MicroWriter ML® 3 family overview

EXCELLENT ENVIRONMENTAL FOOTPRINT

Power consumption of the machine even when exposing is comparable to that of a laptop.

WORLDWIDE USER BASE

Over 170 laboratories around the world, including national labs and international leading Universities.

INTUITIVE WINDOWS® USER INTERFACE

Designed for use by PhD students and post-docs in a research environment while offering high levels of flexibility.

COMPETITIVE PRICE AND LOW COST OF OWNERSHIP

Affordable price ideal for universities and industrial R&D.
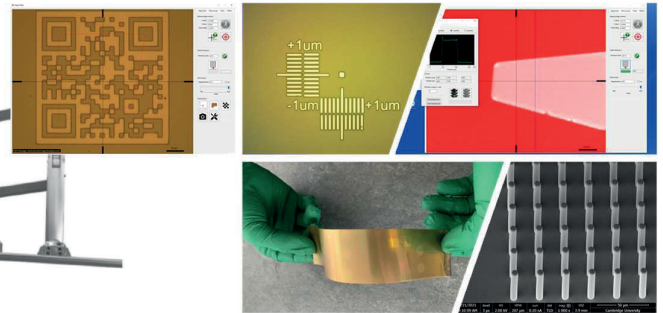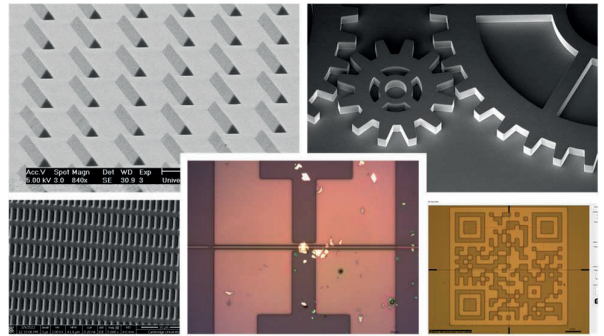
The MicroWriter ML® products are a range of photolithography machines designed for rapid prototyping and small volume manufacturing in R&D laboratories and clean rooms.

Conventional approaches to photolithography are usually based on exposing through a chromium-glass mask manufactured by specialist vendors. In R&D environments it is often necessary to change the mask design frequently. Direct-write lithography tools (also known as digital mask aligners or maskless aligners) overcome this problem by holding the mask in software. Rather than projecting light through a physical mask, direct-write lithography uses computer-controlled optics to project the exposure pattern directly onto the photoresist.

The MicroWriter ML®3 family comprises four compact, high-performance, direct-write optical lithography machines which are designed to offer unprecedented value for money in a small laboratory footprint. All machines have an excellent environmental footprint: power consumption of the machine even when exposing is comparable to that of a laptop.

MicroWriter ML® 3 Baby

This is our entry level machine and is one of the lowest cost direct-write optical lithography machines available anywhere in the world. It operates at a single minimum feature size of 1μm with a wavelength of 405nm and is designed to sit on a standard laboratory bench either in a clean-room or in a general laboratory. A high quality optical microscope with a x10 Olympus objective allows exposures to be aligned to existing structures or to the edges of the substrate. Despite its low cost, it is still fast with a top writing speed of 50mm^2/minute, allowing a typical 50mm x 50mm area to be exposed in under 1 hour.

MicroWriter ML® 3 Baby Plus

The Baby Plus adds a number of features to the Baby which are usually only found in high-end machines. Two different minimum feature sizes (1μm and 5μm) can be selected automatically via software and without the user needing to exchange any lens manually. This allows non-critical parts of the exposure to be performed rapidly at 5μm minimum feature size while retaining high resolution writing for critical parts. Locating alignment markers or edges of substrates is faster thanks to an automatic lens changer on the optical microscope allowing the user to switch between x3 and x10 objectives via software. It also features an optical surface profilometer tool and an automated wafer inspection tool for examining fabricated structures. An edge locator allows wafers and dies to be centred automatically. Writing speeds are some of the fastest on the market: up to 50mm^2/minute at 1μm minimum feature size and up to 180mm^2/minute at 5μm minimum feature size, allowing a typical 50mm x 50mm area combining critical and non-critical areas to be exposed in under 30 minutes.

MicroWriter ML® 3 Mesa

The Mesa has all of the features of the Baby Plus and adds a 0.6μm minimum feature size lens and x20 microscope objective, making it a table-top lithography tool with sub-micron resolution.

