MicroMaster

UV direct laser writer for maskless lithography

Unprecedented finesse in creating micro structures

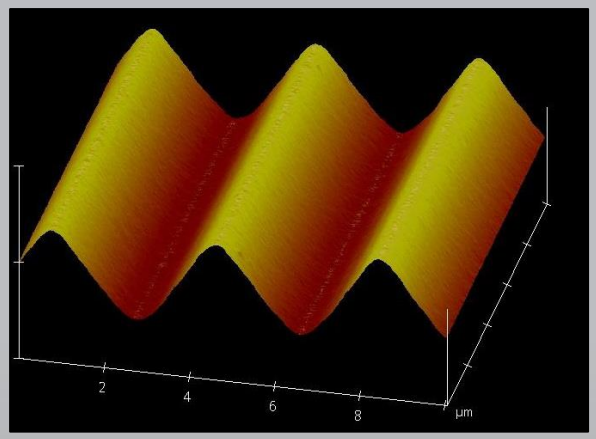
- High quality, cost efficient maskless lithography tool
- Market conform 0.8µm resolution
- 375 nm source available for i-Line resists.
- Compact optical module: use a spare optical module for revolutionary machine downtime reduction
- User-friendly operation

www.4picolitho.nl

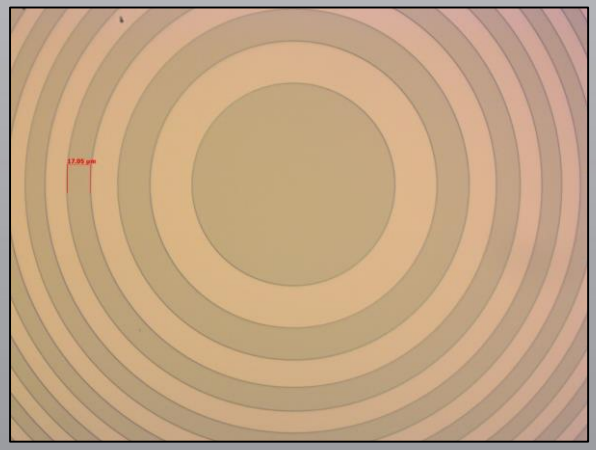
Unique opportunity for R&D

The 375 nm enables the direct exposure of SU-8 coatings.

Contents



Sample of grayscale mode image



Sample of binary mode image

Introducing the ideal litho tool for R&D

Meet the smallest high quality laser beam spot available in the market

The MicroMaster is a versatile UV laser writer with high precision components, specifically designed to give the user the highest degree of freedom to create micro structures in photo sensitive layers. The MicroMaster base system is a fully operating system. It includes a 405 nm optical module capable of writing structures as small as 0.8µm in photo resist layers. This user friendly tool supports up to 4095 levels of grayscale or pure binary mode and allows for 2.5D optical structures, surface structures as well as mask projects. Real time laser controlled auto focus and laser intensity control ensure high quality imaging during the entire exposure process.

The control electronics are all mounted within the frame except for the control PC. This Microsoft Windows based desktop PC and all required software is included in the package.

Applications

- Research / Semiconductor
- Photonic devices
- Mask making
- 3D Lithography
- Diffractive optical elements
- Microfluidics
- Other

State-of-the-art

Unprecedented finesse in creating 2.5D micro structures

Benefits

Capabilities

- Highest resolution in the market utilizing a long life time 405 nm diode laser.
- Critical dimension of 0.8µm.
- Up to 4095 levels of grayscale or pure binary mode.
- 375 nm source available for more demanding applications.
- Raster mode as well as vector mode available.
- Software controllable selection of write modes.
- 4PICO Litho's proprietary light weight objective lens makes real time auto focus possible.
- Supports substrates from 5x5mm^2 up to 125x125mm

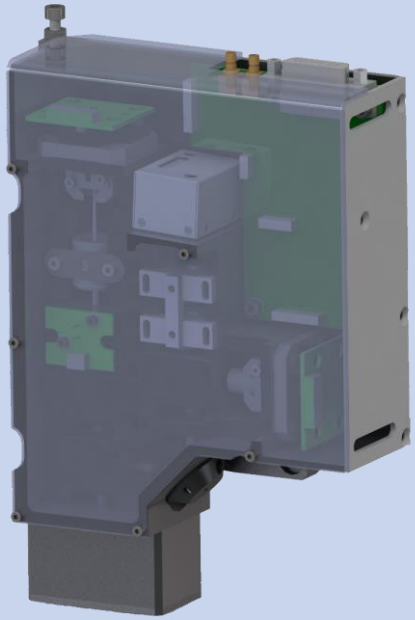
Operation

- A modern Microsoft Windows based user interface allows for user-friendly operation.
- Highly automated processing, one button operation.
- Short preparation time required using MicroMaster Project Manager and MicroMaster Machine Controller applications. On the fly processing of jobs, minimum pre-processing required.
- Up-to-date online manuals.
- Remote internet support.

