



The international technical group of SPIE dedicated
to the advancement of photomask technology



SPIE[®]

2012 Photomask Technology

11-13 September 2012

Technical Program

spie.org/pm

Location

Monterey Marriott & Monterey
Conference Center
Monterey, California, USA

Conference

11-13 September 2012

Exhibition

11-12 September 2012

Technologies

- Patterning
- EUV
- Metrology
- Inspection & Repair
- Cleaning
- Data Prep
- OPC/RET/SMO
- Process Control
- Simulation & Modeling
- Materials

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Welcome!

On behalf of SPIE, BACUS, and the Organizing Committee, we welcome you to the 32nd Annual SPIE/BACUS Photomask Technology in Monterey, California.

This annual meeting continues to be the premier worldwide technical meeting for the photomask industry. The conference will give all attendees a condensed and up-to-date overview of the photomask industry. The various sessions will include presentations and poster papers that span a number of critical topics in the photomask industry. These include current technical issues, emerging technologies and future trends. It will also give the authors an opportunity to present their exciting research findings that relate to the emerging technical challenges facing the photomask industry to a large international audience of their peers.

The official opening session will be on Tuesday 11 September, with a Keynote Presentation by John Y. Chen from NVIDIA Corp. that you will not want to miss! The conference will be a three-day event ending with a vibrant panel discussion on the topic of: "Will optical patterning solutions be ready if EUV lithography continues to be delayed?"

We have received over 100 presentations this year, covering all aspects of mask making, mask application and related technologies. The program this year will be a single track. This means all presentations will be in one room, avoiding the need to hop between rooms to catch your favorite paper. EUV masks are now part of the mainstream of mask technology. To affirm this statement, all individual mask-related tasks of EUV will be part of their regular topic.

This year's special session will be on Optical Extensions. Optical Lithography continues to extend and has surpassed everyone's expectations. The ability to pattern geometries 10x smaller than the wavelength may need to go a step further! Thursday's Special Session is titled: "Will optical patterning solutions be ready if EUV lithography continues to be delayed?", and Bob Socha and Tom Faure have compiled a group of our industry's top experts to discuss.

We hope you enjoy your stay in beautiful Monterey, California. Not only will you have a great experience attending the sessions, you will also have fun on the California coast in the middle of its best season!



Frank E. Abboud
Intel Corp.
2012 Symposium Chair



Thomas B. Faure
IBM Corp.
2012 Symposium Co-chair

SPIE Green Initiative

As host to events that bring together scientists and engineers from around the globe, SPIE is committed to making our symposia as environmentally friendly as possible.

Ongoing efforts of SPIE include using non-disposable materials such as glass plates and metal flatware as often as possible, and encouraging facilities to donate surplus meals to soup kitchens. Many partnering facilities have robust recycling programs for paper, plastic, and aluminum products. SPIE continues to collaborate with venues, hotels, suppliers and the local Chambers of Commerce to assess and ease the conference's environmental impact. SPIE is currently working to implement solutions from the Green Meetings Industry Council guidelines with a goal to take our environmental efficiency to a whole new level.

When at this event, SPIE encourages you to take advantage of recycling bins, to reuse towels at your hotel, and to carpool whenever transportation is required during your stay in Monterey.



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Vote for the Best Photomask Paper

If you registered before the conference, you should have received an email already with a link and instructions.

If you registered onsite, an email will be sent to you the same day you registered.

If you have questions visit the SPIE Registration Desk.



Special Events

Keynote Presentation

Steinbeck Forum • Tuesday 8:10 to 8:50 am

Transforming Designs to Chips: An End User's Point-of-View on Mask Making



John Y. Chen

Vice President of Technology and Foundry Management, NVIDIA Corp.

The Photomask is a tool required to replicate a set of complicated IC geometries numerous times producing chips in large volume. It's arguably the most critical part in the manufacturing process because it has huge impact if it's not done right. Today, the definition of right means perfection. Whether it's data completeness or the pattern fidelity (placement and dimension), the requirement is zero flaws. This presentation will focus on the technology needs which challenge mask making capabilities including data preparation/OPC, CD & LER control, alignment and defect elimination.

As an end user, the speaker intends to discuss the impact of future lithography and mask making on the design and manufacturing of new products. He will emphasize performance, precision and perfection and the necessity of the three p's for the continuation of "Moore's Law."

John Y. Chen has been in the semiconductor industry for 36 years ranging from IDM to Foundry to Fabless. He currently serves as the vice president of technology and foundry management at NVIDIA Corporation. Prior to that, Dr. Chen held executive positions at FlexICs Inc., TSMC, WaferTech LLC, and Cypress Corporation. These positions contributed to his broad industry experience and include Senior VP of engineering, VP of R&D, VP of operations and VP of business development. Earlier in his carrier at Hughes Research Lab and Xerox Palo Alto Research Center, he has contributed in CMOS technology with more than 100 research papers and a book published by Prentice Hall. He was elected to the IEEE Fellow in 1992 for "leadership in and contributions to CMOS device and process technology".

Dr. Chen holds a B.S. in E.E. from National Taiwan University, an M.S. in E.E. from University of Maine, a Ph.D. in E.E. from UCLA, and a Master degree from the UCLA Executive Engineering Management.



Exhibition/Poster Reception

Serra Grand Ballroom

Tuesday, 11 September, 6:00 to 7:30 pm

Symposium attendees are invited to attend an Exhibition/Poster Reception on Tuesday evening in the Serra Ballroom. The reception provides an opportunity for attendees to meet colleagues, network, view poster papers, and visit the exhibition. Refreshments will be served. Attendees are requested to wear their conference registration badges.

Poster Viewing

Serra Grand Ballroom

Tuesday 11 September, 10:00 am to 3:00 pm, and 6:00 to 7:30 pm

Wednesday 12 September, 10:00 am to 3:00 pm

Poster authors may set up their poster papers between 10:00 am and 4:30 pm on Tuesday and will leave them up until Wednesday afternoon. Authors will be present during the Poster Reception 6:00 to 7:30 pm Tuesday to answer questions and provide in-depth discussion regarding their papers.

Don't Miss the Photomask Reception

Marriott San Carlos Ballroom
Wednesday, 6:00 to 8:00 pm

Make plans to join your colleagues and friends at the annual Photomask Reception. This year's event focuses on good food, beverages, and plenty of time to socialize or talk business with fellow conference attendees. Awards and other presentations will be included in the evening.

Admission is included with your paid registration. Guest tickets may be purchased at the Registration Desk (we highly recommend purchasing in advance to assure your guest reservation).

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Special Session Panel Discussion

Will Optical Patterning Solutions Be Ready if EUV Lithography Continues to Be Delayed?

Steinbeck Forum • Thursday 3:20 to 5:00 pm

Panel Moderators: **Thomas B. Faure**, IBM Corp.; **Robert J. Socha**, ASML US, Inc.

If EUV lithography is delayed, lessons learned of extending ArF lithography at the 20nm and 14nm nodes can be applied to the 10nm and 7nm nodes. Most likely the shrink will be enabled by integration of all of the aspects needed to decrease the cost per transistor. These aspects include the mask, the lithography, the EDA, and the design. This panel will focus on the interaction of the mask with lithography, EDA, and design.

In order to focus on the interaction of the mask with integration, the panel will discuss an overview of optical patterning solutions for the 10nm and 7nm nodes for both logic and memory. For these nodes, the mask making challenges will impact the optical lithography extensions which will test and impose limitations on the design and computational lithography ground rules. Furthermore, these issues will require changes in the mask making infrastructure and may require more aggressive mask strategies (PSM rather than binary) and may require a multiple beam mask writer. In order to answer these questions, the panel will discuss these challenges through a diverse group of experts from the mask industry, from the lithography community, from the EDA industry, and from the fabless companies which are end users of the mask.

Panelists:

Allen Gabor, Senior Patterning Program Manager in Advanced Lithography, IBM Corp.

Aki Fujimura, Chairman and CEO, D2S Inc.

Yuri Granik, Chief Scientist, Design to Silicon Division, Mentor Graphics Corp.

Yoshio Kawai, Deputy General Manager, New Functional Materials Research Ctr., ShinEtsu Chemical Co. Ltd.

Tuan Pham, Director of Flash Process & Device Technology, SanDisk Corp.

Geoffery Yeap, Vice President of Technology, Qualcomm Inc.

Franklin Kalk, Executive Vice President and Chief Technology Officer, Toppan Photomasks Inc.





