

2011 Photomask Technology Technical Program

Connecting minds for global solutions

Conference date

19–22 September 2011

Exhibition date

20–21 September 2011

Monterey Marriott & Monterey Conference Center
Monterey, California, USA

spie.org/pm



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



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Welcome to Photomask!

On behalf of SPIE, BACUS, and the Organizing Committee, we welcome you to the 31st Annual SPIE/BACUS Photomask Symposium in Monterey, California.

This annual meeting continues to be the premier worldwide technical meeting for the photomask industry. It will give the authors an opportunity to present their exciting research findings that relate to the emerging technical challenges facing the photomask industry, to an international audience of their peers. And it will give all attendees a condensed and up-to-date overview of the whole industry.

This year we will start on Monday afternoon with a Special PMJ Session in which ten oral papers, originally slated for this year's Photomask Japan Symposium, will be presented. There is also a special PMJ poster session included in the Tuesday evening poster session. The official opening session will be on Tuesday morning with the Keynote Presentation by **Walden C. Rhines**, Chairman and Chief Executive Officer, Mentor Graphics.

We have received 175 presentations this year, covering all aspects of mask making, mask application and related technologies, a more than 15% increase over last year.

The #1 subject this year will be the arrival of EUV in the mainstream of mask technology. To affirm this statement, only topics very specific to EUV will be presented in the two dedicated EUV sessions.

The same statement will provide Thursday's Special Session titled **Is it too late to Panic? ... EUV is real!** **Bob Socha** and **Frank Abboud** have compiled a group of our industry's top experts, who will, in addition to their presentations, be conducting a panel discussion on their assessment of the achievements and challenges with regard to EUV mask. Included are: **William H. Arnold**, ASML US, Inc.; **Vivek K. Singh**, Intel Corp.; **Hiroaki Miromoto**, Toppan Printing Co., Ltd.; **Angu Chin**, Taiwan Semiconductor Manufacturing Co., Ltd.; **Byung-Gook Kim**, Samsung Electronics Co., Ltd.

We welcome you to beautiful Monterey. You will have a great experience attending the sessions and networking with your colleagues. We hope you can also find at least some time to enjoy the California Coast in the middle of its best season!



Wilhelm Maurer
Infineon Technologies AG
Conference Chair 2011



Frank E. Abboud
Intel Corp.
Conference Co-Chair 2011



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SPIE would like to express its deepest appreciation to the symposium chairs, conference chairs, program committees, session chairs, and authors who have so generously given their time and advice to make this symposium possible.

The symposium, like our other conferences and activities, would not be possible without the dedicated contribution of our participants and members. This program is based on commitments received up to the time of publication and is subject to change without notice.

Photomask Japan Special Session

Steinbeck Forum • Monday 19 September • 1:00 to 5:00 pm

Session Chairs: **Hiroaki Morimoto**, Toppan Printing Co., Ltd. (Japan);
Naoya Hayashi, Dai Nippon Printing Co., Ltd. (Japan)

This year the Photomask Japan organizers made the very difficult decision to cancel their symposium because of the earthquake and tsunami. However, the leadership of Photomask Japan and SPIE/BACUS have organized a Special Session with selected PMJ oral presentations. In addition, some posters originally scheduled for Photomask Japan will be presented at the Tuesday evening Poster Reception.

The manuscripts for the presentations in this session and the corresponding posters will be published in the Photomask Japan Proceedings. **Please see conference schedule for paper listings.**



Keynote Presentation

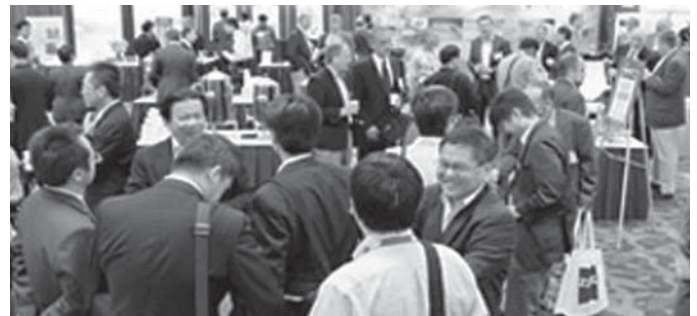


Walden C. Rhines,
Chairman and Chief
Executive Officer,
Mentor Graphics

Bucking the Trend: Driving Changes in How EDA and the Semiconductor Industries Work Together

Steinbeck Forum • Tuesday 20 September • 8:10 to 8:50 am

Walden C. Rhines is Chairman and Chief Executive Officer of Mentor Graphics, a leader in worldwide electronic design automation with revenue of \$915 million in 2010. During his tenure at Mentor Graphics, revenue has more than doubled and Mentor has grown the industry's number one market share solutions in four of the ten largest product segments of the EDA industry. He joined Mentor in 1993 from Texas Instruments (TI) where he was most recently Executive Vice President in charge of TI's semiconductor business. Rhines is currently in his fifth term as Chairman of the Electronic Design Automation Consortium. He is also a board member of the Semiconductor Research Corporation and First Growth Family & Children Charities. He received a BSE degree from the University of Michigan, an MS and PhD from Stanford University, an MBA from Southern Methodist University and an Honorary Doctor of Technology degree from Nottingham Trent University.



Poster Viewing

Serra Ballroom
Tuesday 20 September • 10:00 am to 4 pm and 6:00 to 7:30 pm
Wednesday 21 September • 10:00 am to 3:00 pm

Poster authors may set up their poster papers between 10:00 am and 4:00 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.

Exhibition/Poster Reception

Serra Ballroom
Tuesday 20 September • 6:00 to 7:30 pm

Symposium attendees and guests 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.

Special Events



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. The entertainment for the evening will be provided by Photomask Japan.

Admission to this reception is included with your paid registration. Extra guest tickets may be purchased for \$80 with your pre-registration or onsite (we highly recommend purchasing in advance to assure your reservation).

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Special Session and Panel Discussion

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Is it too late to panic? ... EUV is Real!

Steinbeck Forum • Thursday 1:00 to 5:00 pm

Session Chairs and Panel Moderators: **Frank E. Abboud**, Intel Corp., and **Robert J. Socha**, ASML US Inc.

Presenters/Panelists: **William H. Arnold**, ASML US, Inc., **Vivek K. Singh**, Intel Corp., **Hiroaki Morimoto**, Toppan Printing Co., Ltd., **Sheng-Ji (Angus) Chin**, Taiwan Semiconductor Manufacturing Co. Ltd., **Byung-Gook Kim**, SAMSUNG Electronics Co., Ltd.; **Ronen Benzion**, Applied Materials; **Brian L. Haas**, KLA-Tencor Corp.; **Oliver O. Kienzle**, Carl Zeiss SMS GmbH

It has been over 15 years since a major revolutionary change to the mask material, architecture or technology. The last major change was the introduction of phase shift masks. Granted, the evolutionary progress of the past decade has allowed pushing the envelope and enabling new wafer lithography techniques, like off axis illumination, SMO, and double patterning, but the fundamental architecture of the mask and mask making equipment has been stable. Stability breeds complacency as well as the fear of the unknown. It is no surprise that our industry has been shy about jumping on the EUV bandwagon and has adopted the “wait and see” approach to the point where the mask is now on the short list of key concerns for enabling EUV technology to translate into high volume manufacturing.

With change comes opportunity. Almost everything in mask making will likely change with EUV; materials, blank inspection, writer compensation, etch processes, metrology, inspection, repair, cleaning, and material handling, need I go on? In one view, yes these are problems, but they are also opportunities. Opportunities for new innovations and businesses can possibly be the catalyst to push our industry into a new and vibrant industry. It is not a secret that the world wide mask volume per year has been stagnant for a while now. There are hardly any new comers to the mask equipment industry and most of the existing ones experience little to no growth to justify or adequately fund the needed research and development necessary to stay competitive.

Our industry is now facing the eminent introduction of EUV as the next frontier in the everlasting reduction in feature size, possibly down to the mythical limit of 1 nm! The good news is that fabs want EUV masks and are willing to pay for them. We need to lead the way and see how we can capitalize on this opportunity. Instead of talking and debating about how difficult and how cost prohibitive it is to make EUV masks, we need to talk about how to make it happened. We should not worry about EUV source power, scanner availability or EUV resist viability; there are plenty of people working on devising breakthroughs in those areas. We should simply focus on how fast we can make EUV masks available to get into the hands of the Litho Engineers. We need to get off the short list!

Our panel intends to bring this topic to an open and vibrant discussion to get to the real issues for implementation and to weigh pros and cons. The panel will include senior executives and decision makers from captive and merchant mask fabs, blanks, materials and tool suppliers, IC manufacturers, and consortia.

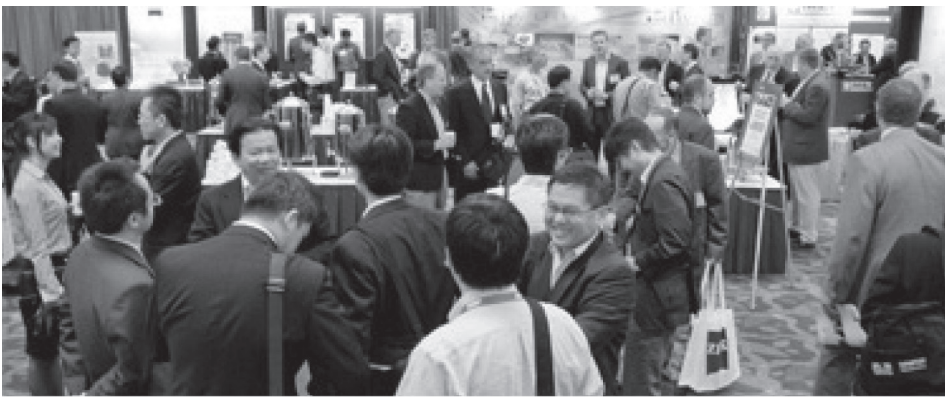
Room: Steinbeck Forum Thurs. 5:00 to 5:10 pm

Best Paper and Poster Awards and Prize Drawing

Session Chairs: **Wilhelm Maurer**, Infineon Technologies AG (Germany); **Frank E. Abboud**, Intel Corp. (United States)

Prize Sponsored by:





