# PLAB/ASML MASKTOOLS CPL COVERAGE REPORT

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**PREPARED BY:**
M C A

**ASML, Photronics team to develop CPL masks**
By David Lammers
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Austin, Texas - ASML MaskTools and Photronics Inc. last week announced an agreement to promote the use of CPL masks, the latest arrow in a growing quiver of reticle-enhancement technologies that chip companies are using to extend 193-nanometer lithography to the 65-nm node and beyond.

Chromeless phase lithography stands somewhere between the space occupied by embedded attenuated phase-shift masks and the much more expensive alternating PSMs. CPL is somewhat of a misnomer, however, because the latest iteration of the technology does leave chrome on the mask.

CPL offers several advantages over the alternating phase-shift masks (altPSMs) that have been used thus far at Intel Corp., Motorola Inc. and elsewhere to define the most critical layers, including the gate polysilicon formation.

Alternating PSMs require a dual-exposure approach, with an initial exposure through the altPSM and a second exposure through a trim mask to remove residual, phase-edge images. That double exposure can cut throughput on the factory floor by as much as 40 percent, according to Motorola, which is testing a CPL mask now for a PowerPC microprocessor.

AltPSMs are also difficult to make, requiring etching steps that often raise costs, said Ken Rygler, an Austin-based consultant who worked earlier at DuPont Photomasks here. CPL masks use materials similar to those employed to make the relatively inexpensive attenuated PSMs.

"I think CPL is going to be cheaper than alternating, because you don't have to do the etching into the glass that is so time-consuming," Rygler said.

The nonexclusive alliance combines Photronics' (Brookfield, Conn.) commercial mask-making skills with ASML's CPL expertise and software, including its MaskWeaver mask optimization software and LithoCruiser lithography optimization tool.

Dinesh Bettadapur, president of ASML MaskTools (Santa Clara, Calif.), said that for 65-nm design rules and beyond, CPL masks may allow 193-nm scanners to be used for critical layers like gate definition and contacts in the interconnect stack.

"This agreement with Photronics is being driven by a customer that uses Photronics as a key mask supplier," Bettadapur said. The companies did not identify the customer.

United Microelectronics Corp. recently issued a news release saying that it intends to use CPL masks for its foundry customers. Canon Inc. has discussed its Vortex approach to chromeless phase lithography, and Dai Nippon Printing (Tokyo), one of the four largest mask houses in the world, is working on the technology. Dai Nippon, DuPont Photomasks, Hoya Glass and Photronics are the dominant mask companies now, Rygler said.

"Ultimately, the industry will need EUV [extreme-ultraviolet] lithography. But if we can use clever reticle-enhancement techniques and immersion, the hope is that we can extend 193-nm lithography and save on costs," said Bernie Roman, director of advanced lithography research at Motorola's advanced products research and development laboratory here.

Designing with CPL technology "is not for kids," however, said Austin-based entrepreneur John Petersen. "Even very smart guys don't have a clue about how to take advantage of CPL. The design tools need to get institutionalized. Right now, ASML MaskTools has far and away the best software for CPL, but it needs to move out to the Mentor and Synopsys kind of companies in order to see widespread use."

**ASML, Photronics ally on CPL masks**

In a move intended to spur the use of chromeless phase shift mask technology, ASML MaskTools and Photronics, Inc. announced an agreement that combines ASML's software and CPL expertise with Photronics' commercial mask-making capability.

ASML calls the approach CPL. Photronics will produce CPL masks using licensed intellectual property from ASML's MaskTools division. ASML acquired the mask tools division of MicroUnity Corp. in June 1999.

The partners said they will work together to create a "seamless CPL manufacturing flow that is optimized for Photronics' mask making process."

ASML MaskTools markets several software tools designed to ease the creation of reticle enhancement techniques. Chris Progler, chief scientist at Photronics, said "mask data treatment tools are an important step" in bringing CPL technology to market and shortening the time needed to create a CPL mask layer.

Executives said one major customer is interested in using the technology. Though they did not identify that customer, other sources said United Microelectronics Corp. intends to use CPL masks for its foundry customers.