Installation and maintenance

- The MicroMaster is a compact tabletop system which requires minimum cleanroom surface.
- Compact optical module: use a spare optical module for revolutionary machine downtime reduction.
- Quick and easy installation: all major components, except for the operating PC and vacuum pump, are installed within the enclosure.
- Minimal maintenance costs, no regular maintenance required.

MicroMaster: the ideal Litho tool for R&D.



Unique

Highest quality focused laser beam spot available in the market

Optics

Compact optical module for excellent stability & revolutionary short machine downtime

The full optical path is contained in a small easily changeable module (optical module). By keeping the optical path as short as possible, the pointing stability is greatly increased compared to traditional optical setups. The optical module contains a long lifetime 405 nm GaN laser diode and beam shaping optics for the best spot shape. Together with 4PICO's proprietary high NA objective lens this results in the smallest high quality laser beam spot available on the market.

Features:

- Smallest high quality laser beam spot available in the market.
- The integrated 650 nm red laser controlled autofocus system automatically corrects for height variations.
- Intergrated Dose control.
- Option: a 375 nm wavelength optical module can be supplied on request.
- Option: for less demanding tasks a larger spot size can be selected by using a fully automated NA switch. This switch allows the system to use a larger spot for increased speed.

Optical properties	
Laser source	405 nm, GaN laser diode.
Lifetime	>10.000 hours
Write modes	0.8 µm, optional 1.5 µm and 2.5 µm FWHM.
Working distance	0.9mm
Intensity	Max. 3 mW in the spot. Software controllable.
Grayscale control	4095 levels
Autofocus	800 Hz bandwidth, 650 nm red laser controlled -0.3…x…+0.3 mm height variation with auto height tracking. Fast voice coil actuator for accurate real-time Z correction.
Focus offset	Adjustable by software control.

Top Side Alignment

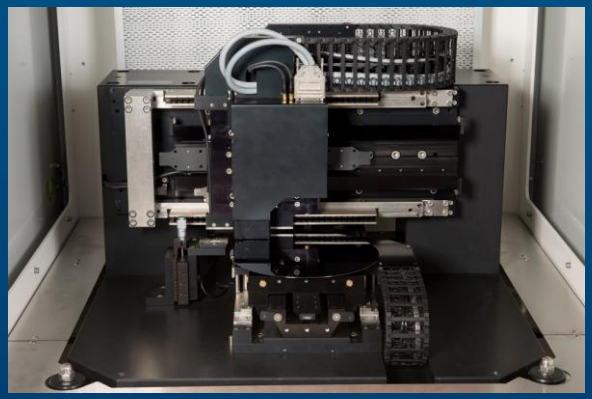
Close to perfection

Automated marker recognition reduces operator errors

Top side alignment

The optical module is equipped with a high resolution camera for applications which require multiple layers. The camera images are processed by advanced imaging software. Automatic marker recognition makes it easy for the user to locate the markers. The user can teach any shape to be used as marker. When the marker cannot be found in the camera's field of view the software supports area scan to automatically search the marker in a larger area. Alignment and image compensation can be based on one, two or three markers.

Specifications Top side alignment	
Alignment camera	Monochrome 5.2 Mpixel.
Pixel resolution	1 µm
Final alignment accuracy	< 0.5 µm
Correction algorithmes	Position, Scale (max 5%), Skew, Rotation (Max +/-5 degrees) Rotation correction is performed by interpolated motion between scan and step axis.