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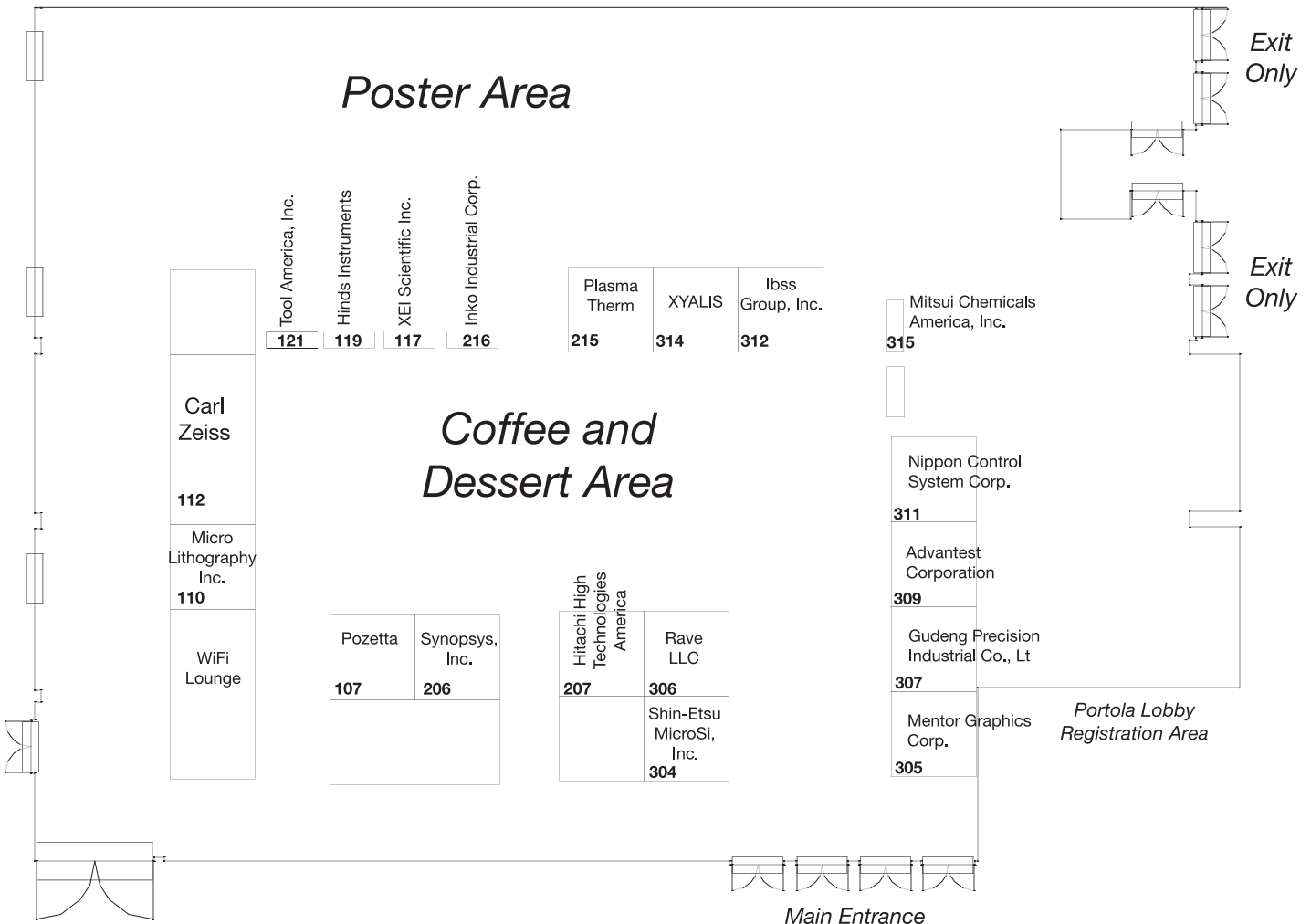
MAKE TIME FOR THE FREE EXHIBITION

Monterey Conference Center · Serra Ballrooms
 Exhibition Dates: 20 – 21 September 2011

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



Exhibition Floor Plan - Serra Ballroom



Advantest Corporation

#309

3201 Scott Blvd, Santa Clara, CA, 95054 United States
+1 408 988 7700; fax +1 408 987 0680
info@advantest.com; www.advantest.com

Featured Product: Critical Dimension Scanning Electron Microscope

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 most advanced semiconductor production lines in the world. The company also focuses on R&D for emerging markets that benefit from advancements in nanotech technologies, and recently introduced critical dimension scanning electron microscopes essential to photomask manufacturing.



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Carl Zeiss SMS GmbH

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Carl Zeiss Promenade 10, Jena, 7745 Germany
+49 3641 64 2563; fax +49 3641 64 2938
info-sms@smt.zeiss.com; www.zeiss.com/sms

Featured Product: AIMS EUV, AIMS, PROVE, Closed-loop PROVE & RegC

Carl Zeiss SMS is a leading global supplier of both semiconductor metrology and manufacturing equipment with the focus on the photomask. Core expertise in light and electron optics, complemented by a revolutionary femtosecond laser technology form the foundation of a product portfolio comprising in-die metrology, actinic qualification, repair and tuning of photomasks. The advanced mask solutions of Carl Zeiss SMS empower mask makers to develop and manufacture zero defect photomasks. Contact: James Polcyn, SMS Sales & Service, polcyn@smt.zeiss.com; Leila Hammad, Marketing Manager, hammad@smt.zeiss.com

Gudeng Precision Industrial Co., Ltd. #307

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irisliu@gudeng.com; www.gudeng.com.tw

Hinds Instruments, Inc. #119

#119

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7245 NW Evergreen Pkwy, Hillsboro, OR, 97124-5822 United States
+1 503 690 2000; fax +1 503 690 3000
sales@hindsinstruments.com; http://www.hindsinstruments.com

Hinds product line includes Stokes polarimeters (for fiber, free space, astronomical light), Exicor® birefringence measurement tools (for research and process control), and an automated Polarization Extinction Ratio (PER) and Extinction Ratio (ER) system. A complete line of polarization components for researchers and OEMs includes optical choppers (20-84kHz), photoelastic modulators (for MOKE, ellipsometry, RAS, and fluorescence), detectors, lock-in amplifiers, and a Pulse Delay Generator. Contact: Doug Mark, Technical Sales Engineer, sales@hindsinstruments.com

Hitachi High Technologies America (Pleasanton)

#207

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5100 Franklin Dr, Pleasanton, CA, 94588 United States
+1 925 218 2800; fax +1 925 218 3230
Sales-LS@hitachi-hita.com; www.hitachi-hita.com

Featured Product: Metrology, Inspection and Process Control Wafer Handling Automation

Hitachi High-Technologies Corporation introduces advanced metrology systems for photomasks;

- CG4500 enabling the high-precision measurement of next generation photomask

- DesignGauge enabling various effective measurement functionalities based on design data

Contact: Lorena Ferry, Director, Technology Department, lorena.ferry@hitachi-hita.com; Mary Tapia, Marketing Communications Specialist, mary.tapia@hitachi-hita.com

Ibss Group, Inc. #312

#312

1559b Sloat Boulevard #270, San Francisco, CA, 94132-1222 United States
+1 415 566 5774; fax +1 415 566 9779
admin@bssgroup.com; www.ibssgroup.com

Inko Industrial Corp. #216

#216

695 Vaqueros Ave, Sunnyvale, CA, 94085 United States
+1 408 830 10401; fax +1 408 830 1055
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, high volume memory production. From broadband to I/G line to 248 nm/193nm DUV lithography. We have the right pellicles for your needs. Contact Joe Mac, Sales and Customer Service, joemac@pellicle-inko.com.



LANYARDS SPONSOR

Mentor Graphics #305

#305

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+1 503 685 1907; fax +1 503 685 1543
rosalin_marte@mentor.com; www.mentor.com

Featured Product: Calibre RET/OPC

Advanced litho flows require a partner that can deliver everything needed for success: tools from design to mask prep; high accuracy, low turnaround time, fast flow development, flexibility, low cost of operation, links to 3rd party tools, and uncompromising support. Mentor is the complete partner for manufacturing success offering best-in-class technology, comprehensive solutions, and continuous innovation. 28 fabs have chosen Mentor. Find out why at www.mentor.com. Contact: Gene Forte, Marketing Communications Manager, gene_forte@mentor.com

Exhibitor Listings



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Micro Lithography Inc.

#110

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

Featured Product: Pellicles

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.

#315

2099 Gateway Pl Ste 260, 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 leader in providing pellicles to the semiconductor industry. ISO 9001 certified full-automated plant produces Mitsui Pellicle with more than 99% of transmission, excellent uniformity and superb longevity. The non-dust structure based on 17 years accumulated expertise and rigorous selection of the materials contributes to maximum production yields at your fab. by eliminating pellicle related particle generations. Contact: Masanari Kitajima, General Manager, m.kitajima@mitsuichem.com

Nippon Control System Corp.

#311

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 30 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, LLC

#215

10050 16th St N, Saint Petersburg, FL 33716-4219 United States
+1 727 577 4999; www.plasmatherm.com

Pozzetta

#107

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

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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RAVE LLC

#306

430 S Congress Ave Ste 7, Delray Beach, FL, 33445-4678 United States
+1 561 330 0411; fax +1 561 330 0647
sales@ravenano.com; www.ravenano.com

Featured Product: Merlin® 22nm Nanomachining Mask Repair; fp650™ Femto-pulse Laser Mask Repair; Rhazer® Haze Removal

RAVE, technology-driven company with a long history of unique technical contributions to the Photomask Industry. RAVE's exceptionally talented team is well recognized for development & on-time delivery of innovative, cost-saving process solutions. RAVE is now delivering the new 5th Generation Merlin® 22nm production mask repair nanomachine & revolutionary Rhazer® haze removal system. RAVE's fp650™ femto-pulse laser tool continues to be the fastest, most efficient >45nm production mask repair. Contact: Michael Archuletta, Director of Marketing, Michael.Archuletta@ravenano.com; Dave Lee, VP of Sales & Marketing, David.Lee@ravenano.com



COFFEE/DESSERT BREAK - WEDNESDAY AFTERNOON SPONSOR

Shin-Etsu MicroSi, Inc.

#304

10028 S 51st St, Phoenix, AZ, 85044 United States
+1 480 893 8898; fax +1 408 893 8637
info@microsi.com; www.microsi.com

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; info@microsi.com



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Synopsys, Inc.

#206

700 E Middlefield Rd, Mountain View, CA, 94043 United States
+1 650 584 5000
info@synopsys.com; www.synopsys.com

Featured Product: Proteus LRC for lithography verification

Synopsys is a world leader in EDA and IC manufacturing software and has the industry's most comprehensive solution from design to silicon. Synopsys' approach ensures an intelligent use of technology and data throughout the flow. Speak with experts about how Synopsys' production-proven mask synthesis, lithography simulation, and leading mask data preparation can provide superior turnaround time, cost of ownership, and accuracy of results at advanced technology nodes. Contact: Anjaneya Thakar, Product Marketing Manager, CATS, thakar@synopsys.com; George Bailey, Director, Technical Marketing, gbailey@synopsys.com

TOOL America, Inc.

#121

10 S 3rd St, 3rd Fl, San Jose, CA, 95113 United States
+1 408 351 3351
www.tool-corp.com

TOOL delivers a powerful fracturing system, MaskStudio for your mask data preparation with its quick conversion speed of design data to mask-writing data and vice versa, precise Boolean operations and high performance parallel distributed processing. It generates a pattern data optimized for each mask-writing machine and mask-making process which leads to yield improvement and reduction of TAT. In addition, OASIS-Utility, a unique set of tools for handling of OASIS data including a fast hierarchical data checker against rigorous custom sign-off regulations is exhibited. Contact: Yukihiro Masuda, General Manager, masuda@tool-corp.com

XEI Scientific, Inc.

#117

SPIE Corporate Member

1755 E Bayshore Rd Ste 17, Redwood City, CA, 94063 United States
+1 650 369 0133; fax +1 650 363 1659
info@evactron.com; www.evactron.com

Featured Product: Evactron® De-Contaminator

XEI Scientific manufactures the Evactron® De-Contaminator, which uses a unique RF plasma source for downstream ashing of carbon contamination by either oxygen or hydrogen atomic radicals. The compact device is easy to install and operate. Over 1100 devices are used on electron microscopes around the world. The process has been proven safe and effective at removing carbon from EUV optics and photomask substrates and materials. Contact: Tom Levesque, Sales Director, levesque@evactron.com

XYALIS

#314

SPIE Corporate Member

World Trade Ctr Grenoble, BP 1510, Grenoble, 38025 France
+33 476 706 475; fax +33 476 282 849
Sylvie@xyalis.com; www.xyalis.com

Featured Product: GTmask – Automated Mask Set generation warranting compatible mask sets between different equipments.

