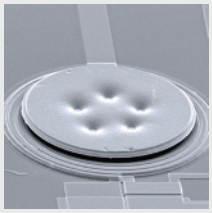
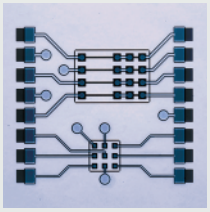
HEIDELBERG INSTRUMENTS

MLA 300

THE MASKLESS ALIGNER FOR VOLUME PRODUCTION





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MLA 300

THE MASKLESS ALIGNER FOR VOLUME PRODUCTION

The MLA 300 features our powerful Maskless Aligner technology that has been specifically adapted to the requirements of high-throughput production applications: You can now employ the unmatched flexibility of maskless lithography in an industrial setting, on wafers with sizes up to 300 x 300 mm^2. Lithography no longer depends on a fixed mask, but can dynamically adapt to surface and process variations from previous fabrication steps.

A MASKLESS ALIGNER FOR INDUSTRY

The Heidelberg Instruments Maskless Lithography technology is a breakthrough in flexibility for microscale production, as lithography exposures can be made directly from design data, bypassing the need to first make a physical mask. The MLA 300 is the highest throughput machine from Heidelberg Instruments with a high resolution of 1.5 µm. It offers the most extensive automation feature set for production, with automatic loading, customizable loader configuration, and software options specifically designed for the production environment, e.g. Cognex image recognition, or automated operation via SECS/GEM.

THE MASKLESS TECHNOLOGY

The Maskless Aligner technology uses a Spatial Light Modulator which essentially acts like a dynamic mask. It offers the flexibility to structure the most challenging substrates, allowing per-die pattern corrections (e.g. to react to distortions or process variations), and employs a real-time autofocus to follow substrate warp or corrugations. The non-contact exposure gives the system an unmatched durability and reliability. The overheads and expense associated with the procurement of masks, and their handling, cleaning, and storage are also eliminated.

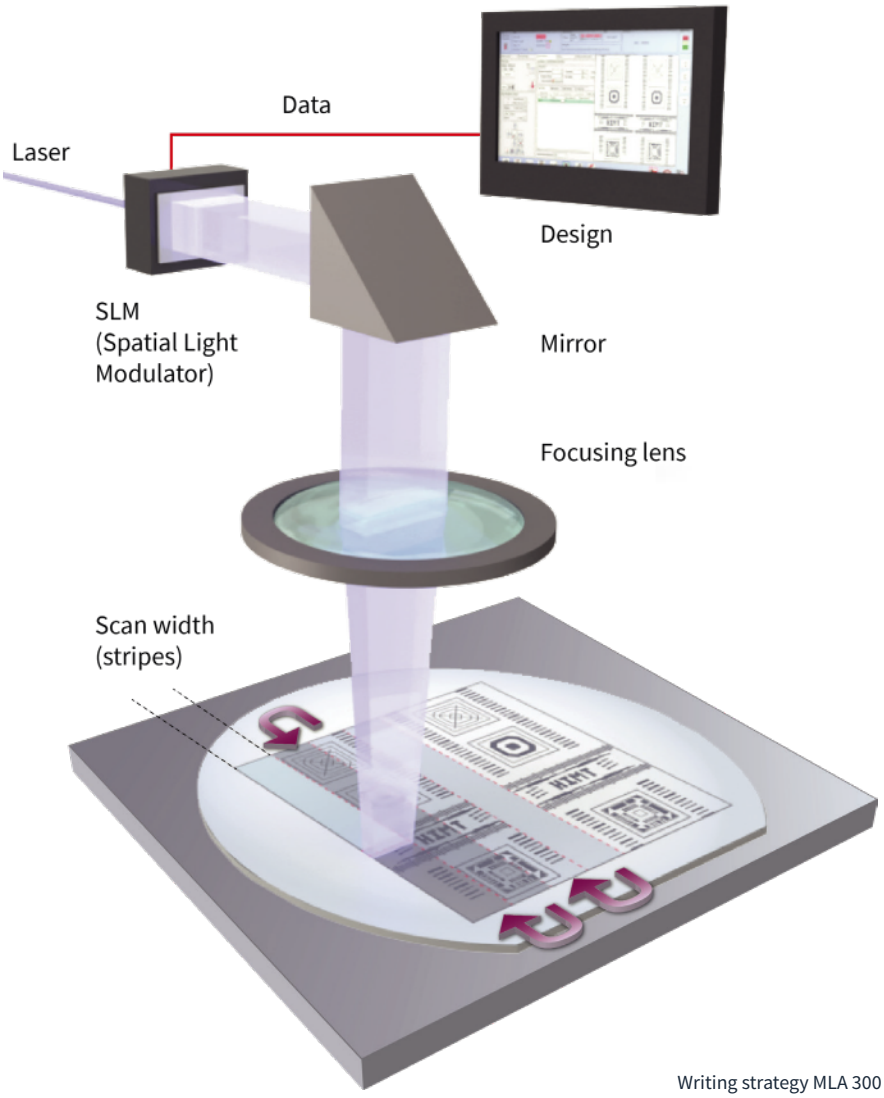
The system is designed for low total cost of ownership with its long-life diode laser and no consumables requirements. The positioning system is based on a frictionless air-bearing table, which offers high speed and high-accuracy motion, while simultaneously optimizing durability and lifetime.

