HEIDELBERG INSTRUMENTS

DWL 2000 GS / DWL 4000 GS

THE PROFESSIONAL GRAYSCALE LITHOGRAPHY TOOL

heidelberg-instruments.com

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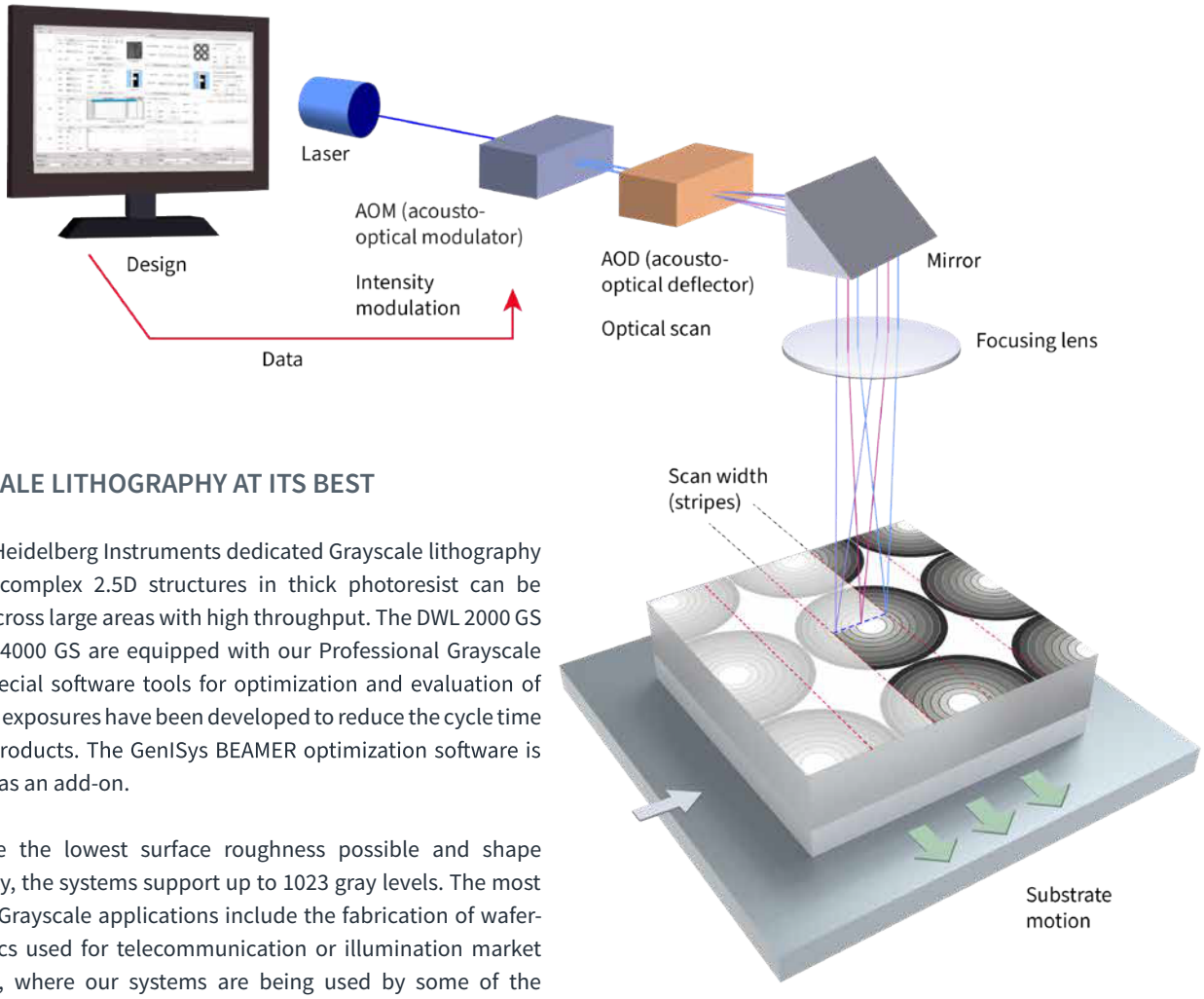
The expert Grayscale (GS) Lithography tools DWL 2000 GS and DWL 4000 GS provide advanced Grayscale technology that satisfies the highest industrial standards. Grayscale Lithography – in contrast to traditional binary laser lithography – produces 2.5D or freeform topographies such as micro-lenses or sloping features like blazed gratings. This technology plays a crucial role in micro-optical applications, producing for example identifiers such as security markers or holograms. It is also frequently employed for large area modifications of surfaces that serve as light modifiers, for example, reflectors.