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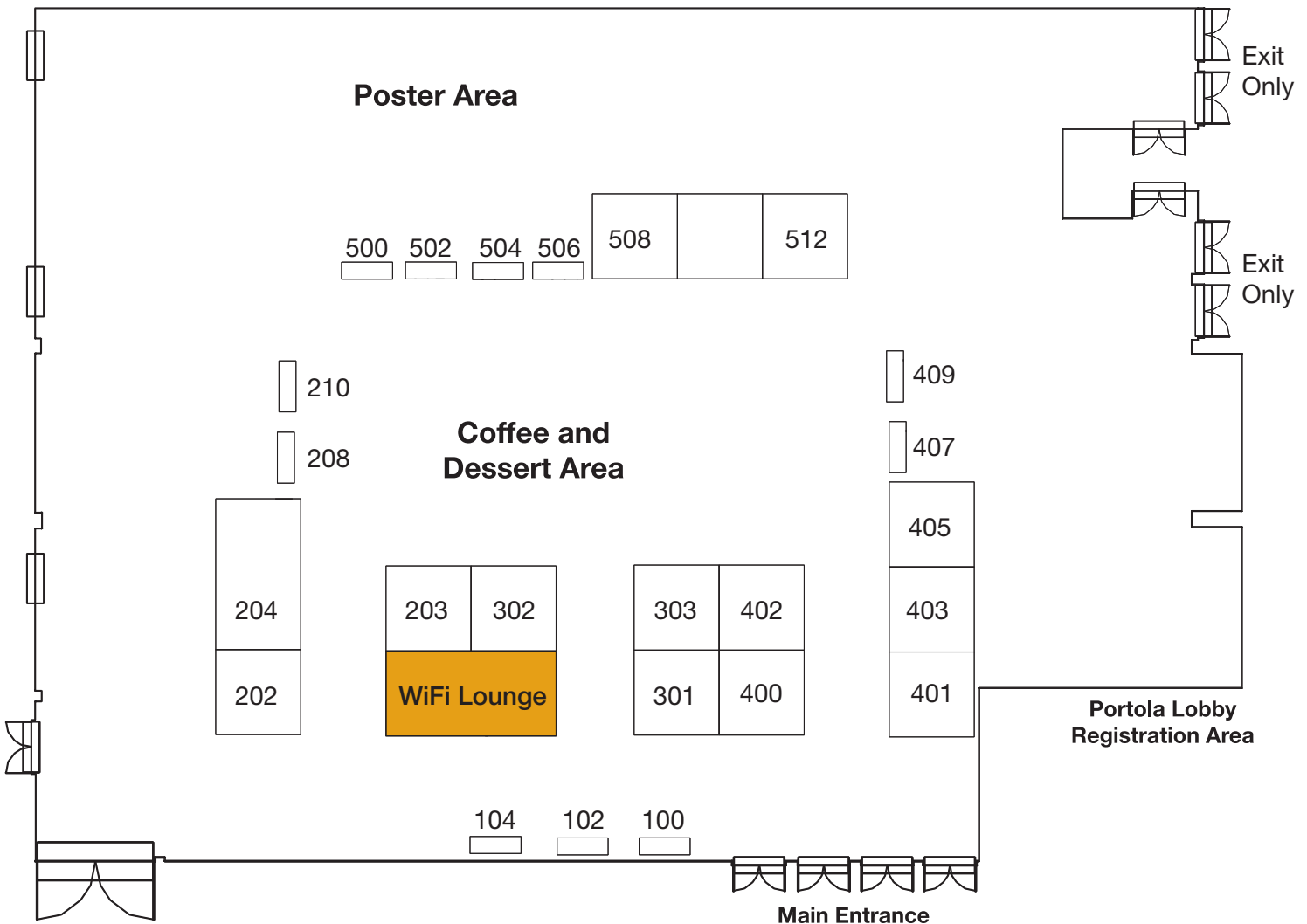
MAKE TIME FOR THE FREE EXHIBITION

Monterey Conference Center · Serra Ballroom
 Exhibition Dates: 11 – 12 September 2012

Tuesday · 10:00 am to 4:30 pm
 Tuesday Poster/Networking Reception · 6:00 to 7:30 pm
 Wednesday · 10:00 am to 4:00 pm



Exhibition Floor Plan - Serra Grand Ballroom



abeam Technologies, Inc.

#100

5286 Dunnigan Ct, Castro Valley, CA, 94546 United States
+1 510 931 5550
support@abeamtech.com; www.abeamtech.com

Advantest America, Inc.

#405

3061 Zanker Road, San Jose, CA, 95134 United States
+1 408 988 7700; fax +1 408 987 0680
info@advantest.com; www.advantest.com

Featured Product: E3630 Multi-Vision Metrology Scanning Electron Microscope (MVM-SEM)

Advantest is the leading producer of automatic test equipment (ATE) for the semiconductor industry and a premier manufacturer of measuring instruments. Its leading-edge products are integrated into the world's most advanced semiconductor production lines. The company also focuses on R&D for emerging markets that benefit from advancements in nanotech and THz technologies, and has recently introduced multi-vision metrology scanning electron microscopes essential to photomask manufacturing. Contact: Amy Gold, Dir. Corp Comm, a.gold@advantest.com; Mark Sheppard, Sales Engineer, m.sheppard@advantest.com

Benchmark Technologies

#500

7 Kimball Lane, Lynnfield, MA, 01940 United States
+1 781 246 3303; fax +1 781 246 0308
contact@benchmarktech.com; www.benchmarktech.com

Featured Product: E-Reticle in-situ ESD risk assessment tool for reticle environments

Benchmark Technologies is the world leader in design and fabrication of test reticles for equipment and process control. The company offers test reticles for focus monitoring, overlay matching, resolution and ESD assessment and many other applications. Contact: Andrew Zanzal, Vice-President of Sales, azanzal@benchmarktech.com

DOOR DECALS AND LANYARD SPONSOR**Carl Zeiss SMS GmbH**

#203

Carl Zeiss Promenade 10, Jena, 07745 Germany
+49 3641 64 2242
info-sms@smt.zeiss.com; www.zeiss.com/sms

Featured Product: PROVE Compact, MeRiT, AIMS, WLCD, CDC32, RegC

The Carl Zeiss Semiconductor Metrology Systems (SMS) division is a leading global supplier of both metrology & manufacturing equipment. Carl Zeiss SMS focuses on a key component in semiconductor manufacturing, the photomask. Core expertise in light and electron optics, complemented by a revolutionary femto-second laser technology form the foundation of a product portfolio comprising in-die metrology, actinic qualification, repair and tuning of photomasks. Contact: James Polcyn, Sales Manager, polcyn@smt.zeiss.com; Leila Hammad, Marketing Manager, hammad@smt.zeiss.com

Fortrend Engineering Corp.

#208

687 N Pastoria Ave, Sunnyvale, CA, 94085 United States
+1 408 734 9311; fax +1 408 734 4299
sales@fortrend.com; www.fortrend.com

Featured Product: EUV SMIF Pod Openers, PLS 200 EUV and PIS 200 EUV dual pod opener

Fortrend launched a new range of Reticle handling equipment in 2011 and 2012 aimed at the new cleaner EUV masks. Fortrend has built a range of SMIF pod openers to meet the SEMI E152 EUV SMIF pod opening requirements, PIS 200EUV dual pod opener for opening the inner and outer pods, and PLS 200 EUV desk top opener on display at the conference. The PLUS 500 G4 SMIF arm ISO Class 1 system enables a Reticle to be picked up, rotated 360° and/or tilted up to 270° to be placed on a host tool stage. Contact: Richard Morgan, VP of Operations, rmorgan@Fortrend.com

Gudeng Precision Industrial Co., Ltd.

#403

SPIE Corporate Member

No 2 Sec 4 Jhongyang Rd, 9F, Tucheng City Taipei, 236 Taiwan
+1 886 2 2268 9141; fax +1 886 2 2269 1943
sales@gudeng.com; www.gudeng.com.tw

Hinds Instruments, Inc.

#504

SPIE Corporate Member

7245 NW Evergreen Pkwy, Hillsboro, OR, 97124 United States
+1 503 690 2000; fax +1 503 690 3000
sales@hindsinstruments.com; www.hindsinstruments.com

Hinds Instruments Exicor@Birefringence Measurement technology is used to measure birefringence and characterize stress birefringence in materials with unsurpassed accuracy, resolution and repeatability. Capable of measuring optical retardation at 0.001nm resolution with noise floors as low as 0.005nm, these systems are robust, dynamic and scalable to fit the requirements of your application. Exicor systems are for use in the DUV, VIS & NIR and are able to measure virtually all optical materials. Contact: Doug Mark, Sales Engineer, sales@hindsinstruments.com

Ibss Group, Inc.

#409

SPIE Corporate Member

1559B Sloat Blvd Ste 270, San Francisco, CA, 94132-1222 United States
+1 415 566 5774; fax +1 415 566 9779
admin@ibssgroup.com; www.ibssgroup.com

Featured Product: GV10x Plasma Asher

In 2007 ibss Group began cooperating with an inventor of a unique, patented IC plasma source. In that time ibss developed and produced the GV10x, next generation in situ downstream asher. Competitively priced the GV10x Downstream Asher reduces carbon & hydrocarbon [HC] contamination 10 to 20 times more effectively than traditional methods at vacuum pressure safe for TMP operation. Contact: Vincent Carlino, President, vince.carlino@ibssgroup.com

Inko Industrial Corp.