APPLICATIONS

The MLA 300 excels in application areas such as the production of sensors, sensor ICs, MEMS devices, discrete electronic components, analog and digital ICs, ASICs, power electronics, OLED displays, as well as for advanced packaging applications.

MAXIMUM FLEXIBILITY

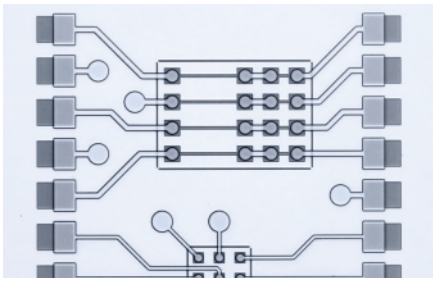
The novel modular concept allows maximum flexibility for the MLA 300, which can thus be tailored precisely to both the production task and facility requirements. The loader module can be configured to interface to existing substrate carrier or FOUP systems and ensures seamless integration to the production line. The fully integrated exposure module is available for a selection of wavelengths (375 nm or 405 nm). In order to increase the exposure speed for substrates of over 150 mm size, a second exposure module may be added to the setup.



Writing strategy MLA 300

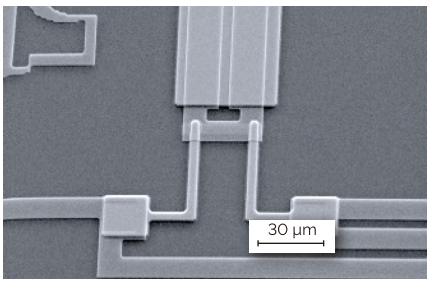
MASKLESS LITHOGRAPHY IN INDUSTRIAL PRODUCTION: APPLICATION AREAS

ADVANCED PACKAGING



For spacing out chip dies in fan-out packaging applications, they are bonded onto wafers or panels after dicing. The bonding process introduces small position shifts, which become a limiting factor as the density of wiring traces increases. The MLA 300 can expose unique patterns for each substrate, taking into account the die shift, so that traces are exposed in their intended place.

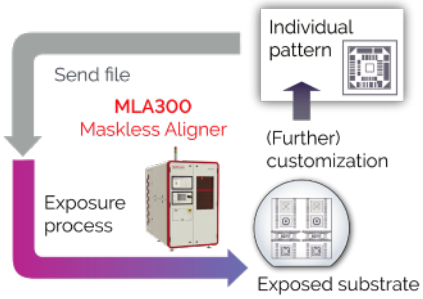
SENSORS



Maskless lithography enables multi-dimensional overlay control beyond standard zoom lens scaling. The Maskless Aligner technology includes compensations for individually scaling x and y directions, rotation, as well as shearing. This capability is demonstrated with an 18-layer SQUID device which shows excellent overlay through all layers (exposure here on MLA 150).

