SPIE. ADVANCED LITHOGRAPHY

Advanced Lithography   2019

TECHNICAL PROGRAM

Your complete guide to conferences, courses, and special events.

Conferences and Courses
24–28 February 2019

Exhibition
26–27 February 2019

San Jose Convention Center
San Jose, California, USA

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ADVANCED LITHOGRAPHY 2019

TECHNOLOGIES FOR LITHOGRAPHY R&D, DEVICES, TOOLS, FABRICATION, AND SERVICES.

Conferences and Courses: 24-28 February 2019
Exhibition: 26-27 February 2019
San Jose, California, USA

Welcome to San Jose

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2019

SPIE. ADVANCED LITHOGRAPHY

2,200 ATTENDEES

3 PLENARY PRESENTATIONS

450 PAPERS

13 COURSES

NETWORKING EVENTS

50 COMPANIES

EXHIBITION
See top suppliers showcasing the newest products, innovations, and cutting-edge technologies. Discuss specific requirements face-to-face.

Welcome

For over 40 years, SPIE Advanced Lithography has played a key role in bringing together the micro- and nanolithography community. Lithography continues to be challenged to extend into ever-shrinking generations, yet remain manufacturable and cost effective. State-of-the-art processes continue with immersion lithography and multiple patterning while EUV lithography moves closer toward production readiness. At the same time, the lithography community aggressively pursues alternative patterning approaches and complementary solutions. Success calls for unique interdisciplinary interactions and coordinated efforts between lithographers, layout designers, materials scientists, and metrology/process control engineers to enable cost-efficient patterning solutions.

A full spectrum of lithography and patterning topics are encompassed by this year's symposium across seven complementary conferences. Participants come from a broad array of backgrounds to share and learn about state-of-the-art lithographic tools, resists, metrology, materials, etch, design, process integration, and novel new approaches. Through provocative panel discussions and seminars, the symposium also probes current issues being faced as we extend current methods, move toward alternative approaches, and identify new ways to complement one technology with another.

Over the years, SPIE Advanced Lithography has provided the unique and primary forum for meeting and interacting with a wide range of industry experts, researchers, and key players working on patterning technology development. Attendance ensures that participants learn and share the latest developments in areas of central importance to many vital technology fields.

All conferences are organized by current practitioners of the art, Conference Chairs, working together with organizing committees that are experts in these fields. Numerous courses have also been organized, which are taught by recognized experts from industry and academia. Additional information is available from the many manufacturers' exhibits that allow tool makers, material suppliers, and software groups to showcase new products while interacting one-on-one with participants.

We welcome you for SPIE Advanced Lithography's 44th year!

2019 SYMPOSIUM CHAIRS

Will Conley
Cymer—An ASML company (USA)

Kafai Lai
IBM T.J. Watson Research Ctr. (USA)

Plenary Presentations
pages 6-7

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

Special Events
page 8

Join your peers and colleagues at these special events including the Welcome Reception, and a panel discussion on Lithography Scaling: Is this the end?

Award Announcements
page 9

Don't miss any of the award announcemnts and presenations at 2019 Advanced Lithography.

Exhibition
page 13

Attend the SPIE Advanced Lithography exhibition. See global suppliers for lithography research and development, devices, tools, fabrication, and services.

Executive Committee

Ofer Adan, Applied Materials (Israel)

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Kenneth A. Goldberg, Lawrence Berkeley National Lab. (USA)

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Jongwook Kye, SAMSUNG Electronics Co., Ltd. (Korea. Republic of)

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Anthony Yen, ASML US, LP (USA)

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Industry leaders solving the latest challenges in lithography and patterning in the semiconductor industry.

Conferences: Hear the latest advancements in optical lithography, metrology, or EUV.

7 CONFERENCES

APPLICATION TRACKS

Look for these icons to help you easily locate presentations you want to attend on these hot topics. The presentations are scheduled to prevent timing conflicts.

Stochastics   Overlay   Machine Learning

Courses page 11 · Stay competitive. Optimal training for career enhancement, taught by recognized experts in industry and academia.

13 COURSES

SAN JOSE CONVENTION CENTER AND MARRIOTT HOTEL
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NORTH

212B
212A

211B
211A

210D
210C
210B
210A

W M

W M

114 113 112 111

Street Level
Meeting Rooms

Down to Rooms
111–114

CONVENTION CENTER ACCESS

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Exhibition

Hall 1

Posters

Hall 2

Down to
San Carlos
Street
Level

Think
Tank

Guadalupe

Salon I

Salon II

Willow
Glen III

Marriott

Willow
Glen II

Willow
Glen I

Salon V

Salon VI

San Jose Marriott,
Second Floor

Westin

MARKET ST.

Grand
Ballroom
220C

Grand
Ballroom
220B

Grand
Ballroom
220A

Hilton Hotel

SOUTH ALMADEN AVE.

WEST SAN CARLOS ST.

Hyatt Place

SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY
Special Events	**Welcome and Announcements** *(Conley, Lai),* 8:00 am to 8:30 am, p. 8	*Symposium-wide Panel Discussion -* **Lithography Scaling: Is This the End?** *(Levinson, Mack),* 6:00 to 8:00 pm, p. 10	**Women in Optics Networking Lunch,** 12:00 to 1:00 pm, p. 10	*Award Announcement for Conf. 10959:* Presentation of the **2019 Karel Urbanek Best Student Paper Award,** 10:20 to 10:30 am, p. 11
	Plenary Presentation: **The Future is Quantum,** 8:30 to 9:10 am, *(Gil),* p. 8		**Poster Session,** 5:30 to 7:30 pm, p. 10	*Award Announcement for Conf. 10957:* Presentation of the 10:20 to 10:30 am, p. 11
	Plenary Presentation: **3D NAND Flash Technology: Roadmap, Process, Design and Challenges,** 9:10 to 9:50 am, *(Choe),* p. 8			
	Plenary Presentation: **Patterning In the Stressful World of 3D NAND,** *(Steen, van Schravendijk, Kubis, Cromwijk, Kattouw),* 9:50 to 10:30 am, p. 9			
	Award Announcement for Conf. 10959: Presentation of the **2018 Diana Nyyssonen Memorial Award for Best Paper in Metrology,** 11:00 to 11:15 am, p. 11			
	Award Announcement for Conf. 10960: Presentation of the **2018 C. Grant Willson Award for Best Paper, 2018 Hiroshi Ito Memorial Award for the Best Student Paper,** and **2018 Jeffrey Byers Memorial Best Poster Award,** 2:00 to 2:20 pm, p. 11			
	SPIE Fellow Member and Student Luncheon, 12:30 to 1:30 pm, p. 10			
	Welcome and Networking Event, 6:00 to 7:00 pm, p. 10			
	Panel Discussion: **Nanotechnology in Microlithography: Intersecting the Quantum Future and the Semiconductor Industry** *(Barnes, Kline),* 7:10 to 8:40 pm, p. 10 ~~CANCELLED~~			

EXHIBITION, p. 13
10:00 am to 5:00 pm   10:00 am to 4:00 pm

COURSES: Sunday, Monday, and Thursday
See Course schedule page 11.
See course descriptions and register onsite.

