Photomask Technology+
Extreme Ultraviolet Lithography 2018

TECHNICAL PROGRAM + EXHIBITION GUIDE

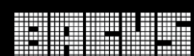
Your complete guide to conferences and special events.

Conferences
17-20 September 2018

Exhibition
18-19 September 2018

Monterey Conference Center and Monterey Marriott
Monterey, California, USA

www.spie.org/puv



TECHNICAL PROGRAM AND EXHIBITION GUIDE

PHOTOMASK TECHNOLOGY + EXTREME ULTRAVIOLET LITHOGRAPHY

Conferences: 17-20 September 2018
Exhibition: 18-19 September 2018

Monterey Conference Center and Monterey Marriott
Monterey, California, USA

SPIE Photomask Technology + Extreme Ultraviolet Lithography 2018 is a technical meeting for mask makers, EUVL, emerging technologies, and the future of mask business.

Photomask Technology

- Computational lithography
- Mask technology
- Imaging and emerging mask technologies
- Mask application
- Mask business

Extreme Ultraviolet Lithography

- Integration in manufacturing
- Tools, including sources and optics
- Masks, mask inspection/repair and review
- Pellicles, mask cleaning and thermal expansion
- Resist materials/process and contamination
- Patterning and process enhancement
- Lithography extendibility

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COLTON 1 2 3

STEINBECK BALLROOM 3 2

Exhibition IA IB IC

LEVEL TWO

SKY BRIDGE

DEL MONTE AVENUE

SAN CARLOS BALLROOM I II III IV

Posters

MARRIOTT MONTEREY

MEZZANINE

Hotel Front Entrance (FIRST FLOOR)

CALLE PRINCIPAL

Plan your week at SPIE Photomask Technology + EUV Lithography

Use the My Schedule tool to build your custom schedule. Sign in with your SPIE account to build, save, and sync your schedule.

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Don't miss these world-class speakers discussing the latest advancements and most promising breakthroughs.

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Join your peers and colleagues in discussions around focused technical topics and networking opportunities.

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Meet key suppliers of components, software, and manufacturing equipment.

Sponsors page 18-19

See the organizations helping to support the industry and this event.

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SPIE is the international society for optics and photonics, an educational not-for-profit organization founded in 1955 to advance light-based science and technology. The Society serves nearly 264,000 constituents from approximately 166 countries, offering conferences and their published proceedings, continuing education, books, journals, and the SPIE Digital Library in support of interdisciplinary information exchange, professional networking, and patent precedent. SPIE provided more than $4 million in support of education and outreach programs in 2016.

For more information, visit www.SPIE.org.

SPIE Green Initiative

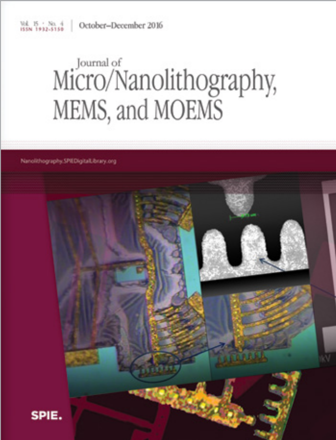
As host to events that bring together scientists and engineers from around the globe, SPIE is committed to making our symposia as environmentally friendly as possible.

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.

Journal of Micro/Nanolithography, MEMS, and MOEMS

The *Journal of Micro/Nanolithography, MEMS, and MOEMS* (JM^3) publishes peer-reviewed papers on the science, development, and practice of lithographic, fabrication, packaging, and integration technologies necessary to address the needs of the electronics, microelectromechanical systems, micro-optoelectromechanical systems, and photonics industries. The wide range of such devices also includes biomedical microdevices, microfluidics, sensors and actuators, adaptive optics, and digital micromirrors. The scope is broad to facilitate synergy and interest between the communities served by the journal.



Chris A. Mack
Lithoguru.com
Editor-in-Chief

Topics include:

- Lithography: tools, materials, and processes associated with the patterning of structures that have submicrometer and nanometer-scale features. Included are imaging and nonimaging approaches using optics, electron and other particle beams, nanoimprint, molecular self-assembly, and their hybrids. Applications include semiconductor fabrication, but also patterning for other micro/nanodevices.
- Microelectromechanical systems (MEMS): the design, fabrication, operation, reliability, and testing of microdevices that contain both electrical and mechanical elements.
- Micro-optoelectromechanical systems (MOEMS): the design, fabrication, operation, reliability, and testing of microdevices that contain electrical, mechanical, and optical elements (that is, the merging of micro-optics and MEMS).
- Microfabrication: technologies to shape three-dimensional structures leading to the fabrication of active and passive electronics, photonics, MEMS, MOEMS, micro/nano-optics, and other micro/nanodevices.
- Metrology: metrology and process control for the above devices and their fabrication processes.

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PHOTOMASK TECHNOLOGY AND EXTREME ULTRAVIOLET LITHOGRAPHY CONFERENCE SCHEDULE

TIME	CONF. 10809: **International Conference on Extreme Ultraviolet Lithography** (Ronse, Hendrickx, Naulleau, Gargini, Itani)	CONF. 10810: **Photomask Technology** (Gallagheri, Rankin)
MONDAY 17 SEPTEMBER		
AM	SESSION 1 (JOINT): (Room: MCC, Steinbeck 2) **Plenary Session** (Naulleau, Abboud) SESSION 2: (Room: MCC, Steinbeck 3) **EUV Scanner and Source** (Kim, Uchiyama)	SESSION 1 (JOINT): (Room: MCC, Steinbeck 2) **Plenary Session** (Naulleau, Abboud) SESSION 2: (Room: MCC, Steinbeck 2) **Deep Learning and Advanced Data Analytics** (Fujimura, Buck)
Lunch		
PM	SESSION 3: (Room: MCC, Steinbeck 3) **EUV Process Control** (De Silva, De Simone)	SESSION 3: (Room: MCC, Steinbeck 2) **Mask Inspection, Metrology, and Repair** (Preil, Grenon)
Selected Poster Speed Talks (JOINT) (Room: Steinbeck 2)		
Monday Poster Session - Marriott, San Carlos Foyer		
TUESDAY 18 SEPTEMBER		
AM	SESSION 4 (JOINT): (Room: MCC, Steinbeck 2) **EUV Mask Blanks** (Onoue, Morgan) SESSION 5: (Room: MCC, Steinbeck 3) **EUV Materials I** (Kozawa, Lio)	SESSION 4 (JOINT): (Room: MCC, Steinbeck 2) **EUV Mask Blanks** (Onoue, Morgan) SESSION 5: (Room: MCC, Steinbeck 2) **Nanoimprint Lithography** (Resnick, Hayashi)
Lunch/Exhibition Break		
PM		SESSION 6: (Room: MCC, Steinbeck 2) **Mask Write and MPC** (Thumma, Yoshitake) SESSION 7: (Room: MCC, Steinbeck 2) **Mask Process and Resist** (Faure, Wu)
WEDNESDAY 19 SEPTEMBER		
AM	SESSION 6 (JOINT): (Room: MCC, Steinbeck 2) **EUV Mask and Imaging** (Finders, Liang) SESSION 7 (JOINT): (Room: MCC, Steinbeck 2) **EUV Inspection, Repair, and Verification** (Ekinci, Scherübl)	SESSION 8 (JOINT): (Room: MCC, Steinbeck 2) **EUV Mask and Imaging** (Finders, Liang) SESSION 9 (JOINT): (Room: MCC, Steinbeck 2) **EUV Inspection, Repair, and Verification** (Ekinci, Scherübl)
Lunch/Exhibition Break		
PM	SESSION 8 (JOINT): (Room: MCC, Steinbeck 2) **EUV Pellicle and Metrology** (Hayashi, Kim) SESSION 9: (Room: MCC, Steinbeck 3) **EUV Materials II** (Dai, Fujimori)	SESSION 10 (JOINT): (Room: MCC, Steinbeck 2) **EUV Pellicle and Metrology** (Hayashi, Kim) Panel Discussion: (Room: MCC, Steinbeck 2) **Optical and EUV Masks: Analyzing the HVM Requirement and Capability Differences**
THURSDAY 20 SEPTEMBER		
AM	SESSION 10: (Room: MCC, Steinbeck 3) **Hi-NA and Imaging** (McIntyre, Suzuki) SESSION 11: (Room: MCC, Steinbeck 3) **Patterning** (Schoot, Hosler)	

WELCOME

SPIE Photomask Technology & Extreme Ultraviolet Lithography

This year we start the week off with John Y. Chen, NVIDIA, and Timothy Brunner, GLOBALFOUNDRIES Inc., each giving a plenary presentation. The Photomask Technology and the Extreme Ultraviolet Lithography conferences will come together throughout the week with joint sessions. Don't miss the joint panel discussion on Wednesday on Optical and EUV Masks: Analyzing the HVM Requirements and Capability Differences.

As conference chairs, we hope you enjoy beautiful Monterey!

SPIE Photomask Technology

The 38th Photomask Conference organized by SPIE in cooperation with BACUS Technical Group, is the global forum for scientists, engineers, and industry leaders to present and discuss key topics related to photomasks. The conference addresses design, fabrication, quality control, and the use of photomasks in the semiconductor industry.

Emily E. Gallagher
imec (Belgium)
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GLOBALFOUNDRIES Inc. (USA)
2018 Photomask Technology Conference Co-Chair

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International Conference on Extreme Ultraviolet Lithography

The International Conference on Extreme Ultraviolet Lithography provides a forum to discuss and assess the worldwide status of EUV technology and infrastructure readiness. Scientists, engineers, and industry leaders meet to present and discuss new and unpublished materials.

Kurt G. Ronse
imec (Belgium)
2018 EUV Lithography Conference Chair

Eric Hendrickx
imec (Belgium)
2018 EUV Lithography Conference Co-Chair

Patrick P. Naulleau
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Paolo A. Gargini
Stanford Univ. (United States)
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Toshiro Itani
EUVL Infrastructure Development Ctr., Inc. (Japan)
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PLENARY PRESENTATIONS

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Monday 8:00 to 8:20 am • Location: Monterey Conference Center, Steinbeck 2

8:00 to 8:20 am

Announcements and Welcome

8:20 to 9:00 am

Accelerate Lithography Improvement for High-performance Computing

John Y. Chen
Vice President, Technology and Foundry Operations NVIDIA (USA)

Artificial intelligence (AI) with deep learning is taking off based on High Performance Computing (HPC) engines fueled by "Big Data" in the cloud. NVIDIA's General Purpose GPU (Graphics Process Unit) is the ideal platform to accelerate computation with its inherent massive parallel processing capability. The Deep Learning machines for AI would be the new driver for the semiconductor industry. In the past, the minimum feature on a semiconductor chip has greatly shrunk with Moore's law. From 1971 to 2018, as the feature size scaled from 10 um to almost 10 nm, the transistors per chip increased from thousands to billions, and remarkably, the prices of 1000 transistors went from $150 down to < 0.03 cent. However, going forward with Moore's law discontinued in its scaling cadence, the economic benefit of scaling can hardly justify the increased cost of wafer manufacturing unless we can find a way to advance lithography and pack more transistors on a chip. In the near future, the only practical way is EUV, which including EUV mask has made great progress lately even though still many challenges ahead. Illustrated by the latest and most complicated AI chip on this planet, the presenter will describe key lithographic requirements from an end user point of view. An example is given to show how precise the Edge Placement of a geometry needs to be controlled in order to scale IC density for the future technology nodes.

John Y. Chen has worked in the industry for 40 years ranging from IDM to Foundry to Fabless. Has been the VP at NVIDIA for the past 14 yrs managing foundries. In his earlier days, Dr. Chen worked in Hughes Research Lab. and Xerox PARC. He has published more than 100 papers and a text book on CMOS. He is an IEEE Fellow and served on few boards. Dr. Chen received four degrees including a Ph.D in EE and a M.S. in Executive Management both from UCLA.

9:00 to 9:40 am

Current Challenges and Opportunities for EUV Lithography

Timothy A. Brunner
Fellow, Technology and Development, GLOBALFOUNDRIES Inc. (USA)

Thirty years ago, the first glimmers of "Soft X-ray Projection Lithography" were achieved by ambitious and far-sighted researchers. Steady progress has overcome many difficult barriers, and the renamed "Extreme Ultra-Violet (EUV) Lithography" is on the brink of High Volume Manufacturing (HVM) applications. This presentation will consider some of the remaining challenges for the next several years. Since an EUV image has only 1/14th as many photons of a 193 image with the same power, stochastic noise is a fundamental EUV concern. This challenge is being addressed by more powerful EUV sources, improved resist processes, advanced etches and other LER smoothing processes. Edge Placement Errors must be reduced to nm levels, which will require advanced data-prep methods to overcome asymmetric 3D mask effects and lens aberrations. Mask defects remain a worrisome issue, and EUV pellicles are highly desired to protect against particles which might fall onto the mask pattern. These pellicle membranes must withstand strong EUV radiation in an H2 environment, along with the physical robustness for normal mask handling and exposure operations. Another mask defect mitigation technique is vote-taking lithography, where several defective masks are used to form a net image with fewer defects. One of the most fundamental challenges for all successful HVM methods is economic viability, and the EUV expose tool throughput is a key metric. Future EUV lithography resolution improvements may be enabled by higher NA projection optics and other advances, but productivity roadmaps must not ignore the need for increased exposure dose to meet fundamental stochastic noise limits.

Timothy A. Brunner has been working in the area of optical lithography since 1981, with particular interests in advanced image formation, simulation, process control, metrology techniques, and interdisciplinary aspects of lithography. He received his B.A. from Carleton College in 1975 and his doctorate from MIT in 1980, both in physics. He has worked at Perkin-Elmer, Xerox PARC, and IBM Research. He joined GLOBALFOUNDRIES in 2015, working at Fab10 in Fishkill, NY. Dr. Brunner has published extensively, and holds several dozen issued patents in the area of optical lithography. He served as the executive chair of the 1997 and 1998 SPIE Microlithography Symposia. He was named an SPIE Fellow in 2003 and won the Frits Zernike award in 2006.