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, intuitive mask set creation, and wafer map optimization, and by streamlining the mask order process. XYALIS' solutions have been developed in cooperation with major semiconductor industry leaders and have been used in production for years. Contact: Sylvie Hurat, US Area Manager, sylvie@xyalis.com.

Product Categories

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Conference Chair: **Wilhelm Maurer**, Infineon Technologies AG (Germany)

Conference Co-Chair: **Frank E. Abboud**, Intel Corp. (United States)

Program Committee: **Artur P. Balasinski**, Cypress Semiconductor Corp. (United States); **Ronald R. Bozak**, RAVE LLC (United States); **William H. Broadbent**, KLA-Tencor Corp. (United States); **Peter D. Buck**, Toppan Photomasks, Inc. (United States); **Emily E. Gallagher**, IBM Corp. (United States); **Brian J. Grenon**, Grenon Consulting, Inc. (United States); **Naoya Hayashi**, Dai Nippon Printing Co., Ltd. (Japan); **Mark T. Jee**, HOYA Corp. USA (United States); **Rik M. Jonckheere**, IMEC (Belgium); **Bryan S. Kasprowicz**, Photonics, Inc. (United States); **Byung-Gook Kim**, SAMSUNG Electronics Co., Ltd. (Korea, Republic of); **Shy-Jay Lin**, Taiwan Semiconductor Manufacturing Co. Ltd. (Taiwan); **M. Warren Montgomery**, College of Nanoscale Science & Engineering (United States); **Thomas H. Newman**, Micronic Laser Systems Inc. (United States); **Hiroshi Nozue**, NuFlare Technology, Inc. (Japan); **James E. Potzick**, National Institute of Standards and Technology (United States); **Emmanuel Rausa**, Plasma-Therm LLC (United States); **Douglas J. Resnick**, Molecular Imprints, Inc. (United States); **Thomas Scherübl**, Carl Zeiss SMS GmbH (Germany); **Steffen F. Schulze**, Mentor Graphics Corp. (United States); **Robert J. Socha**, ASML US, Inc. (United States); **Anna Tchikoulaeva**, GLOBALFOUNDRIES Dresden Module Two, GmbH & Co. KG (Germany); **Banqiu Wu**, Applied Materials, Inc. (United States); **Larry S. Zurbrick**, Agilent Technologies, Inc. (United States)

Monday 19 September

Photomask Japan Opening Remarks

Room: Steinbeck Forum **Mon. 1:00 to 1:10 pm**

Session Chairs: **Hiroaki Morimoto**, Toppan Printing Co., Ltd. (Japan);
Naoya Hayashi, Dai Nippon Printing Co., Ltd. (Japan)

This year Photomask Japan made the very difficult decision to cancel the symposium because of the earthquake and tsunami. However, the leadership of Photomask Japan and SPIE/BACUS have organized a Special Session on Monday 19 September with selected oral presentations, as well as poster presentations at the Tuesday evening Poster Reception.

SESSION JPM1

Room: Steinbeck Forum **Mon. 1:10 to 5:00 pm**

Photomask Japan Special Session

Session Chairs: **Hiroaki Morimoto**, Toppan Printing Co., Ltd. (Japan);
Naoya Hayashi, Dai Nippon Printing Co., Ltd. (Japan)

The manuscripts for the presentations in this session will be published in the Photomask Japan Proceedings.

- 1:10 pm: **Mask blank material optimization impact on leading-edge ArF lithography** (*Presentation Only*), Kei Mesuda, Dai Nippon Printing Co., Ltd. (Japan)..... [8166-200]
- 1:30 pm: **Study on the correlation between mask preparation techniques and its lifetime in the wafer fab** (*Presentation Only*), Eugen Foca, Advanced Mask Technology Ctr. GmbH Co. KG (Germany)..... [8166-201]
- 1:50 pm: **The effect of resist removal methods on mask CD variation by cleaning process** (*Presentation Only*), Jisun Ryu, Hynix Semiconductor Inc. (Korea, Republic of)..... [8166-202]
- 2:10 pm: **Binary 193-nm photomasks aging phenomenon study** (*Presentation Only*), Félix Dufaye, STMicroelectronics (France)..... [8166-203]
- 2:30 pm: **193-nm radiation durability study of MoSi binary mask and resulting lithographic performance** (*Presentation Only*), Isabelle Servin, Commissariat à l'Énergie Atomique (France)..... [8166-204]
- 2:50 pm: **RegC : a new registration control process for photomasks after pattern generation** (*Presentation Only*), Erez Graitzer, Avi Cohen, Vladimir Dmitriev, Guy Ben Zvi, Dan Avizemer, Carl Zeiss SMS Ltd. (Israel)..... [8166-205]
- Coffee Break 3:10 to 3:40 pm
- 3:40 pm: **Benefits of overlapping shots for ArF and EUV mask process correction** (*Presentation Only*), Aki Fujimura, D2S, Inc. (United States)..... [8166-206]
- 4:00 pm: **Evaluation of process variations on OPC model predictions** (*Presentation Only*), Samit Barai, IBM Semiconductor Research and Development Ctr. (India)..... [8166-207]
- 4:20 pm: **Defect printability of advanced binary film photomask** (*Presentation Only*), Masato Naka, Toshiba Corp. (Japan)..... [8166-208]
- 4:40 pm: **Role of ellipsometry in DPT process characterization and impact of performance for contact holes** (*Presentation Only*), Itaru Kamohara, Nihon Synopsys G.K. (Japan)..... [8166-209]

Tuesday 20 September

Opening Remarks

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

Session Chairs: **Wilhelm Maurer**, Infineon Technologies AG (Germany);
Frank E. Abboud, Intel Corp. (United States)

SESSION 1

Room: Steinbeck Forum Tues. 8:10 to 8:50 pm

Keynote Session

Session Chairs: **Wilhelm Maurer**, Infineon Technologies AG (Germany);
Frank E. Abboud, Intel Corp. (United States)



8:10 pm: **Bucking the Trend: Driving Changes in How EDA and the Semiconductor Industries Work Together** (*Keynote Presentation*),
Walden C. Rhines, Mentor Graphics [8166-01]

SESSION 2

Room: Steinbeck Forum Tues. 8:50 to 9:40 am

Invited Session

Session Chairs: **Frank E. Abboud**, Intel Corp. (United States); **Wilhelm Maurer**, Infineon Technologies AG (Germany)

8:50 am: **Mask Industry Assessment: 2011** (*Invited Paper*), Gregory P. Hughes, David Y. Chan, SEMATECH North (United States) [8166-02]

9:20 am: **EMLC 2011 Best Paper: Evidence of printing blank-related defects on EUV masks missed by blank inspection** (*Presentation Only*), Rik M. Jonckheere, Dieter Van den Heuvel, IMEC (Belgium); Tristan Bret, Thorsten Hofmann, Carl Zeiss SMS GmbH (Germany); John F. Magana, Intel Corp. (United States); Israel Aharonson, Doron Meshulach, Applied Materials (Israel); Eric Hendrickx, Kurt G. Ronse, IMEC (Belgium) [8166-03]

Sessions 3 run concurrently with sessions 7.

SESSION 3

Room: Steinbeck Forum Tues. 9:40 am to 12:00 pm

EUV Infrastructure and Application I

Session Chairs: **Rik M. Jonckheere**, IMEC (Belgium); **M. Warren Montgomery**, College of Nanoscale Science & Engineering (United States)

9:40 am: **Accelerating EUV learning with synchrotron light** (*Invited Paper*), Patrick P. Naulleau, Lawrence Berkeley National Lab. (United States) . . [8166-04]

Coffee Break 10:10 to 10:40 am

10:40 am: **Phase defect analysis with actinic full-field EUVL mask blank inspection**, Takeshi Yamane, Toshihiko Tanaka, Tsuneo Terasawa, Osamu Suga, Semiconductor Leading Edge Technologies, Inc. (Japan) [8166-05]

11:00 am: **Defect printability of native blank defects, program defects, and their stack structures**, Hyuk Joo Kwon, Jenah Harris-Jones, Teki Ranganath, Vibhu Jindal, Aaron M. Cordes, David Y. Chan, Frank Goodwin, Gregory P. Hughes, SEMATECH North (United States); Toshio Nakajima, AGC Electronics America, Inc. (United States); Iacopo Mochi, Kenneth A. Goldberg, Lawrence Berkeley National Lab. (United States); Yuya Yamaguchi, Hiroo Kinoshita, Univ. of Hyogo (Japan) [8166-06]

11:20 am: **Advancing EUV mask microscopy with ultra-high resolution and the capacity for shorter EUV wavelengths**, Kenneth A. Goldberg, Iacopo Mochi, Eric M. Gullikson, Erik H. Anderson, Patrick P. Naulleau, Lawrence Berkeley National Lab. (United States); Hyuk Joo Kwon, David Y. Chan, SEMATECH North (United States) [8166-07]

11:40 am: **EUV mask absorber and multi-layer defect disposition techniques using computational lithography**, Vikram L. Tolani, Masaki Satake, Peter Hu, Danping Peng, Ying Li, Linyong Pang, Luminescent Technologies, Inc. (United States); Byung-Cheol Cha, Gisung Yoon, Wonil Cho, Jihoon Na, SAMSUNG Electronics Co., Ltd. (Korea, Republic of) [8166-08]

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

SESSION 7

Room: Ferrante Tues. 11:00 am to 12:20 pm

Design for Manufacturability, and Optical Enhancements: SMO, OPC etc. I

Session Chairs: **Byung-Gook Kim**, SAMSUNG Electronics Co., Ltd. (Korea, Republic of); **Steffen F. Schulze**, Mentor Graphics Corp. (United States)

11:00 am: **SMO applied to contact layers at the 32-nm node and below with consideration of MEEF and MRC**, Wu Te Hung, Jong-Doo Kim, Hong Ji Young, Jin Se Park, Suk Joo Lee, SAMSUNG Electronics Co., Ltd. (Korea, Republic of); Robert Gleason, Robert Sinn, Dong-Hwan Son, Luminescent Technologies, Inc. (United States) [8166-19]

11:20 am: **Evaluation of the accuracy of complex illuminator designs**, Michael S. Hibbs, Jaione Tirapu-Azpiroz, IBM Corp. (United States); Kazunori Seki, Toppan Photomasks, Inc. (United States); Gregory R. McIntyre, IBM Corp. (United States); Shinpei Kondo, Toppan Photomasks, Inc. (United States) [8166-20]

11:40 am: **Double patterning from design enablement to verification**, Qiao Li, David A. Abercrombie, Mentor Graphics Corp. (United States) [8166-21]

12:00 am: **Study on the design rule verification procedure of semiconductor memory devices by using design-based metrology**, Jae-hoon Jeong, SAMSUNG Electronics Co., Ltd. (Korea, Republic of) and NanoGeometry Research Inc. (Japan); Sei-Ryung Choi, Seung-hyun Chang, Myoung-seob Shim, Gyooyoung Jin, SAMSUNG Electronics Co., Ltd. (Korea, Republic of) . . [8166-22]

Lunch/Exhibition Break 12:20 to 1:30 pm

Tuesday 20 September (continued)

Sessions 4-5-6 run concurrently with sessions 8-9-10.