Conferences				
	Conf. 10957 Extreme Ultraviolet (EUV) Lithography X *(Goldberg),* p. 16 –46			
	Conf. 10958 Novel Patterning Technologies for Semiconductors, MEMS/NEMS and MOEMS 2019 *(Sanchez),* p. 16–48			
	Conf. 10959 Metrology, Inspection, and Process Control for Microlithography XXXIII *(Ukraintsev),* p. 16–49			
	Conf. 10960 Advances in Patterning Materials and Processes XXXVI *(Gronheld),* p. 16–48			
		Conf. 10961 Optical Microlithography XXXII *(Kye),* p. 17–31		
	Conf. 10963 Advanced Etch Technology for Nanopatterning VIII *(Wise),* p. 17–37		**Conf. 10962 Design-Process-Technology Co-optimization for Manufacturability XIII** *(Cain),* p. 17–48	

WELCOME, AND PLENARY PRESENTATIONS

Monday 25 February 2019 · 8:00 am to 10:30 am
Convention Center, Grand Ballroom 220A

8:00 am to 8:30 am

Welcome and Announcements

Symposium Chairs: **Will Conley,** Cymer-An ASML Company (USA) and **Kafai Lai,** IBM T. J. Watson Research Ctr. (USA)

· **Introduction of New SPIE Fellows**

· **Presentation of the Zernike Awards**

· **Presentation of the Nick Cobb Memorial Scholarship**

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8:30 to 10:30 am

Plenary Presentations

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8:30 to 9:10 am

The Future is Quantum

Dario Gil

Director, IBM Research and Vice President of AI and Quantum Computing, IBM T.J. Watson Research Ctr. (USA)

Some of the most important technical advances of the 20th century were enabled by decades of fundamental scientific exploration, whose initial purpose was simply to extend human understanding. This era marked the creation and widespread usage of "classical" computers, which represent information as bits – 0 and 1. Despite the continued computational advances we have experienced over the past century, there are still many important and relevant problems that "classical" computers cannot solve.

We are witnessing rapid progress in a new computing paradigm – Quantum Computing. Quantum computing takes advantage of the laws of quantum mechanics found in nature and represents a fundamental change from classical information processing. Two properties of quantum behavior – superposition and entanglement – may allow quantum computers to one day address problems intractable for today's conventional classical machines.

During this talk, I will give an overview of quantum computing, what it means for the future of technology, and how we can separate hype from reality.

Dario Gil is the Director of IBM Research and Vice President of AI and Quantum Computing, a global organization with over 3,000 researchers across 13 laboratories and 21 locations devoted to advancing the frontiers of information technology. As COO, Dr. Gil is responsible for guiding the strategic agenda of IBM Research, defining IBM's annual Global Technology Outlook, driving operations and financial plan execution, and establishing partnerships with companies and universities worldwide. As the Vice President of AI and Quantum Computing, Dr. Gil is also responsible for IBM's global research efforts in artificial intelligence and for IBM's quantum computing program. He co-chairs the MIT-IBM Watson AI Lab along with Professor Anantha Chandrakasan, Dean of the MIT School of Engineering. Dr. Gil's research results have appeared in over 20 international journals and conferences and he is the author of numerous patents. Dr. Gil is an elected member of the IBM Academy of Technology. He received his Ph.D. in Electrical Engineering and Computer Science from MIT.

9:10 to 9:50 am

3D NAND Flash Technology: Roadmap, Process, Design and Challenges

Jeongdong Choe

Senior Technical Fellow, TechInsights (Canada)

Due to many of technical barriers and issues on manufacturing 2D NAND Flash devices such as quadruple patterning technology (QPT), air-gap process, crosstalk/interference and CG/FG leaning, 3D NAND Flash architectures represent an opportunity to overcome the limitations of planar technology. Now, 3D NAND Flash technology is popular in industry and commercial market, and it is one of the most prominent integrated solution for the nonvolatile storage devices including SSD and high volumes of data. After Samsung mass-produced their modified TCAT 3D V-NAND with 24L in 2013, Toshiba/Western Digital BiCS, SK Hynix P-BiCS and Micron/Intel 3D FG CuA have been commercialized. Already, all the major NAND players reached up to 64L/72L and even more than 90L. Although NAND players are now free from QPT, 3D NAND technology challenges for further scaling down on 3D NAND process integration such as very high aspect ratio channel and source contact formation, charge leakage from trap layer, forming staircase/word line pad connection and multi-stack cell architecture are still on the list of their technology barriers. Different cell layouts/design, masks, patterning (Photolithography and Etching), process integration/sequence and materials have been used for each 3D NAND architecture. The general scaling trend for every 3D NAND Flash technology is to increase the number of integrated layers. How to successfully reach out the process integration for the next 3D NAND generation? We'll review recent progress on 3D NAND cell architecture from major 3D NAND players. Future challenges/direction and prospection will be discussed as well.

Jeongdong Choe has a Ph.D. in electronic engineering and 26+ years' experience in semiconductor process integration for DRAM, (V) NAND, SRAM and logic devices. Dr. Choe's background includes positions as a Team Lead in R&D for SK-Hynix and Samsung, where he optimized process and device architectures with state-of-the-art technologies for mass production. He received a Ph. D., Electronics (Semiconductor) at Sungkyunkwan Univ.; a Master Degree, Materials Engineering (Metallurgical) at Yonsei Univ.; a Bachelor's Degree, Metallurgical Engineering at Yonsei Univ.

9:50 to 10:30 am

Patterning in the Stressful World of 3D NAND

Steven Steen
Director, Product Management-3D Memory Software, ASML (Netherlands)

Bart van Schravendijk
Chief Technology Officer, Dielectrics, Lam Research Corp. (USA)

Micheal Kubis
Senior Management System Engineer, ASML (Netherlands)

Jan Willem Cromwijk
Product System Engineer, ASML (Netherlands)

Hans Kattouw
System Engineer for 3D NAND device and applications, ASML (Netherlands)

Yongsik Yu
Managing Technical Director of Memory Program, Lam Research Corp. (USA)

NAND Flash has grown from an infant technology to a crucial building block of modern appliances. Introduced in 1989 [XX], the technology has enabled ever-increasing storage capacity through scaling the underlying device structures. The end of scaling was reached with too few electrons defining the memory state which results in reliability concerns. In order to circumvent this limitation Toshiba proposed a bit cost scaling architecture with the memory devices stacked on each other, what we now call 3D NAND. First demonstrated by Toshiba at VLSI 2007, it wasn't until 2013 when the first chips were commercially available from Samsung.

The revolutionary 3D NAND device drives greater process and integration complexity than any device in the past. Node transitions now target a layer increase above lateral scaling and up to 96 layers of devices are currently being produced. The devices in the entire stack are patterned in a single pass using a high aspect ratio etch and subsequent gate stack & channel multi-layer deposition. We will discuss how many of the process parameters impact the formation of yielding devices. Variations in the layer stack uniformity, stress management, alignment, imaging, hard mask transfer & the high aspect ratio etches all require careful attention and in certain cases new capabilities for optimal results. Different integration approaches with multi-tier approaches split the layers to reduce patterning cost and complexity.

