250 nm	1,2,3,4
Lithographic resolution	≤ 250 nm	1,2,3,4
Autofocus sensitivity	Interface detection feasible down to $\Delta n = 0.0007$	
Autofocus reproducibility	± 50 nm	16
Autofocus grid	(m x n) on demand	
Substrate loading size	Standard size up to 4", up to 8" possible with accessible 4" area	5,6
Substrate type	Any kind	17
Substrate thickness	≤ 49 mm	18
Accessible fabrication volume	100 mm (X) x 100 mm (Y) x 50 mm (Z)	5,6
Operation mode	5-axes system PSO (Position Synchronized Output) for Stage Only, Galvo Only, Mixed Mode (Stages plus Galvo), Infinite Field of View (IFoV) Mode with synchronization of axes and galvo movements	
Fabrication speed	200 mm/s (determined for objective NA = 1.4, 100x)	1
Software		
Control software	LithoStream3D (touch screen) — Fabrication of created Machine Object or job creation via intuitive script language, user-friendly GUI	
Machine Object Creator	LithoSoft3D — Virtual Machine Code Creator	
Laser		
Pulse duration	≤ 250 fs	
Repetition rate	(63 ± 0.6) MHz	
Average output power	> 650 mW	
Pulse energy	> 10 nJ	
Wavelength	(522 ± 3) nm	
Stability at output	< 1 %	
Beam quality M ²	< 1.15	
Beam divergence	< 0.5 mrad	
Focusing Optics		
Numerical aperture	NA 0.45 (air) to 1.4 (immersion)	
Magnification	40x to 100x	
Working distance	Up to 9.1 mm	
Field of View (FoV)	Up to 500 μm x 500 μm	7

LithoProf3D [®]		Ref.
Positioning System		
Galvo scanner		8
Max scan angle	± 20 °	
Accuracy	50 µrad pk-pk	
Repeatability	0.4 µrad _{RMS}	
Positioning stability	≥ 1 nm	1,9
Max speed	200 mm/s for standard objectives	10
Stages		
Type	Electromagnetic direct drive	
Bearing	Air guided	
Travel distance (lateral)	100 mm x 100 mm	5
Travel distance (vertical)	50 mm	5
Max speed	Up to 2 m/s	6
Max acceleration	Up to 2 g	6,11
Accuracy	± 0.2 µm per axis	
Repeatability	Down to ± 0.05 µm per axis	6
Positioning stability	≥ 5 nm	12
Installation Requirements		
Voltage	115/230 V	
Frequency	50 – 60 Hz	
Fuse current	16 A	
Laser safety	Class 1	13
Ambient conditions	(21 ± 1) °C, indoors, free of vibration	14
Relative humidity	40 – 80 % non-condensing	
Compressed air	6 – 8 bar	15
Footprint (W x L x H)	1.7 m x 1.6 m x 1.9 m	
Weight	< 1700 kg	
Room	Yellow light	19

1 Dependent on focussing optics.

2 Dependent on material system.

3 Dependent on fabrication parameters.

4 Dependent on sample configuration.

5 Stages with larger travel distance available on request.

6 Dependent on axis system.

7 The FoV in this example is given for an objective with an NA of 0.6 (x40).

8 LithoProf3D[®] can be delivered with (LithoProf3D[®]-GS) and without galvo scanners (LithoProf3D[®]-S).

9 Determined for NA 1.4 100x and integration time of 8 s with a resolution of 0.1 ms.

10 75 m/s are achievable with f = 160mm F-Theta objective.

11 Dependent on load.

12 Determined for an integration time of 8 s with a resolution of 0.1 ms.

13 Housed system; class 4 during maintenance.

14 Clean room compatible version available on demand.

15 Oil-free and dry; ≤0.25µm filtered; N₂ (99.9%) recommended.

16 Substrate Suprfrost, optical material ORMOCOMP, 63x NA = 1.4

17 Substrate kind can be any except combustable and flammable substrates

18 Substrate thickness of 49 mm allows additional structures of 1 mm in height.

19 Yellow light is required for handling photosensitive materials, No cleanroom is necessary, but system can be also installed in cleanroom environment (cf., 14).

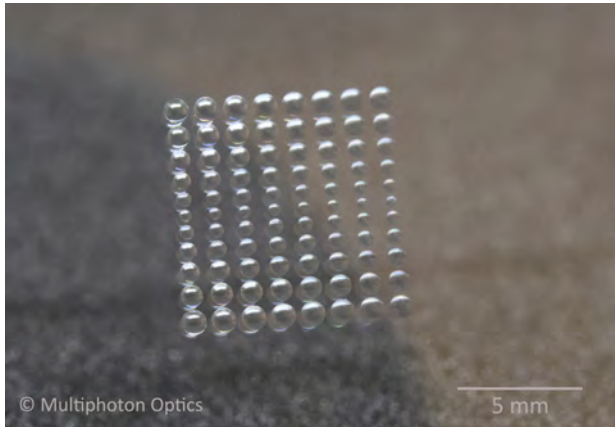
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Application Examples—Selection

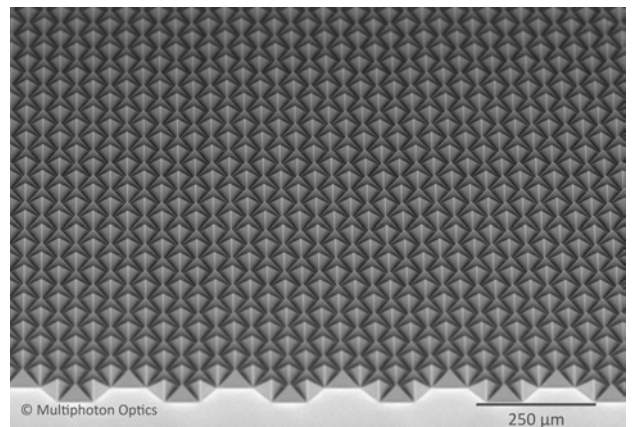


Always a Step Ahead.

