MicroWriter ML®3 family overview

The MicroWriter ML® products are a range of photo-lithography 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 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.

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 1 μm with a wavelength of 405 nm 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 50 mm²/minute, allowing a typical 50 mm x 50 mm 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 (1 μm and 5 μm) 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. The MicroWriter ML®3 Baby Plus also features an optical surface profilometer tool and an automated wafer inspection tool for examining fabricated structures. A laser-based edge locator allows wafers and dies to be centred automatically. As with all of our machines, writing speeds are some of the fastest on the market: up to 50 mm²/minute at 1 μm minimum feature size and up to 180 mm²/minute at 5 μm minimum feature size, allowing a typical 50 mm x 50 mm area combining critical and non-critical areas to be exposed in under 30 minutes.
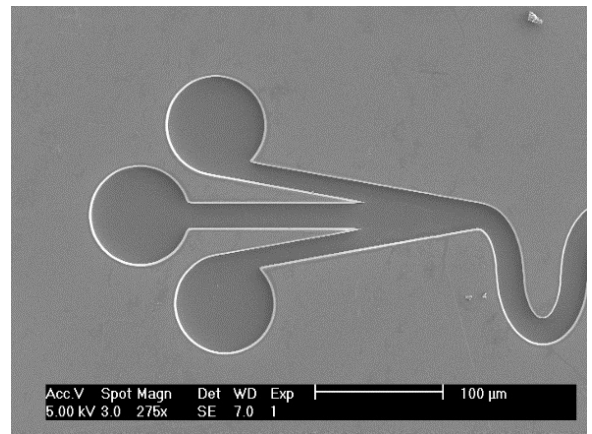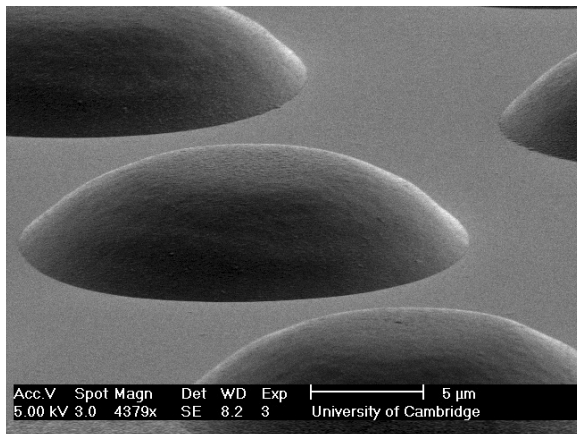
MicroWriter ML®3 Mesa