Formation of the contacts to every device layer is a second aspect of the 3D revolution. This area has undergone a transformation through the holistic optimization of the patterning processes. We will discuss how staircase patterning has evolved from linear single step staircases to highly efficient binary staircases to save on cost, cycle time and yields. The patterning doesn't require high end lithography and proven technology can be used if key challenges are met such as edge placement error, thick resist imaging in combination with resist and etch contributions.

The process innovations in 3D NAND are continuing to drive down cost, improve yields and result in an ever improving bit cost. Creativity and perseverance will continue to drive Moore's Law.

Steven Steen is director of Product Management at ASML. In this role he is responsible for the 3D Memory product portfolio at ASML. He studied at the Hogeschool Enschede and started his career at IBM's T.J. Watson Research Center during the final stages of his education.

Leading edge innovation is the consistent thread during his 20 years' experience in semiconductor R&D (of which 15 in lithography). Steven joined IBM in 1997 to develop and commercialize full chip timing diagnostics through Picosecond Imaging Circuit Analysis. In 2001, Steven joined the microelectronics research line and started his career in lithography there. During a wide variety of roles he worked to realize numerous device technologies and business opportunities. He moved to the Netherlands and joined ASML in 2012 to lead the definition and development of innovations and unique product offerings to ASML's customers. Holder of over 22 US Patents and 35 published research papers, Steven

continues to think of new applications and the challenges of the future. Outside of work he is often found near the water for sailing, swimming or other forms of water sports.

Bart van Schravendijk is currently Chief Technical Officer, Dielectrics at Lam Research Corporation, Fremont, CA, USA. At Lam, he is focused on emerging technologies in the dielectric deposition area. In recent years these have found their application in VNAND, MRAM and Phase Change memories. He has 30+ years of experience in wafer fabrication equipment development, process technology and process integration. He has authored over 95 patents and numerous publications.

Michael Kubis holds a PhD in physics. He worked 5 years in material science research before joining Semiconductor Industry in 2001. He worked as Process Engineer and Senior Manager in Deep-Trench technology DRAM R&D and HVM until joining ASML in 2010 were he became System Engineer for on-product overlay applications. He is now Senior Manager of the System Engineering Patterning Team at ASML.

Jan Willem Cromwijk is Product System Engineer for 3D Memory Solutions in ASML. He studied Mechanical Engineering at University of Twente, and graduated in the department of Fluid Dynamics and Heat Transfer on Modelling of Cavitation and Two-phase flows.

After a year at Cambridge University, Department of Applied Mathematics and Theoretical Physics, he started at TNO, the Netherlands Organization for Applied Scientific Research. In 1997 he joined Philips, in several positions within Research and Development of Philips Innovations Services and Philips Lighting. In 2007 he joined ASML, as System Engineer for Immersion, NXE 3100, in the EUV Source program, and since 2016 in the 3D Memory Solutions program.

Hans Kattouw studied Applied Physics at the University of Twente in the department of Low Temperatures and Superconductivity. After working as an IT consultant, he joined ASML in 2000 where he has held several positions within Development & Engineering, Customer Service, Product Management and now System Engineering. He has worked on the development of immersion lithography, and has extensive knowledge on focus, overlay and 3D NAND process and device technology. In his free time, he plays electric guitar and climbs mountains.

Yongsik Yu is managing technical director of memory program in advanced technology department of Lam Research. He earned a doctorate degree in materials science from University of Maryland at College Park, a master's degree in metallurgical science and engineering from Stevens Institute of Technology, and a bachelor's degree in metallurgical engineering from Hanyang University. Before joining Lam Research, he worked at various semiconductor companies such as Novellus Systems and SK Hynix Inc. And, he holds 30+ patents and has authored numerous technical papers.

Coffee Break 10:30 am to 11:00 am

SPECIAL EVENTS

Technical Events

Nanotechnology in Microlithography Panel on Intersecting the Quantum Future and the Semiconductor Industry

Monday 25 February 2019 · 7:10 to 8:40 pm

Location: Convention Center,
Grand Ballroom 220C

Moderators: **Bryan M. Barnes** and **R. Joseph Kline,** NIST (USA)

Quantum computing has been a long-anticipated emerging computational paradigm to complement and compete with conventional CMOS technologies. The last decade has featured reports of the initial development of using CMOS processing techniques for qubits and the atomistic fabrication of single atom transistors. Will the semiconductor industry embrace this new architype, and if so, how? When quantum devices begin to scale as predicted, will our industry be ready to integrate radically different architectures and device structures? Are there known obstacles not yet addressed that would enable the industry to more readily adopt and benefit from today's achievements in the laboratory? What are the emerging designs and the potential fundamental challenges that are to be overcome? We have assembled a panel of experts that will share their insights on the state-of-the-art in quantum computing as well as intellectual leaders that will share their vision of the eventual merger of these new technologies with our computing capabilities today, even as lithography is approaching the near-atomic domain. Join us as we discuss the impending critical impact of quantum computing on the semiconductor industry.

CANCELLED

Symposium-wide Panel Discussion

Tuesday 26 February 2019 · 6:00 to 8:00 pm

Location: Convention Center,
Grand Ballroom 220A

Lithography Scaling: Is This the End?

Moderators: **Harry J. Levinson,** HJL Lithography (USA); **Chris A. Mack,** Fractilia (USA)

Lithography scaling has been the main driver of Moore's Law for many decades, but lately scaling has slowed. The difficulties of extending 193-nm immersion multiple patterning, the lack of manufacturing readiness of EUV, and difficulties in scaling the transistor gate pitch means that semiconductor manufacturers have looked elsewhere for so-called "scaling boosters": new materials, new transistor architectures, vertical integration, and new design approaches that can increase density without lithography scaling. Moreover, stochastics could potentially limit the yield of all lithography-scaled features at some dimension. Is this the end of scaling? If so, what will come next? This cross-symposium panel will bring in experts from every conference to discuss these and other critical issues affecting the future of our community.

Poster Session

Wednesday 27 February 2019 · 5:30 to 7:30 pm

Location: Convention Center, Hall 2

Posters will be on display from 10:00 am to 5:00 pm on Wednesday, and from 5:30 pm to 7:30 pm during the poster session. Come to view the high quality papers that are presented in this alternative format and interact with the poster authors who will be present during the poster session. Enjoy light refreshments while networking with your colleagues.

Full author or technical registration is required for entry into the poster session. Please wear your registration badge.

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Social Networking Events

SPIE Fellow Member and Student Luncheon

Monday 25 February 2019 · 12:30 to 1:30 pm

Location: Marriott, Salon I

Student conference attendees and SPIE Fellow Members are invited to this engaging networking lunch. This event gives students an opportunity to network with SPIE Fellows who will share their insights into career paths in lithography. Lunch is complimentary. Fellow Members will receive a personal invitation, student seating is available on a first-come, first-served basis.

Welcome and Networking Event

Monday 25 February 2019 · 6:00 to 7:00 pm

Location: Convention Center,
x Ballroom Concourse

Join your colleagues at the Welcome Reception. Relax, socialize, and enjoy beverages and hors-d'oeuvres on the first night of the conference. All attendees welcome.

Beverage tickets are included with your paid conference registration. Please remember to wear your registration badge. Dress is casual.

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Women in Optics Networking Lunch

Wednesday 27 February 2019 · 12:00 to 1:00 pm

Location: Convention Center, Room 114

Join other women in the field for informal discussions and networking during the scheduled lunch on Wednesday. Welcome and opening remarks by Dr. Emily Gallagher.