SESSION 4

Room: Steinbeck Forum Tues. 1:10 to 1:50 pm

Mask Business

Session Chairs: **Naoya Hayashi**, Dai Nippon Printing Co., Ltd. (Japan); **Bryan S. Kasprovicz**, Photonics, Inc. (United States)

1:10 pm: **Mask cycle-time reduction for foundry projects**, Artur P. Balasinski, Cypress Semiconductor Corp. (United States) [8166-09]

1:30 pm: **The novel CD MTT prediction system in photomask fabrication**, Jun Chun, Eui-Sang Park, Sang-Pyo Kim, Chang-Reol Kim, Oscar Han, Hynix Semiconductor Inc. (Korea, Republic of) [8166-11]

SESSION 5

Room: Steinbeck Forum Tues. 1:50 to 3:10 pm

Simulation of Mask Making and Application

Session Chairs: **Larry S. Zurbrick**, Agilent Technologies, Inc. (United States); **Peter D. Buck**, Toppan Photomasks, Inc. (United States)

1:50 pm: **More than monitoring: advanced lithographic process tuning**, Rusty Cantrell, Jo Alvin Dumaya, Martin Häcker, Clemens S. Utzny, Advanced Mask Technology Ctr. GmbH Co. KG (Germany) [8166-12]

2:10 pm: **Mask topography effect modeling in the context of source and mask optimization**, Christophe Pierrat, IC Images Technologies, Inc. (United States) [8166-13]

2:30 pm: **Mask CD-SEM image contour extraction for production wafer simulation**, Thuc Dam, Dongxue Chen, Hsien-Min Chang, Noel Corcoran, Paul Yu, Linyong Pang, Luminescent Technologies, Inc. (United States); Chung-Jen Chen, Rick Lai, Laurent Tuo, Taiwan Semiconductor Manufacturing Co. Ltd. (Taiwan) [8166-87]

2:50 pm: **PPF-Explorer: pointwise proximity function calibration using a new radial symmetric calibration structure**, Reinhard R. Galler, Michael Krueger, Detlef Melzer, Martin Suelzle, EQUIcon Software GmbH Jena (Germany); Ulf Weidenmueller, Luis E. Ramos, Vistec Electron Beam GmbH Jena (Germany) [8166-88]

Coffee Break 3:10 to 3:40 pm

SESSION 6

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

Mask Data Preparation and Process Correction

Session Chairs: **Peter D. Buck**, Toppan Photomasks, Inc. (United States); **Wilhelm Maurer**, Infineon Technologies AG (Germany)

3:40 pm: **OPC modeling and correction solutions for EUV lithography** (*Invited Paper*), James C. Word, Michael Lam, Christian Zuniga, Mentor Graphics Corp. (United States); Mohamed Habib, Mentor Graphics Egypt (Egypt) [8166-14]

4:10 pm: **High-speed mask inspection data prep flow based on pipelining**, Stephen H. Kim, Daniel Hung, Synopsys, Inc. (United States); Po Liu, Jean-Paul E. Sier, KLA-Tencor Corp. (United States) [8166-15]

4:30 pm: **QoR analysis of fractured data solutions using distributed processing**, D. S. S. Bhardwaj, Nageswara R. Guntupalli, Ravi R. Pai, Nitin P. Bhat, SoftJin Technologies Pvt. Ltd. (India) [8166-16]

4:50 pm: **Reducing shot count through optimization-based fracture**, Timothy Lin, Mentor Graphics Corp. (United States) [8166-17]

5:10 pm: **Application of signal reconstruction techniques to shot count reduction in simulation driven fracturing**, Shangliang Jiang, Avideh Zakhor, Univ. of California, Berkeley (United States) [8166-18]

SESSION 8

Room: Ferrante Tues. 1:30 to 3:00 pm

EUV Infrastructure and Application II

Session Chairs: **M. Warren Montgomery**, College of Nanoscale Science & Engineering (United States); **Rik M. Jonckheere**, IMEC (Belgium)

1:30 pm: **Holistic lithography for EUV: NXE:3100 characterization of first printed wafers using an advanced scanner model and scatterometry** (*Invited Paper*), Frank A. Driessen, Natalia V. Davydova, ASML Netherlands B.V. (Netherlands); Jiong Jiang, Hoyoung Kang, Brion Technologies, Inc. (United States); Vidya Vaenkatesan, Dorothe Oorschot, ASML Netherlands B.V. (Netherlands); Insung Kim, Soonnam Kang, Youngmi Lee, Jeongho Yeo, SAMSUNG Electronics Co., Ltd. (Korea, Republic of); Keith D. Gronlund, Hua-yu Liu, Brion Technologies, Inc. (United States); Koen van Ingen Schenau, Rudy Peeters, Christian Wagner, ASML Netherlands B.V. (Netherlands); Jörg Zimmermann, Oliver Schumann, Carl Zeiss SMT GmbH (Germany) [8166-23]

2:00 pm: **Development status and infrastructure progress update of aerial imaging measurements on EUV masks**, Sascha Perltz, Wolfgang Harnisch, Ulrich Stroessner, Carl Zeiss SMS GmbH (Germany); Markus R. Weiss, Dirk Hellweg, Carl Zeiss SMT GmbH (Germany) [8166-24]

2:20 pm: **EUV mask preparation considering blank defects mitigation**, Yuelin Du, Hongbo Zhang, Martin D. F. Wong, Univ. of Illinois at Urbana-Champaign (United States); Rasit O. Topaloglu, GLOBALFOUNDRIES Inc. (United States) [8166-25]

2:40 pm: **EUV mask inspection field applications: status update**, Lior Shoval, Shmoolik Mangan, Neil Berns, Applied Materials (Israel) [8166-26]

Coffee Break 3:00 to 3:40 pm

SESSION 9

Room: Steinbeck Forum Tues. 3:40 to 4:10 pm

Invited Session

This presentation will be held in the Steinbeck Forum. Immediately after this presentation is over, move back into the Ferrante for your 4 o'clock session.

OPC modeling and correction solutions for EUV lithography (*Invited Paper*), James C. Word, Michael Lam, Christian Zuniga, Mentor Graphics Corp. (United States); Mohamed Habib, Mentor Graphics Egypt (Egypt) [8166-14]

SESSION 10

Room: Ferrante Tues. 4:10 to 5:10 pm

Mask Cleaning, Contamination, Haze, and Prevention I

Session Chairs: **Brian J. Grenon**, Grenon Consulting, Inc. (United States); **Anna Tchikoulaeva**, GLOBALFOUNDRIES Dresden Module Two, GmbH & Co. KG (Germany)

4:10 pm: **A study on irregular growing defect mechanism and removal process**, Hyemi Lee, Jea-Young Jun, Goo-Min Jeong, Sang-Chul Kim, Sang-Pyo Kim, Chang-Reol Kim, Hynix Semiconductor Inc. (Korea, Republic of) [8166-27]

4:30 pm: **MegaSonic cleaning: possible solutions for 22-nm node and beyond**, Hrishi Shende, MP Mask Technology Ctr., LLC (United States); Sherjang Singh, SUSS MicroTec Inc. (United States); James Baugh, MP Mask Technology Ctr., LLC (United States); Peter Dress, HamaTech APE GmbH & Co. KG (Germany); Uwe Dietze, SUSS MicroTec Inc. (United States) [8166-29]

4:50 pm: **Extending CO₂ cryogenic aerosol cleaning for advanced photomask cleaning**, Ivin Varghese, Charles W. Bowers, Mehdi Balooch, Eco-Snow Systems (United States) [8166-30]

Poster Session

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

Symposium attendees and guests 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, and view poster papers. Refreshments will be served. Attendees are requested to wear their conference registration badges.

Poster authors may set-up their poster papers between 10:00 am and 4:00 pm on Tuesday and will leave them up until Wednesday afternoon. Authors will be present during the poster reception from 6:00 pm to 7:30 pm to answer questions and provide in-depth discussion regarding their papers. Any posters and materials left up after 3:00 pm on Wednesday will be considered unwanted and will be discarded. SPIE assumes no responsibility for papers and materials left up after 3:00 pm on Wednesday.

Mask Business

Reticle process monitoring and qualification based on reticle CDU and wafer CDU correlation, Guoxiang Ning, GLOBALFOUNDRIES Dresden Module Two, GmbH & Co. KG (Germany); Byoung-II Choi, GLOBALFOUNDRIES Singapore (Singapore); Christian Hoffeld, GLOBALFOUNDRIES Dresden Module Two, GmbH & Co. KG (Germany); Yee Ta Ngow, Sia Kim Tan, GLOBALFOUNDRIES Singapore (Singapore); Anna Tchikoulaeva, GLOBALFOUNDRIES Dresden Module Two, GmbH & Co. KG (Germany); Fang Hong Gn, GLOBALFOUNDRIES Singapore (Singapore). [8166-89]

Mask Cleaning, Contamination, Haze, and Prevention

Contamination control of reticle SMIF pods through intelligent material selection and purification, Chenwei Ku, Gudeng Precision Industrial Co., Ltd. (Taiwan). [8166-90]

Effects of cleaning on NIL templates: surface roughness, CD, and pattern integrity, Sherjang Singh, SUSS MicroTec Inc. (United States); Kenji Onuki, SUSS MicroTec KK (Japan); Naoshi Kawamata, Nagai Takaharu, Masaaki Kurihara, Tatsuya Tomita, Naoya Hayashi, Dai Nippon Printing Co., Ltd. (Japan); Eric S. Woster, SUSS MicroTec Inc. (United States); Peter Dress, HamaTech APE GmbH & Co. KG (Germany). [8166-91]

Study on EUV photomask resist striping and cleaning, Yuji Nagashima, Shibaura Mechatronics Corp. (Japan). [8166-93]

Removing carbon from EUV photomask blanks using downstream plasma cleaning, Christopher Morgan, XEI Scientific, Inc. (United States); Vibhu Jindal, Frank Goodwin, Patrick A. Kearney, SEMATECH North (United States); Ronald Vane, XEI Scientific, Inc. (United States). [8166-94]

EUV Infrastructure and Application

Investigating the intrinsic cleanliness of automated handling designed for EUV mask pod-in-pod systems, Oliver Brux, Tobias Waehler, HamaTech APE GmbH & Co. KG (Germany); Jetske Stortelder, Jacques van der Donck, TNO (Netherlands); Peter Dress, HamaTech APE GmbH & Co. KG (Germany). [8166-95]

Optimized qualification protocol on particle cleanliness for EUV mask infrastructure, Jacques van der Donck, Jetske Stortelder, Giljam Derksen, TNO (Netherlands). [8166-96]

EQ-10 electrodeless Z-pinch EUV source for metrology applications, Deborah Gustafson, Stephen F. Horne, Matthew M. Besen, Donald K. Smith, Paul A. Blackborow, Energetiq Technology, Inc. (United States). [8166-97]

Mask Inspection and Repair

Improve the efficiency of the inspection process via a thorough control of the scanning focus, Ernesto Villa, Luca Sartelli, Hiroyuki Miyashita, DNP Photomask Europe S.p.A. (Italy). [8166-98]