SQUID image courtesy of the Kirchhoff Institute for Physics (KIP), Heidelberg University

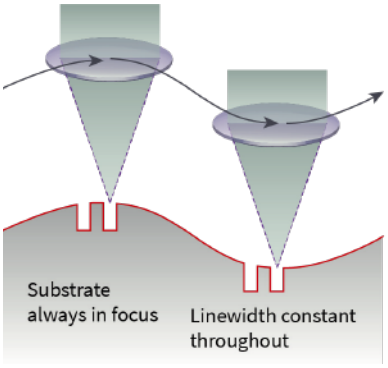
CUSTOMIZED PRODUCTS



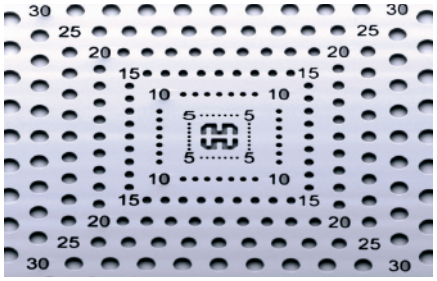
The benefit of Maskless Lithography is the inherent rapid turnaround and adaptation of the exposed patterns. Modifications for customized products no longer entail production and maintenance of an expensive mask set. Switching between product types is seamless, and does not require intervention to change masks.

WARPED SUBSTRATES

Structuring warped substrates is challenging, as shape and distortions vary with applied forces. Maskless lithography offers the unique option of exposing the substrates with warpage-dependent pre-distortions, to maximise yield. Electronic components are often produced on substrate materials such as ceramics which are selected for their robustness or thermal properties rather than surface quality. The Maskless Aligner technology flexibly follows surface warp and corrugations, increasing uniformity and yield. Process variations can also be compensated for dynamically by adjusting the exposed pattern.



ELECTRONIC COMPONENTS



Fan-out wafer-level technology helps to achieve a high I/O-density and allows the flexible, heterogeneous integration of multiple chips. Challenges include varied chip heights and warped substrates. These can be solved by the special wafer handling system, customizable vacuum chucks, and large autofocus compensation range provided by the MLA 300.

MLA 300 HIGHLIGHTS

- High throughput
- Dynamic distortion correction
- Handling of challenging substrates
- Contactless exposure
- High precision and overlay accuracy
- Flexible pattern adaptations
- Individual labeling
- Confidentiality
- Quick time to market
- Quick turnaround time
- Low cost of ownership

The MLA 300 is available in a variety of configurations with or without different types of automatic loaders. Each system will be customized exactly to suit your applications and requirements.

Left: The surface of ceramic substrates as are used in the production of electronic components may have local thickness variations. The MLA 300 real-time autofocus follows these variations, leading to a superior uniformity of the resulting design.

MLA 300

SYSTEM SPECIFICATIONS

Writing performance		Write Mode 2		Write Mode 3	
Minimum lines and spaces [µm]		2		3	
Minimum feature size [µm]		1.5		3	
CD uniformity [3σ, nm]		200		300	
Edge roughness [3σ, nm]		80		100	
2nd layer alignment [3σ, nm]		500		700	
Backside alignment [3σ, nm]		1000		1000	
	Number of exposure modules installed	1	2	1	2
Exposure time (80 mJ/cm² 405 nm laser):	100 x 100 mm²	2.75 min	-	1.5 min	-
	200 x 200 mm²	9 min	4.7 min	4.6 min	2.5 min
	300 x 300 mm²	19.5 min	10 min	9.6 min	5 min
Maximum write speed (405 nm laser) [mm²/min]		4615	9000	9375	18 000

System features	
Light source	Laser wavelength: 375 nm and/or 405 nm High power diode laser with long life-time
Maximum substrate size	300 x 300 mm²
Maximum exposure area	300 x 300 mm²
Substrate thickness	0.1 - 10 mm
Internal temperature stability	± 0.1°C
Real-time autofocus	Optical and pneumatic autofocus
Autofocus dynamic range	Up to 150 µm
Alignment	Advanced alignment; backside alignment optional
Automation (optional)	Automatic wafer handling and pre-alignment
System dimensions (excluding loader)	
Height × width × depth	1980 mm x 1200 mm x 2310 mm
Weight	2600 kg
Installation requirements	
Electrical	400 VAC, 50/60 Hz, 16 A
Compressed air	7 - 10 bar

Please note: Specifications and throughput depend on individual process conditions and equipment configuration. Design and specifications are subject to change without prior notice.

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