Emily Gallagher is a Principal Member of Technical Staff at IMEC, focusing on pellicle membrane development, EUV imaging and photomasks. Emily received her PhD in physics studying free electron lasers before shifting to the semiconductor industry. She worked at IBM Microelectronics, working in wafer process, device characterization, and lithography before leading EUV mask development. She has authored over 80 technical papers, holds ~20 patents, and is an SPIE Fellow.

Metrology, Inspection, and Process Control for Microlithography (10959)

Monday 25 February 2019 • 11:00 to 11:15 am
Location: Convention Center, Grand Ballroom 220B

Presentation of the 2018 Diana Nyyssonen Memorial Award for Best Paper in Metrology

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Thursday 28 February 2019 • 10:20 to 10:30 am
Location: Convention Center, Grand Ballroom 220B

Presentation of the 2019 Karel Urbánek Best Student Paper Award

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Advances in Patterning Materials and Processing Technology (10960)

Monday 25 February 2019 • 2:00 to 2:20 pm
Location: Convention Center, Grand Ballroom 220C

Presentation of the 2018 C. Grant Willson Award for Best Paper

and

Presentation of the 2018 Hiroshi Ito Memorial Award for the Best Student Paper

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Presentation of the 2018 Jeffrey Byers Memorial Best Poster Award

Award Sponsored by

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Extreme-Ultraviolet (EUV) Lithography X (10957)

Thursday 28 February 2019 • 10:25 to 10:30 am
Location: Convention Center, Grand Ballroom 220A

Presentation of the 2019 ASML-Cymer Leadership for Best Student Paper Award

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CREATE THE FUTURE

Scientific advancement and commercial innovations are often sparked by the face-to-face meetings that occur among people who gather at SPIE events like Advanced Lithography.

People all over the world and across disciplines have gained competitive advantage thanks to their involvement with SPIE. Whether you are pushing the frontier of research, engineering a better product, working on new applications, or building a business, SPIE brings you the best resources and the best connections to help you create the future.

We invite you to get more involved and share your ideas with your community.

In 2018 SPIE provided over $4 million in community support, including sponsorships and awards, outreach and advocacy programs, travel grants, public policy, and educational resources as part of our not-for-profit mission.

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Information for Course attendees:
www.spie.org/education/course-attendees

SUNDAY 24 FEBRUARY 2019

SC101: **Introduction to Microlithography: Theory, Materials, and Processing** *(Willson, Bowden, Dammel)* 8:30 am to 5:30 pm, $655 / $383 / $770

SC1099: **Chemistry and Lithography** *(Okoroanyanwu)* 8:30 am to 5:30 pm, $755 / $423 / $870

SC1100: **Scatterometry in Profile, Overlay and Focus Process Control** *(Cramer, Turovets)* 1:30 pm to 5:30 pm, $405 / $261 / $465

SC1132: **Computational Basis for Advanced Lithography Techniques** *(Lai)* 8:30 am to 5:30 pm, $655 / $383 / $770

SC1133: **Advanced concepts in Metrology Toolset Stability and Matching** *(Solecky, Adan)* 8:30 am to 12:30 pm, $405 / $261 / $465

SC1158: **Metrology of Image Placement** *(Starikov)* 1:30 pm to 5:30 pm, $410 / $263 / $470

SC1263: *NEW* **Stochastic Lithography** *(Mack, Petersen)* 8:30 am to 5:30 pm, $740 / $417 / $855

SC1264: *NEW* **Machine Learning for Lithography,** *(Shiely),* 1:30 pm to 5:30 pm, $440 / $275 / $500

SC885: **Principles and Practical Implementation of Multiple Patterning,** *(Dusa, Hsu),* 8:30 am to 5:30 pm, $655 / $383 / $770

SC888: **EUV Lithography,** *(Bakshi, Ahn, Naulleau),* 8:30 am to 5:30 pm, $885 / $475 / $1,000

SC992: **Lithography Integration for Semiconductor FEOL & BEOL Fabrication** *(Lin, Zhang)* 8:30 am to 5:30 pm, $655 / $383 / $770

MONDAY 25 FEBRUARY 2019

SC1030: **Interaction of Physical Design and Lithography** *(Yuan)* 1:30 pm to 5:30 pm, $405 / $261 / $465

THURSDAY 28 FEBRUARY 2019

SC616: **Practical Photoresist Processing** *(Dammel)* 8:30 am to 12:30 pm, $405 / $261 / $465

Review course descriptions onsite or online.

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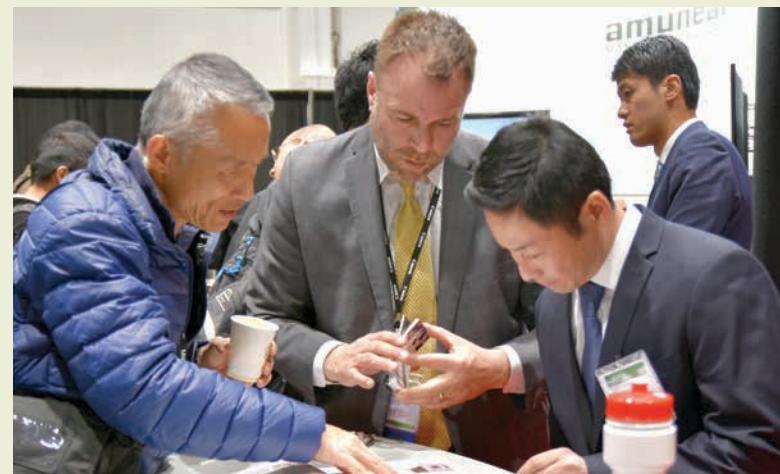
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SESSION SCHEDULE