SPECIAL EVENTS

imec Workshop on EUV Mask Blanks

Sunday 1:00 to 5:00 pm
Location: Monterey Conference Center, Colton

EUV lithography has demonstrated patterning at the N7 technology node and below, while the EUV mask has remained unaltered using a 60-70nm Ta-based absorber. The mask's composition, materials, and thickness have a significant impact on the EUV imaging performance at wafer level, e.g., shadowing, feature-dependent pattern placement, and focus behavior. When pushing EUV lithography to enable ever-shrinking feature sizes, we need to challenge the EUV mask and its absorber - as confirmed during the first workshop. At this workshop, we focus on the complexity of a mask absorber change by drawing insights from the complete mask life cycle: blank manufacturing, mask fabrication and qualification, and mask use. Leverage the opportunity to discuss advanced photomask absorbers for EUV with other key stakeholders.

Registration is required and the cost is $50. See SPIE Cashier to register. Space is limited; therefore, there is a two-person maximum per company.

POSTER SESSION

Monday 6:00 to 7:30 pm
Location: Monterey Marriott, San Carlos Foyer

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Symposium attendees are invited to attend the Poster Session on Monday evening in the Monterey Marriott, Mezzanine Level. This session provides an opportunity for attendees to meet with colleagues, network, view posters, and interact with the authors.

Attendees are requested to wear their conference registration badges.

PHOTOMASK/EUVL JOINT PANEL DISCUSSION

Optical and EUV Masks: Analyzing the HVM Requirements and Capability Differences

Wednesday 4:10 to 5:50 pm
Location: Monterey Conference Center, Steinbeck 2

Moderators:

Jed Rankin
GLOBALFOUNDRIES Inc. (USA)

Jeff Farnsworth
Intel Corp. (USA)

Industry experts will discuss the state of EUV Mask readiness as HVM looms. Experts include equipment and material suppliers, captive and commercial mask suppliers, and end users. These experts will share their view on the requirements and capabilities for advanced EUV and optical masks and what work is being done to address these gaps.

Panelists: **Takahiro Onoue,** HOYA Corp. (Japan); **Paul A. Morgan,** Micron Technology, Inc. (USA); **Thomas Scherübl,** Carl Zeiss SMT GmbH (German); **Peter Buck,** Mentor, A Siemens Business (USA)

Conference Dinner and Evening at the Theatre

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Wednesday 6:00 to 9:30 pm

6:00 to 8:00 pm: **Dinner and Awards**
Location: Marriott, San Carlos Ballroom

All paid registered attendees are welcome to attend. This is a time to visit with your colleagues, enjoy delicious Monterey cuisine, and congratulate Photomask Technologies and EUV Lithography Award Winners.

8:15 to 9:30 PM: **After Dinner Show and Awards**
Location: Golden State Theatre

Continue your evening at the beautiful Golden State Theatre, where you will enjoy entertainment that you won't want to miss.

One ticket is included in your paid registration fee. Registered attendees may purchase extra tickets for their guests.

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EXHIBITION DATES AND HOURS

Tuesday 18 September 2018 .... 10 am to 4 pm
Wednesday 19 September 2018 .... 10 am to 4 pm

The SPIE Photomask Technology + EUV Lithography Exhibition

Meet key suppliers and stay up to date on industry trends.
See the latest in:

- Mask technologies: inspection/repair, metrology, cleaning
- Mask business
- EUV
- Nanoimprint
- Direct write
- Patterning
- Wafers
- Tools
- Simulation
- Resists and substrates
- Materials and etching

“This conference is critical for getting the core people together to have discussions. The exchange of technology really helps us to innovate new technologies and that’s what we need with all these emerging markets.”
— Petrie Yam, KLA-Tencor

Steinbeck Ballroom 1

Lit1

410 408 406

516 114

Entrance

514 409 407 112

512 308 306 110

510

Entrance

108

309 307

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Coffee Area

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208 Micro Lithography, Inc.
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211 NTT Advanced Technology Corp.
213 Energetiq Technology
306 Shin-Etsu MicroSi, Inc.
307 Carl Zeiss SMT GmbH
308 RAVE LLC
309 Pozzetta, Inc.
406 Gudeng Precision Industrial Co., Ltd.
407 Plasma-Therm LLC
408 Nippon Control System Corp.
409 FST
410 Rigaku Innovative Technologies, Inc.
510 HORIBA Instruments Inc.
512 INKO Industrial Corp.
514 Nikon Glass Business Unit
516 Nano-Master, Inc.
1-Lit Solid State Technology

attocube systems Inc. #108

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Featured Product: PROVE neXT, AIMS EUV, ARC

With its broad product portfolio and expertise, the Semiconductor Manufacturing Technology segment of ZEISS covers a variety of key processes in the production of microchips. Its products include semiconductor manufacturing optics – notably lithography optics – as well as photomask systems and process control solutions for semiconductor manufacturing. Semiconductor Manufacturing Technology is headquartered in Oberkochen, Germany. Contact: Leila Hammad, Marketing Manager, leila.hammad@zeiss.com; Jim Polcyn, Sales Director, jim.polcyn@zeiss.com

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CyberOptics Corp. #104

SPIE Corporate Member

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info@cyberoptics.com; www.cyberoptics.com

Featured Product: ReticleSense® Measurement Portfolio including AMSR and APSRQ

CyberOptics Corporation is a leading global developer and manufacturer of high precision sensing technology solutions. CyberOptics sensors are being used in general purpose metrology and 3D scanning, surface mount technology (SMT) and semiconductor markets to significantly improve yields and productivity. Headquartered in Minneapolis, Minnesota, CyberOptics conducts worldwide operations through its facilities in North America, Asia and Europe. Contact: Allyn Jackson, Sales Manager & Sr. FAE, ajackson@cyberoptics.com; Ferris Chen, Global Sales Director, fchen@cyberoptics.com

Energetiq Technology #213

SPIE Corporate Member

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Featured Product: EQ-10 Electrodeless Z-Pinch™ 10 Watt EUV Source

Energetiq Technology is the world's leading developer and manufacturer of ultra-bright light sources. Energetiq's EUV Sources are compact, easy-to-use, reliable, and cost-effective. Energetiq's EUV light sources are based on proven Electrodeless Z-pinch™ technology using Xenon gas. The EQ-10 Series EUV sources are uniquely suited for metrology and research applications and has become the workhorse EUV source through its proven reliability, ease of use, and low operating cost. Contact: Samuel Gunnell, Technical Sales Engineer, sgunnell@energetiq.com

ESTION Technologies GmbH #110

Im Duerren Kopf 38, Griesheim, Hesse, 64347 Germany
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ESTION has more than 25 years of experience in electrostatic analyzing and problem solving in various industries concentrating on ESD, EOS, EFM and ESA related problems. Our main focus is cleanrooms, wafer front-end / photomask / flat-panel manufacturing and handling, packaging and assembly. We develop, manufacture and sell in-situ electrostatic test equipment mainly for the electronic industry. ESTION offers training as well as certifying and optimizing of cleanrooms. Contact: Heike Müller, Director, heike.mueller@estion-tech.com

FST #409

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sales@fst.co.kr; www.fstc.co.kr/en/index.php

Featured Product: Pellicle, Chiller

Since its establishment in 1987, FST has been committed to supplying high quality products to high-end semiconductor and FPD industries. We have achieved continuous growth in Pellicle business, one of main material used in semiconductor or FPD manufacturing process - and Chiller which controls temperature and humidity of various equipment. FST also innovates self-developed optical inspection systems and secures competitiveness in the newly developing semiconductor. Contact: Heesu Chang, Sales Manager, heesu@fstc.co.kr

Gudeng Precision Industrial Co., Ltd. #406

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sales@gudeng.com; www.gudeng.com

Featured Product: EUV Reticle SMIF Pod

Gudeng Precision Industrial Co., LTD is principally engaged in the production and sale of integrated solutions for protection, transfer and storage of photo masks and molds. The Company primarily operates two business segments. Gudeng Precision has contributed to developing innovative technology and has been a technological leader of Extreme Ultraviolet Lithography (EUV) mask handling. Gudeng Equipment is our subsidiary established in August, 2016 focusing on purging stations and mask cleaners. Contact: Ellen Wu, Product Assistant Manager, ellen.wu@gudeng.com; Lynn Chu, Sales Executive, sales@gudeng.com

Hitachi High-Tech Science Corp. #209

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hideki.waki.wd@hitachi-hightech.com; www.hitachi-hightech.com/global/about/corporate/group/hhs/

Featured Product: GFIS Mask Repair System and FPD Mask Repair System

Hitachi High-Tech Science Corporation is a Hitachi High-Tech group manufacturer of analysis/measurement equipment. In the areas of surface analysis, element/property analysis and spectroscopic/separation analysis, we offer cutting edge products and high-quality solutions globally to our forefront customers. Contact: Hideki Waki, Beam Technology Sales & Marketing, hideki.waki.wd@hitachi-hightech.com

HORIBA Instruments Inc. #510

7007 SW Cardinal Ln, Ste 185, Semiconductor, Portland, OR, 97224 United States
+1 503 624 9767
mark.mahoney@horiba.com; www.horiba.com

Featured Product: Blank Reticle and Reticle Particle Detection System/ Particle Removal System

HORIBA Instruments Semiconductor Division provides metrology and instrumentation solutions for a wide range of applications and industries, including particle detection / removal on reticles and pellicles (EUV and optical), Horiba provides solutions for wet process control, measurement and analysis via Chemical Concentration Monitors, Raman Spectroscopy, Ellipsometry, etc. Horiba also provides a wide range of fluid / gas flow control and instrumentation for etch and deposition. Contact: Mark Mahoney, Sales Manager, mark.mahoney@horiba.com; Dustin Hoeffel, Product Manager, dustin.hoeffel@horiba.com

ibss Group, Inc. #114

SPIE Corporate Member

111 Anza Blvd., Suite 110, Burlingame, CA 94010 United States
+1 650 513 1488
andrewvillegas@ibssgroup.com; www.ibssgroup.com

INKO Industrial Corp. #512

695 Vaqueros Ave, Sunnyvale, CA, 94085-3524 United States
+1 408 830 1040; fax +1 408 830 1058
sales@pellicle-inko.com; www.pellicle-inko.com

Featured Product: pellicle, ArF pellicle, KrF pellicle, I/G line pellicle

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 248nm/193nm DUV lithography, we have the right pellicles for your needs. Contact: Joe Mac, Sales and Customer Service Manager, joemac@pellicle-inko.com, or Feng Ye, ye@pellicle-inko.com

JENOPTIK Optical Systems, LLC #112

SPIE Corporate Member

16490 Innovation Dr, Jupiter, FL, 33478-6428 United States
+1 561 881 7400; fax +1 561 881 1947
sales@jenoptik-inc.com; www.jenoptik.us

Jenoptik Optical Systems is a globally operating photonics technology group which is present in more than 80 countries. Optical technologies are the very basis of our business. We design and build high-performance optical and micro optical lenses and systems leading semiconductor manufacturing equipment, medical diagnostic instruments, security and projection systems as well as internet communications technology. We are ISO 9001 and ISO 13485 certified as well as ITAR compliant. Contact: Mark Bigelow, Director Business Development, Mark.Bigelow@jenoptik-inc.com; Jim Hillendahl, Applications Engineer, jim.hillendahl@jenoptik-inc.com

Sponsor

Micro Lithography, Inc. #208

1257 Elko Dr, Sunnyvale, CA, 94089-2211 United States
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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.

Mitsui Chemicals America, Inc. #207

61 Metro Dr, San Jose, CA, 95110 United States
+1 408 487 2891; fax +1 408 453 0684
www.mitsuichemicals.com

MSP Corporation #106

5910 Rice Creek Pkwy Ste 300, Shoreview, MN, 55126 United States
+1 651 287 8100; fax +1 651 287 8140
sales@mspcorp.com; www.mspcorp.com

Featured Product: Particle Deposition Services for EUV & Optical Photomask Inspection, Calibration & System Matching

MSP, a Division of TSI, provides services and equipment for optical photomasks for development, calibration, and qualification of reticle inspection systems. With equipment for depositing particle size standards and material standards on patterned or unpatterned EUV as small as 10nm and as large as 20 um, PSL spheres can be deposited in spot patterns, ranging from 10 to 25 mm in diameter. MSP Process Particles Suspensions include 13 materials for deposition: Si, Si3N4, Al2O3, Ti, and W. Contact: Bill Dick, Global Product Manager, wdick@mspcorp.com

Nano-Master, Inc. #516

3019 Alvin Devane Blvd Ste 300, Austin, TX, 78741-7416 United States
+1 512 385 4552; fax +1 512 385 4900
main@nanomaster.com; www.nanomaster.com

Nano-Master, Inc. manufactures and custom designs tools for Thin Film Processing areas. Nano-Master products include PECVD systems for deposition of SiO2, Si3N4, DLC and CNT; PE-MOCVD Systems for GaN growth; Sputtering Systems (reactive, co-sputtering, combinatorial); Thermal and E-beam Evaporators, Ion Beam and Reactive Etching Systems; Megasonic Wafer/Mask Cleaners.

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Nikon Glass Business Unit #514

1399 Shoreway Rd, Glass, Belmont, CA, 94002-4107 United States
+1 650 454 7360; fax +1 650 508 4600
Glass.Sales@nikon.com; www.nikon.com/products/glass/index.htm

Featured Product: Photomask substrate, Optics and raw material of silica glass, CaF2, Optical glass and etc.