Dinesh Bettadapur, president of ASML MaskTools, said that for 65-nm design rules and beyond, chip companies will need to develop the design software that will support reticle enhancement techniques, including CPL masks. The approach may allow 193-nm scanners to be used for critical layers, such as gate definition and contacts in the interconnect stack.

"This is being driven by a customer which uses Photronics as a key mask supplier. The goal is to make this a broadly accepted form of (RET) nhancement technology," said Bettadepur.

Bernie Roman, director of advanced lithography research at Motorola Inc.'s advanced products research and development laboratory (APRDL) here, said Motorola has been testing a CPL mask for a PowerPC microprocessor. However, Roman said Motorola only recently received the mask, and testing has just begun. Motorola may be a year or so away from using CPL technology in production, he cautioned.

Chromeless phase shift masks provide a strong shift to light from the scanner, sharpening the image as it is printed on the wafer. Though alternating phase-shift masks provide similar benefits, such "hard" phase-shift masks require that the initial exposure be followed by a "trim" mask which removes unwanted patterns. The CPL approach does not require a trim mask, boosting throughput by an estimated 40 percent.

**- David Lammers**
***EE Times***

**ASML, Photronics ally on CPL masks**
By David Lammers, EE Times
URL: http://www.eetimes.com/story/

AUSTIN, Texas — In a move intended to spur the use of chromeless phase shift mask technology, ASML MaskTools and Photronics, Inc. announced Wednesday (Dec. 17) an agreement that combines ASML's software and CPL expertise with Photronics' commercial mask-making capability.

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**ASML, Photronics ally on CPL masks**
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URL: http://www.electronicstimes.com/story/OEG20031217S0016

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## ASML Brings Photronics Onboard for CPL Masks

Electronic News

ASML MaskTools and Photronics Inc. have embarked on a strategic alliance to develop a production-ready, mask-making infrastructure for ASML MaskTools' chromeless phase lithography (CPL) technology, the companies said today.

CPL is a resolution enhancement technique that uses chromeless features on a standard binary reticle that have nearly 100 percent transmission and are phase-shifted by 180 degrees. But unlike alternating phase shift technology, CPL doesn't require a second exposure of a trim mask, making for a more simplified process flow in the litho cell, according to MaskTools.

While the technique requires exposure tools with a numerical aperture greater than 0.7 and strong off axis illumination, it is not dependent on the wavelength of the tool's light source. CPL has the potential to extend current 193nm tools and processes to the 90nm and 65nm nodes, the companies said.

MaskTools, a subsidiary of Dutch lithography tool vendor ASML, is marketing the technology primarily for critical gate and contact layers for both logic and memory applications. "Establishing a mature mask making infrastructure is one of the keys to enabling the adoption of a new technology such as CPL," noted Dinesh Bettadapur, MaskTools' president and CEO, in a statement.

With Brookfield, Conn.-based photomask maker Photronics on board, MaskTools will deliver the software component of the CPL technology through its LithoCruiser and MaskWeaver products, while ASML will deliver exposure tools through its 248nm krypton fluoride and 193nm argon fluoride Twinscan platforms. Photronics in turn will deliver CPL masks.

Photronics will work with ASML to develop a CPL manufacturing flow optimized for Photronics' advanced mask making process. In turn, ASML will provide Photronics with an R&D license for its portfolio of CPL patents encompassing the mask making, wafer imaging and software implementation. Each company will also promote each other's CPL- related products and services to their common customer base.

**CPL mask link-up**
News:Alliances

ASML MaskTools and Photronics plan to jointly develop a production-ready, mask making infrastructure for ASML MaskTools' patented chromeless phase lithography (CPL) technology. CPL is a single mask, single exposure resolution enhancement technique that enables low k1 lithography at advanced technology nodes.

CPL has the potential to extend the lifecycle of current 193nm lithography processes to the 90nm and 65nm nodes and can be broadly applied to logic and memory devices for critical gate and contact layers.

Adoption of CPL technology requires the availability of three critical components: leading edge software, advanced imaging systems and high-end photomasks.

ASML MaskTools will deliver the software component through its LithoCruiser (CPL imaging simulation) and MaskWeaver (full-chip CPL mask data conversion) products. ASML will deliver the imaging components through its KrF and ArF Twinscan platform including the recently announced XT:1250 scanner. Photronics will deliver the mask component through the delivery of CPL masks.