MicroWriter ML® 3 Pro

This is our flagship machine and best seller and offers no-compromise sub-micron lithography on up to 9" wafers. It is designed for highly demanding individual research groups or for central clean room facilities. Four different minimum feature sizes (0.6μm, 1μm, 2μm and 5μm) can be selected automatically via software and without the user needing to exchange any lens manually. The optical microscope contains a full set of high performance bright and sharp infinite conjugate objectives (x3, x5, x10 and x20) with a software controlled automatic lens changer, allowing large substrate areas to be searched rapidly and individual sub-micron objects such as nanowires and crystal flakes to be accurately located. An additional lens offering 0.4μm minimum feature size and x50 microscope is available as an option. Top writing speeds are very fast: 15mm^2/minute at 0.6μm resolution, 50mm^2/minute at 1μm resolution, 120mm^2/minute at 2μm resolution and 180mm^2/minute at 5μm resolution. In addition to the optical surface profilometer tool and automated wafer inspection tool present in the Baby Plus and Mesa, there is also a Virtual Mask Aligner mode in which the pattern to be exposed is displayed on top of the real-time microscope image, allowing the machine to be used like a traditional mask aligner. A backside alignment camera for aligning double-polished wafers is available as an option.

FAST WRITING SPEEDS

120mm^2/minute at 2μm resolution and 180mm^2/minute at 5μm resolution, allowing a typical 100mm x 100mm area to be exposed at 2μm resolution in under 2 hours.

PROPER AUTOMATIC LENS CHANGER

Automatically changes microscope objective lenses and exposure resolution beams using a motorised motor.

DUAL WAVELENGTH EXPOSURE LIGHTSOURCE OPTION

Adds both 365nm light source and 405nm light source; software selectable.

BACKSIDE ALIGNMENT OPTION

Adds imaging module underneath the wafer chuck, allowing alignments of structures on both sides of wafers.

Why choose the MicroWriter ML® 3 family?

AUTOCALIBRATION

Autocalibration tool allowing users to check and correct calibration.

AUTOMIC MARKER RECOGNITION

Automatically identify the precise position of lithographic markers visible the real-time microscope.
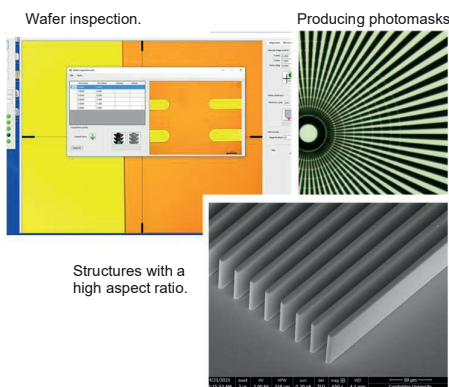
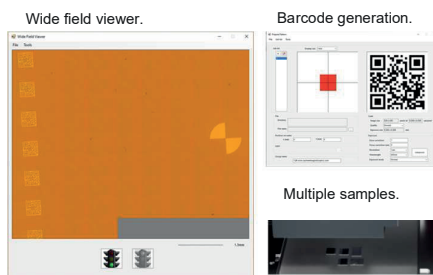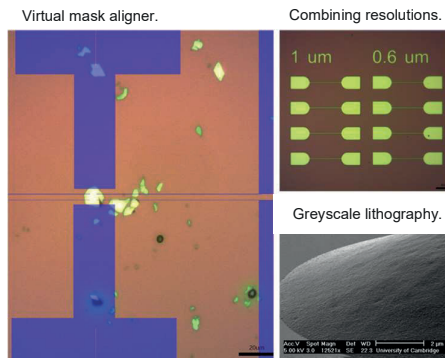## AUTOMATIC BARCODE GENERATION AND RECOGNITION

Automatically create the exposure pattern for 2D barcode. Developed barcode can be identified automatically.

COMPACT LABORATORY FOOTPRINT

70cm (w) x 70cm (d) x 75cm (h) for a Baby, a Baby Plus, or a Mesa.

90cm (w) x 75cm (d) x 153cm (h) (optical table included) for a Pro.

TECHNICAL SUPPORT

International network of trained local service engineers to keep you running.

Virtual mask aligner.

Combining resolutions.

Greyscale lithography.

Wide field viewer.

Barcode generation.

Multiple samples.

Wafer inspection.

Producing photomasks.

Structures with a high aspect ratio.

Well-established user base around the world.