Nikon's highly transparent, highly pure synthetic silica glass has superior internal qualities, such as no bubbles or inclusions. It is ideally suited for large FPD photomask substrates as, when manufactured, it is larger than commonly used silica glass. Nikon's FPD photomask substrates are produced from this superior quality large material using precision polishing, cleaning and measurement technologies. We provide photomask substrates as large as 2,000 mm. Contact: Naoyasu Uehara, Sales and Marketing, naoyasu.uehara@nikon.com

Nippon Control System Corp. #408

1999 S Bascom Ave Ste 700, US Branch, Campbell, CA, 95008 United States
+1 408 737 0338; fax +1 408 737 0329
ncs-patacon@nippon-control-system.co.jp; www.nippon-control-system.co.jp

Featured Product: NDE Mask Manufacture Suite (NDE-MS)

Nippon Control System Corp (NCS) has been dedicated to semiconductor Industry for 30 years. PATACON PC-cluster which NCS provided was one of the most reliable MDP system in the world. NDE Mask Manufacture Suite (NDE-MS) is the successor and offers total solutions to mask manufacture that covers from post-OPC though pre-mask writing. NDE-MS contains fracture, MPC, MRC, pattern-match, shot count reduction, and more. Contact: Shu Ohara, Director, oohara@nippon-control-system.co.jp

NTT Advanced Technology Corp. #211

1950 University Ave Ste 600, East Palo Alto, CA, 94303-2250 United States
+1 408 392 4280; fax +1 408 573 7721
bizdevelop@ml.ntt-at.co.jp; www.ntt-at.com

Featured Product: EUV Optics

NTT Advanced Technology Corporation (NTT-AT) delivers optical solutions for EUV lithography and related technologies including Multilayer mirrors, Nano-scale test patterns, Ultra-thin SiN/SiC membranes and Fresnel zone plates. These leading-edge custom design components are fabricated for R&D solutions of light sources, inspection systems, photo resist and other fields. NTT-AT's optics are corresponding to LPPs, SRs/XFELs, HHGs and soft x-ray lasers. Contact: Mayumi Yamashita, Sales and Business Development, m.yamashita@ntt-at.com; Masatoshi Hatayama, Sales Engineer, masatoshi.hatayama@ntt-at.co.jp

Plasma-Therm LLC #407

SPIE Corporate Member

10050 16th St N, Saint Petersburg, FL, 33716-4219 United States
+1 727 577 4999; fax +1 727 577 7035
sales@plasmatherm.com; www.plasmatherm.com

Featured Product: Plasma-Therm Mask Etcher ®

Plasma-Therm is a leading provider of advanced plasma processing equipment. Our systems perform critical process steps in the fabrication of integrated circuits, micro-mechanical devices, solar power cells, lighting, and components of products from computers and home electronics to military systems and satellites. The company's Mask Etcher® series for photomask production has exceeded technology roadmap milestones for more than 15 years.

Pozzetta, Inc. #309

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

Featured Product: Photomask Boxes, Reticle Casettes, SMIF Pods, Wafer Carriers, PFA Fittings

We help our customers reduce costs with customized in-process solutions such as reticle boxes, wafer carriers, PFA fittings, and critical device shipping solutions. We help optimize fab space by personally reviewing the storage and processing of critical devices and delivering complete solutions that include tracking tags, reticle pods and custom cleanroom storage solutions. We also help manage cleaning and maintenance programs for cassettes, pods and wet process stations. Contact: Scott Reese, Account Executive, scott.reese@pozzetta.com; Artemis Vasiliades, Account Executive, artemis.vasiliades@gmail.com

Sponsor

RAVE LLC #308

430 S Congress Ave Ste 7, Delray Beach, FL, 33445 United States
+1 561 330 0411; fax +1 561 330 0896
ravesales@ravenano.com; www.ravenano.com

Featured Product: nm-VI® 7nm Nanomachine; fp-III® 45nm Laser Repair; Rhazer-III® Haze Removal

RAVE is a technology driven company with a 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 taking orders for the new 6th Generation – nmVI® 7nm Nanomachining Mask Repair System, the new 3rd Generation – Rhazer-III® Haze Removal System and RAVE's newest system, the 3rd Generation – fp-III® Femto-Pulse Laser Mask Repair System. Contact: Brian Grenon, Executive Director of Worldwide Sales & Marketing, Brian.Grenon1@ravenano.com; Michael Archuletta, Director of Marketing, Michael.Archuletta@ravenano.com

Rigaku Innovative Technologies, Inc. #410

SPIE Corporate Member

1900 Taylor Rd, Auburn Hills, MI, 48326-1740 United States
+1 248 232 6400; fax +1 248 232 6500
optics@rigaku.com; www.RigakuOptics.com

Featured Product: EUVL Optics and Coatings

RIT is at the forefront of Multilayer optic technology for EUV Lithography. Formerly Osmic Inc., RIT was the first commercial supplier of multilayer optics for X-ray Sciences. Since 1993 RIT has been a global leader in the development and supply of EUV optics thus shaping the vision of EUVL for high volume manufacturing. For additional information about RIT and its EUV related product, please visit www.rigaku.com/products/optics/euv. Contact: Alex Sedlacek, Sales Engineer, alex.sedlacek@rigaku.com

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Shin-Etsu MicroSi, Inc. #306

SPIE Corporate Member

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, Synthetic quartz substrates, photoresist

From its corporate and manufacturing headquarters in Phoenix, Arizona Shin-Etsu MicroSi supplies a worldwide customer base with the most advanced technologies and innovative products. As a subsidiary of Shin-Etsu Chemical Company, LTD., MicroSi is backed by the development and technical strength of one of the worlds largest suppliers to the semiconductor industry. Contact: Edwin Nichols, Marketing Manager, enichols@microsi.com

Solid State Technology #1-Lit

1786 18th St, San Francisco, CA, 94107-2343 United States
+1 415 255 0390; fax +1 415 255 9214
info@extensionmedia.com; solid-state.com

Featured Product: solid-state.com

Solid State Technology reaches the largest, most qualified community of decision makers for semiconductor and electronics manufacturing through the magazine, email newsletters, website, webcasts and The ConFab Conference & Networking event. Topics include Advanced Packaging, MEMS, LEDs and Displays as well as current trends in the industry. Visit us here www.solid-state.com Contact: Kerry Hoffman, Director of Sales, khoffman@extensionmedia.com

XYALIS #206

SPIE Corporate Member

5 Pl Robert Schuman, Grenoble, 38000 France
+33 4 56 58 36 34; fax +33 476 282 849
info@xyalis.com; www.xyalis.com

Featured Product: With XYALIS geometric signature trace the design not the layout file for faster, safer exchanges.

XYALIS expertise in Mask Data Preparation and its flexible MDP software toolset complement your existing flow (OPC, fracturing…) to deliver complex field and mask layout faster while removing the risk of error during mask and wafer production. We help you automate your flow from layout finishing to mask order: MPW placement, frame generation, maskset layout and layout manipulation tools able to handle the largest designs with optimum performance and memory usage. Contact: Sylvie Hurat, US Area Manager, sylvie@xyalis.com

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Rigaku Innovative Technologies, Inc.

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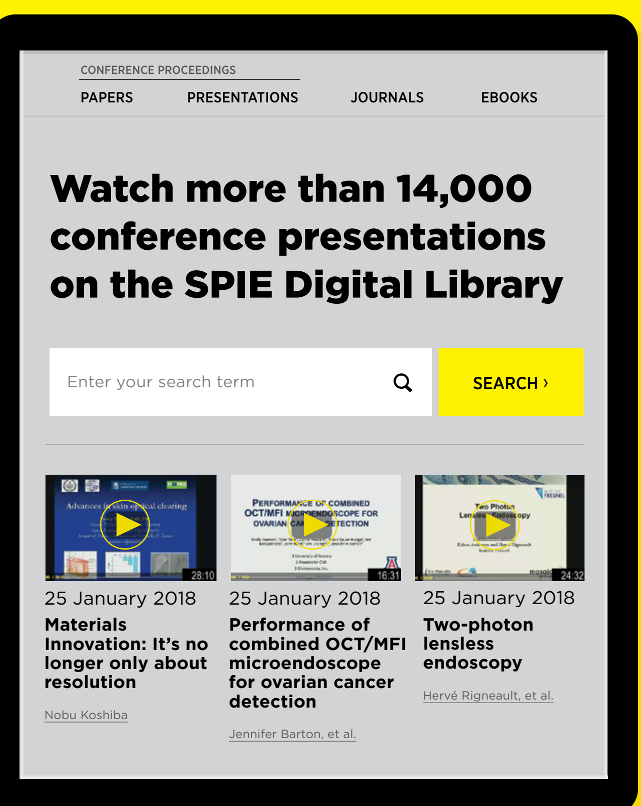

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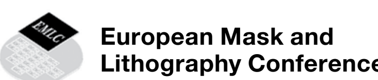

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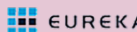
CONFERENCE 10809

Monday–Thursday 17–20 September 2018
Proceedings of SPIE Vol. 10809
Location: Monterey Conf. Ctr., Steinbeck 3

International Conference on Extreme Ultraviolet Lithography 2018

Conference Chairs: **Kurt G. Ronse,** imec (Belgium); **Eric Hendrickx,** imec (Belgium); **Patrick P. Naulleau,** Lawrence Berkeley National Lab. (United States); **Paolo A. Gargini,** Stanford Univ. (United States); **Toshiro Itani,** EUVL Infrastructure Development Ctr., Inc. (Japan)

Program Committee: **Eric M. Panning,** Intel Corp. (United States); **Winfried Kaiser,** Carl Zeiss SMT GmbH (Germany); **Satoshi Tanaka,** EUVL Infrastructure Development Ctr., Inc. (Japan)

Conference Cosponsors: 

MONDAY 17 SEPTEMBER

OPENING REMARKS

Location: Monterey Conf. Ctr., Steinbeck 2 . . . . 8:00 to 8:20 am

Joint with conferences 10809 and 10810

SESSION 1

LOCATION: MONTEREY CONF. CTR., STEINBECK 2 . . . . MON 8:20 to 9:40 am

Plenary Session

Joint session with conferences 10809 and 10810.

Session Chairs: **Patrick P. Naulleau,** Lawrence Berkeley National Lab. (United States); **Frank E. Abboud,** Intel Corp. (United States)

8:20 am: **Accelerate lithography improvement for high-performance computing** *(Plenary)*, John Y. Chen, NVIDIA Corp. (United States) [10809-1]

9:00 am: **Current Challenges and Opportunities for EUV Lithography** *(Plenary)***,** Timothy A. Brunner, GLOBALFOUNDRIES Inc. (United States) . . . . [10809-2]

Coffee Break . . . . Mon 9:40 to 10:10 am

EUV LITHOGRAPHY OPENING REMARKS

Location: Monterey Conf. Ctr., Steinbeck 3 . . . . . . 10:10 to 10:20 am

SESSION 2

Location: Monterey Conf. Ctr., Steinbeck 3 . Mon 10:20 am to 12:10 pm

EUV Scanner and Source

Session Chairs: **Chang-Moon Lim,** SK Hynix, Inc. (Korea, Republic of); **Takayuki Uchiyama,** EIDEC (Japan)

10:20 am: **NXE:3400B scanner, EUV high-volume manufacturing for 7nm node lithography and beyond** *(Invited Paper)*, Marcel Mastenbroek, ASML Netherlands B.V. (Netherlands) . . . . [10809-3]

10:50 am: **NXE:3400B imaging performance assessed from a customer perspective**, Friso Wittebrood, Guido Schiffelers, Colette Legein, ASML Netherlands B.V. (Netherlands) . . . . [10809-4]

11:10 am: **Long collector mirror lifetime demonstration around 100W average LP-EUV source for semiconductor high volume manufacturing**, Hakaru Mizoguchi, Hiroaki Nakarai, Tamotsu Abe, Yasufumi Kawasuji, Hiroshi Tanaka, Yukio Watanabe, Tsukasa Hori, Takeshi Kodema, Yutaka Shiraishi, Tatsuya Yanagida, Georg Soumagne, Tsuyoshi Yamada, Taku Yamazaki, Takashi Saitou, Gigaphoton Inc. (Japan) . . . . [10809-5]

11:30 am: **Accelerator-based compact extreme ultraviolet (EUV) sources for lithography**, Juhao Wu, Alexander W. Chao, SLAC National Accelerator Lab. (United States). . . . . [10809-6]

11:50 am: **Upgrade plan of cERL for the POC as a first stage of the development on EUV-FEL high power light source**, Hiroshi Kawata, Norio Nakamura, Ryukou Kato, High Energy Accelerator Research Organization, KEK (Japan). . . . . [10809-7]

Lunch Break . . . . Mon 12:10 pm to 1:40 pm

CONFERENCE 10810

Monday–Thursday 17–20 September 2018
Proceedings of SPIE Vol. 10810
Location: Monterey Conf. Ctr., Steinbeck 2

Photomask Technology

Conference Chair: **Emily E. Gallagher,** imec (Belgium)

Conference Co-Chair: **Jed H. Rankin,** GLOBALFOUNDRIES Inc. (United States)

Program Committee: **Frank E. Abboud,** Intel Corp. (United States); **Uwe F.W. Behringer,** UBC Microelectronics (Germany); **Peter Buck,** Mentor, a Siemens Business (United States); **Byungcheol (Brian) Cha,** SAMSUNG Electronics Co., Ltd. (Korea, Republic of); **Lucien Bouchard,** Photronics, Inc. (United States); **Thomas B. Faure,** GLOBALFOUNDRIES Inc. (United States); **Aki Fujimura,** D2S, Inc. (United States); **Brian J. Grenon,** RAVE LLC (United States); **Naoya Hayashi,** Dai Nippon Printing Co., Ltd. (Japan); **Izak Kapilevich,** Applied Materials, Inc. (United States); **Bryan S. Kasprowicz,** Photronics, Inc. (United States); **Byung Gook Kim,** SAMSUNG Electronics Co., Ltd. (Korea, Republic of); **Lloyd C. Litt,** GLOBALFOUNDRIES Inc. (United States); **Paul A. Morgan,** Micron Technology, Inc. (United States); **Kent H. Nakagawa,** Toppan Photomasks, Inc. (United States); **Takahiro Onoue,** HOYA Corp. (Japan); **Jan Hendrik Peters,** BMBG Consult (Germany); **Moshe E. Preil,** KLA-Tencor Corp. (United States); **Douglas J. Resnick,** Canon Nanotechnologies, Inc. (United States); **Thomas Scherübl,** Zeiss (Germany); **Yuyang Sun,** Mentor Graphics Corp. (United States); **Bala Thumma,** Synopsys, Inc. (United States); **Banqiu Wu,** Applied Materials, Inc. (United States); **Shusuke Yoshitake,** NuFlare Technology, Inc. (Japan)

MONDAY 17 SEPTEMBER

OPENING REMARKS

Location: Monterey Conf. Ctr., Steinbeck 2 . . . . 8:00 to 8:20 am

Joint with conferences 10809 and 10810

SESSION 1

LOCATION: MONTEREY CONF. CTR., STEINBECK 2 . . . . .MON 8:20 to 9:40 am

Plenary Session

Joint session with conferences 10809 and 10810.