Efficiency and throughput improvement on defect disposition through automated defect classification: enhancing yield and throughput of sub-32-nm mask technology, Rick Lai, Chung-Jen Chen, T. H. Yen, B. H. Ong, Laurent Tuo, Taiwan Semiconductor Manufacturing Co. Ltd. (Taiwan); Noel Corcoran, Danping Peng, Lin He, Vikram L. Tolani, Hsien-Min Chang, Paul Yu, Kechang Wang, Luminescent Technologies, Inc. (United States). [8166-100]

Electron-beam EUV patterned mask inspection system, Keizo Yamada, Holon Co., Ltd. (Japan); Peter J. Fiekowsky, AVI-Automated Visual Inspection (United States); Yasunobu Kitayama, Holon Co., Ltd. (Japan). [8166-101]

Productivity of femtosecond DUV-laser photomask repair in a real-world mask house, Tod E. Robinson, RAVE LLC (United States); Jiin-Hong Lin, Taiwan Semiconductor Manufacturing Co. Ltd. (Taiwan). [8166-103]

Nanomachining repair for the latest reticle enhancement technologies, Tod E. Robinson, RAVE LLC (United States). [8166-104]

Parallelized automatic false defect detection using GPUs during mask inspection, Anil Parchuri, Mark Pereira, Manabendra Maji, Gangadhar Budde, Ravi R. Pai, Ila Nigam, SoftJin Technologies Pvt. Ltd. (India). [8166-105]

Studies of test pattern of electron-beam inspection for sub-2x-nm nano-imprint template development, Hong Xiao, Hermes-Microvision Inc., USA (United States); Nobuhito Toyama, DNP America, LLC (United States); Jack Y. Jau, Chiyen Kuan, Hermes-Microvision Inc., USA (United States); Takaaki Hiraka, Satoshi Yusa, Reiji Hirota, Takao Nishiguchi, Shiho Sasaki, Masaaki Kurihara, Tatsuya Tomita, Naoya Hayashi, Dai Nippon Printing Co., Ltd. (Japan). [8166-106]

EUV mask e-beam inspection working conditions study, Shmoolik Mangan, Applied Materials (Israel); Ilan England, Applied Materials BV (Netherlands); Lior Shoval, Ran Brikman, Applied Materials (Israel); Gregory P. Hughes, Chih-Cheng Lin, SEMATECH North (United States). [8166-107]

Mask Data Preparation and Process Correction

Optimization of mask shot count using MB-MDP and lithography simulation, Gek-Soon Chua, GLOBALFOUNDRIES Singapore (Singapore); Yi Zou, GLOBALFOUNDRIES Inc. (United States); Kazuyuki Hagiwara, D2S, KK (Japan); Ingo Bork, Aki Fujimura, D2S, Inc. (United States). [8166-110]

Shot-based mask optimization, Anatoly D. Adamov, Stanford Robotics (United States). [8166-111]

Assessment and comparison of different approaches for mask write time reduction, Timothy Lin, Emile Sahouria, Steffen F. Schulze, Mentor Graphics Corp. (United States). [8166-151]

Mask Metrology

Joint research on scatterometry and AFM wafer metrology, Bernd Bodermann, Egbert Buhr, Physikalisches-Technische Bundesanstalt (Germany); Sven Burger, JCMwave GmbH (Germany); Hans-Ulrich Danzebrink, Physikalisches-Technische Bundesanstalt (Germany); Poul-Erik Hansen, Danish Fundamental Metrology Ltd. (Denmark); Petr Klapetek, Czech Metrology Institute (Czech Republic); Virpi Korpelainen, MIKES Mittatekniikan keskus (Finland); Toni Saastamoinen, Univ. of Eastern Finland (Finland); Frank Scholze, Physikalisches-Technische Bundesanstalt (Germany); Marijn van Veghel, VSL Dutch Metrology Institute (Netherlands); Andrew Yacoot, National Physical Lab. (United Kingdom). [8166-113]

The mask CD control (CDC) using OCD applications, Seok Park, Wonsik Yun, Changhwan Lee, Sungsu Kim, Hynix Semiconductor Inc. (Korea, Republic of); Taekyoung Kim, Consultant (Korea, Republic of); Hyung Won Yoo, Ilkeoun Han, Hynix Semiconductor Inc. (Korea, Republic of). [8166-114]

Reticle CD uniformity on 2x-nm logic photomasks, Aditya Dayal, KLA-Tencor Corp. (United States); Jan Richter, Advanced Mask Technology Ctr. GmbH Co. KG (Germany); Alexander Pokrovskiy, Ge Cong, Animesh Khemka, KLA-Tencor Corp. (United States). [8166-115]

The application of logic CD uniformity maps from a reticle inspection tool for wafer intra-field CD correction, Frank Sundermann, STMICROELECTRONICS (France); Aditya Dayal, KLA-Tencor Corp. (United States); Hidemichi Imai, Dai Nippon Printing Co., Ltd. (Japan); Bertrand Le-Gratiet, Jonathan Planchoat, STMICROELECTRONICS (France); Masaharu Nishiguchi, Hideyoshi Takamizawa, Dai Nippon Printing Co., Ltd. (Japan); Dan Lopez, Alexander Pokrovskiy, Ge Cong, Trent Hutchinson, KLA-Tencor Corp. (United States). [8166-116]

In-die mask registration measurement with existing inspection tools, Shuichi Tamamushi, Takanao Touya, NuFlare Technology, Inc. (Japan). [8166-118]

The influence and improvement of through pellicle image placement, Wei-Cyuan Lo, Yung Feng Cheng, Ming Jui Chen, United Microelectronics Corp. (Taiwan). [8166-119]

NIL Infrastructure and Application

Releasing material screening and continuous nano-imprinting in mold replication for nano-imprint lithography, Kouta Suzuki, Hideo Kobayashi, Takashi Sato, Hiroshi Yamashita, Tsuyoshi Watanabe, HOYA Corp. (Japan). [8166-121]

Design for Manufacturability, and Optical Enhancements: SMO, RET, OPC, etc.

Layout decomposition and mask synthesis for double and triple exposure with image reversal in a single photoresist layer, Coumba Ndoye, Marius Orlowski, Virginia Polytechnic Institute and State Univ. (United States). [8166-122]

Hotspot detection for indecomposable self-aligned double patterning layout, Hongbo Zhang, Yuelin Du, Martin D. F. Wong, Univ. of Illinois at Urbana-Champaign (United States); Rasit O. Topaloglu, GLOBALFOUNDRIES Inc. (United States). [8166-123]

Layout decomposition and mask preparation for pitch quartering process, Hongbo Zhang, Yuelin Du, Martin D. F. Wong, Univ. of Illinois at Urbana-Champaign (United States); Rasit O. Topaloglu, GLOBALFOUNDRIES Inc. (United States). [8166-124]

Determination of CD variance factors of 28-nm 1x-metal layer hot spots using experimental and simulated CD contours, Francois Weisbuch, Jessy Schramm, GLOBALFOUNDRIES Inc. (Germany). [8166-125]

Yield optimization through MLR techniques, Philippe Morey-Chaisemartin, Eric Beisser, XYALIS (France). [8166-126]

- Can fast rule-based assist feature generation in random-logic contact layout provide sufficient process window?**, Ahmed S. Omran, Mentor Graphics Egypt (Egypt); Jochen Schacht, Mentor Graphics Taiwan, Ltd. (Taiwan); George Lippincott, Junjiang Lei, Le Hong, Loran J. Friedrich, Mentor Graphics Corp. (United States); Regina Shen, Pin-Jan Chou, Mentor Graphics Taiwan, Ltd. (Taiwan) [8166-127]
- Dynamic feedback controller for optical proximity correction**, Ahmed S. Omran, Mentor Graphics Egypt (Egypt); Jochen Schacht, July Pan, Mentor Graphics Taiwan, Ltd. (Taiwan); Junjiang Lei, Le Hong, Mentor Graphics Corp. (United States); Mohamed Al-Imam, Mentor Graphics Egypt (Egypt); Nick Cobb, Mentor Graphics Corp. (United States); Regina Shen, Pin-Jan Chou, Mentor Graphics Taiwan, Ltd. (Taiwan) [8166-128]
- Anticipation of dimensional issues caused by topography during photolithography**, Lionel Ravel, Romain Lallement, STMicroelectronics (France); Christophe M. Brault, Dow Advanced Materials (France); Antonio Digiacomo, STMicroelectronics (France) [8166-129]
- Fast DoF awareness inverse SRAFs generation by using interference guidance map**, Han-Hsien Tsai, Jue-Chin Yu, Peichen Yu, National Chiao Tung Univ. (Taiwan) [8166-130]
- Iterative source mask optimization incorporating Abbe's method and Hopkins' approach**, Jue-Chin Yu, Peichen Yu, National Chiao Tung Univ. (Taiwan) [8166-131]
- Total source mask optimization: high-capacity, resist modeling, and production-ready mask solution**, Moutaz Fakhry, Yuri Granik, Kostas Adam, Mentor Graphics Corp. (United States); Kafai Lai, IBM Corp. (United States) [8166-132]
- A validation of source mask optimization for logic device through experiments**, Jong-Hwa Baek, Jeong Hoon Lee, Yong-Kug Bae, Jeongho Yeo, Siyoung Choi, Samsung Electronics Co. Ltd. (Korea, Republic of); Bong-Ryoul Choi, Stefan Hunsche, ASML Korea Co., Ltd. (Korea, Republic of); Xinjian Zhou, Stephen D. Hsu, Brion Technologies, Inc. (United States) [8166-133]
- Performance and variability driven guidelines for BEOL layout decomposition with LELE double patterning**, Tuck Boon Chan, Kwangok Jeong, Andrew B. Kahng, Univ. of California, Los Angeles (United States) [8166-134]
- Integrated advanced hotspot analysis techniques in the post-OPC verification flow**, Makoto Miyagi, Synopsys, Inc. (United States) [8166-135]
- Double patterning for a 56-nm pitch metal layer test design using inverse lithography**, Thuc Dam, Robert Gleason, Paul Rissman, Robert Sinn, Luminescent Technologies, Inc. (United States) [8166-136]
- Using custom features to check OPC model performance**, Amr Y. Abdo, Ramya Viswanathan, IBM Corp. (United States) [8166-137]

Mask Pattern Generation

- A new method to optimize CD uniformity for photomask in the HP 3x node**, Dong-Sik Jang, Eui-Sang Park, Chang-Reol Kim, Oscar Han, Hynix Semiconductor Inc. (Korea, Republic of) [8166-139]

Mask Processes, Substrates, and Materials

- Development status of EUVL mask blank and substrate**, Yusuke Hirabayashi, Asahi Glass Co., Ltd. (Japan) [8166-140]
- The trade-offs between thin and thick absorbers for EUV photomasks**, Gregory R. McIntyre, Emily E. Gallagher, John Y. Whang, Louis M. Kindt, IBM Corp. (United States) [8166-143]
- Attenuated phase-shift mask with high tolerance for 193-nm radiation damage**, Taichi Yamazaki, Ryohei Gorai, Yosuke Kojima, Takashi Haraguchi, Tsuyoshi Tanaka, Toppan Printing Co., Ltd. (Japan); Ryuji Koitabashi, Yukio Inazuki, Hiroki Yoshikawa, Shin-Etsu Chemical Co., Ltd. (Japan) [8166-142]
- A study of closed-loop application: WLCD-CDC for 32nm and beyond reticles**, Arosha W. Goonesekera, Carl Zeiss SMT Inc. (United States); Ute Buttgerit, Thomas Thaler, Carl Zeiss SMS GmbH (Germany); Erez Graitzer, Carl Zeiss SMS Ltd. (Israel) [8166-144]
- Dry etching technologies for the advanced binary film**, Yoshinori Iino, Shibaura Mechatronics Corp. (Japan) [8166-145]

Simulation of Mask Making and Applications

- Impact of mask corner rounding on wafer printing**, Christophe Pierrat, IC Images Technologies, Inc. (United States) [8166-146]
- Prediction of pattern collapse hotspots for full-chip layouts**, John L. Sturtevant, Aasutosh Dave, Mentor Graphics Corp. (United States) [8166-147]
- Rigorous EMF simulation of the impact of photomask line-edge and line-width roughness on lithographic processes**, Oliver H. Rudolph, Peter Evanschitzky, Andreas Erdmann, Eberhard Bär, Jürgen Lorenz, Fraunhofer-Institut für Integrierte System und Bauelementetechnologie (Germany). [8166-148]
- Accurate prediction of 3D mask topography induced best focus variation in full-chip photolithography applications**, Peng Liu, Brion Technologies, Inc. (United States) [8166-149]

New Mask Making and Alternatives

- Improving the accuracy of the bimetallic grayscale photomasks using a feedback controlled flat-top beam**, Glenn H. Chapman, Reza Qarehbaghi, Simon Fraser Univ. (Canada) [8166-150]

Photomask Japan 2011

The manuscripts for the presentations in this session will be published in the Photomask Japan Proceedings.