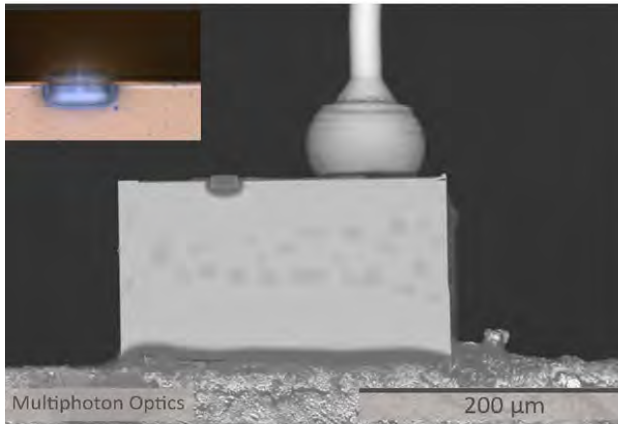
MLA with microlenses of varying size & shape.



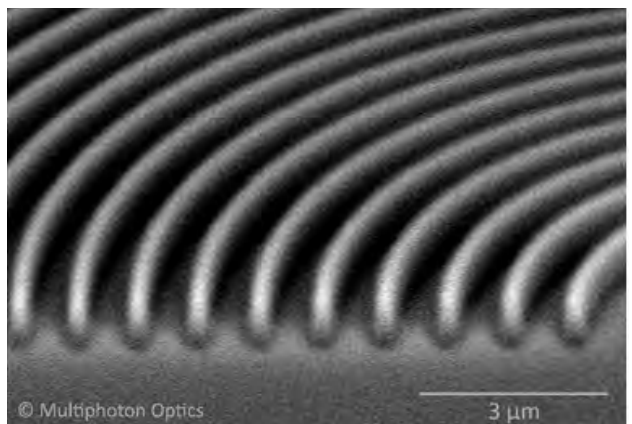
Retroreflector master structure.



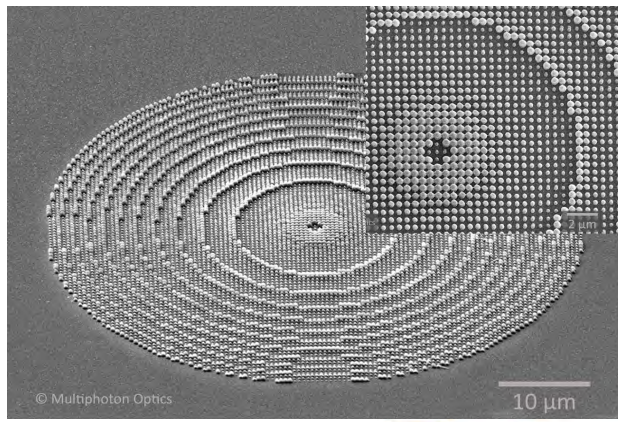
Cylindrical microlenses on NIR laser die.



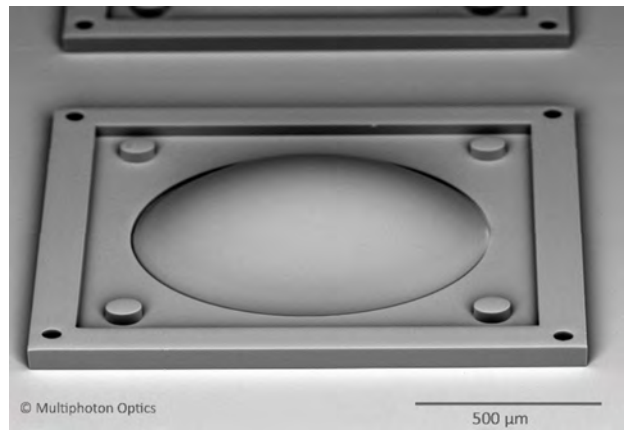
Nanostructures grating (aspect ratio 3:1).



Metalens for VIS fabricated in one step.



Macrolens w. alignment features for replication.



Optional accessories for LithoProf3D[®]-GSII:

- ✓ Vision2Align – High precision detection system for the detection of alignment marks, assemblies, and components for adapted automated processes for Level 0 and Level 1 packaging with passive alignment to create optical interconnects, optical packages, and optical elements on active or passive optical components.
- ✓ LithoBath3D – Easy to exchange exposure configuration for large-scale structures in the cm range (no adjustment required).
- ✓ Wafer Chuck – Chuck for different substrate formats and shapes.
- ✓ LithoDILL3D – Provides capability of Dip-In 3D Lithography.

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