#502

695 Vaqueros Ave, Sunnyvale, CA, 94085-3524 United States
+1 408 830 1041; fax +1 408 830 1058
sales@pellicle-inko.com; www.pellicle-inko.com

Featured Product: 193 DUV pellicle with minimized outgas

INKO, a U.S. based company, manufactures a complete line of pellicles for applications ranging from ASIC production to high volume memory production. From broadband to I/G line to 248 nm/193 nm DUV lithography, we have the right pellicles for your needs. Contact Joe Mac, sales and customer service, joemac@pellicle-inko.com Contact: Joe Mac, customer service, joemac@pellicle-inko.com; Feng Ye, QA manager, ye@pellicle-inko.com

WEDNESDAY LUNCH CO-SPONSOR**Mentor Graphics Corp.**

#301

SPIE Corporate Member

8005 SW Boeckman Rd, Wilsonville, OR, 97070-7777 United States
+1 503 685 7000; fax +1 503 685 1543; www.mentor.com

Featured Product: Calibre nmOPC, Calibre OPCverify, Calibre nmMPC, Calibre FRACTURE, Calibre MDPverify

The challenges of developing advanced litho flows require a partner that can deliver everything needed for success: tools for all data processing steps from design to mask prep; high accuracy and fast turnaround time; rapid flow development; flexibility; low cost of operation; interfaces to third party tools and equipment; and uncompromising support. 34 fabs choose Mentor as their partner. Find out how a partnership with Mentor can accelerate your success. Get more info at www.mentor.com. Contact: Gene Forte, Marketing Communication Manager, gene_forte@mentor.com

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#302

1257 Elko Dr, Sunnyvale, CA, 94089-2211 United States
+1 408 747 1769; fax +1 408 747 1978
www.mliusa.com

Featured Product: Pellicles and Mounting Tool

MLI is featuring pellicles formulated to yield high rates of transmission and long lifetimes for UV exposure. Our complete line of pellicle films ranges from broadband, g-/i-line to DUV (KrF-248nm and ArF-193nm). MLI's DUV pellicles have the lowest outgassing materials available in the market today. Contact: Kevin Duong, Customer Service Manager, kevin.duong@mliusa.com; Diana Tjin, Sales Administrative Manager, diana.tjin@mliusa.com

◆ Mitsui Chemicals America, Inc. #407

2099 Gateway Pl Ste 300, San Jose, CA, 95110-1017 United States
+1 408 487 2889; fax +1 408 453 0684
info@mitsuichem.com; www.mitsuichemicals.com

Since 1986, Mitsui has been the industry leader in providing pellicles to the semiconductor industry. Mitsui's ISO 9001 certified full automated plant produces Mitsui Pellicle, which transmits more than 99% of exposed light with excellent uniformity and longevity. Mitsui Pellicle, manufactured by rigorous selection of all materials and with 20 years accumulated expertise of non-dust structure, contributes to maximum production yields by eliminating pellicle related particle generations.

◆ Nippon Control System Corporation #508

3333 Bowers Ave Suite 280, Santa Clara, CA, 95054 United States
+1 408 737 0338; fax +1 408 737 0329
ncs-patacon@nippon-control-system.co.jp;
www.nippon-control-system.co.jp/en/index.html

Featured Product: NDE-MS offers total solutions to mask manufacture. It covers from post-opc through pre-mask writing.

Nippon Control System Corp has been providing fracturing tool to the industry for 20 years. Now we offer NDE Mask Manufacturable Suite (NDE-MS) which includes all applications required by mask manufactures from post-opc through pre-mask writing. The applications are NDE-Fracture, MRC, Select, PEC, MPC, and View. The Fracture w/ MRC and Select can offer the rule-based MPC. The PEC and MPC are absolutely model-based approach, and the PEC can handle EUV mask phenomenon. Contact: Shu Ohara, General Manager, oohara@nippon-control-system.co.jp

◆ Plasma-Therm #401

SPIE Corporate Member

10050 16th Street North, Saint Petersburg, FL, 33716 United States
+1 727 577 4999
information@plasmatherm.com; www.plasmatherm.com

◆ Pozzetta, Inc #204

3121 S Platte River Dr, Englewood, CO, 80110-2139 United States
+1 303 783 3172; fax +1 303 374 7342
customerservice@pozzetta.com; www.pozzetta.com

Featured Product: Photomask Compacts

Companies around the world trust Pozzetta to create secure environments for the handling, storage, and transport of photomasks, reticles, and wafers. Pozzetta will protect your valuable products from particles, ESD damage, outgassed components, and high costs Contact: Scott Reese, Account Executive, scott.reese@pozzetta.com; Artemis Vasiliades, Account Executive, artemis@pozzetta.com

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+1 561 330 0411; fax +1 561 330 0647
sales@ravenano.com; www.ravenano.com

Featured Product: Merlin® 20nm Nanomachine Mask Repair fp650 Femto-pulse Laser Mask Repair Rhazer® Haze Removal System

RAVE is a technology driven company with a long history of unique technical contributions to the Photomask Industry.

RAVE's exceptionally talented team is well known for the development and on-time delivery of innovative, cost-saving process solutions. RAVE is now delivering the new Gen 5 - Merlin® 20nm mask repair nanomachine and the revolutionary Rhazer® haze removal system. RAVE's fp650™ femto-pulse laser tool continues to be the fastest, most efficient 45nm production mask repair system. Contact: Dave Lee, Vice President of Sales & Marketing, Dave.Lee@ravenano.com; Michael Archuletta, Director of Marketing, michael.archuletta@ravenano.com

◆ COFFEE BREAK AND WI-FI SPONSOR Shin-Etsu MicroSi, Inc. #400

10028 S 51st St, Phoenix, AZ, 85044-5203 United States
+1 480 893 8898; fax +1 480 893 8637
info@microsi.com; www.microsi.com

Featured Product: Photomask Blanks; Pellicles; Quartz substrates and templates

Shin-Etsu, the world's No. 1 supplier of semiconductor silicon wafers and a leading supplier of essential electronic materials. Shin-Etsu's product portfolio includes, photomask blanks, EB resists, pellicles, synthetic quartz, semiconductor advanced resists along with numerous specialized thermal interface materials. Contact: Edwin Nichols, Marketing Manager, enichols@microsi.com

◆ Solid State Technology #102

98 Spit Brook Rd, PennWell Corp., Nashua, NH, 03062 United States
+1 603 891 9118; www.solid-state.com

◆ CONFERENCE BAG SPONSOR Synopsys, Inc. #402

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info@synopsys.com; www.synopsys.com

◆ TOOL America, Inc. #210

830 Stewart Drive, Suite #141, Sunnyvale, CA, 94085 United States
+1 408 627 4850
info@tool-corp.com; www.tool-corp.com

◆ XEI Scientific, Inc. #506

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info@evactron.com; www.evactron.com

Featured Product: Evactron® EUV-3000™ & Evactron® De-Contaminator™ for Lg. Chamber Cleaning & Extended Pressure Range

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◆ XYALIS #510

SPIE Corporate Member

World Trade Center Grenoble BP 1510, Grenoble, 38025 France
+33 476 706 475 info@xyalis.com; www.xyalis.com

Featured Product: GTmodus – enterprise-wide mask data management system, for an error-free mask order process.

XYALIS is an EDA company offering a fully integrated Mask Data Preparation solution to eliminate the risk of error, reduce time to manufacturing, and increase manufacturing yield by automating frame generation, Multi-Project Wafers assembly, mask set creation, wafer map optimization and mask rule checking. XYALIS MDP solution streamlines the mask order process. and has been developed in cooperation with major semiconductor industry leaders. It has been used in production for years. Contact: Sylvie Hurat, US Area Manager, sylvie@xyalis.com; Eric Beisser, CEO, ebeisser@xyalis.com

Photomask Technology

Conference Chairs: **Frank E. Abboud**, Intel Corp. (United States); **Thomas B. Faure**, IBM Corp. (United States)

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Tuesday 11 September

OPENING REMARKS AND INTRODUCTION

Room: Steinbeck Forum Tues. 8:00 to 8:10 am

Session Chairs: **Frank E. Abboud**, Intel Corp. (United States); **Thomas B. Faure**, IBM Corp. (United States)

SESSION 1

Room: Steinbeck Forum 8:10 to 8:50 am

Keynote Session



8:10 am: **Transforming designs to chips: an end user's point-of-view on mask making** (Keynote Presentation), John Y. Chen, NVIDIA Corp. (United States) [8522-1]

Room: Steinbeck Forum Tues. 8:50 to 9:30 am

Invited Session

Session Chairs: **Frank E. Abboud**, Intel Corp. (United States); **Thomas B. Faure**, IBM Corp. (United States)

8:50 am: **2012 Mask Industry Assessment**, Lloyd C. Litt, Matt Malloy, SEMATECH North (United States) [8522-2]

