

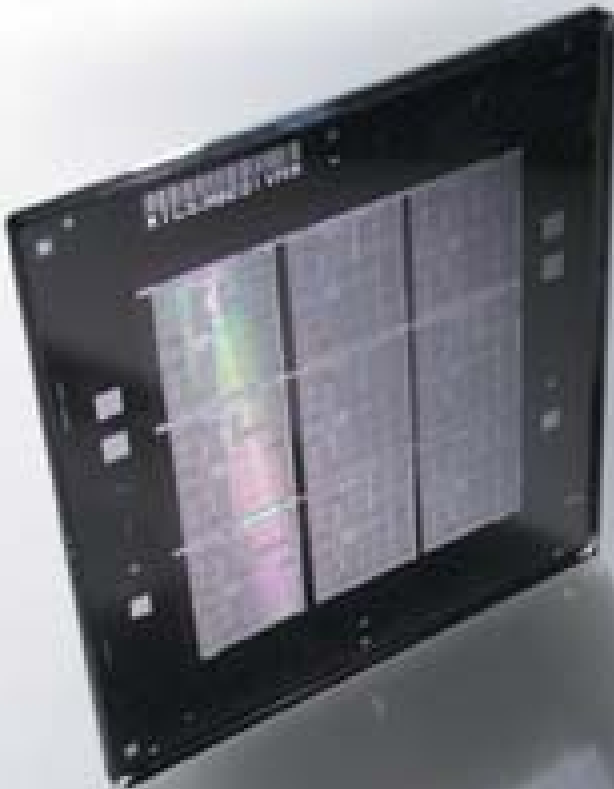


ADVANCED LITHOGRAPHY SOLUTIONS

Phase Shift Masks

The world of semiconductor technology continues to advance rapidly. Keeping pace with this change—by delivering the world's most advanced reticle solutions to support increasingly complex photomask specifications—is what sets Photronics apart from the competition.

To support the need for robust manufacturing solutions for the quickly ramping 130nm technology node, with its generations of shrinks, quickly followed by the 90nm node, Photronics delivers the Sub-Wavelength Reticle Solutions™ (SRS™) product families. This includes our ePhase embedded attenuated phase shift masks and tPhase alternating aperture phase shift masks. These solution families are supported by our leading-edge e-beam and laser patterning tools and advanced resist and etch processes to ensure that our customers can achieve the CD uniformity and cycle time volume production requirements they demand. Understanding 65nm or 45nm node requirements are just around the corner, Photronics also maintains highly advanced research and development efforts to ensure that we stay at the forefront of technology's continued advances.



Global Coverage

Photronics supports the diverse needs of the global semiconductor and photonics communities through a network of manufacturing facilities in Asia, Europe and North America. Each manufacturing region supports a variety of the advanced solutions described in this brochure at one or more of its facilities. Advanced solutions customers can draw upon local teams of technical professionals to help implement these applications. They are also supported by our global CyberMask™ mask specification environment and MaskTrac™ manufacturing control system—offering customers the highest degree of production and delivery flexibility, in accordance with their site qualification requirements.

ePHASE

EMBEDDED ATTENUATED PHASE SHIFT MASKS

The Photonics ePhase EAPSM product family is targeted at sub-wavelength contact hole printing applications for technology nodes at and below 130nm. Photonics uses both laser and e-beam approaches to generate embedded phase shift reticles. However, for most applications we leverage the unparalleled critical dimension uniformity attributes of our NanoRange or UltraRes Advanced Binary processes as a platform for our ePhase 248 and ePhase 193 product manufacturing.

Photonics ePhase phase shift masks derive their 180 degree phase shifting properties from the molybdenum silicide (MoSi) absorber films on the raw quartz substrate. Reticles can be produced with a chrome border such that advanced steppers and scanners can readily discern barcodes and reticle alignment marks. Focused ion beam repair processes have been developed that emulate both the phase and transmission of the surrounding MoSi. The process can be enhanced, with engineering intervention, to produce ternary or tri-tone EAPSM for applications where large unexposed areas could benefit from incremental optical density. Customers are seeing

better resolution and improved process margins, effectively a lower k_1 , with ePhase solutions.

ePHASE 248 PRODUCT SPECIFICATIONS	
PARAMETER	SPECIFICATION
Reticle size	6" X 6" X .250
Field size	110 X 132mm
Target features	Contact or Line/Space
CD uniformity	< 25nm X-Y dense & isolated
CD mean target	< ± 15 nm
Defects	Zero at 200nm
Phase control	$180^\circ \pm 3^\circ$
Transmission uniformity	$6\% \pm 0.3\%$

For ePhase 193 Product Specifications, contact your Photonics representative.

Standard 6% transmission products are currently in production. In addition, early samples have been built and shipped at transmissions ranging from 6-20% for 248nm and for 193nm. Mask manufacturing tool infrastructure is now in place to handle inspection of high transmission films with tri-tone applications.



Photonics ePhase Material Development

Supporting the growing demand for ePhase sub-wavelength solutions, Photonics has moved ePhase material research and development work in-house. We have installed a Veeco IBD 350-LDD dual beam sputter deposition tool and are performing film analysis on our JA Woollam VASE ellipsometer.

tPHASE

ALTERNATING APERTURE PHASE SHIFT MASKS

The Photonics tPhase product family leverages our extensive work in etching fused silica for photonics applications. tPhase masks are single mask, hard phase shift reticles, that derive their 180 degree phase shifting properties from quartz trenches that are precisely etched into desired areas of the reticle. These products are targeted at sub-wavelength applications for technology nodes at and below 130nm. Photonics uses both laser and e-beam approaches to generate AAPSM reticles, the choice dependent on customer patterning requirements and reticle specifications.

tPhase products are currently offered in low volume for 248nm applications through our Productization Group, with additional work on glass defect repair being completed as a final requirement for robust manufacturing. Products currently use a triple-etch strategy until zero defect masks can be guaranteed by repair. Photonics' processes for 193nm lithography AAPSM applications are also in final development and have begun low volume production with selected partner customers. Photonics also supports chromeless (CPL) layouts and cPSM sets consisting of a binary trim mask and a complementary AAPSM.