Benefit

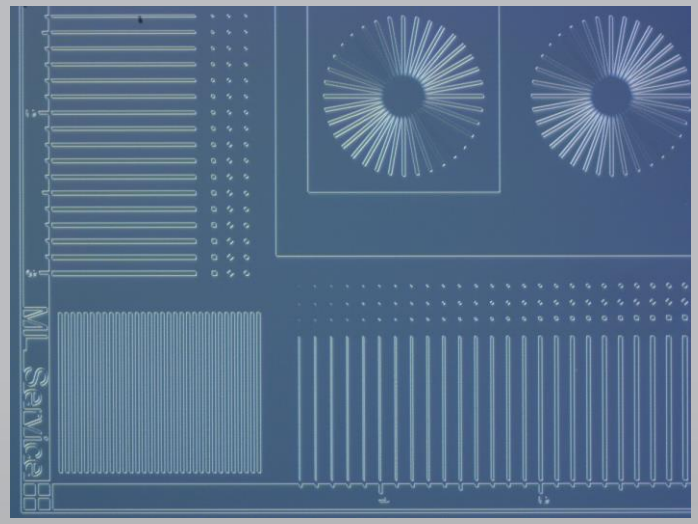
High precision axes

Mechanics

The MicroMaster is equipped with high precision axes for X and Y motion and one optional axis for Z motion. The scan and step axis uses a precision caged roller bearing with linear motor and high resolution optical encoder. This system allows for extreme low mechanical errors and fast scan movements. The optional motorized controlled Z-axis has a 12 mm stroke to support various substrate thicknesses.

Substrates are clamped down by using a vacuum chuck. Vacuum chucks are easily exchangeable to support different substrate sizes.

Mechanical properties	
Stroke Scan and Step	Max. 115 mm
Repeatability	< 50 nm RMS
Resolution	10 nm
Scan speed	Max 200 mm/s
Straightness axis	< 1 µm over 100 mm
Substrate thickness	0 - 10 mm manual adjustment. 12 mm with the optional motorized Z-axis installed.
Substrate thickness variation	Max +/- 0.2mm
Substrate size	Min. 5 x 5 mm, max. 125 x 125 mm.
Exposable area	Max. 110 x 110 mm (speed dependent).



800nm lines

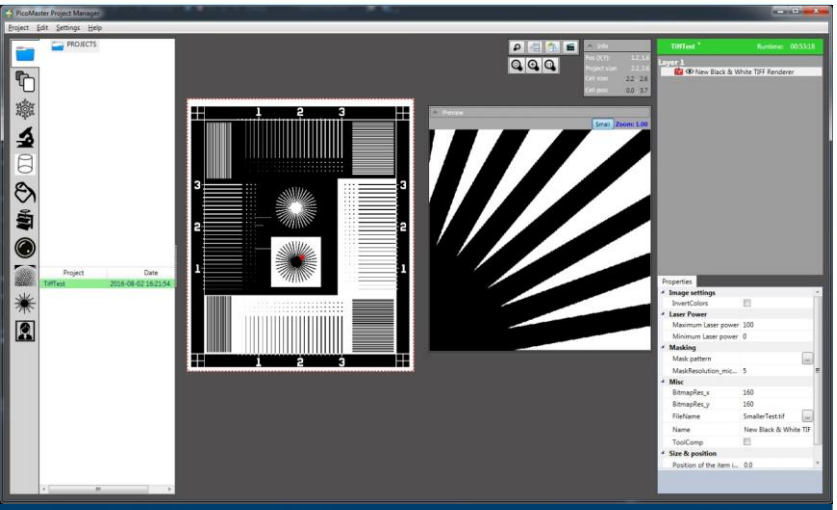
Performance

Performance specifications	
CD[1]	Min. 800 nm
Line width uniformity	< 75 nm
Address grid	Selectable. Standard: 60 nm in scan direction and 200 nm in step direction.
Data rate	3Mhz

[1]Critical Dimension of the MicroMaster strongly depends on process parameters, such as resist types and layer thickness.

Writing speeds	Write mode (µm)	Normal Quality (mm²/min)	Reduced Quality[2] (mm²/min)
High resolution	0.8	4	6
Mid resolution	1.5	8	12
Low resolution	2.5	12	18
Extra low resolution	5 (example)	23	35

[2]When exposing with reduced quality the line edge roughness will increase.



Screenshot of the visual Project Manager software.

User friendly

Minimum preparation time required using MicroMaster Project Manager and MicroMaster Machine Controller

Software

MicroMaster Machine Controller and MicroMaster Project Manager

The MicroMaster comes with two Windows based applications: MicroMaster Machine Controller and Project Manager. Project Manager allows the user to select features and combine images while MicroMaster Machine Controller processes these jobs and control the machine. Jobs are processed on the fly, reducing preparation time to the minimum.

MicroMaster Machine Controller allows the operator to queue jobs, monitor progress and gives a high level of manual control features.

Features of MicroMaster Machine Controller:

- On the fly processing of jobs.
- Job queuing.
- Freely definable process and substrate recipes.
- Extended history database.
- Remote support.
- User access control through login credentials or smart card.