9:10 am: **JPM12 Best Paper: Photomask repair technology by using gas field ion sources**, Fumio Aramaki, Tomokazu Kozakai, Osamu Matsuda, Osamu Takaoka, Yasuhiko Sugiyama, SII NanoTechnology Inc. (Japan); Hiroshi Oba, SII NanoTechnology Inc (Japan); Kazuo Aita, Anto Yasaka, SII NanoTechnology Inc. (Japan) [8522-3]

SESSION 3

Room: Steinbeck Forum Tues. 9:30 to 12:00 pm

Patterning

Session Chairs: **Jacek K. Tyminski**, Nikon Precision Inc. (United States); **Robert J. Socha**, ASML US, Inc. (United States)

9:30 am: **Improving mask CD uniformity using MB-MDP for 14nm node and beyond**, Byung-Gook Kim, Jin Choi, Jissong Park, Chan-Uk Jeon, SAMSUNG Electronics Co., Ltd. (Korea, Republic of); Ingo Bork, Ryan Pearman, Sterling Watson, Aki Fujimura, D2S, Inc. (United States) [8522-4]

9:50 am: **Impact of an etched EUV mask black border on imaging and overlay**, Natalia V. Davydova, Robert C. de Kruif, Eelco van Setten, ASML Netherlands B.V. (Netherlands); Brid Connolly, Toppan Photomasks, Inc. (Germany); Norihito Fukugami, Toppan Printing Co., Ltd. (Japan); Ad Lammers, ASML Netherlands B.V. (Netherlands); Vicky Philipsen, IMEC (Belgium); John Zimmerman, Noree Harned, ASML (United States) [8522-5]

Coffee Break 10:10 to 10:40 am

10:40 am: **An enhanced measure of mask quality using separated models**, Anthony D. Adamov, Kazuyuki Hagiwara, Ingo Bork, D2S, Inc. (United States); Jin Choi, Jissong Park, Byung-Gook Kim, SAMSUNG Electronics Co., Ltd. (Korea, Republic of) [8522-6]

11:00 am: **Cold-development tool and technique for the ultimate resolution of ZEP520A to fabricate an EB master mold for NIL for 1Tbit/in2 BPM/HDD development**, Hideo Kobayashi, Hiromasa Iyama, Takeshi Kagatsume, Tsuyoshi Watanabe, HOYA Corp. (Japan) [8522-7]

11:20 am: **Improvement of lithographic performance and reduction of mask cost by simple OPC**, Koichiro Tsujita, Canon Inc. (Japan); Michael C. Smayling, Tela Innovations, Inc. (United States); Valery Axelrad, Sequoia Design Systems, Inc. (United States); Yuichi Gyoda, Ryo Nakayama, Canon Inc. (Japan) .. [8522-8]

11:40 am: **A profile-aware resist model with an image location dependant threshold**, Sylvain Moulis, Vincent Farys, STMicroelectronics (France); Jérôme Belledent, Romain Therese, CEA-LETI (France); Song Lan, Qian Zhao, Mu Feng, Laurent Depre, Russell J. Dover, Brion Technologies, Inc. (United States) [8522-9]

Lunch/Exhibition Break 12:00 to 1:10 pm

SESSION 4

Room: Steinbeck Forum Tues. 1:10 to 3:10 pm

Metrology

Session Chairs: **Thomas Scherübl**, Carl Zeiss SMS GmbH (Germany); **Peter D. Buck**, Toppan Photomasks, Inc. (United States)

1:10 pm: **CD control with defect inspection: you can teach an old dog a new trick**, Clemens S. Utzny, Albrecht Ullrich, Jan P. Heumann, Elias Mohn, Stefan Meusemann, Advanced Mask Technology Ctr. GmbH Co. KG (Germany)[8522-10]

1:30 pm: **Study of critical dimension uniformity (CDU) using a mask inspector**, Mei-Chun Lin, Ching-Fang Yu, Mei-Tsu Lai, Luke T. H. Hsu, Angus Chin, Anthony Yen, Taiwan Semiconductor Manufacturing Co. Ltd. (Taiwan) [8522-11]

1:50 pm: **Correcting image placement errors using registration control (RegC®) technology in the photomask periphery**, Avi Cohen, Carl Zeiss SMS Ltd. (Israel); Falk Lange, Advanced Mask Technology Center GmbH & Co. KG (Germany); Guy Ben-Zvi, Erez Graitzer, Vladimir Dmitriev, Carl Zeiss SMS Ltd. (Israel) [8522-84]

2:10 pm: **An impact of mask CDU and local CD variation on intra-field CDU**, Junji Miyazaki, ASML Japan Co., Ltd. (Japan); Orion Mouraille, ASML Netherlands B.V. (Netherlands); Masaru Higuchi, Yosuke Kojima, Shunsuke Sato, Toppan Printing Co., Ltd. (Japan); Jo Finders, ASML Netherlands B.V. (Netherlands); Hiroaki Morimoto, Toppan Printing Co., Ltd. (Japan) [8522-13]

2:30 pm: **Reticle CDU and wafer CDU correlation for 28nm reticle processes**, GuoXiang Ning, Frank Richter, Thomas Thamm, GLOBALFOUNDRIES Dresden Module Two, GmbH & Co. KG (Germany); Paul W. Ackmann, GLOBALFOUNDRIES Inc. (United States); Marc Staples, Francois Weisbuch, Karin Kurth, Joerg Schenker, Andre Leschok, GLOBALFOUNDRIES Dresden Module Two, GmbH & Co. KG (Germany); Fang Hong Gn, GLOBALFOUNDRIES Singapore (Singapore) [8522-14]

2:50 pm: **Comparison of critical dimension uniformity measurements on an inspection system with measurements on a reticle SEM**, John M. Whittey, KLA-Tencor Corp. (United States); Jan P. Heumann, Albrecht Ullrich, Advanced Mask Technology Ctr. GmbH Co. KG (Germany); Edgardo Garcia, Mark Wagner, KLA-Tencor Corp. (United States); Norbert J. Schmidt, KLA-Tencor Germany (Germany); Clemens S. Utzny, Stefan Meusemann, Advanced Mask Technology Ctr. GmbH Co. KG (Germany) [8522-85]

Coffee Break 3:10 to 3:40 pm

SESSION 5

Room: Steinbeck Forum Tues. 3:40 to 5:40 pm

Mask Inspection and Repair I

Session Chairs: **Emily E. Gallagher**, IBM Corp. (United States);
William H. Broadbent, KLA-Tencor Corp. (United States)

3:40 pm: **Impact of EUVL mask surface roughness on an actinic blank inspection image and a wafer image**, Takeshi Yamane, Tsuneo Terasawa, EUVL Infrastructure Development Ctr., Inc. (Japan) [8522-16]

4:00 pm: **Illuminating EUVL mask defect printability**, Karen D. Badger, Zhengqing J. Qi, Emily E. Gallagher, IBM Corp. (United States); Kazunori Seki, Toppan Photomasks, Inc. (United States); Gregory R. McIntyre, IBM Corp. (United States) [8522-17]

4:20 pm: **EUUV multilayer defect compensation (MDC) by absorber pattern modification: calibrating the model and validate accuracy with real data**, Linyong Pang, Masaki Satake, Vikram L. Tolani, Anthony D. Vacca, Peter Hu, Danping Peng, Ying Li, Dongxue Chen, Luminescent Technologies (United States) [8522-18]

4:40 pm: **Capability of EBeyeM for EUV mask production**, Masato Naka, Shinji Yamaguchi, Motoki Kadowaki, Toru Koike, Takashi Hirano, Masamitsu Itoh, Yuichiro Yamazaki, Toshiba Corp. (Japan); Kenji Terao, Masahiro Hatakeyama, Kenji Watanabe, Hiroshi Sobukawa, Takeshi Murakami, Kiwamu Tsukamoto, Takehide Hayashi, Ryo Tajima, Norio Kimura, EBARA Corp. (Japan); Naoya Hayashi, Dai Nippon Printing Co., Ltd. (Japan) [8522-19]

5:00 pm: **Electron-beam inspection of 16nm HP node EUV masks**, Takeya Shimomura, DNP Corp. USA (United States); Shogo Narukawa, Tsukasa Abe, Tadahiko Takikawa, Naoya Hayashi, Dai Nippon Printing Co., Ltd. (Japan); Fei Wang, Long E. Ma, Chia-Wen Lin, Yan Zhao, Chiyuan Kuan, Jack Y. Jau, Hermes-Microvision Inc., USA (United States) [8522-20]

5:20 pm: **EUUV mask inspection study for sub-20nm device**, Inkyun Shin, Gisung Yoon, Won Sun Kim, Ji Hoon Na, Paul D. H. Chung, Chan-Uk Jeon, SAMSUNG Electronics Co., Ltd. (Korea, Republic of) [8522-21]

POSTER SESSIONS

Room: Serra Ballroom Tues. 6:00 pm to 7:30 pm

Session Chairs: **Artur P. Balasinski**, Cypress Semiconductor Corp. (United States); **Mark T. Jee**, HOYA Corp. USA (United States);
Abbas Rastegar, SEMATECH North (United States)

EXHIBITION/POSTER RECEPTION

Symposium attendees are invited to attend an Exhibition/Poster Reception on Tuesday evening in the Serra Grand Ballroom. The reception provides an opportunity for attendees to meet colleagues; network, view poster papers, and visit the exhibition booths. Refreshments will be served. Attendees are requested to wear their conference registration badges.

