

# Optical Solutions for Lithography & Inspection Equipment



DigitalOptics Corporation™ (DOC) offers its OptiML™ Diffractive Optical Elements (DOEs) that diffract light into a defined angular distribution, creating a specific pupil image pattern. Our DOEs enable optical illumination for immersion lithography and high-speed reticle and wafer inspection applications, enabling semiconductor manufacturers to produce chips that meet higher performance standards at better throughputs.

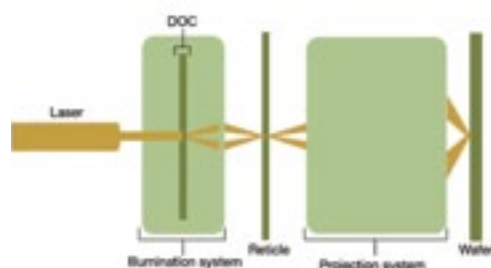
## High-Volume, Copy Exact Production Capabilities

DOC employs high-resolution lithographic techniques in combination with precision glass-etching capabilities to provide semiconductor manufacturers with customized, high-efficiency DOEs. Our elements are fabricated with sub-micron features to match each application's custom requirements. Comprehensive, automated, in-house test systems provide full process and quality controls.

DOC's state-of-the-art 100,000 ft<sup>2</sup> ISO 9001:2008 & 14001:2008 certified facility for wafer-level optic fabrication provides high repeatability, offering tool owners consistent performance between first article and follow-on orders.

## Tunable DOEs

DOC has created a new family of OptiML DOEs that allows the pupil response to be actively tuned by slight spatial movement of the DOE with respect to the light source. The tunable DOE can be used for subtle matching adjustments or to allow for broader pupil flexibility when library exchange options are limited. When applied to a SMO system, DOC's tunable DOEs have been proven to significantly improve CD fidelity at critical nodes.



OptiML DOEs are located in a scanner's illumination system to provide customized off-axis illumination at the reticle plane.

## Benefits

- 193, 248 and 266nm primary wavelengths
- High NA binary designs
- High efficiency multiphase designs
- Free-form designs for source mask optimization
- Higher resolution and reliability than reconfigurable systems
- Better efficiency and throughput compared to aperture blades
- Long lifetime, high damage threshold
- Low stray light: reduced diffraction flare
- Precise and consistent edge profiles
- Speckle management for coherence control
- Beam splitting for multiple inspection paths

## Offerings

- Custom illumination profiles
- UV grade fused silica or crystal quartz substrates
- Tunable DOEs for in-situ pupil customization
- High-performance anti-reflective coatings
- Expedited fast track services
- Comprehensive optical metrology



Controlled angle patterns

### Low Stray Light (Optical Flare) Elements

OptiML technology addresses the need to reduce the node size in several ways: higher resolution, more intensity levels and stray light reduction.

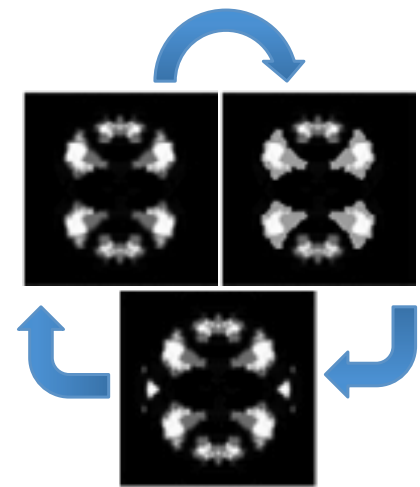
DOC's low stray light solution suppresses the diffractive scatter within the dark regions of the pupil. This provides higher contrast, reduced optical flare and a dramatic improvement in the overall signal-to-noise ratio of the source pupil definition. Implementing this approach using OptiML advanced DUV lithography capabilities reduces stray light up to 60%.

### Reliability, Precision and Performance

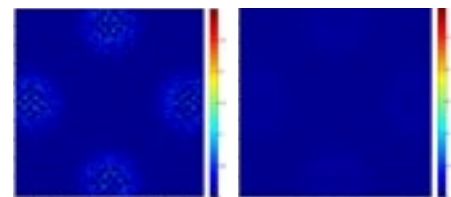
As the inspection tool industry has advanced, so have we, with modern stepper and scanner manufacturing tools and expanded cleanroom facilities. DOC's optic products are made with a strong attention to detail: precision, performance and rapid response.

### Comparison of performance for 2-, 8- and 16-phase level diffusers fabricated with DOC's in-house processes and illuminated with 193nm light.

Number of Phase Levels	$\theta_{\max}$ (In-house Stepper)	$\theta_{\max}$ (In-house Scanner)	Efficiency
2-phase	11° / 190 mrad	22° / 380 mrad	Up to 80%
8-phase	1.6° / 28 mrad	5.5° / 95 mrad	Up to 90%
16-phase	0.8° / 14 mrad	2.7° / 47 mrad	Up to 93%



Tunable DOE example depicting variations in intensity as well as spatial pupil content in a single DOE



Over 60% reduction in stray light using advanced lithography tool

### Contact a DOC sales representative for more information.

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