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9:00 am: **Current Challenges and Opportunities for EUV Lithography** *(Plenary)***,** Timothy A. Brunner, GLOBALFOUNDRIES Inc. (United States) . . . . [10809-2]

Coffee Break . . . . Mon 9:40 am to 10:10 am

PHOTOMASK OPENING REMARKS

Location: Monterey Conf. Ctr., Steinbeck 2 . . . 10:10 am to 10:20 am

SESSION 1A

LOCATION: MONTEREY CONF. CTR., STEINBECK 2 . . .MON 10:20 to 10:40 am

Invited Session

Session Chairs: **Emily E. Gallagher,** IMEC (Belgium); **Jed H. Rankin,** GLOBALFOUNDRIES Inc. (United States)

10:20 am: **2018 Mask Maker Survey conducted by the eBeam Initative** *(Invited Paper)*, Aki Fujimura, D2S, Inc. (United States); Jan Willis, eBeam Initiative (United States) . . . .[10810-57]

CONFERENCE 10809 CONTINUED

International Conference on

Extreme Ultraviolet Lithography 2018

MONDAY 17 SEPTEMBER

SESSION 3

Location: Monterey Conf. Ctr., Steinbeck 3 . . . . Mon 1:40 to 3:30 pm

EUV Process Control

Session Chairs: **Anuja De Silva,** IBM Corp. (United States); **Danilo De Simone,** IMEC (Belgium)

1:40 pm: **EUV stochastic defect monitoring with advanced broadband optical wafer inspection and e-beam review systems** *(Invited Paper)*, Kaushik Sah, KLA-Tencor Corp. (United States); Andrew Cross, KLA-Tencor England (United Kingdom); Martin Plihal, Vidyasagar Anantha, Raghav Babulnath, KLA-Tencor Corp. (United States); Peter De Bisschop, Sandip Halder, imec (Belgium); Derek Fung, KLA-Tencor Corp. (United States) . . . . [10809-8]

2:10 pm: **Non-Gaussian CD distribution characterization for DRAM application in EUV lithography**, Alessandro Vaglio Pret, KLA-Tencor Texas (United States); Inhwan Lee, Mijung Lim, SK Hynix, Inc. (Korea, Republic of); Trey Graves, David Blankenship, Stewart A. Robertson, John J. Biafore, KLA-Tencor Texas (United States) . . . . [10809-9]

2:30 pm: **Advanced modeling of anisotropic stochastics in EUV resist**, Luke Long, Andrew Neureuther, Univ. of California, Berkeley (United States); Patrick Naulleau, Lawrence Berkeley National Lab. (United States). . . . . [10809-10]

2:50 pm: **Massive CD metrology for EUV failure characterization and EPE metrology**, Harm Dillen, ASML Netherlands B.V. (Netherlands); Yi-Hsin Chang, Fei Wang, Marc Kea, ASML US, Inc. (United States); Gijsbert Rispens, Marleen Kooiman, ASML Netherlands B.V. (Netherlands); Stefan Hunsche, Fuming Wang, ASML US, Inc. (United States); Jo Finders, ASML Netherlands B.V. (Netherlands) . . . . [10809-11]

3:10 pm: **Using machine learning algorithms to understand stochastic behaviour of EUV based patterning for N7 and smaller nodes**, Sandip Halder, Philippe Leray, imec (Belgium) . . . . [10809-12]

Coffee Break . . . . Mon 3:30 pm to 4:00 pm

CONFERENCE 10810 CONTINUED

Photomask Technology

MONDAY 17 SEPTEMBER

SESSION 2

Location: Monterey Conf. Ctr., Steinbeck 2 . .Mon 10:40 am to 12:10 pm

Deep Learning and Advanced Data Analytics

Session Chairs: **Aki Fujimura,** D2S, Inc. (United States); **Peter Buck,** Mentor, a Siemens Business (United States)

10:40 am: **Deep learning primer: data is the new source code** *(Invited Paper)*, Aki Fujimura, Mike Meyer, D2S, Inc. (United States); Noriaki Nakayamada, NuFlare Technology, Inc. (Japan) . . . . [10810-1]

11:05 am: **The self-driving photomask** *(Invited Paper)*, James P. Shiely, Synopsys, Inc. (United States) . . . . [10810-2]

11:30 am: **Fracture time predictor in mask data preparation using machine learning**, Diego Palma, Daniel Calderon, Synopsys Chile Ltda. (Chile) . [10810-4]

11:50 am: **Deep learning in DFM applications**, Tetsuaki Matsunawa, Shigeki Nojima, Toshiba Corp. (Japan) . . . . [10810-5]

Lunch Break . . . . Mon 12:10 pm to 1:40 pm

SESSION 3

Location: Monterey Conf. Ctr., Steinbeck 2 . . . . Mon 1:40 to 3:30 pm

Mask Inspection, Metrology, and Repair

Session Chairs: **Moshe E. Preil,** KLA-Tencor Corp. (United States); **Brian J. Grenon,** RAVE LLC (United States)

1:40 pm: **Minimizing tone reversal during 19x nm mask inspection: PMJ18 Best Paper** *(Invited Paper)*, Masashi Yonetani, Toppan Photomasks, Inc. (United States); Kazunori Seki, Toppan Printing Co., Ltd. (Japan); Karen D. Badger, GLOBALFOUNDRIES Inc. (United States); Anka Birnstein, Jan Heumann, Advanced Mask Technology Ctr. GmbH Co. KG (Germany); Takeshi Isogawa, Toshio Konishi, Yutaka Kodera, Toppan Printing Co., Ltd. (Japan) . . . . [10810-6]

2:10 pm: **Sensitivity optimization for early 7nm EUV masks using an optical 19x nm inspection system**, Karen D. Badger, GLOBALFOUNDRIES Inc. (United States); Masashi Yonetani, Yusuke Toda, Masayuki Kagawa, Toppan Photomasks, Inc. (United States); Takeshi Isogawa, Toppan Printing Co., Ltd. (Japan); Jan Heumann, Advanced Mask Technology Ctr. GmbH Co. KG (Germany) . . . . [10810-7]

2:30 pm: **Ultrashort pulse laser repair of masks for advanced lithography technologies**, Tod E. Robinson, Jeff LeClaire, RAVE LLC (United States)[10810-8]

2:50 pm: **Fast local registration measurements for efficient e-beam writer qualification and correction: EMLC18 Best Paper** *(Invited Paper)*, Klaus-Dieter Roeth, Hendrik Steigerwald, Runyuan Han, Oliver Ache, Frank Laske, KLA-Tencor MIE GmbH (Germany) . . . . [10810-58]

3:10 pm: **Simulation of fogging electron trajectories in a scanning electron microscope: PMJ18 Best Paper** *(Invited Paper)*, Yuka Ito, Takotoshi Donga, Kentaro Morimoto, Masatoshi Kotera, Osaka Institute of Technology (Japan) . . . . . [10810-10]

Coffee Break . . . . Mon 3:30 pm to 4:00 pm

SELECTED POSTER SPEED TALKS:

LOCATION: MONTEREY CONF. CTR., STEINBECK 2. . . . . 4:00 to 5:50 pm

Joint Session with conferences 10809 and 10810

Session Chairs: **Eric Hendrickx,** imec (Belgium); **Emily E. Gallagher,** imec (Belgium); **Jed H. Rankin,** GLOBALFOUNDRIES Inc. (United States)

Four poster authors are invited to give 10-minute speed-talks

4:10 pm: **Intra-field mask-to-mask overlay: separating the mask writing from the dynamic pellicle contribution (PMJ18 Best Poster)**. . . . . Paper 10810-38
Author: Richard J. F. van Haren, ASML Netherlands B.V. (Netherlands)

4:20 pm: **Deep supervised learning to estimate true rough line images from SEM images** . . . . Paper 10810-60
Author(s): Narendra Chaudhary, Serap A. Savari, Sai Swaroop Yeddulapalli, Texas A&M Univ. (United States)

4:30 pm: **EUV mask and pellicle metrology for high-volume manufacturing** . . . . Paper 10810-42
Author(s): Rupert Perera, EUV Technology (USA)

4:40 pm: **Operational and productization status of Adlyte's light source for actinic patterned mask inspection HVM tools**. . . . . Paper 10809-55
Author(s): Fariba Abhari, Adlyte (Switzerland)

Additional authors are selected to present 2-minute speed talks introducing their work. These authors will be available at their posters during the poster session starting at 6:00 pm for more in-depth discussion with attendees.

International Conference on

Extreme Ultraviolet Lithography 2018

MONDAY 17 SEPTEMBER POSTERS

POSTER SESSIONS

Location: Marriott, San Carlos Foyer . . . . Mon 6:00 to 7:30 pm

Symposium attendees are invited to attend the poster session on Monday evening in the Monterey Marriott, San Carlos Foyer, Mezzanine Level. Authors will be present during the poster reception for the from 6:00 pm to 7:30 pm to answer questions and provide in-depth discussion regarding their work.

Attendees are requested to wear their conference registration badge.

EUV Mask

Validation of EUV mask defect disposition using SEM-2-Aerial, Gisung Yoon, Daniel Price, Paul A. Morgan, Daniel Rost, Micron Technology, Inc. (United States); Masaki Satake, Vikram L. Tolani, Dean Yonenaga, KLA-Tencor Corp. (United States). . . . . [10809-42]

Optimization of absorber and multilayer in EUV mask for 1D and 2D patterns, Zhizhen Yang, North China Univ. of Technology (China); Lisong Dong, Yayi Wei, Institute of Microelectronics (China); Jiang Yan, Jing Zhang, Yanrong Wang, North China Univ. of Technology (China); Taian Fan, Institute of Microelectronics (China) . . . . [10809-43]

Holographic masks for computational proximity lithography with EUV radiation, Valerie Deuter, Forschungszentrum Jülich GmbH (Germany) and RWTH Aachen Univ. (Germany); Maciej Grochowicz, RWTH Aachen Univ. (Germany) and Warsaw Univ. of Technology (Poland); Jan Biller, RWTH Aachen Univ. (Germany) and Forschungszentrum Jülich GmbH (Germany); Sascha Brose, Thomas Taubner, RWTH Aachen Univ. (Germany); Agnieszka Siemion, Warsaw Univ. of Technology (Poland); Detlev Grützmacher, Forschungszentrum Jülich GmbH (Germany); Larissa Juschkin, RWTH Aachen Univ. (Germany) and Forschungszentrum Jülich GmbH (Germany) . . . . [10809-44]

Mask 3D effects experimental measurements with NA 0.55 anamorphic imaging, Vincent Wiaux, Vicky Philipsen, Eric Hendrickx, imec (Belgium) . . . . [10809-45]

Extreme ultraviolet pellicle cooling by hydrogen gas flow, Hye-Lim Lee, Sung-Gyu Lee, Jae-Hun Park, Hye-Keun Oh, Hanyang Univ. (Korea, Republic of) . . . . [10809-46]

Maximizing thermal emission characteristics of EUV pellicle, Yong Ju Jang, Seong Ju Wi, Hanyang Univ. (Korea, Republic of); Juhee Hong, Kee Soo Nam, S&S TECH (Korea, Republic of); Jinho Ahn, Hanyang Univ. (Korea, Republic of) . . . . [10809-47]

Mechanical property enhancement of SiNx pellicle layer by graphene, Seong In Kim, Gangwon Technopark (Korea, Republic of); Jinho Ahn, Hanyang Univ. (Korea, Republic of) . . . . [10809-48]

EUV-PTT: The EUV pellicle transmission mapping tool, Rainer Lebert, Christian Pampfer, Andreas Biermanns-Foeth, Thomas Missalla, Christoph Phiesel, Jennifer Arps, Christian Piel, RI Research Instruments GmbH (Germany) . . . . [10809-49]

Evaluation of mechanical strength improvement by stress improvement of EUV pellicle membrane, Gi-Sung Lee, Gap-Sub Sim, Dongeun Yoo, National Nanofab Ctr. (Korea, Republic of) . . . . [10809-50]

Pattern degradation with larger particles on EUV pellicle, Hee-Ra No, Sung-Gyu Lee, Hye-Keun Oh, Hanyang Univ. (Korea, Republic of) . . [10809-51]

Defect avoidance for extreme-ultraviolet mask defects using intentional pattern deformation, Yoo-Jin Chae, Puneet Gupta, Univ. of California, Los Angeles (United States); Rik Jonckheere, IMEC (Belgium) . . . . [10809-52]

AIMER™: full reticle area, scanner-effective EUV reflectometry mapping, Rainer Lebert, Christoph Phiesel, Andreas Biermanns-Foeth, Jennifer Arps, Thomas Missalla, Christian Piel, RI Research Instruments GmbH (Germany). . . . . [10809-53]

History of actinic inspection of phase defects on EUVL mask blanks, Tosihisa Tomie, Changchun Univ. of Science and Technology (China) [10809-54]

Photomask Technology

MONDAY 17 SEPTEMBER POSTERS

POSTER SESSIONS

Location: Marriott, San Carlos Foyer . . . . Mon 6:00 to 7:30 pm

Poster Sessions

Symposium attendees are invited to attend the poster session on Monday evening in the Monterey Marriott, San Carlos Foyer, Mezzanine Level. Authors will be present during the poster reception for the from 6:00 pm to 7:30 pm to answer questions and provide in-depth discussion regarding their work.