- Improvement of polymer type EB resist sensitivity and line-edge roughness (Presentation Only)**, Makoto Otani, Yamaguchi Univ. (Japan) [8166-210]
- 22-nm node ArF lithography performance improvement by utilizing mask 3D topography: controlled sidewall angle (Presentation Only)**, Hiroshi Watanabe, Dai Nippon Printing Co., Ltd. (Japan) [8166-211]
- In-die job automation for PROVE (Presentation Only)**, Dirk Beyer, Carl Zeiss SMS GmbH (Germany) [8166-212]
- Solution for silicon performance using large field of mask images (Presentation Only)**, Ryoichi Matsuoka, Hitachi High-Technologies Corp. (Japan) [8166-213]
- EB resolution capability with CP exposure (Presentation Only)**, Masaki Kurokawa, Advantest Corp. (Japan) [8166-214]
- Elimination of lithographic hotspots which have been waived by means of pattern matching (Presentation Only)**, Aditya Chaudhary, IBM Semiconductor Research and Development Ctr. (India) [8166-215]
- Efficient method for SRAF rule determination (Presentation Only)**, Pavan Y. Bashaboina, IBM Semiconductor Research and Development Ctr. (India) [8166-216]
- MRC optimization for EUV high-NA imaging for the 32-nm HP technology node (Presentation Only)**, Shih-En Tseng, ASML Taiwan Ltd. (Taiwan) . [8166-217]
- CD-metrology of EUV masks in the presence of charging: measurement and simulation (Presentation Only)**, Sergey V. Babin, Abeam Technologies (United States) [8166-219]

SPIE Green Initiative

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Wednesday 21 September

Sessions 11-12-13 run concurrently with sessions 16-17.

SESSION 11

Room: Steinbeck Forum Wed. 8:00 to 9:50 am

Mask Processes, Substrates, and Materials I

Session Chairs: **Emmanuel Rausa**, Plasma-Therm LLC (United States);
Banqiu Wu, Applied Materials, Inc. (United States)

- 8:00 am: **Advanced electron-beam resist requirements and challenges** (*Invited Paper*), Andrew T. Jamieson, Yong Kwan Kim, Bennett W. Olson, Maiying Lu, Nathan E. Wilcox, Intel Corp. (United States) [8166-31]
- 8:30 am: **High-resolution mask process and substrate for 20-nm and early 14-nm node lithography**, Thomas B. Faure, IBM Corp. (United States); Satoshi Akutagawa, Toppan Photomasks, Inc. (United States); Karen D. Badger, Louis M. Kindt, IBM Corp. (United States); Jun Kotani, Toppan Photomasks, Inc. (United States); Takashi Mizoguchi, Toppan Electronics, Inc. (United States); Satoru Nemoto, Toppan Photomasks, Inc. (United States); Kazunori Seki, Toppan Electronics, Inc. (United States); Tasuku Senna, Toppan Photomasks, Inc. (United States); Richard E. Wistrom, IBM Corp. (United States); Shinichi Igarashi, Yukio Inazuki, Kazuhiro Nishikawa, Hiroki Yoshikawa, Shin-Etsu Chemical Co., Ltd. (Japan) [8166-32]
- 8:50 am: **Phase-shifting effect of thin-absorber EUV masks**, Hiroyoshi Tanabe, Tetsunori Murachi, Intel Kabushiki Kaisha (Japan); Sang Hun Lee, Manish Chandhok, Seh-jin Park, Guojing Zhang, Intel Corp. (United States); Tsukasa Abe, Taichi Ogase, Naoya Hayashi, Dai Nippon Printing Co., Ltd. (Japan) [8166-33]
- 9:10 am: **Closed-loop registration control (RegC) using PROVE as the data source for the RegC process**, Erez Graitzer, Avi Cohen, Dan Avizemer, Vladimir Dmitriev, Guy Ben Zvi, Carl Zeiss SMS Ltd. (Israel); Dirk Beyer, Klaus Boehm, Ch. Ehrlich W. Degel, Carl Zeiss SMS GmbH (Germany) [8166-34]
- 9:30 am: **Negative-tone e-beam resist processing for bit-patterned media NIL template**, Morihisa Houga, Kimio Itoh, Mikio Ishikawa, Naoko Kuwahara, Masaharu Fukuda, Yuusuke Kawano, Dai Nippon Printing Co., Ltd. (Japan); Nobuhito Toyama, DNP America, LLC (United States) [8166-35]

SESSION 12

Room: Steinbeck Forum Wed. 9:50 to 11:20 am

Mask Pattern Generation I

Session Chairs: **Thomas H. Newman**, Micronic Laser Systems Inc. (United States); **Shy-Jay Lin**, Taiwan Semiconductor Manufacturing Co. Ltd. (Taiwan)

- 9:50 am: **The requirements for the future e-beam mask writer: statistical analysis of pattern accuracy**, Sang-Hee Lee, Jin Choi, Hee-Bom Kim, Byung-Gook Kim, Han-Ku Cho, SAMSUNG Electronics Co., Ltd. (Korea, Republic of) [8166-36]
- Coffee Break 10:10 to 10:40 am
- 10:40 am: **The trouble starts with using electrons: putting charging effect correction models to the test**, Timo A. Wandel, Clemens S. Utzny, Advanced Mask Technology Ctr. GmbH Co. KG (Germany); Noriaki Nakayamada, NuFlare Technology, Inc. (Japan) [8166-37]
- 11:00 am: **EBM-8000: EB mask writer for product mask fabrication of 22-nm half-pitch generation and beyond**, Shusuke Yoshitake, Takashi Kamikubo, Noriaki Nakayamada, Kiyoshi Hattori, Hiroyoshi Ando, Tomohiro Iijima, Kenji Ohtoshi, Kenichi Saito, Ryoichi Yoshikawa, Shuichi Tamamushi, Rikio Tomiyoshi, Hitoshi Higurashi, Yoshiaki Hattori, Seiichi Tsuchiya, Masayuki Katoh, Kouichi Suzuki, Yuichi Tachikawa, NuFlare Technology, Inc. (Japan); Munehiro Ogasawara, Toshiba Corp. (Japan); Victor Katsap, Steven D. Golladay, Rodney A. Kendall, NuFlare Technology, Inc. (United States) [8166-38]

SESSION 13

Room: Steinbeck Forum Wed. 11:20 am to 12:00 pm

Mask Metrology I

Session Chairs: **Thomas Scherübl**, Carl Zeiss SMS GmbH (Germany);
Larry S. Zurbrick, Agilent Technologies, Inc. (United States)

- 11:20 am: **In-die photomask registration and overlay metrology with PROVE using 2D correlation methods**, Dirk Seidel, Carl Zeiss SMS GmbH (Germany); Michael Arnz, Carl Zeiss SMT GmbH (Germany); Dirk Beyer, Carl Zeiss SMS GmbH (Germany) [8166-39]
- 11:40 am: **Evaluation of KLA-Tencor LMS IPRO5 beta system for 22-nm node registration and overlay applications**, Michael Ferber, Frank Laske, Klaus-Dieter Röth, Dieter K. Adam, KLA-Tencor MIE GmbH (Germany) [8166-40]
- Lunch/Exhibition Break 12:00 to 1:40 pm

SESSION 16

Room: Ferrante Wed. 8:50 to 11:00 am

Mask Metrology II

Session Chairs: **James E. Potzick**, National Institute of Standards and Technology (United States); **Emily E. Gallagher**, IBM Corp. (United States)

- 8:50 am: **EUV and x-ray scattering methods for CD and roughness measurement**, Frank Scholze, Akiko Kato, Jan Wernecke, Michael Krumrey, Physikalisch-Technische Bundesanstalt (Germany) [8166-52]
- 9:10 am: **Investigation of 3D patterns on EUV masks by means of scatterometry and comparison to numerical simulations**, Sven Burger, Konrad-Zuse-Zentrum für Informationstechnik Berlin (Germany) and JCMwave GmbH (Germany); Lin Zschiedrich, Jan Pomplun, JCMwave GmbH (Germany); Frank Schmidt, Konrad-Zuse-Zentrum für Informationstechnik Berlin (Germany); Akiko Kato, Christian Laubis, Frank Scholze, Physikalisch-Technische Bundesanstalt (Germany) [8166-53]
- 9:30 am: **Addressing 3D metrology challenges by using a multiple detector CSEM**, Mitsuo Hiroyama, Tsutomu Murakawa, Masayuki Kuribara, Toshimichi Iwai, Minoru Soma, Ikuro Iko, Masahiro Seyama, Jun Matsumoto, Takayuki Nakamura, Advantest Corp. (Japan); Hidemitsu Haki, Isao Yonekura, Masashi Kawashita, Yasushi Nishiyama, Keishi Tanaka, Kenji Komoto, Toppan Printing Co., Ltd. (Japan) [8166-54]
- 9:50 am: **The assessment of the impact of mask pattern shape variation on the OPC-modeling by using SEM-contours from wafer and mask**, Daisuke Hibino, Hiroyuki Shindo, Yutaka Hojyo, Hitachi High-Technologies Corp. (Japan); Thuy Do, Aasutosh Dave, Timothy Lin, Ir Kusnadi, John L. Sturtevant, Mentor Graphics Corp. (United States) [8166-55]
- Coffee Break 10:10 to 10:40 am
- 10:40 am: **X-ray metrology for characterizing shape of nanostructure of bit-patterned medias**, Kazuhiko Omote, Yoshiyasu Ito, Rigaku Corp. (Japan) [8166-56]

SESSION 17

Room: Ferrante Wed. 11:00 to 11:40 am

NIL Infrastructure and Application I

Session Chairs: **Naoya Hayashi**, Dai Nippon Printing Co., Ltd. (Japan);
Douglas J. Resnick, Molecular Imprints, Inc. (United States)

- 11:00 am: **30-nm full-field quartz template replicated from Si master for FLASH active layer NIL**, Duhyun Lee, Byung-Kyu Lee, Woong Ko, Jaekwan Kim, Kiyeon Yang, Samsung Advanced Institute of Technology (Korea, Republic of); Byounghoon Seung, Il-Yong Jang, Mun Ja Kim, SAMSUNG Electronics Co., Ltd. (Korea, Republic of); Changyool Moon, Samsung Advanced Institute of Technology (Korea, Republic of) [8166-58]
- 11:20 am: **Fabrication of 20-nm half-pitch quartz template by nano-imprinting**, Naotoshi Sato, Tadashi Oomatsu, Satoshi Wakamatsu, Katsuhiro Nishimaki, Toshihiro Usa, Kunihiko Kodama, Kazuyuki Usuki, FUJIFILM Corp. (Japan) [8166-120]
- Lunch/Exhibition Break 11:40 am to 1:20 pm

Wednesday 21 September (continued)

Sessions 14-15 run concurrently with sessions 18-19-20-21.