As part of the agreement, Photronics will work with ASML to help develop a seamless CPL manufacturing flow for Photronics' mask making process. In turn, ASML will provide Photronics with an R&D license for CPL technology patents encompassing the mask making, wafer imaging and software implementation domains. In addition, each side will promote each other's CPL products and services to their common customer base.

**ASML MaskTools, Photronics form partnership for chromeless phase lithography**

SANTA CLARA, Calif. -- ASML MaskTools Inc. and Photronics Inc., Brookfield, Conn., today announced an alliance aimed at developing a production-ready mask making infrastructure for ASML MaskTools' Chromeless Phase Lithography (CPL) resolution enhancement technology.

CPL is a technique that can help enable low k1 lithography at advanced technology nodes, potentially extending 193-nm lithography processes to 90 and 65 nm nodes, the two companies said.

"ASML welcomes Photronics as the newest partner in our fast maturing CPL technology development program," said Dinesh Bettadapur, president and CEO, ASML MaskTools. "They will provide value to the program through their expertise and experience in high volume mask manufacturing. Establishing an efficient mask making infrastructure is one of the keys to enabling the adoption of a new technology such as CPL."

CPL "represents a very viable solution for extending optical lithography well beyond 90 nm," said Chris Progler, chief scientist at Photronics.

Foundry United Microelectronics Corp. said earlier this month that it is considering chromeless technology to help it extend 193-nm wavelength lithography to the 65-nm process generation (see Dec. 3 story).

A single mask, single exposure resolution enhancement technique, CPL can be broadly applied to logic and memory devices and is primarily targeted toward critical gate and contact layers, according to ASML MaskTools. ASML MaskTools' software for CPL includes LithoCruiser, which does CPL imaging simulation, and MaskWeaver, which performs full-chip CPL mask data conversion.

Photronics will work with ASML to help develop a seamless CPL manufacturing flow that is optimized for Photronics' advanced mask making process. ASML will provide Photronics with an R&D license for its CPL patents encompassing the mask making, wafer imaging, and software implementation domains.

**Photronics agrees to make masks for MaskTools' CPL**
Peter Clarke
URL: http://www.siliconstrategies.com/article/showArticle.jhtml?articleId=17000014

BROOKFIELD, Connecticut -- Photronics Inc. has agreed partner with ASML MaskTools Inc. and provide masks for the CPL (chromeless phase lithography) technology developed by ASML MaskTools, the company said Wednesday (December 17, 2003).

CPL is a resolution enhancement technique that enables low k1 lithography at advanced manufacturing process nodes, Photronics added.

"They [Photronics] will provide value to the program through their expertise and experience in high volume mask manufacturing," said Dinesh Bettadapur, president and chief executive officer of ASML MaskTools, in a statement. "Establishing an efficient mature mask making infrastructure is one of the keys to enabling the adoption of a new technology such as CPL."

A single mask, single exposure resolution enhancement technique, CPL can be broadly applied to logic and memory devices and is primarily targeted toward critical gate and contact layers.

MaskTools has two software tools to help customers implement CPL. These are: CPL imaging simulation tool and a CPL mask data conversion software program. Photronics is expected to deliver CPL masks.

"CPL technology...represents a very viable solution for extending optical lithography well beyond 90 nanometers," said Chris Progler, Photronics' chief scientist, in the same statement.

As part of the agreement, Photronics and ASML are to collaborate on the development of a CPL manufacturing flow that is optimized for Photronics' mask making process. ASML is to provide Photronics with an R&D license for its CPL technology patents encompassing the mask making, wafer imaging, and software implementation domains.

**ASML MaskTools, Photronics forge alliance**

December 17, 2003 - ASML MaskTools, Santa Clara, CA, a subsidiary of Netherlands-based ASML, and Photronics Inc., Brookfield, CT, have agreed to co-develop a production-ready maskmaking infrastructure for ASML MaskTools' CPL technology, a technique that enables low-k lithography. Under the deal, ASML MaskTools will help develop a CPL manufacturing flow optimized for Photronics' maskmaking process, while Photronics will receive an R&D license encompassing its maskmaking, wafer imaging, and software implementation.