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Mask Inspection, Metrology, and Repair

Pattern edge roughness study on OMOG mask repair, Xuefei Qin, Jie Wang, Irene Shi, Fen Xue, Alan Li, Wenjun Ling, Elena Cong, Semiconductor Manufacturing International Corp. (China) . . . . [10810-9]

Throughput improvement method for cross-sectional profile measurement of hole patterns in nanoimprint template, Kazuki Hagihara, Rikiya Taniguchi, Eiji Yamanaka, Takashi Hirano, Toshiba Memory Corp. (Japan); Yoshiyasu Ito, Kiyoshi Ogata, Kazuhiko Omote, Rigaku Corp. (Japan); Naoya Hayashi, Dai Nippon Printing Co., Ltd. (Japan) . . . . [10810-18]

Using 3D Monte Carlo simulation to develop resists for next-generation lithography, Hayden Alty, Scott Lewis, Richard E. P. Winpenny, Stephen Yeates, The Univ. of Manchester (United Kingdom) . . . . [10810-36]

Optimizing the partial coherence factor of a deep-ultraviolet microscope to enhance critical dimension and defect sensitivity for a OMOG photomask, Martin Y. Sohn, Yoon Sung Bae, Bryan M. Barnes, National Institute of Standards and Technology (United States); Sang-Soo Choi, Photronics, Inc. (Korea, Republic of); Ronald G. Dixson, Richard M. Silver, National Institute of Standards and Technology (United States) . . . . [10810-37]

Intra-field mask-to-mask overlay: separating the mask writing from the dynamic pellicle contribution (PMJ18 Best Poster), Richard J. F. van Haren, ASML Netherlands B.V. (Netherlands) . . . . [10810-38]

Multiple beam technology development and application for defect inspection on EUV wafer/mask, Eric L. Ma, Hermes-Microvision Inc., USA (United States) . . . . [10810-39]

KLA DNIR generation by SmartMRC, Xiaoming Fan, Xuan Zhu, Cong Lu, Danyi Zhu, Semiconductor Manufacturing International Corp. (China); Yuan Zhang, Kokoro Kato, Synopsys, Inc. (United States) . . . . [10810-40]

Design of phase-shifting algorithm for measuring the optical thickness variation of mask blank in wavelength tuning Fizeau interferometer, Yangjin Kim, Pusan National Univ. (Korea, Republic of); Mamoru Mitsuishi, The Univ. of Tokyo (Japan) . . . . [10810-41]

Improving mask yield by implementing an advanced mask blank inspection system, Gregg A. Inderhees, Bill Kalsbeck, Alexander Tan, KLA-Tencor Corp. (United States); JeongHun Seo, SAMSUNG Electronics Co., Ltd. (Korea, Republic of) . . . . [10810-59]

EUV Pellicle and Metrology

Simplified numerical method for analyzing pellicle defect printability in EUV lithography, Chih Tsung Shih, Hung-Wen Cho, Hao-Shiang Chang, Fu-Jye Liang, Bo-Tsun Liu, Tommy Lee Sr., C.K. Chen, John C. Lin, Li-Kong Turn Sr., Taiwan Semiconductor Manufacturing Co. Ltd. (Taiwan) . . . . [10810-43]

EUV mask and pellicle metrology for high-volume manufacturing, Rupert Perera, EUV Technology (United States). . . . . [10810-42]

Mask Process and Resist

3D NTD resist deformation compact model for OPC and ILT applications, Rich Wu, Synopsys Taiwan Ltd. (Taiwan); Delian Yang, Folarin Latinwo, Kevin Lucas, Hua Song, Synopsys, Inc. (United States). . . . . [10810-44]

A study of the TMAH based clean performance on advanced photomask, Fen Xue, Irene Shi, Alan Li, Eric Tian, Ming Chen, Max Lu, Semiconductor Manufacturing International Corp. (China); Fei Xu, Wei Jiang, Jian Shen, Changzhou Ruize Microelectronics Technology Co., Ltd. (China) . . . . [10810-45]

Fabrication method of the patterned mask for controllable growth of low-dimensional semiconductor nanostructures form Renewable Energy Sources Laboratory, Liliia Dvoretckaia, Alexey M. Mozharov, Vladimir V. V. Fedorov, Alexey A. D. Bolshakov, St. Petersburg Academic Univ. (Russian Federation); Ivan I. S. Mukhin, St. Petersburg Academic Univ. (Russian Federation) and ITMO Univ. (Russian Federation) . . . . [10810-46]

International Conference on

Extreme Ultraviolet Lithography 2018

MONDAY 17 SEPTEMBER POSTERS

EUV Source

Operational and productization status of Adlyte's light source for actinic patterned mask inspection HVM tools, Fariba Abhari, Adlyte (Switzerland) . . . . . [10809-55]

NXE:3400B EUV source performance in the field, readiness for high volume manufacturing and power scaling beyond 250W, Igor V. Fomenkov, Michael A. Purvis, Alexander A. Schafgans, Yezheng Tao, Slava Rokitski, Jayson Stewart, Andrew LaForge, Alexander I. Ershov, Robert J. Rafac, Silvia De Dea, Chirag Rajyaguru, Georgiy O. Vaschenko, Mathew Abraham, David C. Brandt, Daniel J. Brown, ASML US, LP (United States) . . . . . [10809-56]

Key components development progress of high-power LPP-EUV light source with unique debris mitigation system using a magnetic field, Yuichi Nishimura, Tsukasa Hori, Takayuki Yabu, Katsuhiko Wakana, Yoshifumi Ueno, Georg Soumagne, Shinji Nagai, Tatsuya Yanagida, Yasufumi Kawasuji, Yutaka Shiraishi, Tamotsu Abe, Hiroaki Nakarai, Takashi Saito, Hakaru Mizoguchi, Gigaphoton Inc. (Japan). . . . . [10809-57]

Collector cleaning by surface wave plasma in the Illinois NXE:3100 chamber, Gianluca A. Panici, Dren Qerimi, David N. Ruzic, Univ. of Illinois (United States) . . . . . [10809-58]

Cost-of-ownership improvements for droplet-based LPP EUV light source for HVM APMI applications, Reza S. Abhari, Markus Brandstätter, Jeremy Nickol, Marco Weber, Duane Hudgins, Flori Alickaj, ETH Zurich (Switzerland); Fariba Abhari, Adlyte (Switzerland). . . . . [10809-59]

The Impact of the sub-fab on the availability of EUVL, Anthony M. Keen, Edwards Ltd. (United Kingdom); Niall Walsh, Cansin Badan, Jos Donders, Edwards (Netherlands) . . . . . [10809-60]

High brightness light source based on LPP for actinic EUV nanoscopy and metrology applications, Konstantin Koshelev, EUV Labs, Ltd. (Russian Federation) and Institute of Spectroscopy (Russian Federation) and RnD-ISAN (Russian Federation); Alexander Vinokhodov, Oleg Yakushev, Alexey Yakushkin, Dimitri Abramenko, Alexander Lash, Mikhail Krivokorytov, Yuri Sidelnikov, Vladimir Ivanov, Vladimir Krivtsun, Vyacheslav Medvedev, EUV Labs, Ltd. (Russian Federation) and RnD-ISAN (Russian Federation); Denis Glushkov, Pavel Seroglazov, Samir Ellwi, ISTEQ (Netherlands); Rainer Lebert, RI Research Instruments GmbH (Germany). . . . . [10809-61]

A possible wafer heating during EUV exposure, Se-Hun Oh, Sung-Gyu Lee, Jae-Hun Park, Chung-Hyun Ban, Hye-Keun Oh, Hanyang Univ. (Korea, Republic of) . . . . . [10809-62]

Imaging/Optics

Lateral shearing interferometry for high-NA EUV wavefront measurement, Wenhua Zhu, Ryan H. Miyakawa, Patrick Naulleau, Lawrence Berkeley National Lab. (United States). . . . . [10809-63]

Reflectance measurement of EUV mirrors with s- and p-polarization light using polarization control unit, Tetsuo Harada, Takeo Watanabe, Univ. of Hyogo (Japan) . . . . . [10809-64]

Spatially resolved reflectometry for EUV optical components, Frank Scholze, Andreas Fischer, Claudia Fotso-Kwamou, Victor Soltwisch, Christian Laubis, Physikalisch-Technische Bundesanstalt (Germany) . . . . . [10809-65]

Materials

Actinic tools for EUV photoresist characterization in research and production, Rainer Lebert, Christoph Phiesel, Christian Piel, RI Research Instruments GmbH (Germany); Sascha Brose, Serhiy Danylyuk, Peter Loosen, RWTH Aachen Univ. (Germany); Klaus Bergmann, Jochen Vieker, Fraunhofer-Institut für Lasertechnik (Germany) . . . . . [10809-67]

In-situ measurement of outgassing generated from EUV metal oxide nanoparticles resist, Yoichi Minami, Litho Tech Japan Co., Ltd. (Japan); Seiji Takahashi, Hiroko Minami, Yoko Matsumoto, Mikio Kadoi, Atsushi Sekiguchi, Litho Tech Japan Co. (Japan); Takeo Watanabe, Center for EUVL, Laboratory of Advanced Science and Technology for Industry, University of Hyogo (Japan). . . . . [10809-68]

EUV sensitizer for resists and spin-on-carbon materials, Takashi Sato, Yuta Togashi, Sachiko Shinjo, Takumi Toida, Masatoshi Echigo, Mitsubishi Gas Chemical Co., Inc. (Japan) . . . . . [10809-69]

Photomask Technology

MONDAY 17 SEPTEMBER POSTERS

Mask Write and MPC

Variable shaped beam lithography capabilities enhancement by "small-shots" correction, Aurélien Fay, Alexis Girodon, Jacky Chartoire, Jérôme Hazart, CEA-LETI (France) and Univ. Grenoble Alpes (France); Sébastien Bayle, Patrick Schiavone, ASELTA Nanographics (France) . . . . . [10810-47]

2D SRAF rule extraction for fast application based on model-based results, Yaoxuan Dai, North China Univ. of Technology (China); Xiaojing Su, Pengzheng Gao, Yayi Wei, Institute of Microelectronics (China); Jing Zhang, Yanrong Wang, Jiang Yan, North China Univ. of Technology (China) . . . . . [10810-48]

Inverse bevel retargeting process to solve kissing corner shapes in implant layers, Liang Cao, Jie Zhang, Wenxin Li, Wenchao Jiang, Bob Sayah, Guoxiang Ning, William Wilkinson, Ashutosh Rathi, Harold Mendoza, GLOBALFOUNDRIES Inc. (United States) . . . . . [10810-49]

Multiple exposure on single blank for electron-beam writer characterization, Andre Eilert, Michael Finken, Christian Buergel, Mark Herrmann, Ronald Hellriegel, Rico Nestler, Oliver Loeffler, Frank Huebenthal, Rico Buettner, Katja Steidel, Advanced Mask Technology Ctr. GmbH Co. KG (Germany) . . . . . [10810-50]

Applying MPC for EUV mask fabrication, Dai Tsunoda, Nippon Control System Corp. (Japan); Gek-Soon Chua, GLOBALFOUNDRIES Singapore Pte. Ltd. (Singapore); Christian Buergel, Advanced Mask Technology Ctr. GmbH Co. KG (Germany) . . . . . [10810-51]

EUV Mask Blanks

Nikon's large-size photomask blanks with attenuated phase-shift film for production of high-resolution panels, Takashi Yagami, Yohei Takarada, Kento Hayashi, Takashi Ozawa, Nikon Corp. (Japan). . . . . [10810-53]

Recent bottom layered half-tone mask blanks development for large-sized and high-resolution flat panel displays, Narihiro Morosawa, Yasunori Noguchi, Satoru Mochizuki, Kagehiro Kageyama, ULVAC Coating Corp. (Japan) . . . . . [10810-54]

Deep Learning and Advanced Analytics

Hotspot analysis and empirical correction through mask and wafer technology harmonization, Yohan Choi, Photronics, Inc. (United States); William Chou, Hsin-Fu Chou, C. H. Twu, Adder Lee, United Microelectronics Corp. (Taiwan); Colbert Lu, Josh Tzeng, Photronics DNP Semiconductor Mask Corp. (Taiwan); Michael Green, Mohamed Ramadan, Young Ham, Photronics, Inc. (United States); Shang Hao Yeh, Jeffrey Cheng, Chih Hsuan Chao, United Microelectronics Corp. (Taiwan); Jackie Cheng, H.J. Lee, Photronics DNP Semiconductor Mask Corp. (Taiwan) . . . . . [10810-3]

Automated rough line-edge estimation from SEM images using deep convolutional neural networks, Narendra Chaudhary, Serap A. Savari, Sai Swaroop Yeddulapalli, Texas A&M Univ. (United States). . . . . [10810-56]