SESSION 14

Room: Steinbeck Forum Wed. 1:40 to 3:00 pm

Mask Inspection and Repair I

Session Chairs: **Emily E. Gallagher**, IBM Corp. (United States); **Ronald R. Bozak**, RAVE LLC (United States)

- 1:40 pm: **Repair of natural EUV reticle defects**, Rik M. Jonckheere, IMEC (Belgium); Tristan Bret, Carl Zeiss SMS GmbH (Germany); Dieter Van den Heuvel, IMEC (Belgium); John F. Magana, Intel Corp. (United States); Weimin Gao, Synopsys GmbH (Belgium); Markus Waiblinger, Carl Zeiss SMS GmbH (Germany) [8166-42]
- 2:00 pm: **EUVL mask inspection using 257-nm and 193-nm wavelengths for 30-nm node and beyond**, Jihoon Na, Wonil Cho, Tae-Geun Kim, Byung-Cheol Cha, Inkyun Shin, Han-Ku Cho, SAMSUNG Electronics Co., Ltd. (Korea, Republic of) [8166-43]
- 2:20 pm: **Printability and detection of backside defects on photomasks**, Guoxiang Ning, Christian Holfeld, Anna Tchikoulaeva, GLOBALFOUNDRIES Dresden Module Two, GmbH & Co. KG (Germany); Martin Sczyrba, Advanced Mask Technology Ctr. GmbH Co. KG (Germany); Karsten Bubke, GLOBALFOUNDRIES Dresden Module Two, GmbH & Co. KG (Germany); Angeline Ho, Soon Yoeng Tan, Sia Kim Tan, Byoung-II Choi, GLOBALFOUNDRIES Singapore (Singapore) [8166-44]
- 2:40 pm: **Clean and repair of EUV photomasks**, Tod E. Robinson, RAVE LLC (United States) [8166-45]
- Coffee Break 3:00 to 3:30 pm

SESSION 15

Room: Steinbeck Forum Wed. 3:30 to 5:20 pm

Mask Cleaning, Contamination, Haze, and Prevention II

Session Chairs: **Anna Tchikoulaeva**, GLOBALFOUNDRIES Dresden Module Two, GmbH & Co. KG (Germany); **Brian J. Grenon**, Grenon Consulting, Inc. (United States)

- 3:30 pm: **Challenges associated with advanced mask cleaning (Invited Paper)**, Brian J. Grenon, Grenon Consulting, Inc. (United States) [8166-46]
- 4:00 pm: **Study on the soft defects related to dry etch process of phase shift mask**, Young-Jin An, Byung-Sun Kang, Jong-Min Kim, Dong-Heok Lee, Sang-Soo Choi, PKL Co., Ltd. (Korea, Republic of) [8166-47]
- 4:20 pm: **Effect of cleaning POR upon EUV mask performance**, Jaehyuck Choi, SEMATECH North (United States) [8166-48]
- 4:40 pm: **Study of tolerance of the patterned EUV masks to the megasonic cleaning by scanning probe microscopy**, Takeya Shimomura, DNP Corp. USA (United States); Abbas Rastegar, SEMATECH North (United States) [8166-49]
- 5:00 pm: **Effects of repetitive acid-based cleaning on EUV mask lithography process and lifetime**, Robert J. Chen, Intel Corp. (United States); Simi A. George, SCHOTT North America, Inc. (United States); Ted Liang, Intel Corp. (United States); Patrick P. Naulleau, Lawrence Berkeley National Lab. (United States) [8166-50]

SESSION 18

Room: Ferrante Wed. 1:20 to 2:20 pm

Mask Processes, Substrates, and Materials II

Session Chairs: **Mark T. Jee**, HOYA Corp. USA (United States); **Bryan S. Kasprovicz**, Photronics, Inc. (United States)

- 1:20 pm: **Dry etching performance of novel EUV blanks**, John Y. Whang, IBM Corp. (United States); Amitabh Sabharwal, Banqiu Wu, Applied Materials, Inc. (United States); David H. Barry, Emily E. Gallagher, IBM Corp. (United States); Jeff Chen, Keven Yu, Madhavi Chandrachood, Michael Grimbergen, Applied Materials, Inc. (United States); Richard E. Wistrom, Shaun Crawford, Thomas B. Faure, IBM Corp. (United States) [8166-59]
- 1:40 pm: **Development of sub-20-nano patterning technology using new hard mask in NIL**, Byoungsoon Seung, Duhyun Lee, Mun Ja Kim, Il-Yong Jang, Byung-Kyu Lee, Byung-Gook Kim, Han-Ku Cho, SAMSUNG Electronics Co., Ltd. (Korea, Republic of) [8166-60]
- 2:00 pm: **The impact of a thinner binary mask absorber on 22 nm and beyond mask inspectability and defect sensitivity**, Karen D. Badger, IBM Corp. (United States); Kazunori Seki, Toppan Photomasks, Inc. (United States) [8166-61]

SESSION 19

Room: Ferrante Wed. 2:20 to 3:00 pm

Mask Pattern Generation II

Session Chairs: **Shy-Jay Lin**, Taiwan Semiconductor Manufacturing Co. Ltd. (Taiwan); **Thomas H. Newman**, Micronic Laser Systems Inc. (United States)

- 2:20 pm: **Pattern placement error due to resist charging effect at 50kV e-beam writer: mechanism and its correction**, Jin Choi, Sukjong Bae, Hyun-Soo Kim, Hee-Bom Kim, Byung-Gook Kim, Han-Ku Cho, SAMSUNG Electronics Co., Ltd. (Korea, Republic of) [8166-62]
- 2:40 pm: **Enhancement of global CD correction in EB mask writer EB-8000**, Hiroshi Matsumoto, Yasuo Kato, Tomoo Motosugi, Jun Yashima, Takayuki Abe, Noriaki Nakayamada, Shusuke Yoshitake, Kiyoshi Hattori, NuFlare Technology, Inc. (Japan) [8166-63]
- Coffee Break 3:00 to 3:30 pm

SESSION 20

Room: Steinbeck Forum Wed. 3:30 to 4:00 pm

Invited Session

This presentation will be held in the Steinbeck Forum. Immediately after this presentation is over, move back into the Ferrante for your 4 o'clock session.

Challenges associated with advanced mask cleaning (Invited Paper), Brian J. Grenon, Grenon Consulting, Inc. (United States) [8166-46]

SESSION 21

Room: Ferrante Wed. 4:00 to 5:20 pm

New Mask Making and Alternatives I

Session Chair: **Artur P. Balasinski**, Cypress Semiconductor Corp. (United States)

- 4:00 pm: **Efficient large-volume data preparation for electron-beam lithography for sub-45-nm node**, Kang-Hoon Choi, Manuela S. Gutsch, Martin Freitag, Christoph K. Hohle, Fraunhofer-Ctr. Nanoelektronische Technologien (Germany); Luc Martin, Sebastien Bayle, Serdar Manakli, Patrick Schiavone, Asetla Nanographics (France) [8166-64]
- 4:20 pm: **eMET POC: realization of a proof-of-concept 50-keV electron multibeam mask exposure tool**, Elmar Platzgummer, Christof Klein, Hans Loeschner, IMS Nanofabrication AG (Austria) [8166-65]
- 4:40 pm: **CD error budget analysis of CP exposure**, Masaki Kurokawa, Keita Bunya, Toshihide Irii, Akio Yamada, Advantest Corp. (Japan) [8166-66]
- 5:00 pm: **Mask aspects of EUVL imaging at 27nm and below**, Natalia V. Davydova, Eelco van Setten, ASML Netherlands B.V. (Netherlands); Sang-In Han, ASML US, Inc. (United States); Mark A. van de Kerckhof, Robert de Kruijff, Dorothee Oorschot, ASML Netherlands B.V. (Netherlands); John D. Zimmerman, ASML (United States); Ad Lammers, ASML Netherlands B.V. (Netherlands); Brid Connolly, Toppan Photomasks Inc (Germany); Frank A. Driessen, Anton B. van Oosten, ASML Netherlands B.V. (Netherlands); Mircea V. Dusa, ASML US, Inc. (Belgium); Youri van Dommelen, ASML US, Inc. (United States); Noreen Harned, ASML (United States); Jiong Jiang, Wei Liu, Hoyoung Kang, Brion Technologies Inc. (United States); Hua-yu Liu, Brion Technologies, Inc. (United States) [8166-67]

Thursday 22 September

Sessions 22-23 run concurrently with sessions 26-27.

SESSION 22

Room: Steinbeck Forum Thurs. 8:00 to 9:10 am

NIL Infrastructure and Application II

Session Chairs: Douglas J. Resnick, Molecular Imprints, Inc. (United States); *Naoya Hayashi*, Dai Nippon Printing Co., Ltd. (Japan)

8:00 am: **Defectivity status for jet and flash imprint lithography** (*Invited Paper*), Matt Malloy, Lloyd C. Litt, SEMATECH (United States) [8166-68]

8:30 am: **Imprint lithography template technology for bit patterned media (BPM)**, Jeff Lille, Gabriel Zeltzer, Ricardo Ruiz, Tsai-Wei Wu, Kanaiyalal Patel, Elizabeth A. Dobisz, He Gao, Thomas R. Albrecht, Hitachi Global Storage Technologies, Inc. (United States) [8166-69]

8:50 am: **Mask replication using jet and flash imprint lithography**, Kosta S. Selinidis, Chris E. Jones, Laura Brown, Gary F. Doyle, Joseph Imhof, Dwayne L. LaBrake, Douglas J. Resnick, S. V. Sreenivasan, Molecular Imprints, Inc. (United States) [8166-70]

SESSION 23

Room: Steinbeck Forum Thurs. 9:10 to 11:00 am

Design for Manufacturability, and Optical Enhancements: SMO, OPC etc. II

Session Chairs: Steffen F. Schulze, Mentor Graphics Corp. (United States); *Byung-Gook Kim*, SAMSUNG Electronics Co., Ltd. (Korea, Republic of)

9:10 am: **Statistical analysis of the effects of mask process on OPC errors**, Woojoo Sim, Sungsoo Suh, Chunsuk Suh, Seong-Woon Choi, Young Hee Kim, Ho-Kyu Kang, SAMSUNG Electronics Co., Ltd. (Korea, Republic of) . . . [8166-71]