Grayscale exposure strategy

GRAYSCALE LITHOGRAPHY AT ITS BEST

With the Heidelberg Instruments dedicated Grayscale lithography systems, complex 2.5D structures in thick photoresist can be created across large areas with high throughput. The DWL 2000 GS and DWL 4000 GS are equipped with our Professional Grayscale setup. Special software tools for optimization and evaluation of Grayscale exposures have been developed to reduce the cycle time for new products. The GenISys BEAMER optimization software is available as an add-on.

To ensure the lowest surface roughness possible and shape conformity, the systems support up to 1023 gray levels. The most common Grayscale applications include the fabrication of wafer-level optics used for telecommunication or illumination market segments, where our systems are being used by some of the largest multinational corporations. Other applications include display manufacturing as well as device fabrication in the fields of biology and life sciences.

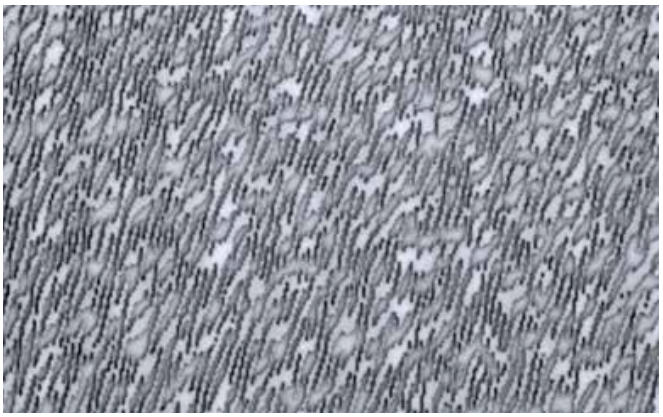
HIGH-STABILITY SYSTEM SETUP

A fixed optical setup, a reliable real-time autofocus system, and a high-precision air-bearing stage system guarantee the quality and position accuracy of the exposed structures.

A high-resolution interferometer monitors the position of the stage at all times. To ensure maximum stability, an advanced climate control provides constant temperature stability during operation. Additional software is used to compensate for any remaining variation in the mechanical structures or the environmental parameters. The systems are equipped with an integrated CCD camera and an overview camera for easy alignment to existing features.

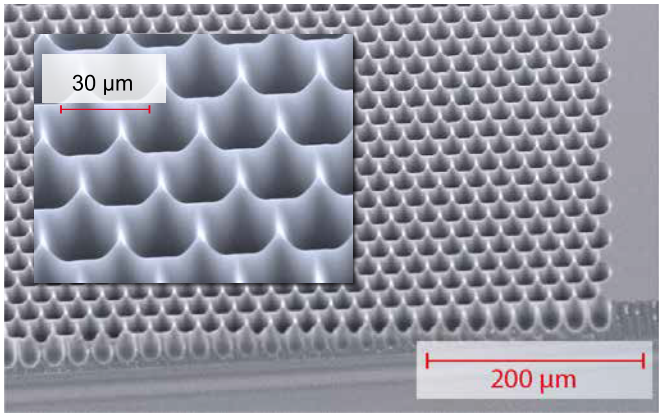
You can choose between four available write modes to optimize the system performance for different applications.