Deep supervised learning to estimate true rough line images from SEM images, Narendra Chaudhary, Serap A. Savari, Sai Swaroop Yeddulapalli, Texas A&M Univ. (USA). . . . . [10810-60]

CONFERENCE 10809 CONTINUED

International Conference on

Extreme Ultraviolet Lithography 2018

Development of absorption-coefficient-measurement method of EUV resist by direct-resist coating on a photodiode, Shota Niihara, Tetsuo Harada, Takeo Watanabe, Univ. of Hyogo (Japan) . . . . [10809-70]

Studying resist performance for contact holes printing using EUV interference lithography, Xiaolong Wang, Li-Ting Tseng, Dimitrios Kazazis, Zuhal Tasdemir, Michaela Vockenhuber, Iacopo Mochi, Yasin Ekinci, Paul Scherrer Institut (Switzerland) . . . . [10809-71]

Process Control

Litho performance improvement with novel track processing, Harold W. Stokes Jr., SCREEN Semiconductor Solutions Co., Ltd. (Belgium); Masahiko Harumoto, Yuji Tanaka, Chisayo Nakayama, Charles Pieczulewski, SCREEN Semiconductor Solutions Co., Ltd. (Japan) . . . . [10809-72]

Study of roughness components in the frequency domain via experimental and simulated images, Alessandro Vaglio Pret, John J. Biafore, KLA-Tencor Texas (United States); Chris A. Mack, Fractilia, LLC (United States) . . [10809-73]

Track based techniques to improve high-resolution EUV patterning defectivity, Naoki Shibata, Lior Huli, Corey Lemley, TEL Technology Ctr., America, LLC (United States); Shinichiro Kawakami, Tokyo Electron Kyushu Ltd. (Japan); Karen Petrillo, Luciana Meli, Nelson M. Felix, Cody Murray, Alex Hubbard, Rick Johnson, IBM Corp. (United States); Dave Hetzer, TEL Technology Ctr., America, LLC (United States) . . . . [10809-74]

Bridging the defect gap in EUV photoresist, Tetsu Kohyama, Nihon Entegris K.K. (Japan) . . . . [10809-75]

Improvement of CD stability and defectivity in resist coating and developing process in EUV lithography process, Yuya Kamei, Tokyo Electron Kyushu Ltd. (Belgium); Shinichiro Kawakami, Masahide Tadokoro, Yusaku Hashimoto, Takeshi Shimoaoki, Masashi Enomoto, Tokyo Electron Kyushu Ltd. (Japan); Kathleen Nafus, Tokyo Electron Kyushu Ltd. (Belgium); Akihiro Sonoda, Tokyo Electron Ltd. (Japan); Philippe Foubert, IMEC (Belgium) . . . . [10809-76]

Fight Bias, Embrace Diversity

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International Conference on
Extreme Ultraviolet Lithography 2018

TUESDAY 18 SEPTEMBER

ANNOUNCEMENTS
LOCATION: MONTEREY CONF. CTR., STEINBECK 2 . . . . 8:00 to 8:10 am

SESSION 4

Location: Monterey Conf. Ctr., Steinbeck 2 . . . . Tue 8:10 to 10:00 am

EUV Mask Blanks

Joint Session with conferences 10809 and 10810

Session Chairs: **Takahiro Onoue,** HOYA Corp. (Japan); **Paul A. Morgan,** Micron Technology, Inc. (United States)

8:10 am: **Novel EUV mask absorber evaluation in support of next-generation EUV imaging** *(Invited Paper)*, Vicky Philipsen, Vu Luong, Karl Opsomer, imec (Belgium); Andreas Erdmann, Peter Evanschitzky, Fraunhofer-Institut für Integrierte Systeme und Bauelementetechnologie IISB (Germany); Frank Scholze, Christian Laubis, Physikalisch-Technische Bundesanstalt (Germany); Robbert W. E. van de Kruijs, Zahra Heidarnia-Fathabad, Univ. Twente (Netherlands); Eric Hendrickx, imec (Belgium). . . . . [10810-11]

8:40 am: **Requirements and development of next-generation EUV mask blanks**, Vibhu Jindal, Grace Fong, Shuwei Liu, Binni Varghese, Madhavi Chandrachood, Abbas Rastegar, Vikash Banthia, Applied Materials, Inc. (United States) . . . . [10810-12]

9:00 am: **Cleaning durability of the applied materials EUV mask blanks for sub-10nm HP nodes**, Abbas Rastegar, Applied Materials, Inc. (United States); Sankesha Bhoyar, Khim Tiong Soon, Applied Materials South East Asia Pte. Ltd. (Singapore); Vik Banthia, Applied Materials, Inc. (United States) . . . . . [10809-13]

9:20 am: **Advances in high-volume manufacturing of EUV mask blanks: current status and roadmap**, Katrina Rook, Meng Lee, Sandeep Kohli, Frank Cerio, Boris Druz, Adrian Devasahayam, Veeco Instruments Inc. (United States) . . . . [10809-14]

9:40 am: **Enhanced EUV lithographic performance through advanced SMO, RET, and novel EUV mask absorber**, Germain L. Fenger, Mentor Graphics Corp. (United States); Ana-Maria Armeanu, Mentor Graphics (Ireland) Ltd. (France); Vicky Philipsen, imec (Belgium); Fan Jiang, Neal Lafferty, Mentor, a Siemens Business (United States); Eric Hendrickx, IMEC (Belgium); John Sturtevant, Mentor, a Siemens Business (United States) . . . . [10809-21]

Coffee Break . . . . .Tue 10:00 am to 10:30 am

SESSION 5

Location: Monterey Conf. Ctr., Steinbeck 3 . . Tue 10:30 am to 12:20 pm

EUV Materials I

Session Chairs: **Takahiro Kozawa,** Osaka Univ. (Japan); **Anna Lio,** Intel Corp. (United States)

10:30 am: **Recent progress of materials and processes for EUV lithography. Ready for HVM?** *(Invited Paper)*, Toru Fujimori, FUJIFILM Corp. (Japan). . . . . [10809-15]

11:00 am: **Pattern formation mechanism of zirconia nanoparticle resist used for extreme-ultraviolet lithography**, Takahiro Kozawa, Teppei Yamada, Satoshi Ishihara, Hiroki Yamamoto, Yusa Muroya, Osaka Univ. (Japan); Julius Joseph S. Santillan, Toshiro Itani, Evolving Nano-process Infrastructure Development Ctr., Inc. (Japan) . . . . [10809-16]

11:20 am: **Analysis of resist film stability of metal-based EUV resists**, Julius Joseph S. Santillan, Toshiro Itani, Evolving Nano-process Infrastructure Development Ctr., Inc. (Japan) . . . . [10809-17]

11:40 am: **Progress in multi-trigger resists for EUV lithography**, Carmen Popescu, The Univ. of Birmingham (United Kingdom); Alexandra McClelland, Irresistible Materials Ltd. (United Kingdom); Guy Dawson, The Univ. of Birmingham (United Kingdom); John Roth, Nano-C, Inc. (United States); Yannick Vesters, imec (Belgium) and KU Leuven (Belgium); Dimitrios Kazazis, Yasin Ekinci, Paul Scherrer Institut (Switzerland); Wolfgang Theis, The Univ. of Birmingham (United Kingdom); Danilo De Simone, Geert Vandenberghe, imec (Belgium); Alex P. G. Robinson, The Univ. of Birmingham (United Kingdom) and Irresistible Materials Ltd. (United Kingdom) . . . . [10809-18]

12:00 pm: **Evaluation of EUV resists for 5nm technology node and beyond**, Zuhal Tasdemir, Xiaolong Wang, Iacopo Mochi, Paul Scherrer Institut (Switzerland); Lidia van Lent-Protasova, Marieke Meeuwissen, Rolf Custers, Gijsbert Rispens, Rik Hoefnagels, ASML Netherlands B.V. (Netherlands); Yasin Ekinci, Paul Scherrer Institut (Switzerland) . . . . [10809-19]

Photomask Technology

TUESDAY 18 SEPTEMBER

ANNOUNCEMENTS
LOCATION: MONTEREY CONF. CTR., STEINBECK 2 . . . . 8:00 to 8:10 am

SESSION 4

Location: Monterey Conf. Ctr., Steinbeck 2 . . . . Tue 8:10 to 10:00 am

EUV Mask Blanks

Joint Session with conferences 10809 and 10810

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8:40 am: **Requirements and development of next-generation EUV mask blanks**, Vibhu Jindal, Grace Fong, Shuwei Liu, Binni Varghese, Madhavi Chandrachood, Abbas Rastegar, Vikash Banthia, Applied Materials, Inc. (United States) . . . . [10810-12]

9:00 am: **Cleaning durability of the applied materials EUV mask blanks for sub-10nm HP nodes**, Abbas Rastegar, Applied Materials, Inc. (United States); Sankesha Bhoyar, Khim Tiong Soon, Applied Materials South East Asia Pte. Ltd. (Singapore); Vik Banthia, Applied Materials, Inc. (United States) . . . . . [10809-13]

9:20 am: **Advances in high-volume manufacturing of EUV mask blanks: current status and roadmap**, Katrina Rook, Meng Lee, Sandeep Kohli, Frank Cerio, Boris Druz, Adrian Devasahayam, Veeco Instruments Inc. (United States) . . . . [10809-14]

9:40 am: **Enhanced EUV lithographic performance through advanced SMO, RET, and novel EUV mask absorber**, Germain L. Fenger, Mentor Graphics Corp. (United States); Ana-Maria Armeanu, Mentor Graphics (Ireland) Ltd. (France); Vicky Philipsen, imec (Belgium); Fan Jiang, Neal Lafferty, Mentor, a Siemens Business (United States); Eric Hendrickx, IMEC (Belgium); John Sturtevant, Mentor, a Siemens Business (United States) . . . . [10809-21]

Coffee Break . . . . .Tue 10:00 am to 10:30 am

SESSION 5

Location: Monterey Conf. Ctr., Steinbeck 2 Tue 10:30 am to 12:00 pm

Nanoimprint Lithography

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

10:30 am: **Nanoimprint lithography and a perspective on cost of ownership** *(Invited Paper)*, Douglas J. Resnick, Canon Nanotechnologies, Inc. (United States); Junji Iwasa, Canon Inc. (Japan) . . . . [10810-14]

11:00 am: **High volume semiconductor manufacturing using nanoimprint lithography**, Zenichi Hamaya, Junichi Seki, Toshiya Asano, Keita Sakai, Canon Inc. (Japan); Ali Aghili, Makoto Mizuno, Jin Choi, Chris Jones, Canon Nanotechnologies, Inc. (United States). . . . . [10810-15]

11:20 am: **Sub-15nm template fabrication with multi-beam mask writer**, Koji Ichimura, Koichi Kanno, Masaaki Kurihara, Naoya Hayashi, Dai Nippon Printing Co., Ltd. (Japan). . . . . [10810-16]

11:40 am: **Status of NIL replica template development**, Akihiko Ando, Ryota Seki, Keisuke Yagawa, Eiji Yamanaka, Shingo Kanamitsu, Toshiba Memory Corp. (Japan). . . . . [10810-17]

Lunch/Exhibition Break . . . . Tue 12:00 pm to 1:50 pm

Photomask Technology

TUESDAY 18 SEPTEMBER

SESSION 6

Location: Monterey Conf. Ctr., Steinbeck 2 . . . . .Tue 1:50 to 3:40 pm

Mask Write and MPC

Session Chairs: **Bala Thumma,** Synopsys, Inc. (United States); **Shusuke Yoshitake,** NuFlare Technology, Inc. (Japan)

1:50 pm: **Multi-beam – enabling leading-edge mask writing** *(Invited Paper)*, Christoph Spengler, Elmar Platzgummer, Hans Loeschner, IMS Nanofabrication GmbH (Austria) . . . . [10810-19]

2:20 pm: **Multi-beam writer MBM-1000**, Hiroshi Matsumoto, Hironobu Matsumoto, Noriaki Nakayamada, Hayato Kimura, NuFlare Technology, Inc. (Japan) . . . . [10810-20]

2:40 pm: **Mask process correction validation for multi-beam mask lithography**, Ingo Bork, Peter Buck, Mentor Graphics, A Siemens Co. (United States); Bhardwaj Durvasula, Mentor Graphics (India) Pvt. Ltd. (India); Stefan Eder-Kapl, Peter Hudek, Elmar Platzgummer, IMS Nanofabrication GmbH (Austria); Rao Nageswara, Murali Reddy, Mentor Graphics (India) Pvt. Ltd. (India); Christoph Spengler, IMS Nanofabrication GmbH (Austria). . . . . [10810-21]

3:00 pm: **Extending mask data preparation to scale to thousands of CPUs and beyond**, Archana Rajagopalan, Mentor Graphics (India) Pvt. Ltd. (India); Amanda Bowhill, Peter Buck, Mentor Graphics Corp. (United States); Bhardwaj Durvasula, Mentor Graphics (India) Pvt. Ltd. (India); Pascal Gilgenkrantz, Mentor Graphics (Ireland) Ltd. (France); Stephen Kim, Minyoung Park, Mentor Graphics Corp. (United States); Nageswara Rao, Mentor Graphics (India) Pvt. Ltd. (India). . . . . [10810-22]

3:20 pm: **Advanced jog handling techniques in MPC for better QoR**, Bhardwaj Durvasula, Mentor Graphics (India) Pvt. Ltd. (India); Ingo Bork, Peter Buck, Mentor Graphics Corp. (United States); Archana Rajagopalan, Nageswara Rao, Murali Reddy, Mentor Graphics (India) Pvt. Ltd. (India) . . . . [10810-23]