The Mesa has all of the features of the Baby Plus and adds a 0.6 μm 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 (0.6 μm, 1 μm, 2 μm and 5 μm) 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: 17 mm²/minute at 0.6 μm resolution, 50 mm²/minute at 1 μm resolution, 120 mm²/minute at 2 μm resolution and 180 mm²/minute at 5 μm resolution, allowing a typical 100 mm x 100 mm area to be exposed at 2 μm resolution in under 2 hours. 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. An backside alignment camera for aligning double-polished wafers is available as an option.
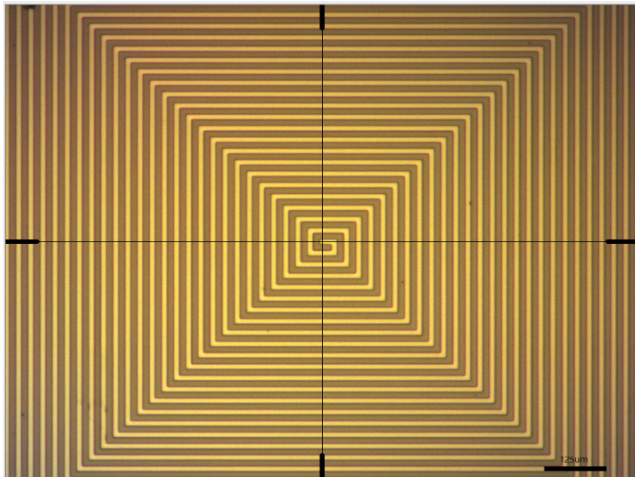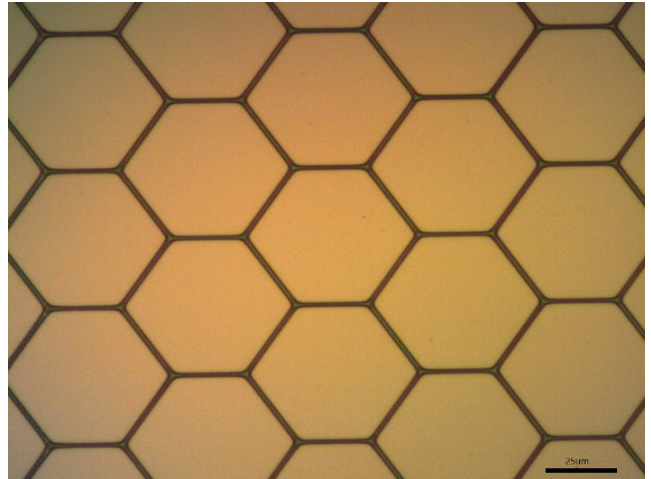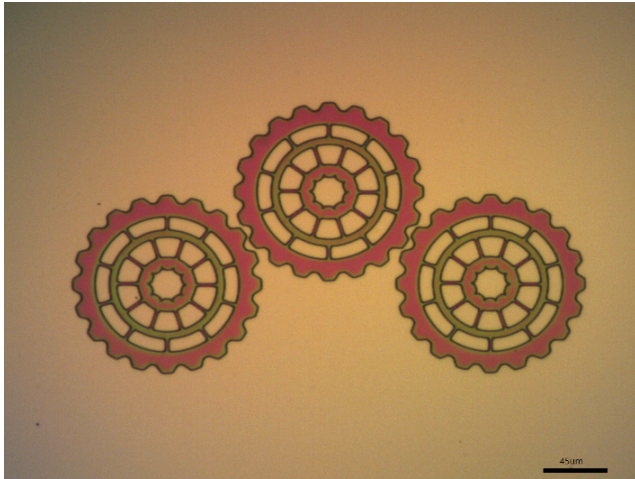
MicroWriter ML®3 family overview

	MicroWriter ML®3 Baby	MicroWriter ML®3 Baby Plus	MicroWriter ML®3 Mesa	MicroWriter ML®3
Maximum substrate size [mm]	155 x 155 x 7	155 x 155 x 7	155 x 155 x 7	230 x 230 x 15
Maximum writing area [mm]	149 x 149	149 x 149	149 x 149	195 x 195
Exposure resolutions [µm]	1	1 and 5	0.6, 1, 5	0.6, 1, 2, 5, 0.4 as option
Surface tracking autofocus system	Yes	Yes	Yes	Yes
Edge locating laser for automatic wafer centering?	No	Yes	Yes	Yes
Greyscale lithography	Yes	Yes	Yes	Yes
Alignment microscope objectives	x10	x3 and x10	x3, x10, x20	x3, x5, x10, x20, x50 as option
Automatic lens changer for exposure resolution and alignment microscope	No	Yes	Yes	Yes
Backside alignment	No	No	No	Available as option
Exposure wavelength [nm]	405, 385 and 365 as option	405, 385 and 365 as option	405, 385 and 365 as option	385, 365 as option
Maximum writing speed	50 mm^2/minute at 1 µm	50 mm^2/minute at 1 µm 180 mm^2/minute at 5 µm	17 mm^2/minute at 0.6 µm, 50 mm^2/minute at 1 µm 180 mm^2/minute at 5 µm	17 mm^2/minute at 0.6 µm, 50 mm^2/minute at 1 µm, 120 mm^2/minute at 2 µm, 180 mm^2/minute at 5 µm
Overlay alignment accuracy at best resolution [µm]	±2	±1	±1	±0.5
Minimum addressable grid [nm]	200	200	100	100
Motion stage minimum XY step size [nm]	15	15	15	4
XY interferometer resolution	15	15	15	1
Optical surface profiler Z resolution [nm]	not applicable	200	200	100
Automatic wafer inspection tool	No	Yes	Yes	Yes
Virtual Mask Aligner tool	No	Available as option	Available as option	Yes
Temperature stabilized enclosure	No	Available as option	Available as option	Yes
Vibration isolating optical table	No	No	No	Yes
Mask design software	Open source KLayout supplied. Clewin available as option	Open source KLayout supplied. Clewin available as option	Open source KLayout supplied. Clewin available as option	Clewin supplied
Can be upgraded?	Yes	Yes	Yes	N/A

MicroWriter ML®3 family overview

Structure gallery

Courtesy of the Francis Crick Institute's Making Lab, London

## Why choose the MicroWriter ML3 family?

- 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 often used in R&D, as well as large wafers.
- 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 60 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.