HOLOGRAMS



Hologram: Resist: AZ 1500

MICROLENSES AND MICROLENS ARRAYS



Microlens array: Width of lenses 20 µm, depth 30 µm

DIFFUSORS AND REFLECTORS

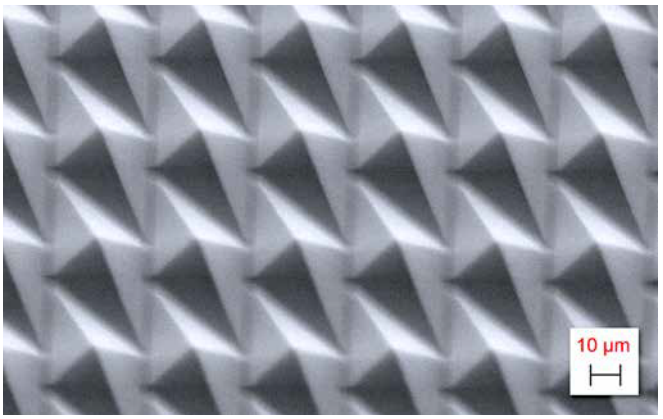
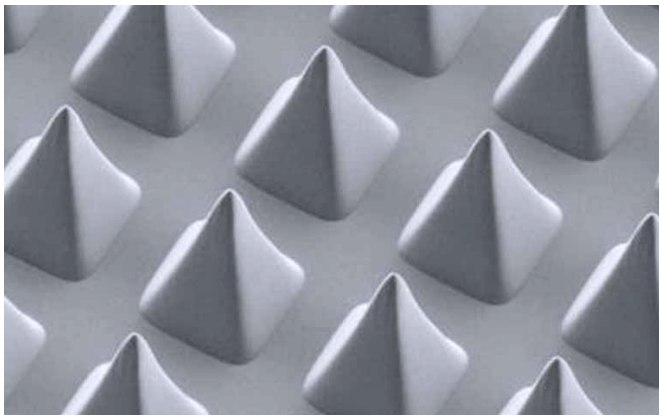
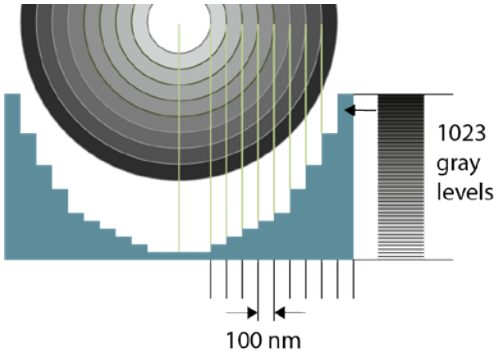