Coffee Break . . . . Tue 3:40 pm to 4:10 pm

SESSION 7

Location: Monterey Conf. Ctr., Steinbeck 2 . . . . .Tue 4:10 to 6:00 pm

Mask Process and Resist

Session Chairs: **Thomas B. Faure,** GLOBALFOUNDRIES Inc. (United States); **Banqiu Wu,** Applied Materials, Inc. (United States)

4:10 pm: **Design and implementation of the next-generation electron-beam resists for the production of EUVL photomasks** *(Invited Paper)*, Scott Lewis, The Univ. of Manchester (United Kingdom); Guy DeRose, Matthew Hunt, Axel Scherer, The Kavli Nanoscience Institute, Caltech (United States); Stephen Yeates, Richard E. P. Winpenny, Hayden R Alty, The Univ. of Manchester (United Kingdom); Alex Werthiem, Jarvis Li, Trevor Fowler, Sangkook Lee, The Kavli Nanoscience Institute (United States). . . . . [10810-24]

4:40 pm: **Material design for the improvement of ZEP520A performance**, Takahiro Kozawa, Ayako Nakajima, Osaka Univ. (Japan); Manabu Hoshino, Masakazu Hashimoto, Zeon Corp. (Japan). . . . . [10810-25]

5:00 pm: **Lithographic benefits and mask manufacturability study of curvilinear masks**, Wei Guo, GLOBALFOUNDRIES Inc. (United States); Fan Jiang, Mentor, a Siemens Business (United States); Jed Rankin, GLOBALFOUNDRIES Inc. (United States); Alexander Tritchkov, Yuyang Sun, Srividya Jayaram, Mentor, a Siemens Business (United States); Larry Zhuang, GLOBALFOUNDRIES Inc. (United States); Ingo Bork, Mentor, a Siemens Business (United States); Todd Bailey, GLOBALFOUNDRIES Inc. (United States); James Word, Mentor, a Siemens Business (United States) . . . . [10810-26]

5:20 pm: **Photomask manufacturability and pattern fidelity for curvilinear structures**, Richard Gladhill, Kent H. Nakagawa, Toppan Photomasks, Inc. (United States). . . . . [10810-27]

5:40 pm: **Advancements in pellicle-glue residue removal**, Davide Dattilo, SUSS MicroTec Photomask Equipment GmbH & Co. KG (Germany); Uwe Dietze, Martin Samayoa, SUSS MicroTec Inc. (United States); Zhenxing Han, Micron Technology, Inc. (United States) . . . . [10810-28]

International Conference on

Extreme Ultraviolet Lithography 2018

WEDNESDAY 19 SEPTEMBER

ANNOUNCEMENTS
LOCATION: MONTEREY CONF. CTR., STEINBECK 2 . . . . 8:00 to 8:10 am

SESSION 6

Location: Monterey Conf. Ctr., Steinbeck 2 Wed 8:10 am to 10:00 am

EUV Mask and Imaging

Joint Session with conferences 10809 and 10810

Session Chairs: **Jo Finders,** ASML Netherlands B.V. (Netherlands); **Ted Liang,** Intel Corp. (United States)

8:10 am: **AIMS™ EUV first insertion into the back end of the line of a mask shop: a crucial step enabling EUV production** *(Invited Paper)*, Renzo Capelli, Carl Zeiss SMT GmbH (Germany); Nathan Wilcox, Intel Corp. (United States); Dirk Hellweg, Martin Dietzel, Carl Zeiss SMT GmbH (Germany); Scott Chegwidden, Joseph Rodriguez, Intel Corp. (United States) . . . . [10810-29]

8:40 am: **Optimization and stability assessment of the CD variability in pitch 40nm contact holes on NXE:3300**, Lieve van Look, Joost Bekaert, Andreas Frommhold, Eric Hendrickx, imec (Belgium); Gijsbert Rispens, Guido Schiffelers, ASML Netherlands B.V. (Netherlands) . . . . [10809-20]

9:00 am: **EUV pupil optimization for 32nm pitch logic structures**, David Rio, ASML (Belgium); Victor M. Blanco Carballo, Joern-Holger Franke, imec (Belgium); Mircea V. Dusa, Etienne De Poortere, ASML (Belgium); Serge Biesemans, Kathleen Nafus, Tokyo Electron Europe Ltd. (Belgium); Werner Gillijns, Eric Hendrickx, imec (Belgium); Paul van Adrichem, Kateryna Lyakhova, ASML Netherlands B.V. (Netherlands); Chris A. Spence, ASML San Jose (United States) . . . . [10809-66]

9:20 am: **Pattern shift response metrology**, Kit Ausschnitt, Vincent Truffert, Koen D'Have, Philippe Leray, imec (Belgium) . . . . [10810-30]

9:40 am: **Rapid image-based pupil plane characterization for EUV lithography systems**, Zachary Levinson, Rochester Institute of Technology (United States); Erik Verduijn, Timothy A. Brunner, Obert Wood, GLOBALFOUNDRIES Inc. (United States); Bruce W. Smith, Rochester Institute of Technology (United States) . . . . [10809-22]

Coffee Break . . . . Wed 10:00 am to 10:30 am

SESSION 7

Location: Monterey Conf. Ctr., Steinbeck 2 . .Wed 10:30 am to 12:20 pm

EUV Inspection, Repair, and Verification

Joint Session with conferences 10809 and 10810

Session Chairs: **Yasin Ekinci,** Paul Scherrer Institut (Switzerland); **Thomas Scherübl,** Carl Zeiss SMT GmbH (Germany)

10:30 am: **Progress update on actinic mask inspection and observation** *(Invited Paper)*, Hiroki Miyai, Tsunehito Kohyama, Tomohiro Suzuki, Hirokazu Seki, Hal Kusunose, Lasertec Corp. (Japan). [10809-23]

11:00 am: **Phase defect inspection on EUV masks using RESCAN**, Rajendran Rajeev, Sara Fernandez, Iacopo Mochi, Patrick Helfenstein, Dimitrios Kazazis, Yasin Ekinci, Paul Scherrer Institut (Switzerland) . . . . [10809-24]

11:20 am: **E-beam based EUV mask characterization for studying mask induced wafer effects,** Vidya Vaenkatesan, ASML Netherlands B.V. (Netherlands); Qing Tian, Hermes-Microvision Inc., USA (United States); Emily Gallagher, imec (Belgium); Jim Wiley, ASML US, Inc. (United States); Jo Finders, Michael Kubis, Jan Mulkens, ASML Netherlands B.V. (Netherlands); Chiyan Kuan, Kevin Gao, Hermes-Microvision Inc., USA (United States). . . . . [10810-31]

11:40 am: **AIMS™ EUV tool platform: aerial-image based qualification of EUV masks**, Renzo Capelli, Dirk Hellweg, Martin Dietzel, Ralf Gehrke, Markus Bauer, Markus Koch, Carl Zeiss SMT GmbH (Germany) . . . . [10810-32]

12:00 pm: **A high-brightness accelerator-based EUV source for actinic mask inspection**, Yasin Ekinci, Terence Garvey, Andreas Streun, Albin Wrulich, Leonid Rivkin, Paul Scherrer Institut (Switzerland) . . . . [10810-33]

Lunch/Exhibition Break . . . . .Wed 12:20 pm to 1:50 pm

Photomask Technology

WEDNESDAY 19 SEPTEMBER

ANNOUNCEMENTS
LOCATION: MONTEREY CONF. CTR., STEINBECK 2 . . . . 8:00 to 8:10 am

SESSION 8

Location: Monterey Conf. Ctr., Steinbeck 2 . . . Wed 8:10 to 10:00 am

EUV Mask and Imaging

Joint Session with conferences 10809 and 10810

Session Chairs: **Jo Finders,** ASML Netherlands B.V. (Netherlands); **Ted Liang,** Intel Corp. (United States)

8:10 am: **AIMS™ EUV first insertion into the back end of the line of a mask shop: a crucial step enabling EUV production** *(Invited Paper)*, Renzo Capelli, Carl Zeiss SMT GmbH (Germany); Nathan Wilcox, Intel Corp. (United States); Dirk Hellweg, Martin Dietzel, Carl Zeiss SMT GmbH (Germany); Scott Chegwidden, Joseph Rodriguez, Intel Corp. (United States) . . . . [10810-29]

8:40 am: **Optimization and stability assessment of the CD variability in pitch 40nm contact holes on NXE:3300**, Lieve van Look, Joost Bekaert, Andreas Frommhold, Eric Hendrickx, imec (Belgium); Gijsbert Rispens, Guido Schiffelers, ASML Netherlands B.V. (Netherlands) . . . . [10809-20]

9:00 am: **EUV pupil optimization for 32nm pitch logic structures**, David Rio, ASML (Belgium); Victor M. Blanco Carballo, Joern-Holger Franke, imec (Belgium); Mircea V. Dusa, Etienne De Poortere, ASML (Belgium); Serge Biesemans, Kathleen Nafus, Tokyo Electron Europe Ltd. (Belgium); Werner Gillijns, Eric Hendrickx, imec (Belgium); Paul van Adrichem, Kateryna Lyakhova, ASML Netherlands B.V. (Netherlands); Chris A. Spence, ASML San Jose (United States) . . . . [10809-66]

9:20 am: **Pattern shift response metrology**, Kit Ausschnitt, Vincent Truffert, Koen D'Have, Philippe Leray, imec (Belgium) . . . . [10810-30]

9:40 am: **Rapid image-based pupil plane characterization for EUV lithography systems**, Zachary Levinson, Rochester Institute of Technology (United States); Erik Verduijn, Timothy A. Brunner, Obert Wood, GLOBALFOUNDRIES Inc. (United States); Bruce W. Smith, Rochester Institute of Technology (United States) . . . . [10809-22]

Coffee Break . . . . Wed 10:00 am to 10:30 am

SESSION 9

Location: Monterey Conf. Ctr., Steinbeck 2 . .Wed 10:30 am to 12:20 pm

EUV Inspection, Repair, and Verification

Joint Session with conferences 10809 and 10810

Session Chairs: **Yasin Ekinci,** Paul Scherrer Institut (Switzerland); **Thomas Scherübl,** Carl Zeiss SMT GmbH (Germany)

10:30 am: **Progress update on actinic mask inspection and observation** *(Invited Paper)*, Hiroki Miyai, Tsunehito Kohyama, Tomohiro Suzuki, Hirokazu Seki, Hal Kusunose, Lasertec Corp. (Japan). [10809-23]

11:00 am: **Phase defect inspection on EUV masks using RESCAN**, Rajendran Rajeev, Sara Fernandez, Iacopo Mochi, Patrick Helfenstein, Dimitrios Kazazis, Yasin Ekinci, Paul Scherrer Institut (Switzerland) . . . . [10809-24]

11:20 am: **E-beam based EUV mask characterization for studying mask induced wafer effects** , Vidya Vaenkatesan, ASML Netherlands B.V. (Netherlands); Qing Tian, Hermes-Microvision Inc., USA (United States); Emily Gallagher, imec (Belgium); Jim Wiley, ASML US, Inc. (United States); Jo Finders, Michael Kubis, Jan Mulkens, ASML Netherlands B.V. (Netherlands); Chiyan Kuan, Kevin Gao, Hermes-Microvision Inc., USA (United States). . . . . [10810-31]

11:40 am: **AIMS™ EUV tool platform: aerial-image based qualification of EUV masks**, Renzo Capelli, Dirk Hellweg, Martin Dietzel, Ralf Gehrke, Markus Bauer, Markus Koch, Carl Zeiss SMT GmbH (Germany) . . . . [10810-32]

12:00 pm: **A high-brightness accelerator-based EUV source for actinic mask inspection**, Yasin Ekinci, Terence Garvey, Andreas Streun, Albin Wrulich, Leonid Rivkin, Paul Scherrer Institut (Switzerland) . . . . [10810-33]

Lunch/Exhibition Break . . . . .Wed 12:20 pm to 1:50 pm

International Conference on

Extreme Ultraviolet Lithography 2018

WEDNESDAY 19 SEPTEMBER

SESSION 8

Location: Monterey Conf. Ctr., Steinbeck 2 . . . . Wed 1:50 to 3:40 pm

EUV Pellicle and Metrology

Joint Session with conferences 10809 and 10810

Session Chairs: **Naoya Hayashi,** Dai Nippon Printing Co., Ltd. (Japan); **Byung Gook Kim,** SAMSUNG Electronics Co., Ltd. (Korea, Republic of)

1:50 pm: **EUV pellicle progresses and future outlook** *(Invited Paper)*, Guido Salmaso, ASML Netherlands B.V. (Netherlands) . . . . [10810-34]

2:20 pm: **Development of full-size EUV pellicle with thermal emission layer coating**, Juhee Hong, Chulkyun Park, Changhun Lee, Keesoo Nam, S&S TECH (Korea, Republic of); Yongju Jang, Seong Ju Wi, Jinho Ahn, Hanyang Univ. (Korea, Republic of). . . . . [10809-25]

2:40 pm: **Experimental evaluation of EUV pellicles on reticle imaging**, Iacopo Mochi, Rajendran Rajeev, Patrick Helfenstein, Sara Fernandez, Dimitrios Kazazis, Yasin Ekinci, Paul Scherrer Institut (Switzerland); Emily Gallagher, Marina Timmermans, Marina Mariano Juste, Ivan Pollentier, imec (Belgium) . [10810-35]

3:00 pm: **Actinic laboratory EUV tools for mask and pellicle metrology,** Serhiy Danylyuk, Lukas Bahrenberg, Sascha Brose, RWTH Aachen Univ. (Germany); Rainer Lebert, RI Research Instruments GmbH (Germany); Jochen Stollenwerk, Peter Loosen, RWTH Aachen Univ. (Germany) . . . . [10809-26]

3:20 pm: **EUV mask characterization with actinic scatterometry**, Stuart Sherwin, Andrew Neureuther, Univ. of California, Berkeley (United States); Patrick Naulleau, Lawrence Berkeley National Lab. (United States). . . [10809-27]