	CONFERENCE 10957 **Extreme Ultraviolet (EUV) Lithography X**	CONFERENCE 10958 **Novel Patterning Technologies for Semiconductors, MEMS/NEMS and MOEMS 2019**	CONFERENCE 10959 **Metrology, Inspection, and Process Control for Microlithography XXXIII**
Monday 25 February	**Session 1** · Mon 11:00 am to 12:20 pm **Keynote Session** **Session 2** · Mon 2:00 pm to 3:20 pm **The Future is High NA** **Session 3** · Mon 3:50 pm to 5:30 pm **Inorganic Resists: Joint session with conferences 10960 and 10957**	**Opening Remarks** · 3:30 pm to 3:50 pm **Session 1** · Mon 3:50 pm to 5:10 pm **Keynote Session**	**Opening Remarks and Award Announcement** · 11:00 am to 11:15 am **Session 1** · Mon 11:15 am to 12:25 pm **Keynote Session** **Session 2** · Mon 1:30 pm to 3:10 pm **Overlay News** **Session 3** · Mon 3:40 pm to 5:20 pm **Challenges and New Methods**
Tuesday 26 February	**Session 4** · Tue 8:00 am to 10:00 am **Stochastics and Exposure Mechanisms: Joint session with conferences 10960 and 10957** **Session 5** · Tue 10:30 am to 11:50 am **Order from Chaos: Stochastic Modeling** **EUV Poster Preview Speed Talks I** · 11:50 am to 12:10 pm **Session 6** · Tue 1:40 pm to 3:20 pm **EUV Mask Fidelity** **Session 7** · Tue 3:50 pm to 5:10 pm **Printing at the Edge: EUV Patterning Applications**	**Session 2** · Tue 8:00 am to 10:00 am **MEMS/NEMS and MOEMS I** **Session 3** · Tue 10:30 am to 12:10 pm **MEMS/NEMS/and MOEMS II** **Session 4** · Tue 1:40 pm to 3:20 pm **Nanoimprint Lithography I: Technology** **Session 5** · Tue 3:50 pm to 5:50 pm **Nanoimprint Lithography II: Manufacturing**	**Session 4** · Tue 8:00 am to 10:00 am **Inspection I** **Session 5** · Tue 10:30 am to 12:10 pm **Advances in Physical Characterization** **Session 6** · Tue 1:30 pm to 3:10 pm **LWR** **Session 7** · Tue 3:40 pm to 5:20 pm **New Methods: Student Session**
Wednesday 27 February	**Session 8** · Wed 8:20 am to 10:00 am **EUV Patterning and Etch:Joint session with conferences 10957 and 10963** **Session 9** · Wed 10:30 am to 12:10 pm **EUV Masks, Defects, and Pellicles** **Session 10** · Wed 1:40 pm to 3:00 pm **EUV Imaging Enhancement I** **EUV Poster Preview Speed Talks II** · 3:00 to 3:20 pm **Session 11** · Wed 3:50 pm to 4:50 pm **EUV Imaging Enhancement II** **EUV Poster Preview Speed Talks III** · 4:50 to 5:10 pm	**Session 6** · Wed 8:00 a m to 10:00 am **Multi-beam Lithography: Invited Session** **Session 7** · Wed 10:30 am to 12:10 pm **Directed Self-assembly I: Joint session with conferences 10960 and 10958** **Session 8** · Wed 1:40 pm to 3:20 pm **Novel Patterning and Applications I** **Session 9** · Wed 3:50 pm to 4:50 pm **3-D Printing and Structures: Invited Session**	**Session 8** · Wed 8:00 am to 10:00 am **Machine Learning** **Session 9** · Wed 10:30 am to 12:10 pm **SEM** **Session 10** · Wed 1:30 pm to 3:10 pm **SEM and e-Beam Metrology** **Session 11** · Wed 3:40 pm to 5:20 pm **Overlay**
Thursday 28 February	**Session 12** · Thu 8:00 am to 10:00 am **Progress in EUV Sources** **2019 AS mer Award Presentation** · 10:25 to 10:30 am **Session 13** · Thu 10:30 am to 12:10 pm **EUV OPC and Modeling: Joint session with conferences 10957 and 10962**	**Session 10** · Thu 8:00 am to 10:00 am **Quantum/Neuromorphic Computing: Invited Session** **Session 11** · Thu 10:30 am to 12:10 pm **Novel Patterning and Applications II** **Session 12** · Thu 1:30 pm to 2:30 pm **Novel Materials/Novel Directed Self-assembly**	**Session 12** · Thu 8:00 am to 10:00 am **Design Interactions with Metrology:Joint session with conferences 10959 and 10962** **2019 Karel Ubánek Best Student Paper Award Presentation** · 10:20 to 10:30 am **Session 13** · Thu 10:30 am to 12:10 pm **Process Control** **Session 14** · Thu 1:30 pm to 3:10 pm **Inspection II** **Session 15** · Thu 3:40 pm to 5:40 pm **Optical Metrology and Late News**

CONFERENCE 10960 **Advances in Patterning Materials and Processes XXXVI**	CONFERENCE 10961 **Optical Microlithography XXXII**	CONFERENCE 10962 **Design-Process-Technology Co-optimization for Manufacturability XIII**	CONFERENCE 10963 **Advanced Etch Technology for Nanopatterning VIII**
Opening Remarks and Award Announcements · 2:00 pm to 2:20 pm Session 1 · Mon 2:20 pm to 3:20 pm **Keynote Session** **Session 2** · Mon 3:50 pm to 5:30 pm **Inorganic Resists: Joint session with conferences 10960 and 10957**			**Session 1** · Mon 1:30 pm to 3:30 pm **Keynote Session: Plasma Based Patterning Innovations** **Session 2** · Mon 4:00 pm to 6:00 pm **Materials and Etch Integration**
🔲 **Session 3** · Tue 8:00 am to 10:00 am **Stochastics and Exposure Mechanisms: Joint session with conferences 10960 and 10957** **Session 4** · Tue 10:30 am to 12:10 pm **EUV Resists** **Session 5** · Tue 1:40 pm to 3:20 pm **Resist Fundamentals** **Session 6** · Tue 3:50 pm to 5:10 pm **Integration**	**Opening Remarks** · 8:00 am to 8:20 am **Session 1** · Tue 8:20 am to 10:00 am **Keynote Session** 🔷 **Session 2** · Tue 10:30 am to 12:10 pm **Machine Learning and Computational Lithography I** 🔷 **Session 3** · Tue 1:40 pm to 3:20 pm **Machine Learning and Computational Lithography II** **Session 4** · Tue 3:50 pm to 5:30 pm **Resist Modeling and Process Control**		**Session 3** · Tue 1:30 pm to 3:10 pm **Patterning Process Control and Computational Patterning** **Session 4** · Tue 3:40 pm to 5:20 pm **Atomic Layer Etching and Novel Plasma Techniques**
Session 7 · Wed 8:10 am to 10:00 am **Monolayer Materials in Device Fabrication** **Session 8** · Wed 10:30 am to 12:10 pm **Directed Self-assembly I: Joint session with conferences 10960 and 10958** **Session 9** · Wed 1:40 pm to 3:20 pm **Directed Self-assembly II: Defectivity** **Session 10** · Wed 3:50 pm to 4:50 pm **Student Session** **Poster Preview Speed Talks** · 4:50 to 5:20 pm	**Session 5** · Wed 8:00 am to 9:40 am **Lithography Equipment** **Remarks** · 9:40 am to 10:00 am	**Session 1** · Wed 8:00 am to 10:00 am **Design-Technology Co-optimization** **Session 2** · Wed 10:30 am to 12:10 pm **Layout Analytics** 🔷 **Session 3** · Wed 1:40 pm to 3:20 pm **Machine Learning** **Session 4** · Wed 3:50 pm to 5:30 pm **Process Modeling and Layout Optimization**	**Session 5** · Wed 8:20 am to 10:00 am **EUV Patterning and Etch: Joint session with conferences 10957 and 10963** **Session 6** · Wed 10:30 am to 12:10 pm **Patterning Solutions for Emerging Applications** **Session 7** · Wed 1:40 pm to 3:20 pm **Advanced Patterning Integration** **Session 8** · Wed 3:50 pm to 5:10 pm **Patterning Solutions for Emerging Applications II**
Session 11 · Thu 8:00 am to 10:00 am **Material Supplier** **Session 12** · Thu 10:30 am to 12:10 pm **Underlayers** **Tribute to C. Grant Willson (retiring in 2019)** · 1:40 pm to 5:00 pm		**Session 5** · Thu 8:00 am to 10:00 am **Design Interactions with Metrology: Joint session with conferences 10959 and 10962** **Session 6** · Thu 10:30 am to 12:10 pm **EUV OPC and Modeling: Joint session with conferences 10957 and 10962** **Session 7** · Thu 1:30 pm to 3:30 pm **Hotspot Detection**	**APPLICATION TRACKS** Easily find sessions on these three important topics within the program. Each conference has grouped the applicable presentations together and do not overlap with other conferences. 🔷 • **Machine Learning** 🔲 • **Stochastics** 🔶 • **Overlay**