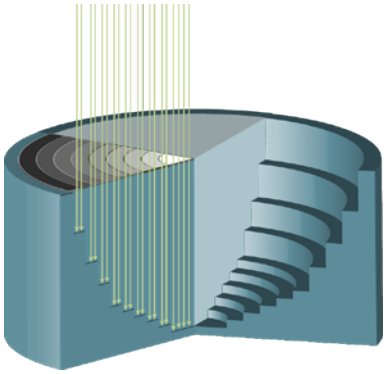
Image courtesy of karmic.ch

TEXTURED SURFACES



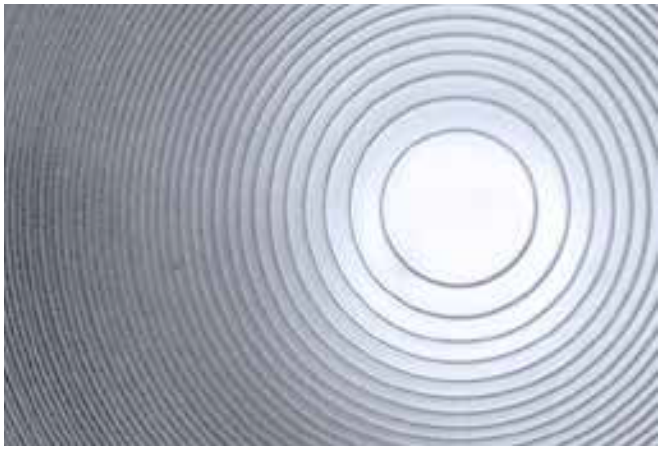
Resist: AZ 4562, thickness 54 µm. Pyramid height 50 µm, distance between pyramids 8 µm





The gray value model: From 3D-CAD to light intensity. The input data defines a 3D topography. Each position in the 3D input data is mapped to the gray values according to the exposure pixel grid. Each gray value corresponds to an individual exposure intensity level. The system determines the pixel-by-pixel exposure depth accordingly.

FRESNEL LENSES



PROFESSIONAL GRAYSCALE: HIGHLIGHTS

- Create complex topographies for micro-optical components or other Grayscale applications: Optical quality surfaces (roughness down to 5 nm) can be produced
- File formats: DXF, BMP, STL and X,Y,Z-ASCII
- Expose CAD files with up to 1023 levels
- Extensive software package:
  - Manipulate and combine CAD files to create complex patterns
  - Optimize layouts to maximize structure quality and minimize exposure time
- Optional GenISys BEAMER and LAB software data optimization and simulation

DWL 2000 GS / DWL 4000 GS

SYSTEM SPECIFICATIONS

Write mode	I	II	III	IV	V
Writing performance - Grayscale					
Overlay [3σ, nm] (over 8" x 8")			300		
Pixel Grid Grayscale [nm]	100	200	250	500	1000
Write Speed DWL 2000 GS [mm²/minute]	12	50	75	270	870
Write Speed DWL 4000 GS [mm²/minute]	12	50	75	270	1000
Exposure Time DWL 2000 GS: For 200 mm x 200 mm [hours]	51	13.5	9	2.5	0.8
Exposure Time DWL 4000 GS: For 400 mm x 400 mm [hours]	223	54	36	10	3
Maximum Dose [mJ/cm²]	5600	1400	900	225	50
Writing performance - Binary					
Minimum Feature Size [µm]	0.5	0.7	0.8	1	2
Minimum Lines and Spaces [µm]	0.7	0.9	1	1.5	3
Address Grid [nm]	5	10	12.5	25	50
Edge Roughness [3 σ nm]	40	50	60	80	110
CD Uniformity [3 σ nm]	60	70	80	130	180
Registration [3 σ nm]			200		
Write Speed DWL 2000 GS [mm²/minute]	12	50	75	270	870
Write Speed DWL 4000 GS [mm²/minute]	12	50	75	270	1000
System features					
Light source	Diode laser with 405 nm				
Maximum substrate size	DWL 2000 GS: 9" x 9" / DWL 4000 GS: 17" x 17"				
Substrate thickness	0 to 12 mm				
Maximum exposure area	DWL 2000 GS: 200 x 200 mm² / DWL 4000 GS: 400 x 400 mm²				
Temperature controlled environmental chamber	Temperature stability ± 0.1°, ISO 4 environment				
Real-time autofocus	Optical autofocus or air-gauge autofocus				
Autofocus compensation range	80 µm				
System dimensions					
Lithography unit (width × depth × height); weight	2350 mm × 1650 mm × 2100 mm; 3000 kg				
Electronic rack (width × depth × height); weight	800 mm × 600 mm × 1800 mm; 180 kg				
Installation requirements					
Electrical	400 VAC ± 5 %, 50/60 Hz, 16 A				
Compressed air	6 - 10 bar				
Cleanroom	ISO 6 or better recommended				

Please note: Specifications depend on individual process conditions and may vary according to equipment configuration.

Visit product website for more information

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