POSTER VIEWING

Tuesday 11 September 10:00 am to 4:30 pm and
6:00 to 7:30 pm

Wednesday 12 September 10:00 am to 3:00 pm

Poster authors may set up their poster papers between 10 am and 4 pm on Tuesday and will leave them up until Wednesday afternoon. Authors will be present during the Poster Reception 6:00 to 7:30 pm Tuesday to answer questions and provide in-depth discussion regarding their papers.

Cleaning

Study of droplet spray impact on a photomask surface, SherJang Singh, SUSS MicroTec Inc. (United States) [8522-42]

Study of the durability of the Ru-capped MoSi multilayer surface under megasonic cleaning, Hüseyin Kurtuldu, Abbas Rastegar, Matthew House, SEMATECH North (United States) [8522-60]

Mask Inspection and Repair

Layout relocation considering defect inspection tolerance for EUV blank defect mitigation, Yuelin Du, Hongbo Zhang, Martin D. F. Wong, Univ. of Illinois at Urbana-Champaign (United States) [8522-62]

Efficient simulation of EUV multilayer defects with rigorous data base approach, Peter Evanschitzky, Andreas Erdmann, Fraunhofer-Institut für Integrierte System und Bauelementetechnologie (Germany) [8522-63]

High-brightness EUV light source for actinic mask inspection and AIMS, Fariba Abreau, Samir S. Ellwi, Adlyte (Switzerland) [8522-64]

Fiducial mark requirements from the viewpoints of actinic blank inspection tool for phase-defect mitigation on EUVL mask, Tetsunori Murachi, Tsuyoshi Amano, Sung Hyun Oh, EUVL Infrastructure Development Ctr. In.c (Japan) [8522-65]

EUVL mask inspection at Lyman alpha, Thiago S. Jota, Thomas D. Milster, College of Optical Sciences, The Univ. of Arizona (United States) [8522-66]

EUV mask-blank defect avoidance solutions assessment, Ahmad H. Elayat, Peter G. Thwaite, Steffen Schulze, Mentor Graphics Corp. (United States) [8522-67]

Backside defect printability for contact layer with different reticle blank material, GuoXiang Ning, Christian Holfeld, Daniel Fischer, GLOBALFOUNDRIES Dresden Module Two, GmbH & Co. KG (Germany); Paul W. Ackmann, GLOBALFOUNDRIES Inc. (United States); Andre Holfeld, GLOBALFOUNDRIES Dresden Module Two, GmbH & Co. KG (Germany); Martin Sczyrba, Advanced Mask Technology Ctr. GmbH Co. KG (Germany); Tino Hertzsch, Rolf Seltmann, GLOBALFOUNDRIES Dresden Module Two, GmbH & Co. KG (Germany); Angeline Ho, Fang Hong Gn, GLOBALFOUNDRIES Singapore (Singapore) [8522-68]

Key issues in automatic classification of defects in post-inspection review process of photomasks, Mark Pereira, Ravi R. Pai, Manabendra Maji, Samir Bhamidipati, Pradeep K. Patil, SoftJin Technologies Pvt. Ltd. (India) ... [8522-70]

RDMS: a Windows-based reticle defect search database with AHDC for interconnected mask and wafer fabs, Saghir Munir, Reticle Labs. (United States) [8522-71]

Status of the AIMS™ EUV Project, Anthony D. Garetto, Jan Hendrik Peters, Sascha Perlitz, Ulrich Matejka, Carl Zeiss SMS GmbH (Germany); Dirk Hellweg, Markus R. Weiss, Carl Zeiss SMT GmbH (Germany) [8522-72]

Mask Data Preparation

Double patterning for 20nm and beyond: design rules aware splitting, Tamer S. Desouky, Mentor Graphics Egypt (Egypt); David A. Abercrombie, Mentor Graphics Corp. (United States); Omar H. El-Sewefy, Mentor Graphics Egypt (Egypt); Hojun Kim, Soo-Han Choi, SAMSUNG Electronics Co., Ltd. (Korea, Republic of) [8522-73]

Decomposition of standard cells library for double-patterning aware placement, Heba Sharaf, Mentor Graphics Egypt (Egypt); Amr G. Wassal, Cairo Univ. (Egypt); Sherif Hammouda, Mentor Graphics Egypt (Egypt) [8522-74]

Novel customized manufacturable DFM solutions, Mark Lu, Congshu Zhou, Yi Tian, Soo Muay Goh, Shyue-Fong Quek, Hein-Mun Lam, Jian Zhang, GLOBALFOUNDRIES Singapore (Singapore) [8522-76]

Enhancement of mask process correction(MPC) through dose modulation of already geometrically corrected layout data, Murali M. Reddy, Bhardwaj D. S. S., Archana Rajagopalan, Nageswara Rao Guntupalli, Ravi R. Pai, SoftJin Technologies Pvt. Ltd. (India) [8522-77]

Efficient Boolean and multi-input flow techniques for advanced mask data processing, William Moore, Daniel Salazar, John Valadez, Synopsys, Inc. (United States) [8522-78]

Split-It!: From Litho Etch Litho Etch (LELE) to self-aligned double patterning (SADP) decomposition, Yasmine A. Badr, Amr G. Wassal, Cairo Univ. (Egypt); Sherif Hammouda, Mentor Graphics Egypt (Egypt) [8522-79]

Metrology

Photomask quality evaluation using lithography simulation and precision SEM image contour data, Naoki Fukuda, Tsutomu Murakawa, Soichi Shida, Toshimichi Iwai, Jun Matsumoto, Takayuki Nakamura, Advantest Corp. (Japan); Kazuyuki Hagiwara, Shohei Matsushita, Daisuke Hara, D2S K.K. (Japan); Anthony D. Adamov, D2S, Inc. (United States) [8522-81]

Grayscale and colorscale microstructures formed by layered distributing microdroplets over polymer film for photomask utilized in single mask photolithography, Qingle Tang, Huazhong Research Institute of Electro-Optical Technology (China) [8522-83]

Mask Pattern Generators

Study for compensation of unexpected image placement error caused by variable shape beam mask writer deflector, Hyunjoon Lee, SAMSUNG Electronics Co., Ltd. (Korea, Republic of) [8522-86]

Proximity effect correction optimizing image quality and writing time for an electron multi-beam mask writer, Martin Schulz, Synopsys GmbH (Germany); Jan Klikovits, IMS Nanofabrication AG (Austria); Thomas Klimpel, Synopsys GmbH (Germany); Alex Zepka, Synopsys, Inc. (United States); Hans-Jürgen Stock, Synopsys GmbH (Germany) [8522-87]

Evaluation of CP shape correction for e-beam writing, Masahiro Takizawa, Keita Bunya, Hideaki Isobe, Hideaki Komami, Kenji Abe, Masaki Kurokawa, Akio Yamada, Kiichi Sakamoto, Takayuki Nakamura, Advantest Corp. (Japan); Kazusumi Kuwano, Masahiro Tateishi, D2S K.K. (Japan); Larry Chau, D2S, Inc. (United States) [8522-88]

An 8192-channel grating light valve modulator for direct-write ultraviolet lithography, Alexander P. Payne, Gregory Myatt, James A. Hunter, Michael Yeung, Joshua Lu, Gregory Beach, Lars Eng, Silicon Light Machines (United States) [8522-89]

OPC/RET/SMO

Determining printability of reticle defects exposed under advanced SMO/ILT free-form scanner illumination sources, Anthony D. Vacca, Luminescent Technologies (United States) [8522-90]

Resist model validity regarding source variation in SMO, Clovis Alleaume, Vincent Farys, Emek Yesilada, STMicroelectronics (France) [8522-91]

Patterning

Model-based fracturing with shot overlap for edge-based OPC layouts, Shangliang Jiang, Avideh Zakhori, Univ. of California, Berkeley (United States) [8522-93]

Direct dose map synthesis for raster-based multiple electron-beam systems, Amyn A. Poonawala, Synopsys, Inc. (United States); Lars H. Bomholt, Synopsys Switzerland, LLC (Switzerland) [8522-94]

Application of KrF (248nm) Alt-PSM (strong-shift) technology for special patterning requirements in MEMS applications, Gong Chen, Headway Technologies, Inc. (United States) [8522-95]

Impact of EUV photomask line-edge roughness on wafer prints, Zhengqing J. Qi, Emily E. Gallagher, Amy E. Zweber, IBM Corp. (United States); Yoshiyuki Negishi, Tasuku Senna, Satoshi Akutagawa, Toshio Konishi, Toppan Photomasks, Inc. (United States); Gregory R. McIntyre, IBM Corp. (United States) ... [8522-96]