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15

CONFERENCE 10957

Monday–Thursday
25–28 February 2019
Proceedings of SPIE Vol. 10957

Extreme Ultraviolet (EUV) Lithography X

Conference Chair: **Kenneth A. Goldberg,** Lawrence Berkeley National Lab. (USA)

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CONFERENCE 10958

Monday–Thursday
25–28 February 2019
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Novel Patterning Technologies for Semiconductors, MEMS/NEMS and MOEMS 2019

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Conference Co-Chair: **Eric M. Panning,** Intel Corp. (USA)

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CONFERENCE 10959

Monday–Thursday
25–28 February 2019
Proceedings of SPIE Vol. 10959

Metrology, Inspection, and Process Control for Microlithography XXXIII

Conference Chair: **Vladimir A. Ukraintsev,** Qorvo Corp. (USA)

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CONFERENCE 10960

Monday–Thursday
25–28 February 2019
Proceedings of SPIE Vol. 10960

Advances in Patterning Materials and Processes XXXVI

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CONFERENCE 10961

Tuesday–Wednesday
26–27 February 2019
Proceedings of SPIE Vol. 10961

Optical Microlithography XXXII

Conference Chair: **Jongwook Kye,** SAMSUNG Electronics Co., Ltd. (Korea, Republic of)

Conference Co-Chair: **Soichi Owa,** Nikon Corp. (Japan)

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CONFERENCE 10962

Wednesday–Thursday
27–28 February 2019
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Design-Process-Technology Co-optimization for Manufacturability XIII

Conference Chair: **Jason P. Cain,** Advanced Micro Devices, Inc. (USA)

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CONFERENCE 10963

Monday–Tuesday
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Advanced Etch Technology for Nanopatterning VIII

Conference Chair: **Richard S. Wise,** Lam Research Corp. (USA)

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PLENARY SESSION · MONDAY · 8:00 AM TO 10:30 AM · LOCATION: CONVENTION CENTER, GRAND BALLROOM 220A

Welcome and Announcements

Symposium Chairs: **Will Conley,** Cymer, An ASML Company (USA), and **Kafai Lai,** IBM T. J. Watson Research Ctr. (USA)

- **Introduction of New SPIE Fellows**
- **Presentation of the Zernike Awards**
- **Presentation of the Nick Cobb Memorial Scholarship**

Plenary Presentations

8:30 am:

The Future is Quantum *(Plenary)*, Dario Gil, Director, IBM Research, Vice President of AI and Quantum Computing IBM T.J. Watson Research Ctr. (USA) [10957-500]

9:10 am:

3D NAND Flash Technology: Roadmap, Process, Design, and Challenges *(Plenary)*, Jeongdong Choe, Techinsights (Canada) [10957-501]

9:50 am:

Patterning in the Stressful World of 3D NAND *(Plenary)*, Steven Steen, Director, Product Management-3D Memory Software, ASML (Netherlands); Bart van Schravendijk, Chief Technology Officer, Dielectrics, Lam Research Corp. (USA); Micheal Kubis, Senior Management System Engineer, ASML (Netherlands) ; Jan Willem Cromwijk, Product System Engineer, ASML (Netherlands); Hans Kattouw, System Engineer for 3D NAND device and applications, ASML (Netherlands) [10957-502]

Coffee Break . . . . . .Mon 10:30 am to 11:00 am

CONFERENCE 10957
Extreme Ultraviolet (EUV) Lithography X

SESSION 1

LOCATION: CONVENTION CENTER, GRAND BALLROOM 220A MON 11:00 AM TO 12:20 PM

Keynote Session

Session Chairs: **Kenneth A. Goldberg,** Lawrence Berkeley National Lab. (USA); **Nelson M. Felix,** IBM Corp. (USA)

11:00 am: **EUVL: the natural evolution of optical microlithography** *(Keynote Presentation)*, Bernd Geh, Carl Zeiss SMT GmbH (USA) . . . . [10957-1]

11:40 am: **EUV insertion strategy into logic technology on the horizon of scaling paradigm change** *(Keynote Presentation)*, Ryoung-Han R. Kim, IMEC (Belgium) . . . . [10957-2]

Lunch Break . . . . .Mon 12:20 pm to 2:00 pm

CONFERENCE 10959
Metrology, Inspection, and Process Control for Microlithography XXXIII

LOCATION: CONVENTION CENTER, GRAND BALLROOM 220B · 11:00 AM TO 11:15 AM

Opening Remarks and Award Announcement

Session Chairs: **Vladimir A. Ukraintsev,** Qorvo Corp. (USA); **Ofer Adan,** Applied Materials Israel, Ltd. (Israel)

Presentation of the **2018 Diana Nyyssonen Best Paper Award in Metrology**

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SESSION 1

LOCATION: CONVENTION CENTER, GRAND BALLROOM 220B · MON 11:15 AM TO 12:25 PM

Keynote Session

Session Chairs: **Vladimir A. Ukraintsev,** Qorvo Corp. (USA); **Ofer Adan,** Applied Materials Israel, Ltd. (Israel)

11:15 am: **Tough road ahead for device overlay and edge placement error** *(Keynote Presentation)*, Kaustuve Bhattacharyya, ASML Netherlands B.V. (Netherlands) . . . .[10959-1]

11:50 am: **Silicon-based quantum computing: manufacturing and metrology challenges** *(Keynote Presentation)*, Richard M. Silver, National Institute of Standards and Technology (USA) . . . .[10959-2]

Lunch Break . . . . .Mon 12:25 pm to 1:30 pm

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APPLICATION TRACKS

Easily find sessions on these three important topics within the program. Each conference has grouped the applicable presentations together and do not overlap with other conferences.