9:30 am: **Exploring the impact of mask making constraints on double-patterning design rules**, Thuc Dam, Robert Sinn, Paul Rissman, Robert Gleason, Luminescent Technologies, Inc. (United States) [8166-72]

9:50 am: **Freeform source optimization for improving litho-performance of warm spots**, Chun-Wei Wu, Chun-Cheng Liao, Chiang-Lin Shih, Nanya Technology Corp. (Taiwan); Stephen D. Hsu, Brion Technologies, Inc. (United States); Chung-Hsing D. Chang, Brion Technologies (Taiwan); Hua-yu Liu, Brion Technologies, Inc. (United States) [8166-73]

Coffee Break 10:10 to 10:40 am

10:40 am: **A critical impact of model-based SRAF on multiple patterning**, Kazuya Iwase, Sony Corp. (Belgium); Bart Laenens, Peter De Bisschop, IMEC (Belgium); Keith D. Gronlund, Brion Technologies, Inc. (United States); Paul van Adrichem, ASML Netherlands B.V. (Netherlands) and Brion Technologies, Inc. (United States); Stephen D. Hsu, Brion Technologies, Inc. (United States) [8166-74]

SESSION 24

Room: Steinbeck Forum Thurs. 11:00 to 11:50 am

New Mask Making and Alternatives II

Session Chair: Artur P. Balasinski, Cypress Semiconductor Corp. (United States)

11:00 am: **Si stencil masks for organic thin film transistor fabrication** (*Invited Paper*), Florian Letzkus, Jörg Butschke, Tarek Zaki, Harald Richter, Joachim N. Burghartz, Institut für Mikroelektronik Stuttgart (Germany); Hagen Klauck, Frederik Ante, Max-Planck-Institut für Festkörperforschung (Germany) . [8166-75]

11:30 am: **Bottlenecks in data preparation flow for multibeam direct write**, Daniel Hung, Otto Meijer, Alex Zepka, Synopsys, Inc. (United States) . . [8166-76]

Lunch Break 11:50 am to 1:00 pm

SESSION 26

Room: Steinbeck Forum Thurs. 8:00 to 8:30 am

Invited Session

This presentation will be held in the Steinbeck Forum. Immediately after this presentation is over, move back into the Ferrante for your 8:30 AM session.

Defectivity status for jet and flash imprint lithography (*Invited Paper*), Matt Malloy, Lloyd C. Litt, SEMATECH (United States) [8166-68]

SESSION 27

Room: Ferrante Thurs. 8:30 to 10:10 am

Mask Inspection and Repair II

Session Chairs: Bryan S. Kasprovicz, Photronics, Inc. (United States); *William H. Broadbent*, KLA-Tencor Corp. (United States)

8:30 am: **Simulation-based mask defect printability verification and disposition, part II**, Eric G. Guo, Irene Shi, Skin Zhang, Sandy Qian, Semiconductor Manufacturing International Corp. (China); Guojie Cheng, Ling Li, Ke Zhou, Gary Zhang, Anchor Semiconductor, Inc. (China); Ye Chen, Hsiang Chingyun, Bo Su, Anchor Semiconductor, Inc. (United States) [8166-82]

8:50 am: **EUV multilayer defect compensation (MDC) by absorber pattern modification: from theory to wafer validation**, Linyong Pang, Peter Hu, Danping Peng, Ying Li, Dongxue Chen, Masaki Satake, Vikram L. Tolani, Luminescent Technologies, Inc. (United States) [8166-83]

9:10 am: **Performance of EBeyeM for EUV mask inspection**, Shinji Yamaguchi, Masato Naka, Motoki Kadowaki, Tooru Koike, Takashi Hirano, Masamitsu Itoh, Yuichiro Yamazaki, Toshiba Corp. (Japan); Terao Kenji, 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) [8166-84]

9:30 am: **NPI-7000: a mask inspection tool enabling both EUV and optical mask inspection using DUV (199-nm) laser**, Hideaki Hashimoto, Nobutaka Kikuri, Ryoichi Hirano, Ikunao Isomura, Manabu Isobe, NuFlare Technology, Inc. (Japan) [8166-85]

9:50 am: **Outlook and initial results for inspection of flare-corrected EUV masks**, Gregg A. Inderhees, Tao-Yi Fu, Ray Shi, Weston L. Sousa, William J. Huang, KLA-Tencor Corp. (United States); KangJoon Seo, Byung Ho M. Nam, Hynix Semiconductor Inc. (Korea, Republic of) [8166-86]

Special Session Opening Remarks



Room: Steinbeck Forum Thurs. 1:00 to 1:10 pm

Session Chairs: **Frank E. Abboud**, Intel Corp. (United States);
Robert J. Socha, ASML US, Inc. (United States)

SESSION 25

Room: Steinbeck Forum Thurs. 1:10 to 3:15 pm

Special Session: Is it too late to panic? EUV is Real!

Session Chairs: **Frank E. Abboud**, Intel Corp. (United States);
Robert J. Socha, ASML US, Inc. (United States)

- 1:10 pm: **Challenges for 1x device manufacturing using EUVL: scanner and mask** (*Invited Paper*), William H. Arnold, ASML US, Inc. (United States) [8166-77]
- 1:35 pm: **Computational lithography in the EUV era** (*Invited Paper*), Vivek K. Singh, Intel Corp. (United States) [8166-78]
- 2:00 pm: **Current status and challenges in EUV mask** (*Invited Paper*), Hiroaki Morimoto, Toppan Printing Co., Ltd. (Japan) [8166-79]
- 2:25 pm: **EUV masks for HVM: progress and challenges** (*Invited Paper*), Sheng-Ji Chin, Taiwan Semiconductor Manufacturing Co. Ltd. (Taiwan) [8166-80]
- 2:50 pm: **Imaging performance and defect printability of 22-nm node EUV mask using EUV exposure tool** (*Invited Paper*), Byung-Gook Kim, SAMSUNG Electronics Co., Ltd. (Korea, Republic of) [8166-81]
- Coffee Break 3:15 to 3:40 pm



Room: Steinbeck Forum Thurs. 3:40 to 5:00 pm

Panel Discussion: Is it too late to panic? EUV is Real!

Panel Moderators: **Frank E. Abboud**, Intel Corp. (United States);
Robert J. Socha, ASML US, Inc. (United States)

Room: Steinbeck Forum Thurs. 5:00 to 5:10 pm

Best Paper and Poster Awards and Prize Drawing

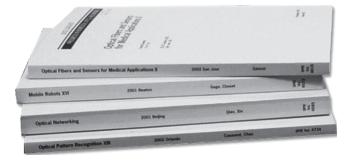
Session Chairs: **Wilhelm Maurer**, Infineon Technologies AG (Germany);
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Registration

Onsite Registration and Information Hours

Portola Lobby

Monday 19 September	11:00 am to 5:00 pm
Tuesday 20 September	7:15 am to 4:00 pm
Wednesday 21 September	7:30 am to 4:00 pm
Thursday 22 September	8:00 am to 10:30 am

Exhibition Hours

Serra Grand Ballroom

Tuesday 20 September	10:00 am to 4:00 pm
	6:00 to 7:30 pm
Wednesday 21 September	10:00 am to 4:00 pm



Author/Presenter Information

Speaker Preview Room

Sloat Room

Open during Registration Hours

All conference rooms will have a computer workstation, LCD projector, screen, lapel microphone, and laser pointer. All presenters are requested to come to the speaker check-in desk to confirm display settings of their presentations from their memory devices or laptops with the audiovisual equipment being used at this symposium.

Poster Setup Instructions

Serra Ballroom

Poster presenters must set up their posters between 10:00 am and 4:00 pm on Tuesday, 20 September.

- 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, 21 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 will be served from 7:30 to 8:30 am, Tuesday through Thursday, for symposium attendees in the Steinbeck Lobby.

Coffee Breaks

Complimentary coffee will be served at the following times and locations. Please check the individual technical conference listings for exact times and locations.

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Serra Grand Ballroom

Tuesday 20 September	10:10 to 10:40 am; 3:00 to 3:30 pm
Wednesday 21 September	10:00 to 10:30 am; 3:00 to 3:30 pm

Steinbeck Lobby

Monday 19 September	3:00 to 3:45 pm
Thursday 22 September	10:15 to 11:00 am; 3:30 to 4:15 pm

Hosted Lunches

Marriott San Carlos Ballroom

Tuesday through Thursday Noon to 1:00 pm

Tuesday Lunch Co-Sponsored by:

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Wednesday Lunch Sponsored by:



Please check the individual technical conference listings for exact times. Complimentary tickets for these lunches are included for full conference registrants. Exhibitors and students may purchase tickets at the SPIE Registration Desk in the Portola Lobby.

General Information

Business Services

Business Center

Monterey Marriott

At the Monterey Marriott, attendees may use their hotel room key to access the onsite Business Center which offers use of a free online 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 \$1.00 per page for domestic usage and \$3.00 per page for international usage.

Offsite Business Center

FedEx Kinkos is located at 799 Lighthouse Ave, Ste A, Monterey, CA 3940. Phone: 800-463-3339. It is 1.3 miles from the Monterey Marriott. Go north on Calle Principal, left onto Del Monte Avenue, right onto Pacific Street, right onto ramp to merge onto Lighthouse Avenue.

Messages

SPIE has an urgent message line available during registration hours, Monday through Thursday by calling: 831-646-5312

Child Care Services

The Monterey Marriott suggests the following child care service companies in Monterey:

- Parent Time Out - Phone: 831.375.9269
- Corporate Kids Events Inc & VIP Babysitting services (for in-room hotel babysitting services). For Reservations call 800.838.2787

Note: SPIE does not imply an endorsement or recommendation of this service. It is provided on an "information only" basis 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.

Parking During Photomask

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

Attendee Services

SPIE Receipts, Badge Corrections, Cashier

Portola Lobby

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 special event requiring payment, or have questions regarding your registration please see the onsite cashier at the Onsite Registration Desk.
- 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 Registration Desk.
- Badge Correction—Attendees who need a correction to their badge information onsite may do so at the Registration Desk. Please have your badge removed from the badge holder, marked with your changes, and ready to hand to the attendant upon approaching the counter.

Online Services

Internet Access

Steinbeck Lobby

Sponsored by



Monday Noon to 6:00 pm
Tuesday – Wednesday 7:30 am to 6:00 pm
Thursday 8:00 am to 10:30 am

There will be multiple workstations allowing attendees to access their internet e-mail during the conference, and several Ethernet connections to use with your personal laptop. There will be a 10-minute time limit per each person's internet session.

WiFi

Exhibition Hall

Complimentary WiFi access for attendees with 802.11b wireless enabled laptops and PDAs will be available Saturday through Thursday in the South Lobby and in the Concourse (exhibit level) near the SPIE Marketplace.

Policies

Desserts

Dessert will be served from 3:00 to 3:30 pm on Tuesday and Wednesday in the Exhibition Hall. Complimentary tickets for dessert will be included in attendee packets.

Refunds

There is a \$40 service charge for processing refunds. Requests for registration refunds must be received no later 8 September 2011. 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 film or 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 film 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.

2012 Photomask Technology

10–13 September 2012

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Location

Monterey Marriott & Monterey
Conference Center
Monterey, California, USA

Conference dates

10–13 September 2012

Exhibition dates

11–12 September 2012

Technologies

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

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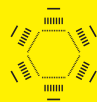
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