Dry etching technologies for reflective multilayers, Yoshinori Iino, Makoto Karyu, Hirotsugu Ito, Yoshihisa Kase, Tomoaki Yoshimori, Makoto Muto, Mikio Nonaka, Shibaura Mechatronics Corp. (Japan); Masayuki Iwami, Furukawa Electric Co., Ltd. (Japan) [8522-105]

Process

Reticle and wafer CD variation for different dummy pattern, GuoXiang Ning, GLOBALFOUNDRIES Dresden Module Two, GmbH & Co. KG (Germany); Christian Buerger, Advanced Mask Technology Ctr. GmbH Co. KG (Germany); Paul W. Ackmann, GLOBALFOUNDRIES Inc. (United States); Thomas Thamm, Marc Staples, Francois Weisbuch, Andre Leschok, Stefan Roling, GLOBALFOUNDRIES Dresden Module Two, GmbH & Co. KG (Germany); Anthony Zhou, Fang Hong Gn, GLOBALFOUNDRIES Singapore (Singapore) ... [8522-97]

Bimetallic grayscale photomasks for micro-optics fabrication using dual-wavelength laser writing techniques, Glenn H. Chapman, Reza Qarehbaghi, Waris Boonyasirawat, Simon Fraser Univ. (Canada) [8522-98]

CD uniformity improvement through elimination of hardware influences on post-exposure bake, JongHoon Lim, SK Hynix Semiconductor Inc. (Korea, Republic of) [8522-99]

Photomask etch: addressing the resist challenges for advanced phase-shift and binary photomask, Madhavi Chandrachood, Michael Grimbergen, Keven Yu, Amitabh Sabharwal, Ajay Kumar, Applied Materials, Inc. (United States) [8522-100]

Simulation

Process variation aware inverse mask optimization, Han-Hsien Tsai, Jue-Chin Yu, Peichen Yu, National Chiao Tung Univ. (Taiwan) [8522-101]

Hotspot classification based on higher-order local autocorrelation, Bin Lin, Zheng Shi, Zhejiang Univ. (China); Ye Chen, Anchor Semiconductor, Inc. (United States) [8522-102]

Proximity effect correction parameters for patterning of EUV reticles with Gaussian electron-beam lithography, Adam Lyons, John G. Hartley, Univ. at Albany (United States) [8522-103]

Nanoparticle detection limits of TNOs RapidNano: modeling and experimental results, Peter van der Walle, Pragati Kumar, Dmitry Ityakov, Richard Versulis, Diederik J. Maas, Olaf Kievit, Jochem Janssen, Jacques van der Donck, TNO (Netherlands) [8522-106]

Wednesday 12 September

SESSION 6

Room: Steinbeck Forum Wed. 8:00 am to 10:10 am

Material and Process

Session Chairs: **Banqiu Wu**, Applied Materials, Inc. (United States); **Byung-Gook Kim**, SAMSUNG Electronics Co., Ltd. (Korea, Republic of)

8:00 am: **The e-beam resist test facility: performance testing and benchmarking of e-beam resists for advanced mask writers** (*Invited Paper*), Matt Malloy, SEMATECH North (United States); Ananthan Raghunathan, John G. Hartley, College of Nanoscale Science & Engineering (United States); Mason Jang, Lloyd C. Litt, SEMATECH North (United States) [8522-22]

8:30 am: **Conductive layer for charge dissipation during electron-beam exposures**, Luisa D. Bozano, Ratnam Sooriyakumaran, IBM Almaden Research Ctr. (United States); Takayuki Nagasawa, Satoshi Watanabe, Yoshio Kawai, Shin-Etsu Chemical Co., Ltd. (Japan); Shinpei Kondo, Jun Kotani, Masayuki Kagawa, Toppan Printing Co., Ltd. (Japan); Linda K. Sundberg, Martha I. Sanchez, Elizabeth M. Lofano, Charles T. Rettner, IBM Almaden Research Ctr. (United States); Tasuku Senna, Toppan Photomasks, Inc. (United States); Thomas B. Faure, IBM Corp. (United States) [8522-23]

8:50 am: **Mask characterization for CDU budget breakdown in advanced EUV lithography**, Peter Nikolsky, Chris Strolenberg, Rasmus Nielsen, Natalia V. Davydova, ASML Netherlands B.V. (Netherlands); Greg Yang, ASML Korea Co., Ltd. (Korea, Republic of); Shawn Lee, ASML Netherlands B.V. (Netherlands); Chang-Min Park, Insung Kim, Jeong Ho Yeo, SAMSUNG Electronics Co., Ltd. (Korea, Republic of) [8522-24]

9:10 am: **Process challenges in advanced photomask etch processes**, Chang-Ju Choi, Karmen Yung, Cheng-Hsin Ma, Ganesh Vanamu, Intel Corp. (United States) [8522-25]

9:30 am: **Advanced photomask fabrication process to increase pattern reliability for sub-20nm node**, Dongil Shin, Hynix semiconductor Inc. (Korea, Republic of) [8522-26]

9:50 am: **Study and comparison of negative tone resists for fabrication of bright field masks for 14nm node**, Amy E. Zweber, Thomas B. Faure, Anne E. McGuire, IBM Corp. (United States); Linda K. Sundberg, Ratnam Sooriyakumaran, Martha I. Sanchez, Luisa D. Bozano, IBM Almaden Research Ctr. (United States); Tasuku Senna, Yoshiyuki Negishi, Toppan Photomasks, Inc. (United States); Masahito Tanabe, Takahiro Kaneko, Toppan Printing Co., Ltd. (Japan) . [8522-27]

Coffee Break 10:10 to 10:40 am

SESSION 7

Room: Steinbeck Forum Wed. 10:40 am to 12:20 pm

Mask Data Preparation I

Session Chairs: **Aki Fujimura**, D2S, Inc. (United States); **Steffen F. Schulze**, Mentor Graphics Corp. (United States)

10:40 am: **Novel DPT methodology co-optimized with design rules for sub-20nm device**, Hyun-Jong Lee, Soo-Han Choi, Jae-Seok Yang, Chul-Hong Park, SAMSUNG Electronics Co., Ltd. (Korea, Republic of) [8522-28]

11:00 am: **Mask design automation: an integrated approach**, Richard Gladhill, Peter D. Buck, Al Wong, Toppan Photomasks, Inc. (United States) [8522-29]

11:20 am: **Generating well-behaved OASIS files for mask data processing**, Daniel D. Hung, Synopsys, Inc. (United States); Juan Pablo Canepa, Synopsys, Inc. (Chile); Ken Kuo, Synopsys Taiwan Ltd. (Taiwan); Jia-Guei Jou, Taiwan Semiconductor Manufacturing Co. Ltd. (Taiwan) [8522-30]

11:40 am: **Novel routing layer trim/cut reduction in SADP SID process**, Yuelin Du, Hongbo Zhang, Martin D. F. Wong, Univ. of Illinois at Urbana-Champaign (United States) [8522-31]

12:00 pm: **Automatic marking by use of MRCC and range pattern matching for advanced MDP**, Daniel Salazar, Synopsys, Inc. (Chile); William Moore, John Valadez, Synopsys, Inc. (United States) [8522-32]

Lunch/Exhibition Break 12:20 to 1:20 pm

SESSION 8

Room: Steinbeck Forum Wed. 1:20 to 3:00 pm

Simulation and Modeling

Session Chairs: **Linyong Pang**, Luminescent Technologies (United States); **M. Warren Montgomery**, College of Nanoscale Science & Engineering (United States)

1:20 pm: **Choosing the data flow paradigm for EUV mask process corrections**, Christian Buerger, Advanced Mask Technology Ctr. GmbH Co. KG (Germany); Keith P. Standiford, GLOBALFOUNDRIES Inc. (United States) [8522-33]

1:40 pm: **Bridging the gaps between aerial image inspection/review systems and actual ILT/SMO scanner performance using computational inspection and metrology technologies**, Linyong Pang, Vikram L. Tolani, Masaki Satake, Peter Hu, Danping Peng, Tingyang Liu, Dongxue Chen, Anthony D. Vacca, Luminescent Technologies (United States) [8522-34]

2:00 pm: **Particle transport in plasma systems for development of extreme-ultraviolet lithography mask blanks**, Peter Stoltz, Chuandong Zhou, Alex Likhanskii, Tech-X Corp. (United States); Patrick A. Kearney, Vibhu Jindal, SEMATECH North (United States) [8522-104]

2:20 pm: **Interaction of 3D mask effects and NA in EUV lithography**, Jens Timo Neumann, Paul Gräupner, Johannes Ruoff, Winfried Kaiser, Reiner Garreis, Carl Zeiss SMT GmbH (Germany); Bernd Geh, Carl Zeiss SMT Inc./ASML-TDC (United States) [8522-107]