MicroWriter ML®3 family overview

Designed for R&D in:

- Microelectronics and semiconductors
- Spintronics
- MEMS/NEMS
- Sensors
- Microfluidics and lab-on-a-chip
- Nanotechnology
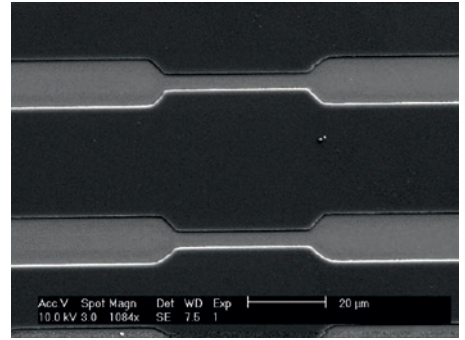- Materials science
- Graphene and other 2-dimensional materials
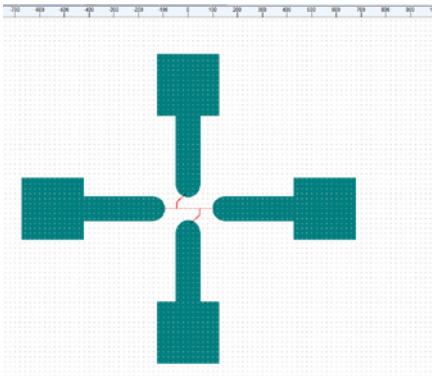
Examples of fabricated structures
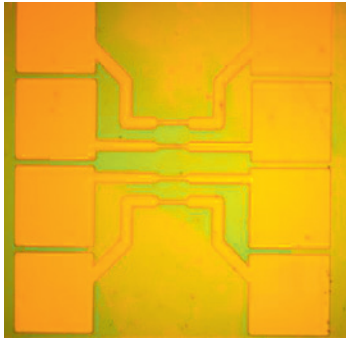
ML 3 microscope image of exposed AZ® ECI 3007 positive photoresist developed in AZ® 326 MIF developer
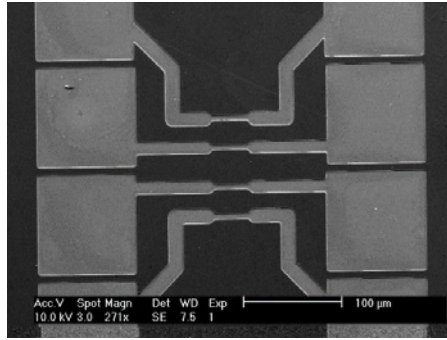
SEM images after metallisation with 20 nm of gold (centre and right)

Square contact pads are 100 μm wide; central wires are 3 μm wide

Combining different resolutions

Clewin 5 mask design layout showing large contact pads and large contact wires on one layer (green) to be exposed with 5 μm resolution and connecting fine wires on another layer (red) to be exposed with 0.6 μm resolution
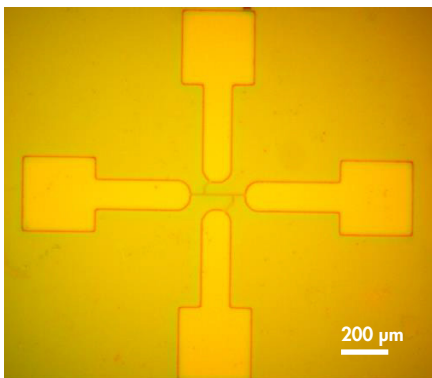
Low magnification optical micrograph of resulting exposure in AZ® ECI 3007 0.7 μm thick positive photoresist;
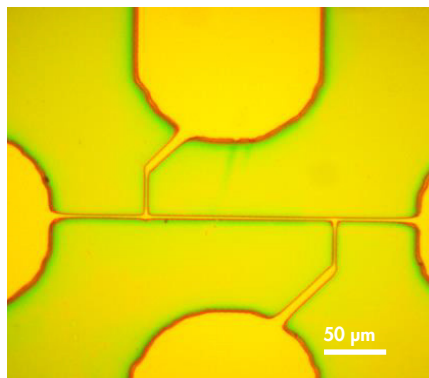
High magnification optical micrograph showing the fine wires correctly connected to the large contact wires. The fine wires are 0.8 μm wide.