- All of our machines are very competitively priced.
- All of our machines have fast writing speeds.
- All of our machines have a low cost of ownership. Our lightsources have a lifetime of 20,000 hours and are guaranteed for 5 years.
- The MicroWriter ML®3 Baby Plus, MicroWriter ML®3 Mesa and MicroWriter ML®3 Pro have an impressive array of advanced features usually only found in high-end machines.
- All of our machines are designed for use by PhD students and post-docs in a research environment and so have an attractive, intuitive and simple Windows® user interface while offering the flexibility and high levels of access to machine operation for those who want to develop new techniques.
- All of our machines handle the small millimetre-size chips and delicate objects often used in R&D, as well as large wafers.
- All of our machines provide optical autofocusing as standard. This works well for large wafers as well as for small dies and other unusual substrates.
- All of our machines have a high performance laser interferometer as standard.
- Proper dual wavelength option gives users the best flexibility between high resolution and SU-8 patterning.
- All of our machines share a common technology platform, allowing you to upgrade from MicroWriter ML®3 Baby to MicroWriter ML®3 Baby Plus, MicroWriter ML®3 Mesa and to MicroWriter ML®3 Pro at a later date.
- There is a well-established user base of MicroWriter ML® machines in over 170 laboratories around the world, including national labs and internationally leading Universities.
- We have an international network of trained local service engineers to keep you running.

Detailed comparison of features and performance

	MicroWriter ML® 3 Baby	MicroWriter ML® 3 Baby Plus	MicroWriter ML® 3 Mesa	MicroWriter ML® 3 Pro
Maximum substrate size.	155mm x 155mm x 7mm.	155mm x 155mm x 7mm.	155mm x 155mm x 7mm.	230mm x 230mm x 15mm. 330mm x 330mm x 175mm as an option.
Maximum writing area.	149mm x 149mm.	149mm x 149mm.	149mm x 149mm.	195mm x 195mm. 295mm x 295mm as an option.
Exposure minimum feature sizes.	1µm.	1µm and 5µm.	0.6µm, 1µm, and 5µm.	0.6µm, 1µm, 2µm, and 5µm. 0.4µm as an option.
Surface tracking autofocus system?	Yes.	Yes.	Yes.	Yes.
Edge locating module for automatic wafer centring?	Yes.	Yes.	Yes.	Yes.
Greyscale lithography?	Yes, up to 255 grey levels.	Yes, up to 255 grey levels	Yes, up to 255 grey levels.	Yes, up to 768 grey levels.
Export image tool ("Draw mode")?	Yes.	Yes.	Yes.	Yes.
Alignment microscope objectives.	x10.	x3 and x10.	x3, x10, and x20.	x3, x5, x10, and x20. x50 as an option.
Automatic lens changer for exposure resolution and alignment microscope?	No.	Yes.	Yes.	Yes.
Backside alignment?	No.	No.	No.	As an option.
Exposure wavelength.	405nm. 385nm, 365nm, and dual wavelength (405nm-365nm) as an option.	405nm. 385nm, 365nm, and dual wavelength (405nm-365nm) as an option.	405nm. 385nm, 365nm, and dual wavelength (405nm-365nm) as an option.	385nm. 405nm, 365nm, and dual wavelength (405nm-365nm) as an option.
Maximum writing speed.	50mm²/minute at 1µm resolution.	50mm²/minute at 1µm resolution and 180mm²/minute at 5µm resolution.	15mm²/minute at 0.6µm resolution, 50mm²/minute at 1µm resolution, and 180mm²/minute at 5µm resolution.	15mm²/minute at 0.6µm resolution, 50mm²/minute at 1µm resolution, 120 mm²/minute at 2µm resolution, and 180mm²/minute at 5µm resolution.

Detailed comparison of features and performance

	MicroWriter ML® 3 Baby	MicroWriter ML® 3 Baby Plus	MicroWriter ML® 3 Mesa	MicroWriter ML® 3 Pro
Overlay alignment accuracy at best resolution.	+/- 2µm.	+/- 1µm.	+/- 0.5µm.	+/- 0.5µm.
Minimum addressable grid.	100nm.	60nm.	30nm.	30nm. 12.5nm as an option.
Motion stage minimum XY step size.	15nm.	15nm.	15nm.	4nm.
XY interferometer resolution.	15nm.	15nm.	15nm.	1nm.
Optical surface profiler Z resolution.	Not applicable.	200nm.	200nm.	100nm.
Autocalibration tool?	Yes.	Yes.	Yes.	Yes.
Automatic marker recognition tool?	Yes.	Yes.	Yes.	Yes.
Automatic wafer inspection tool?	No.	Yes.	Yes.	Yes.
Virtual Mask Aligner tool?	No.	As an option.	As an option.	Yes.
Temperature compensated enclosure?	No.	As an option.	As an option.	Yes.
Can handle multiple wafer/chips?	No.	As an option.	As an option.	Yes.
Installed inside a glove box?	As an option.	As an option.	As an option.	As an option.
Supplied with vibration isolating optical table?	No.	No.	No.	Yes.
Mask design software?	Open source KLayout supplied. Clewin as an option.	Open source KLayout supplied. Clewin as an option.	Open source KLayout supplied. Clewin as an option.	Clewin supplied.
Can be upgraded to higher members of the MicroWriter ML® 3 family?	Yes.	Yes.	Yes.	Not applicable.