Supported formats	
Standard binary sources	Bitmaps, TIFF, GDSII
Offline conversion required	CIF, DXF
Parameterization	Basic shapes can be configured without source files.
3D sources	Grayscale bitmaps, Parametric.

User Algorithms

MicroMaster software supports user libraries. These libraries can be written in C# or VB.net. With these user libraries the user can create his own algorithm to calculate the laser intensity at each grid point.

Benefit

MicroMaster:

a compact system

that requires minimal cleanroom surface

Options

Vacuum pump

When a central vacuum system is not available, a vacuum pump can be supplied. The pump can be controlled by the MicroMaster system.

Additional write modes

The optical module can be fitted with an automatic Numerical Aperture switch. Standard the MicroMaster is fitted with a single spot for resolutions as small as 800 nm. For some applications this resolution is not required. The NA switch allows the user to select a lower resolution. This will enable increased writing speeds at lower resolutions.

Additional write modes	
Standard included: high resolution	0.8 µm
Mid resolution	1.5 µm
Low resolution	2.5 µm

Extra-low resolution

Standard the MicroMaster comes with the highest resolution available in combination with a 405 nm laser source. Sometimes this is too small for the desired application. A second optical path with a low NA focus lens can be fitted to increase the spot size. Please contact us to discuss the required application.

375 nm Optical module instead of 405 nm

The system can be equipped with a 375 nm optical module. This allows the user to use resists only suitable for I-line light sources.

Convenient

A standard 12-month warranty and an optional extended warranty

Motorized Z stage

Some applications require thick substrates. The motorized Z stage will allow the system to detect the surface of a wafer fully automatically. Operator interference for height adjustment based on the used substrate is not required.

Mechanical properties motorized Z stage	
Stroke	Max. 12 mm
Resolution	1 µm
Wafer thickness	0 - 10 mm

Extra optical module

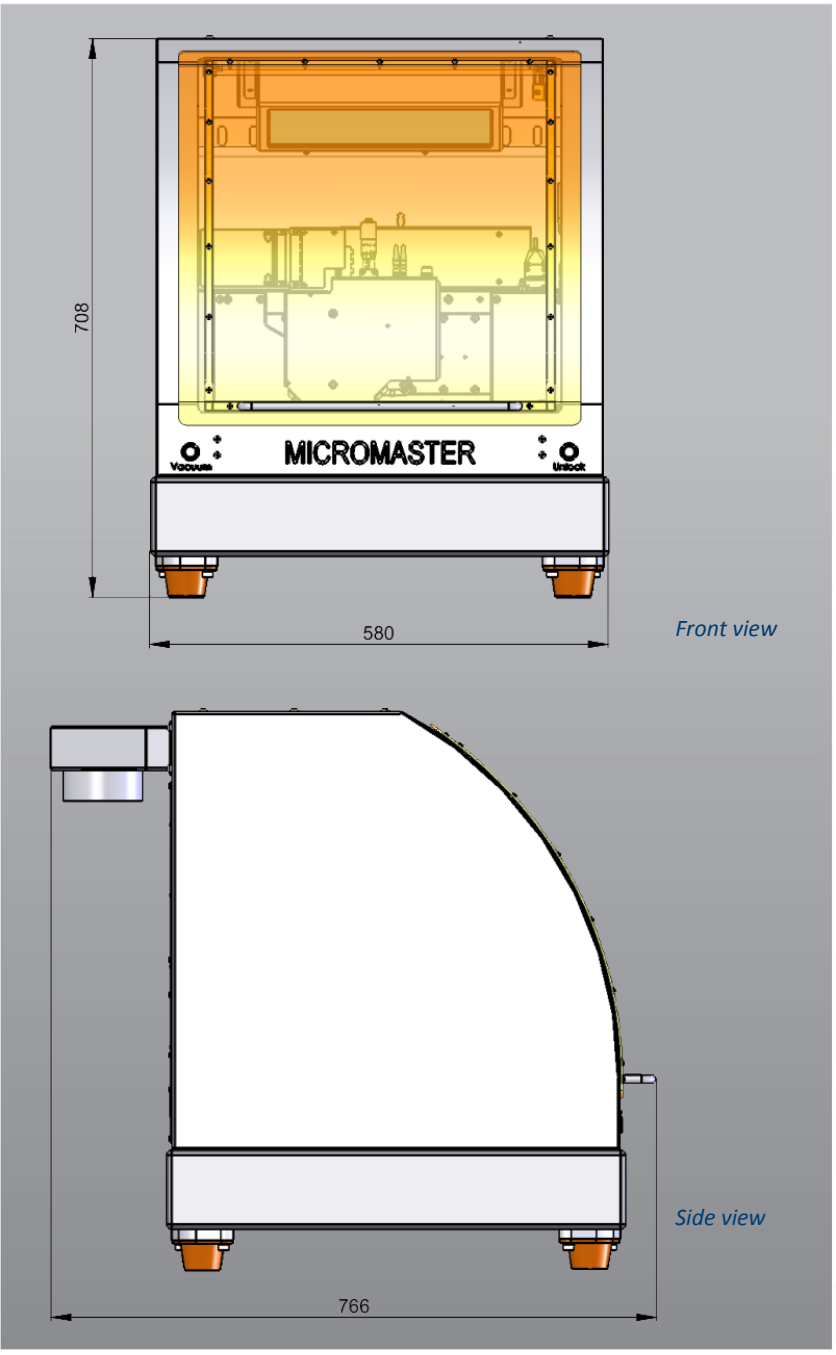
The compact optical module is mounted to the step axis by just 3 bolts and a few electrical connections. Within 5 minutes the entire optical module can be swapped for a different module. When uptime is of critical importance, a spare optical module can be added. There is no need for optical alignment after an exchange. This unique feature introduces a revolutionary reduction of machine downtime!
The extra optical module can be fitted with either a 405 nm or a 375 nm laser diode.