2:40 pm: **Advanced module for model parameter extraction using global optimization and sensitivity analysis for electron-beam proximity effect correction**, Thiago R. Figueiro, Asetla Nanographics (France) and Lab. des Technologies de la Microélectronique CNRS (France); Kang-Hoon Choi, Manuela S. Gutsch, Martin Freitag, Christoph K. Hohle, Fraunhofer-Ctr. Nanoelektronische Technologien (Germany); Jean-Hervé Tortai, Lab. des Technologies de la Microélectronique CNRS (France); Mohamed Saib, Patrick Schiavone, Asetla Nanographics (France) [8522-37]

Coffee Break 3:00 to 3:30 pm

SESSION 9

Room: Steinbeck Forum Wed. 3:30 to 5:40 pm

Cleaning/Contamination/Haze

Session Chairs: **Brian J. Grenon**, Grenon Consulting, Inc. (United States); **Anna V. Tchikoulaeva**, Lasertec U.S.A., Inc. Zweigniederlassung Deutschland (Germany)

3:30 pm: **Zeta potential evaluation for enhancing sub-20nm node photomask cleaning** (*Invited Paper*), Kuan-Wen Lin, Chi-Lun Lu, C. W. Shen, Luke T. H. Hsu, Angus Chin, Anthony Yen, Taiwan Semiconductor Manufacturing Co. Ltd. (Taiwan) [8522-38]

4:00 pm: **Effect of radiation exposure on the surface adhesion at Ru-capped MoSi multilayer blanks**, Göksel Durkaya, Abbas Rastegar, Aron Ceppler, Matthew House, SEMATECH North (United States) [8522-39]

4:20 pm: **The plasma etching methods for minimizing mask CD variation by cleaning process**, Hyun Duck Shin, Soo Kyeong Jeong, Ho Yong Jung, Sang Pyo Kim, Dong Gyu Yim, Hynix Semiconductor Inc. (Korea, Republic of) [8522-40]

4:40 pm: **Preparation of substrates for EUV blanks using an etch clean process to meet HVM challenges**, Arun John Kadaksham, Ranganath Teki, Jenah Harris-Jones, C. C. Lin, SEMATECH North (United States) [8522-41]

5:00 pm: **Controlling MegaSonic performance by optimizing cleaning media's physical and gaseous properties**, SherJang Singh, SUSS MicroTec Inc. (United States) [8522-61]

5:20 pm: **A new approach in dry technology for non-degrading optical and EUV mask cleaning**, Ivin Varghese, Ben Smith, Mehdi Balooch, Charles W. Bowers, Eco-Snow Systems (United States) [8522-43]

Thursday 13 September

SESSION 10

Room: Steinbeck Forum Thurs. 8:00 am to 9:20 am

Source/Mask Optimization

Session Chairs: **Wilhelm Maurer**, Infineon Technologies AG (Germany); **Thomas H. Newman**, Micronic Laser Systems Inc. (United States)

8:00 am: **The significance of rigorous electromagnetic field simulation on mask development for 20nm optical lithography technology**, Fan Jiang, Yunfei Deng, Jongwook Kye, Harry J. Levinson, Paul W. Ackmann, GLOBALFOUNDRIES Inc. (United States); Byoung Il Choi, GLOBALFOUNDRIES Singapore (Singapore); Martin Sozyrba, Frank Schurack, Advanced Mask Technology Ctr. GmbH Co. KG (Germany) [8522-44]

8:20 am: **The new test pattern selection method for OPC model calibration, based on the process of clustering in a hybrid space**, Dmitry A. Vengertsev, Kihyun Kim, Seong-Bo Shim, Artem Shamsuarov, Seung-Hune Yang, Seongho Moon, Sooryong Lee, Seong-Woon Choi, Jungdal Choi, Ho-Kyu Kang, SAMSUNG Electronics Co., Ltd. (Korea, Republic of) [8522-45]

8:40 am: **OPC and verification for LELE double patterning**, Kellen Arb, Chris Reid, Qiao Li, Evgueni Levine, Pradiptya Ghosh, Mentor Graphics Corp. (United States) [8522-46]

9:00 am: **Source mask target optimization flow**, Clovis Alleaume, Emek Yesilada, Vincent Farys, STMicroelectronics (France) [8522-47]

SESSION 11

Room: Steinbeck Forum Thurs. 9:20 am to 10:20 am

Mask Long-Term Durability

Session Chairs: **Naoya Hayashi**, Dai Nippon Printing Co., Ltd. (Japan); **Stefan Wurm**, SEMATECH North (United States)

9:20 am: **Photomask film degradation effects in the wafer fab: How to detect and monitor over time**, John M. Whitley, KLA-Tencor Corp. (United States); Mark Wagner, KLA-Tencor Israel (Israel); Carl E. Hess, Edgardo Garcia, KLA-Tencor Corp. (United States) [8522-48]

9:40 am: **Reticle storage in mini-environment with extreme clean dry air**, Detlev Glueer, Astrid Gettel, GLOBALFOUNDRIES Dresden Module Two, GmbH & Co. KG (Germany); Alfred Honold, InReCon Consulting GmbH (Germany) [8522-49]

10:00 am: **Haze management with aerial mask inspection: case study**, Wen-Jui Tseng, Rexchip Electronics Corp. (Taiwan); Aviram Tam, Applied Materials (Israel); Shean-Hwan Choiu, Yong-Ying Fu, Ming-Sian Jiang, Shih-Ping Lu, Rexchip Electronics Corp. (Taiwan); Clare Wu, Jeffrey Lin, Applied Materials (Taiwan) [8522-50]

Coffee Break 10:20 to 10:40 am

SESSION 12

Room: Steinbeck Forum Thurs. 10:40 am to 12:20 pm

Mask Pattern Generators

Session Chairs: **Hiroshi Nozue**, NuFlare Technology, Inc. (Japan); **Russell B. Cinque**, JEOL USA Inc. (United States)

10:40 am: **Proposal to extend the loading effect correction in EBM-8000**, Hiroshi Matsumoto, Yasuo Kato, Noriaki Nakayamada, Shusuke Yoshitake, Kiyoshi Hattori, NuFlare Technology, Inc. (Japan) [8522-51]

11:00 am: **Printing results of a proof-of-concept 50keV electron multi-beam mask exposure tool (eMET POC)**, Elmar Platzgummer, Christof Klein, Hans Loeschner, IMS Nanofabrication AG (Austria) [8522-52]

11:20 am: **Shape-dependent dose margin correction using model-based mask data preparation**, Yasuki Kimura, Ryuji Yamamoto, Takao Kubota, Kenji Kouno, HOYA Corp. (Japan); Shohei Matsushita, Kazuyuki Hagiwara, Daisuke Hara, Direct2Silicon (Japan) [8522-53]

11:40 am: **Reflective electron-beam lithography performance for the 10nm logic node**, Regina Freed, Thomas Gubiotti, Mark A. McCord, Upendra Ummethala, Layton C. Hale, John J. Hench, Shinichi Kojima, Walter D. Miehler, Chris F. Bevis, KLA-Tencor Corp. (United States) [8522-54]

12:00 pm: **Future mask writers requirements for the sub-10nm node era**, Mahesh Chandramouli, Nathan E. Wilcox, Andrew T. Sowers, Damon M. Cole, Frank E. Abboud, Intel Corp. (United States) [8522-55]

Lunch Break 12:20 to 1:20 pm

SESSION 13

Room: Steinbeck Forum Thurs. 1:20 to 2:50 pm

Mask Inspection and Repair II

Session Chairs: **Ron R. Bozak**, RAVE LLC (United States);
Uwe Dietze, Suss MicroTec AG (Germany)

1:20 pm: **EUVL mask repair: expanding options with nanomachining** (*Invited Paper*), Emily E. Gallagher, Gregory R. McIntyre, Mark Lawliss, IBM Corp. (United States); Tod E. Robinson, Ronald R. Bozak, Roy L. White, RAVE LLC (United States). [8522-56]

1:50 pm: **E-beam based mask repair as door opener for defect free EUV masks**, Markus Waiblinger, Tristan Bret, Carl Zeiss SMS GmbH (Germany); Rik Jonckheere, Dieter Van den Heuvel, IMEC (Belgium). [8522-57]

2:10 pm: **Applying computational inspection and metrology technologies to mask repair: post repair simulation (PRS)**, C. Y. Chen, S. C. Wei, Laurent Tuo, Chue-San Yoo, Taiwan Semiconductor Manufacturing Co. Ltd. (Taiwan); Dongxue Chen, Hsien-Min Chang, Danping Peng, Anthony D. Vacca, Linyong Pang, Luminescent Technologies (United States). [8522-58]

2:30 pm: **Computational defect review for actinic mask inspections**, Noel Corcoran, Masaki Satake, Peter Hu, Jing Zheng, Dean Yonenaga, Vikram L. Tolani, Luminescent Technologies (United States). [8522-59]

Coffee Break 2:50 to 3:20 pm



SPECIAL SESSION PANEL DISCUSSION
Room: Steinbeck Forum . . . Thurs. 3:20 to 5:00 pm

Will Optical Patterning Solutions Be Ready if EUV Lithography Continues to Be Delayed?