- **Machine Learning**
- **Stochastics**
- **Overlay**

CONFERENCE 10957
Extreme Ultraviolet (EUV) Lithography X

SESSION 2

LOCATION: CONVENTION CENTER, GRAND BALLROOM 220A
MON 2:00 PM TO 3:20 PM

The Future is High NA

Session Chairs: **Patrick P. Naulleau,** Lawrence Berkeley National Lab. (USA); **Jos P. Benschop,** ASML Netherlands B.V. (Netherlands)

2:00 pm: **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, Joerg Zimmermann, Peter Kuerz, Carl Zeiss SMT GmbH (Germany). . . . . [10957-3]

2:20 pm: **Overview and status of the 0.5NA EUV microfield exposure tool at the advanced light source** *(Invited Paper)*, Christopher N. Anderson, Lawrence Berkeley National Lab. (USA) . . . [10957-4]

2:40 pm: **High-NA EUV lithography: the next step in EUV imaging**, Eelco van Setten, John McNamara, Jan van Schoot, Kars Troost, Gerardo Bottiglieri, Joseph Zekry, Timon Fliervoet, ASML Netherlands B.V. (Netherlands); Stephen Hsu, ASML San Jose (USA); Joerg Zimmermann, Jens Timo Neumann, Matthias Roesch, Paul Graeupner, Carl Zeiss SMT GmbH (Germany). . . . .[10957-5]

3:00 pm: **Progress in EUV resists towards high-NA EUV lithography,** Xiaolong Wang, Zuhal Tasdemir, 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) . . . . [10957-6]

Coffee Break . . . . .Mon 3:20 pm to 3:50 pm

CONFERENCE 10959
Metrology, Inspection, and Process Control for Microlithography XXXIII

SESSION 2

LOCATION: CONVENTION CENTER, GRAND BALLROOM 220B
MON 1:30 PM TO 3:10 PM

Overlay

Overlay News

Session Chairs: **Alexander Starikov,** I&I Consulting (USA); **Narender Rana,** Western Digital Corp. (USA)

1:30 pm: **On device EPE: minimizing overlay, pattern placement, and pitch-walk, in presence of EUV stochastics and etch variations**, Ofer Adan, Kevin Houchens, Applied Materials Ltd (Israel) . . . .[10959-3]

1:50 pm: **Overlay error investigation for metal containing resist (MCR),** Roel Gronheid, KLA-Tencor/ ICOS Belgium (Belgium); Satomi Higashibata, Toshiba Electronics Europe GmbH (Germany); Yusuke Tanaka, SanDisk Ltd. (Japan); Masaru Suzuki, Satoshi Nagai, Toshiba Memory Corp. (Japan); Waikin Li, Philippe Leray, IMEC (Belgium) .[10959-4]

2:10 pm: **Process drift compensation by tunable wavelength homing in scatterometry based overlay,** Kun Gao, KLA-Tencor New York (USA) . . . .[10959-5]

2:30 pm: **Measuring after etch overlay and characterizing tilt fingerprints in multi-tier 3D-NAND structures**, Jaap Karssenberg, ASML Netherlands B.V. (Netherlands); Honggoo Lee, Dong-Young Lee, Jun-Yeob Kim, Sangjun Han, Chan-Ha Park, SK Hynix, Inc. (Korea, Republic of); Aileen Soco, ASML Netherlands B.V. (Netherlands); Nang-Lyeom Oh, ASML Korea Co., Ltd. (Korea, Republic of); Arno van Leest, Mir Shahrjerdy, Tjitte Nooitgedagt, ASML Netherlands B.V. (Netherlands) . . . .[10959-6]

2:50 pm: **Standalone alignment technology enabling feed forward compensation of on-product overlay errors**, Takehisa Yahiro, Junpei Sawamura, Sonyong Song, Sayuri Tanaka, Yuji Shiba, Satoshi Ando, Hiroyuki Nagayoshi, Jun Ishikawa, Masahiro Morita, Yuichi Shibazaki, Nikon Corp. (Japan). . . . .[10959-7]

Coffee Break . . . . .Mon 3:10 pm to 3:40 pm

CONFERENCE 10960
Advances in Patterning Materials and Processes XXXVI

LOCATION: CONVENTION CENTER, GRAND BALLROOM 220C
2:00 PM TO 2:20 PM

Opening Remarks and Award Announcements

Session Chairs: **Roel Gronheid,** KLA-Tencor/ICOS Belgium (Belgium); **Daniel P. Sanders,** IBM Research - Almaden (USA)

Presentation of the C. Grant Willson Best Paper Award

Presentation of the Hiroshi Ito Memorial Best Student Paper Award

Awards Sponsored by

IBM.

Presentation of the Jeffrey Byers Memorial Award

Award Sponsored by

TEL

SESSION 1

LOCATION: CONVENTION CENTER, GRAND BALLROOM 220C
MON 2:20 PM TO 3:20 PM

Keynote Session

Session Chairs: **Roel Gronheid,** KLA-Tencor/ICOS Belgium (Belgium); **Daniel P. Sanders,** IBM Research - Almaden (USA)

2:20 pm: **Metal-containing resists for EUV lithography** *(Keynote Presentation)*, Robert L. Brainard, SUNY Polytechnic Institute (USA) . . . . [10960-1]

2:50 pm: **Increased regulatory scrutiny of photolithography chemistries: The need for science and innovation** *(Keynote Presentation)*, Brooke Tvermoes, IBM Corp. (USA); David Speed, GLOBALFOUNDRIES Inc. (USA) . . . . [10960-2]

Coffee Break . . . . .Mon 3:20 pm to 3:50 pm

CONFERENCE 10963
Advanced Etch Technology for Nanopatterning VIII

SESSION 1

LOCATION: CONVENTION CENTER, ROOM 211B
MON 1:30 PM TO 3:30 PM

Keynote Session: Plasma Based Patterning Innovations

Session Chairs: **Efrain Altamirano-Sánchez,** IMEC (Belgium); **Keun Hee Bai,** SAMSUNG Electronics Co., Ltd. (Korea, Republic of)

1:30 pm: **Patterning paradigm shift: from addition of two to the power of two** *(Keynote Presentation)*, Mircea V. Dusa, ASML Belgium N.V. (Belgium). . . . . [10963-1]

2:10 pm: **Combining equipment sensors and control hardware with metrology and advanced computational methods for comprehensive 3D process control** *(Keynote Presentation)*, David Fried, Coventor, Inc., A Lam Research Company (USA); Dan Simon, Boaz Kenane, Lam Research Corp. (USA); Michael Jamiolkowski, Coventor, Inc. (USA); Andrew Bailey, Lam Research Corp. (USA); Marcus Carbery, Lam Research Corp. (Ireland); Lisheng Gao, Lam Research Corporation (USA); Ye Feng, Atashi Basu, Jiangtao Hu, Jason R. Shields, Richard A. Gottscho, Lam Research Corp. (USA) . . . . [10963-2]

2:50 pm: **Etch aware computational patterning in the era of atomic precision processing** *(Keynote Presentation)*, Peter Ventzek, Tokyo Electron America, Inc. (USA); Alok Ranjan, TEL Technology Ctr., America, LLC (USA) . [10963-3]

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

THIS PROGRAM IS CURRENT AS OF 7 JANUARY 2019. Find the latest on the **SPIE CONFERENCE APP**.