Extended warranty

Standard the system comes with a 12-month warranty. The warranty can be extended on a yearly base. The extended warranty includes software updates, telephone and remote support and all non-wear and tear parts.

Air-conditioning unit

For best results the temperature inside the MicroMaster should be maintained at constant environment conditions with a temperature range of +/- 0.5 ˚C and a humidity range of 45 - 70%. It is strongly recommended to use a dedicated air conditioning unit to supply conditioned air to the MicroMaster.



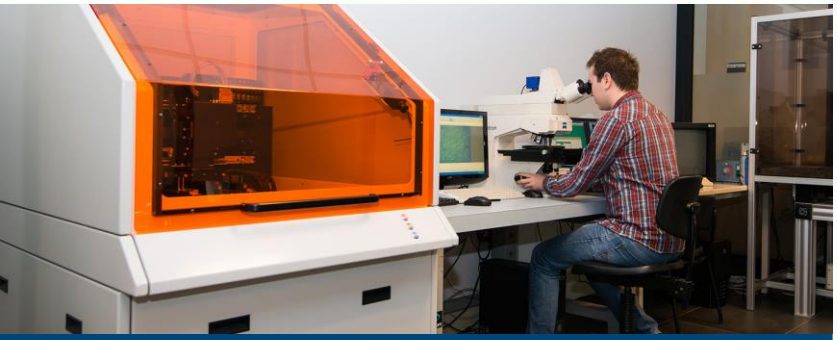
Installation requirements

The MicroMaster is best installed on a vibration isolated table capable supporting a minimum weight of 300 kg. Extra table surface is required for the operating computer.

Dimensions[1]	
Width	580 mm
Height	708 mm
Depth	600 mm (not including optional air duct).
Weight	260 kg
Additional components	Desktop computer (included in delivery)
Electrical connection	230V AC, max. 1 kW
Vacuum	External
Ethernet	For server connections and remote access.
Conditioned air piping[2]	Ø 100 mm in and out
Recommended environment	Clean room ISO class 5 or better.
	Room Temperature 21 ˚C +/- 1 ˚C
	Room Humidity 45 - 70% RH

[1] Specifications may change without notification.

[2] It is strongly recommended to use an air conditioner with recirculation option to maintain optimal process conditions within the MicroMaster.



Innovation

Brainport Region:

A perfect ecosystem

for innovation

About 4PICO Litho

4PICO Litho is specialized in lithography equipment since 2004. The MicroMaster systems are a derivate of 4PICO's CD/DVD mastering system and built on 15 years of experience. The efficient multidisciplinary team of 4PICO Litho is based in Brainport Region and has access to high tech suppliers.
All developments are done in-house.

State-of-the-art

4PICO Litho's demo samples are state-of-the-art

Service and dealer information

Samples

Seeing is believing… 4PICO Litho's demo samples are state-of-the-art. Send in your requirements for a sample. At all times at least 1 demo system is operational.

4PICO Litho has in-house metrology tools such as Microscope, AFM and SEM for analyzing the samples.

Service

Local service engineers, remote support and minimum maintenance will guarantee a smooth and worry-free operation.

Dealer

Questions regarding the MicroMaster and your application: please contact your local contact.

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