Panel Moderators: **Thomas B. Faure**, IBM Corp.;
Robert J. Socha, ASML US, Inc.

See page 3 for details.

BEST PAPER AND BEST POSTER AWARDS
Room: Steinbeck Forum :5:00 to 5:10 pm



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Photomask Technology

Goes Digital

New

Conference registration includes access to Photomask Technology 2012 proceedings in the SPIE Digital Library.

SPIDigitalLibrary.org

The Future is Faster— Available immediately following the meeting.



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Registration

Onsite Registration and Information Hours

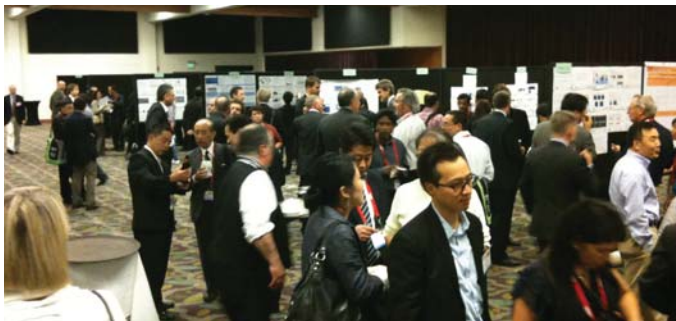
Portola Lobby

Monday 10 September	12:00 pm to 5:00 pm
Tuesday 11 September	7:15 am to 4:00 pm
Wednesday 12 September	7:30 am to 4:00 pm
Thursday 13 September	8:00 am to 10:30 am

Exhibition Hours

Serra Grand Ballroom

Tuesday 11 September	10:00 am to 4:30 pm 6:00 to 7:30 pm
Wednesday 12 September	10:00 am to 4:00 pm



Author/Presenter Information

Speaker Preview Room

Sloat Room

Open during Registration Hours

Conference room will have a computer workstation, LCD projector, screen, lapel microphone, and laser pointer. All presenters are requested to come to the speaker preview room to confirm display settings of their presentations from their memory devices or laptops with the audio-visual equipment being used at this conference.

Poster Setup Instructions

Serra Grand Ballroom

Poster authors may set up their poster papers between 10:00 am and 4:30 pm on Tuesday and will leave them up until Wednesday afternoon. Authors will be present during the Poster Reception 6:00 to 7:30 pm Tuesday to answer questions and provide in-depth discussion regarding their papers..

- Paper numbers will be posted on the poster boards in numerical order; please find your paper number and post your poster in the designated space.
- A poster author or coauthor is required to stand by the poster during the scheduled poster session to answer questions from attendees.
- Presenters who have not placed their papers on their assigned board by 4:00 pm on the day of their presentation will be considered a “no show” and their manuscript will not be published.
- Presenters must remove their posters immediately upon conclusion of poster viewing hours at 3:00 pm on Wednesday, 12 September.
- Posters not removed will be considered unwanted and will be discarded.
- SPIE assumes no responsibility for posters left up after the end of each poster session.

Food and Beverage Services

Breakfast Breads

Steinbeck Lobby

Complimentary breakfast breads and coffee will be served 7:30 to 8:30 am Tuesday through Thursday.

Contributing Sponsors:



Coffee Breaks

Complimentary coffee will be served Tuesday through Thursday in the following locations.

Tuesday 11 September	10:00 am and 3:00 pm
<i>Serra Grand Ballroom · Exhibition Hall</i>	
Wednesday 12 September	10:00 am and 3:00 pm
<i>Serra Grand Ballroom · Exhibition Hall</i>	
Thursday 13 September	10:00 am and 3:00 pm
<i>Steinbeck Lobby</i>	

Contributing Sponsors:



Desserts

Serra Grand Ballroom

Dessert will be served from 3:00 to 3:30 pm. Tuesday and Wednesday in the Exhibition Hall. A complimentary dessert ticket will be included in attendee and exhibitor registration packets.

Hosted Lunches

San Carlos Ballroom - Marriott

Hosted lunches will be served between noon and 1:00 pm Tuesday, Wednesday and Thursday in the San Carlos Ballroom at the Monterey Marriott.

Complimentary lunch tickets will be included for full conference registrants. Exhibitors and students may purchase tickets in the SPIE registration area in the Portola Lobby.

Tuesday Lunch Contributing Sponsors:



DNP America, LLC
a Dai Nippon Printing company



Accelerating Yield

Wednesday Lunch Contributing Sponsor:



General Information

Online Services

Internet Pavilion

Steinbeck Lobby

JEOL sponsors a complimentary pavilion at the Conference Center from Monday afternoon through Thursday afternoon during registration hours. Attendees can use workstations or connect their laptop to an ethernet connection.

Contributing Sponsor: 

WiFi

Monterey Conference Center

Wireless Access available in all of the center during conference hours.

Network: SPIE (No password needed)

Properly secure your computer before accessing the public wireless network. Failure to do so may allow unauthorized access to your laptop as well as potentially introduce viruses to your computer and/or presentation.

Contributing Sponsor: 

Business Services

Business Center

Monterey Marriott

Attendees may use their hotel room key at the Monterey Marriott to access the on-site Business Center which offers use of a free on-line computer. Copy and fax machines are available at the front desk. Copies are free for the first 20 copies, 10 cents per page after. The fax machine is \$1 per page for domestic usage and \$3 per page for international usage.

Off-site

Fedex Kinkos is located at 799 Lighthouse Ave., Suite. A, Monterey, Calif., 93940, Phone: 831.373.2298. It is 1.3 miles from the Monterey Marriott - approximately 5 minutes driving time. Go north on Calle Principal, left onto Del Monte Avenue, right onto Pacific St., right onto ramp to merge onto Lighthouse Avenue.

Messages

SPIE has a urgent message line available during registration hours (831.646.5312). Please check at the SPIE Registration Desk if you expect a message.


Child Care Services

The Monterey Marriott suggests the following childcare service companies in Monterey:

- Parents Time Out. phone: 831.375.9269
- Corporate Kids Events Inc. & VIP Babysitting - for in-room hotel babysitting services. Reservations: 800.838.2787

SPIE does not imply endorsement or recommendation for these services. Information provided as "information only" for your further analysis and decision. Other services may be available.

Car Rental

 Hertz Car Rental is the official car rental agency for this Symposium. To reserve a car, identify yourself as a Photomask attendee using the Hertz Meeting Code CV# 029B0015.

- In the United States call 1-800-654-2240.

Attendee Services

SPIE Receipts, Badge Corrections, Cashier

SPIE cashier can assist with registration payments, receipts and badge corrections.

- Registration payments—If you are paying by cash or check as part of your onsite registration, wish to add a short course, workshop, or special event requiring payment, or have questions regarding your registration please see the onsite cashier at the Cashier station in the registration area.
- Receipts—Preregistered attendees who did not receive a receipt prior to the meeting may obtain a new copy of their registration receipt onsite at the Cashier counter in the registration area.
- Badge corrections—Attendees who need a correction to their badge information onsite may do so at the Cashier counter in the registration area. Please have your badge removed from the badge holder, marked with your changes, and ready to hand to the attendant upon approaching the counter.

Policies

Parking During Photomask

For parking information please check the SPIE website www.spie.org/x24155.xml.

Refunds

There is a \$40 service charge for processing refunds. Requests for registration refunds must be received no later 30 August 2012. All registration fees will be forfeited after this date. Membership dues are not refundable. SPIE Digital Library subscriptions are not refundable.

Audio, Video, Digital Recording Policy

Meeting Rooms and Poster Session

For copyright reasons, recordings of any kind are strictly prohibited without prior written consent of the presenter in any conference session, course or of posters presented. Each presenter being taped must file a signed written consent form. Individuals not complying with this policy will be asked to leave a given session and asked to surrender their recording media. Consent forms are available at the SPIE Registration Desk.

Exhibition Hall

For security and courtesy reasons, photographing or videotaping individual booths and displays in the Exhibit Hall is allowed ONLY with explicit permission from onsite company representatives. Individuals not complying with this policy will be asked to surrender their recording media and to leave the exhibit hall.

Laser Pointer Safety Information

SPIE supplies tested and safety approved laser pointers for all conference meeting rooms, and for course rooms if instructors request one. For safety reasons, SPIE requests that presenters use our provided laser pointers available in each meeting room.

Underage Persons on Exhibition Floor

For safety and insurance reasons, no persons under the age of 16 will be allowed in the exhibition area during move-in and move-out. During open exhibition hours, only children over the age of 12 accompanied by an adult will be allowed in the exhibition area.

2013 Photomask Technology

Mask design, production, integration,
and next-generation mask technologies

Mark your calendar

spie.org/pm2013

Conferences

10–12 September 2013

Exhibition

11–12 September 2013

Location

Location: Monterey Conference Center,
Monterey, California, USA

Technologies

- Mask Making
- Emerging Mask Technologies
- Mask Application
- Mask Business



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