Coffee Break . . . . Wed 3:40 pm to 4:10 pm

SESSION 9

Location: Monterey Conf. Ctr., Steinbeck 3 . . . . Wed 4:10 to 6:00 pm

EUV Materials II

Session Chairs: **Huixiong Dai,** Applied Materials, Inc. (United States); **Toru Fujimori,** FUJIFILM Corp. (Japan)

4:10 pm: **State-of-the-art of EUV materials for N5 logic and DRAM applications** *(Invited Paper)*, Danilo De Simone, imec (Belgium); Yannick Vesters, imec (Belgium) and KU Leuven (Belgium); Pieter Venelderen, imec (Belgium); Ashish Rathore, imec (Belgium) and KU Leuven (Belgium); Ivan Pollentier, Geert Vandenberghe, imec (Belgium) . . . . [10809-28]

4:40 pm: **Using resonant soft x-ray scattering to image patterns on undeveloped resists**, Guillaume Freychet, Isvar Cordova, Terry McAfee, Chris Anderson, Cheng Wang, Patrick Naulleau, Alexander Hexemer, Dinesh Kumar, Lawrence Berkeley National Lab. (United States) . . . . [10809-29]

5:00 pm: **Advances in metal oxide resist performance and production**, Jason K. Stowers, Inpria Corp. (United States). . . . . [10809-30]

5:20 pm: **New resist and underlayer approaches toward EUV lithography**, Juha Rantala, Thomas Gädda, Markus Laukkanen, Kimmo Karaste, Luong Nguyen Dang, PiBond Oy (Finland); Dimitrios Kazizis, Yasin Ekinci, Paul Scherrer Institut (Switzerland) . . . . [10809-31]

5:40 pm: **Advanced development of organic and inorganic under layers for EUV lithography**, Wataru Shibayama, Shuhei Shigaki, Satoshi Takeda, Mamoru Tamura, Yasunobu Someya, Makoto Nakajima, Rikimaru Sakamoto, Nissan Chemical Industries, Ltd. (Japan) . . . . [10809-32]

Photomask Technology

WEDNESDAY 19 SEPTEMBER

SESSION 10

Location: Monterey Conf. Ctr., Steinbeck 2 . . . . Wed 1:50 to 3:40 pm

EUV Pellicle and Metrology

Joint Session with conferences 10809 and 10810

Session Chairs: **Naoya Hayashi,** Dai Nippon Printing Co., Ltd. (Japan); **Byung Gook Kim,** SAMSUNG Electronics Co., Ltd. (Korea, Republic of)

1:50 pm: **EUV pellicle progresses and future outlook** *(Invited Paper)*, Guido Salmaso, ASML Netherlands B.V. (Netherlands) . . . . [10810-34]

2:20 pm: **Development of full-size EUV pellicle with thermal emission layer coating**, Juhee Hong, Chulkyun Park, Changhun Lee, Keesoo Nam, S&S TECH (Korea, Republic of); Yongju Jang, Seong Ju Wi, Jinho Ahn, Hanyang Univ. (Korea, Republic of). . . . . [10809-25]

2:40 pm: **Experimental evaluation of EUV pellicles on reticle imaging**, Iacopo Mochi, Rajendran Rajeev, Patrick Helfenstein, Sara Fernandez, Dimitrios Kazazis, Yasin Ekinci, Paul Scherrer Institut (Switzerland); Emily Gallagher, Marina Timmermans, Marina Mariano Juste, Ivan Pollentier, imec (Belgium) . . . . [10810-35]

3:00 pm: **Actinic laboratory EUV tools for mask and pellicle metrology**, Serhiy Danylyuk, Lukas Bahrenberg, Sascha Brose, RWTH Aachen Univ. (Germany); Rainer Lebert, RI Research Instruments GmbH (Germany); Jochen Stollenwerk, Peter Loosen, RWTH Aachen Univ. (Germany) . . [10809-26]

3:20 pm: **EUV mask characterization with actinic scatterometry**, Stuart Sherwin, Andrew Neureuther, Univ. of California, Berkeley (United States); Patrick Naulleau, Lawrence Berkeley National Lab. (United States). . . [10809-27]

Coffee Break . . . . Wed 3:40 pm to 4:10 pm

PANEL DISCUSSION

LOCATION: MONTEREY CONF. CTR., STEINBECK 2 . . . . . WED 4:10 to 5:50 pm

Optical and EUV Masks: Analyzing the HVM Requirement and Capability Differences

Industry experts will discuss the state of EUV Mask readiness as HVM looms. Experts include equipment and material suppliers, captive and commercial mask suppliers, and end users. These experts will share their view on the requirements and capabilities for advanced EUV and optical masks and what work is being done to address these gaps.

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International Conference on

Extreme Ultraviolet Lithography 2018

THURSDAY 20 SEPTEMBER

ANNOUNCEMENTS
LOCATION: MONTEREY CONF. CTR., STEINBECK 3 . . . . 8:00 to 8:10 am

SESSION 10

Location: Monterey Conf. Ctr., Steinbeck 3 . . . . Thu 8:10 to 10:00 am

High-NA and Imaging

Session Chairs: **Gregory R. McIntyre,** IMEC (Belgium); **Akiyoshi Suzuki,** Gigaphoton Inc. (Japan)

8:10 am: **High-NA EUV lithography exposure tool progress** *(Invited Paper)*, Jan van Schoot, Eelco van Setten, Kars Troost, Frank Bornebroek, Rob van Ballegoij, Sjoerd Lok, Judon Stoeldraijer, Jo Finders, Hans Meiling, ASML Netherlands B.V. (Netherlands); Paul Graeupner, Peter Kuerz, Winfried Kaiser, Erik Loopstra, Bernhard Kneer, Sascha Migura, Carl Zeiss SMT GmbH (Germany). . . . . [10809-33]

8:40 am: **High-NA EUV lithography: The next step in EUV imaging**, Eelco van Setten, John McNamara, Jan van Schoot, Gerardo Bottiglieri, Kars Troost, Timon Fliervoet, ASML Netherlands B.V. (Netherlands); Stephen Hsu, ASML Brion (United States); Jörg Zimmermann, Jens-Timo Neumann, Matthias Rösch, Paul Graeupner, Carl Zeiss SMT GmbH (Germany). . [10809-34]

9:00 am: **Actinic 0.5-NA wavefront measurements on the Berkeley MET5 platform**, Ryan H. Miyakawa, Wenhua Zhu, Geoff Gaines, Chris Anderson, Patrick Naulleau, Lawrence Berkeley National Lab. (United States). . . [10809-35]

9:20 am: **Mask imaging with freeform sources on the SHARP microscope**, Markus P. Benk, Kenneth Goldberg, Patrick Naulleau, Lawrence Berkeley National Lab. (United States). . . . . [10809-36]

9:40 am: **Understanding image fading for EUV,** Michael E. Kling, Timothy A. Brunner, Allen Gabor, Daniel Schmidt, Yulu Chen, GLOBALFOUNDRIES Inc. (United States); Blandine Minghetti, ASML Malta (United States); Edouard Duriau, ASML Netherlands B.V. (Netherlands)[10809-37]

Coffee Break . . . . .Thu 10:00 am to 10:30 am

SESSION 11

Location: Monterey Conf. Ctr., Steinbeck 3 . . Thu 10:30 am to 12:00 pm

Patterning

Session Chairs: **Jan van Schoot,** ASML Netherlands B.V. (Netherlands); **Erik R. Hosler,** GLOBALFOUNDRIES Inc. (United States)

10:30 am: **Integration via 3rd dimension: 3D power scaling** *(Invited Paper)*, Paolo A. Gargini, IEUVI, IRDS (United States). [10809-38]

11:00 am: **Benchmarking of EUV lithography line/space patterning versus immersion lithography multipatterning schemes at equivalent pitch**, Angelique Raley, TEL Technology Ctr., America, LLC (United States); Chris A. Mack, Fractilia, LLC (United States); Eric Liu, Sophie Thibaut, Jeffrey Smith, Akiteru Ko, Anton DeVilliers, Peter Biolsi, TEL Technology Ctr., America, LLC (United States) . . . . [10809-39]

11:20 am: **Study of resist hardmask interaction through surface activation layers**, Anuja De Silva, Luciana Meli, Jing Guo, Nelson M. Felix, IBM Corp. (United States); Dario L. Goldfarb, Bharat Kumar, IBM Thomas J. Watson Research Ctr. (United States); Rudy Wojtecki, Magi Metry, Alexander Hess, IBM Research - Almaden (United States). . . . . [10809-40]

11:40 am: **Characterization of pattern dependent pattern placement error in EUV lithography for 7nm and future generations**, Lei Zhuang, Shiyi Wang, Niladri Gomes, Roger Cornell, Timothy A. Brunner, GLOBALFOUNDRIES Inc. (United States). . . . . [10809-41]

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LOCATION: MONTEREY CONF. CTR., STEINBECK 3 . . . . . . .12:00 TO 12:10 PM

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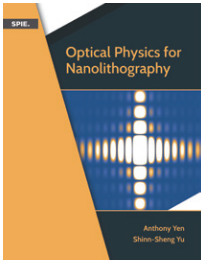

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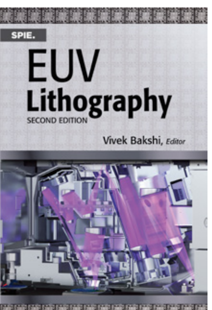

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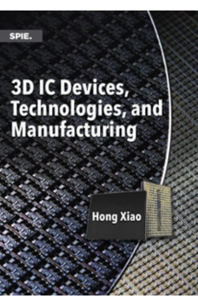
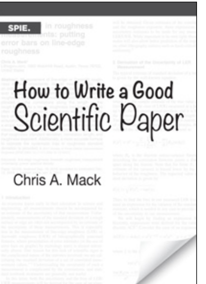


3D IC Devices, Technologies, and Manufacturing
Hong Xiao



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Chris Mack

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GENERAL INFORMATION

Registration

Onsite Registration and Badge Pick-up Hours

Monterey Conference Center, Level 2, Steinbeck Lobby

Sunday 16 September . . . . 11:00 am to 6:00 pm
Monday 17 September . . . . 7:00 am to 4:00 pm
Tuesday 18 September . . . . 7:15 am to 4:00 pm
Wednesday 19 September . . . . 7:30 am to 4:00 pm
Thursday 20 September . . . . 8:00 am to 12:00 pm

Conference Registration

Includes admission to all conference sessions, plenary, panels, and poster session, exhibition, coffee breaks, and online proceedings collection. Full technical registrants also include lunch (Monday-Wednesday) and the Wednesday Conference Dinner and the Theatre Show.

Exhibition Registration

Exhibition-Only visitor registration is complimentary.

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Speaker Check-In

All conference rooms have a computer workstation, projector, screen, lapel microphone, and laser pointer. All presenters are requested to go to their conference room prior to session start with their memory devices or laptops to load their presentation and check display settings.

Poster Setup Instructions

Monterey Marriott, Mezzanine Level

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Monday, 17 September
10:00 am to 5:00 pm

Poster authors to be present and at their posters during the sessions to answer questions and provide in-depth discussion concerning their posters.

- Poster authors may set up their posters between 10:00 am and 5:00 pm on Monday. Paper numbers will be posted on the poster boards in numerical order. Push pins will be provided. Posters can be previewed during the day.
- Presenters who have not placed their papers on their assigned board by 5:00 pm on Monday will be considered a “no show” and their manuscript will not be published.
- The author is responsible to remove their posters and all other materials at the conclusion of the poster session. All posters and material not removed will be considered unwanted and will be discarded. SPIE assumes no responsibility for posters left up after the end of the poster session. Your technical or participant registration badge is required to be worn to attend the poster session.

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Monterey Conference Center and
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Monterey Marriott

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Coffee Breaks | Breakfast Breads

Monterey Conference Center, Steinbeck
Lobby and Exhibition Hall

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Fin & Field Restaurant and Bar, Marriott Hotel Lobby
6:30 to 11 am Breakfast
11 am to 11 pm Dinner

Menus focus on local produce, sustainably sourced seafood and humanely raised cattle.

SPIE-Hosted Lunches

Monterey Marriott, San Carlos Ballroom
Noon to 1:30 pm

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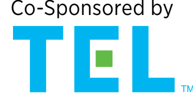

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SPIE supplies tested and safety-approved laser pointers for all conference meeting rooms. For safety reasons, SPIE requests that presenters use provided laser pointers.

Use of a personal laser pointer represents the user's acceptance of liability for use of a non-SPIE-supplied laser pointer. If you choose to use your own laser pointer, it must be tested to ensure <5 mW power output. Laser pointers in Class II and IIIa (<5 mW) are eye safe if power output is correct, but output must be verified because manufacturer labeling may not match actual output. You are required to sign a waiver releasing SPIE of any liability for use of potentially non-safe, personal laser pointers. Waivers are available at Speaker Check-In.

Unsecured Items Policy

Personal belongings should not be left unattended in meeting rooms or public areas. Unattended items are subject to removal by security. SPIE is not responsible for items left unattended.

Wireless Internet Service Policy

At most events, SPIE provides wireless access for attendees. Properly secure your computer before accessing the public wireless network. SPIE is not responsible for computer viruses or other computer damage.

No-Smoking Policy

Smoking, including e-cigarettes, is not permitted at any SPIE event.

Agreement to Hold Harmless

Attendee agrees to release and hold harmless SPIE from any and all claims, demands, and causes of action arising out of or relating to your participation in the event you are registering to participate in and use of any associated facilities or hotels.

Event Cancellation Policy

If for some unforeseen reason SPIE should have to cancel an event, processed registration fees will be refunded to registrants. Registrants will be responsible for cancellation of travel arrangements or housing reservations and the applicable fees.

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