Examples of fabricated structures

FRICTION CHUCK

Carefully designed friction chuck allows MEMS devices with nitride windows or other delicate substrates to be used; no minimum wafer size.

CURVED SUBSTRATES

Perform exposures across a variety of substrates, including flat and curved forms, Si, glass, ceramic, diamond, and liquid polymers.
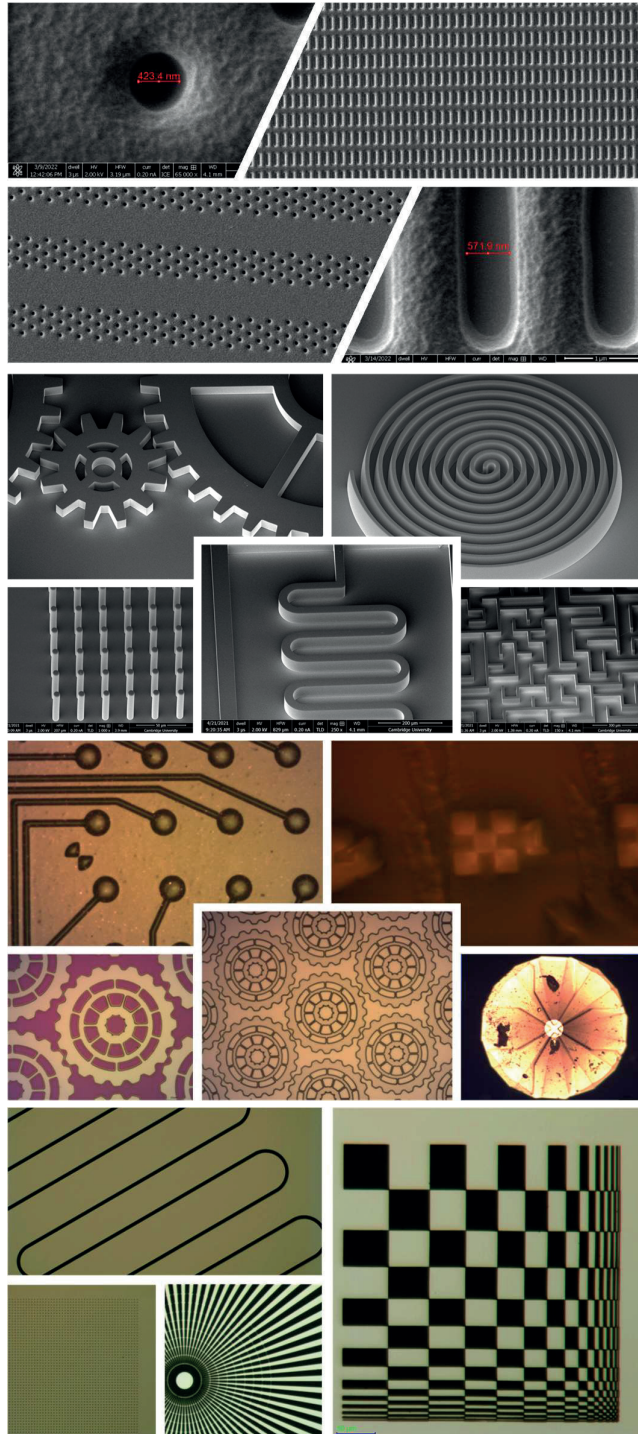
PHOTOMASKS

Produce photomasks conveniently and cheaply.

FREE SOFTWARE UPGRADE

Receives free software upgrades for the lifetime of the machine.

COMPANY CULTURE AND PHILOSOPHY

We are from a research and design (R&D) background based in Cambridge, UK and the Research Triangle Park, Durham, NC, USA.

- Scanning Electron Microscope images of resolution-limited structures.
  Left: Dots array with diameter of 0.4µm.
  Right: Lines array with width of 0.6µm.
  Structures were produced on Si/LOR/S1805 (0.5µm).

- Scanning Electron Microscope images of micro-moulds. Structures were produced on a 50µm thick SU8 layer.
  Aspect ratio of the dots array (bottom left) is 8.

- Optical Microscope images of patterns produced across varied types of substrates:
  Top left: AlN ceramic.
  Top right: Liquid polymer.
  Bottom left: Si/SiO$_2$.
  Bottom middle: Glass.
  Bottom right: Diamond.

- Optical Microscope images of patterns produced on a photomask.