19

CONFERENCE 10957
Extreme Ultraviolet (EUV) Lithography X

SESSION 3

**LOCATION: CONVENTION CENTER, GRAND BALLROOM 220A
MON 3:50 PM TO 5:30 PM**

Inorganic Resists:

Joint session with conferences 10960 and 10957

Session Chairs: **Robert L. Brainard,** SUNY CNSE/SUNYIT (USA); **Jason K. Stowers,** Inpria Corp. (USA)

3:50 pm: **The role of the organic shell in hybrid molecular materials**, Sonia Castellanos Ortega, Lianjia Wu, Neha Thakur, Olivier Lugier, Advanced Research Ctr. for Nanolithography (Netherlands) . . . .[10957-7]

4:10 pm: **Model studies on the metal salt sensitization of chemically amplified photoresists**, Gregory M. Wallraff, Hoa D. Truong, Martha I. Sanchez, Noel Arellano, Alexander M. Friz, Wyatt Thornley, IBM Research - Almaden (USA); Oleg Kostko, Dan S. Slaughter, Lawrence Berkeley National Lab. (USA); D. Frank Ogletree, The Molecular Foundry (USA) and Lawrence Berkeley National Lab. (USA). . . . .[10960-3]

4:30 pm: **Analysis of line-and-space patterns of ZrO$_2$ nanoparticle resist on the basis of EUV sensitization mechanism**, Takahiro Kozawa, Teppei Yamada, Yusa Muroya, Osaka Univ. (Japan); Julius J. Santillan, Toshiro Itani, Evolving Nano-process Infrastructure Development Ctr., Inc. (Japan). . . . .[10957-8]

4:50 pm: **Model reactivity of inorganic and organometallic materials in EUV**, Wyatt Thornley, Hoa D. Truong, Martha I. Sanchez, Daniel P. Sanders, Gregory M. Wallraff, IBM Research - Almaden (USA); Oleg Kostko, D. Frank Ogletree, Daniel S. Slaughter, Lawrence Berkeley National Lab. (USA) . . . .[10960-4]

5:10 pm: **Study of zinc based metal oxoclusters: towards enhanced EUV absorptivity**, Neha Thakur, Sonia Castellanos Ortega, Advanced Research Ctr. for Nanolithography (Netherlands) . . . .[10957-9]

CONFERENCE 10958
Novel Patterning Technologies for Semiconductors, MEMS/NEMS and MOEMS 2019

**LOCATION: CONVENTION CENTER, ROOM 210B
3:30 PM TO 3:50 PM**

Opening Remarks

Session Chairs: **Martha I. Sanchez,** IBM Research - Almaden (USA); **Eric M. Panning,** Intel Corp. (USA)

SESSION 1

**LOCATION: CONVENTION CENTER, ROOM 210B
MON 3:50 PM TO 5:10 PM**

Keynote Session

Session Chairs: **Martha I. Sanchez,** IBM Research - Almaden (USA); **Eric M. Panning,** Intel Corp. (USA)

3:50 pm: **The evolution of the Cornell NanoScale Facility and synergies with the semiconductor Industry** *(Keynote Presentation)*, Donald Tennant, Cornell Univ. (USA). . . . .[10958-1]

4:30 pm: **Will stochastics be the ultimate limiter for nanopatterning?** *(Keynote Presentation)*, Chris A. Mack, Fractilia LLC (USA) . . . .[10958-2]

CONFERENCE 10959
Metrology, Inspection, and Process Control for Microlithography XXXIII

SESSION 3

**LOCATION: CONVENTION CENTER, GRAND BALLROOM 220B
MON 3:40 PM TO 5:20 PM**

Challenges and New Methods

Session Chairs: **Shunsuke Koshihara,** Hitachi High-Technologies Corp. (Japan); **Christopher J. Raymond,** Nanometrics Inc. (USA)

3:40 pm: **Effects of coherence on CDSAXS measurements of high aspect ratio 3D structures**, R. Joseph Kline, Daniel Sunday, National Institute of Standards and Technology (USA); Ruipeng Li, Masafumi Fukuto, Brookhaven National Lab. (USA) . . . .[10959-8]

4:00 pm: **Machine learning and hybrid metrology using scatterometry and LE-XRF to detect voids in copper lines**, Dexin Kong, Koichi Motoyama, Abraham Arceo de la peña, Huai Huang, Brock Mendoza, Mary Breton, Gangadhara R. Muthinti, Hosadurga Shobha, John Gaudiello, IBM Corp. (USA); Aron Cepler, Matthew Sendelbach, Susan Emans, Nova Measuring Instruments Inc. (USA); Shay Wolfing, Avron Ger, Nova Measuring Instruments Ltd. (Israel); Kavita Shah, Nova Measuring Instruments Inc. (USA). . . . . . .[10959-9]

4:20 pm: **Image quality enhancement of a CD-SEM image using conditional generative adversarial networks**, Yoshihiro Midoh, Koji Nakamae, Osaka Univ. (Japan). . . . .[10959-10]

4:40 pm: **Statistical significance of STEM based metrology on advanced 3D transistor structures**, Laurens Kwakman, Thermo Fisher Scientific Inc. (Netherlands); Anne Kenslea, Hayley Johanesen, Jillian Cramer, Michael Strauss, Thermo Fisher Scientific Inc. (USA); Werner Boullart, Hans Mertens, Yong Kong Siew, Kathy Barla, IMEC (Belgium) . . . .[10959-11]

5:00 pm: **Edge placement error measurement in lithography process with die to database algorithm**, Yoshishige Sato, NGR Inc. (Japan); Shang-Chieh Huang, NGR Inc. (Taiwan); Kotaro Maruyama, Yuichiro Yamazaki, NGR Inc. (Japan). . . . .[10959-12]

CONFERENCE 10960
Advances in Patterning Materials and Processes XXXVI

SESSION 2

**LOCATION: CONVENTION CENTER, GRAND BALLROOM 220A
MON 3:50 PM TO 5:30 PM**

Inorganic Resists:

Joint session with conferences 10960 and 10957

Session Chairs: **Robert L. Brainard,** SUNY CNSE/SUNYIT (USA); **Jason K. Stowers,** Inpria Corp. (USA)

3:50 pm: **The role of the organic shell in hybrid molecular materials**, Sonia Castellanos Ortega, Lianjia Wu, Neha Thakur, Olivier Lugier, Advanced Research Ctr. for Nanolithography (Netherlands) . . . .[10957-7]

4:10 pm: **Model studies on the metal salt sensitization of chemically amplified photoresists**, Gregory M. Wallraff, Hoa D. Truong, Martha I. Sanchez, Noel Arellano, Alexander M. Friz, Wyatt Thornley, IBM Research - Almaden (USA); Oleg Kostko, Dan S. Slaughter, Lawrence Berkeley National Lab. (USA); D. Frank Ogletree, The Molecular Foundry (USA) and Lawrence Berkeley National Lab. (USA). . . . .[10960-3]

4:30 pm: **Analysis of line-and-space patterns of ZrO$_2$ nanoparticle resist on the basis of EUV sensitization mechanism**, Takahiro Kozawa, Teppei Yamada, Yusa Muroya, Osaka Univ. (Japan); Julius J. Santillan, Toshiro Itani, Evolving Nano-process Infrastructure Development Ctr., Inc. (Japan). . . . .[10957-8]

4:50 pm: **Model reactivity of inorganic and organometallic materials in EUV**, Wyatt Thornley, Hoa D. Truong, Martha I. Sanchez, Daniel P. Sanders, Gregory M. Wallraff, IBM Research - Almaden (USA); Oleg Kostko, D. Frank Ogletree, Daniel S. Slaughter, Lawrence Berkeley National Lab. (USA) . . . .[10960-4]

5:10 pm: **Study of zinc based metal oxoclusters: towards enhanced EUV absorptivity**, Neha Thakur, Sonia Castellanos Ortega, Advanced Research Ctr. for Nanolithography (Netherlands) . . . .[10957-9]

CONFERENCE 10963
Advanced Etch Technology for Nanopatterning VIII

SESSION 2

LOCATION: CONVENTION CENTER, ROOM 211B
MON 4:00 PM TO 6:00 PM
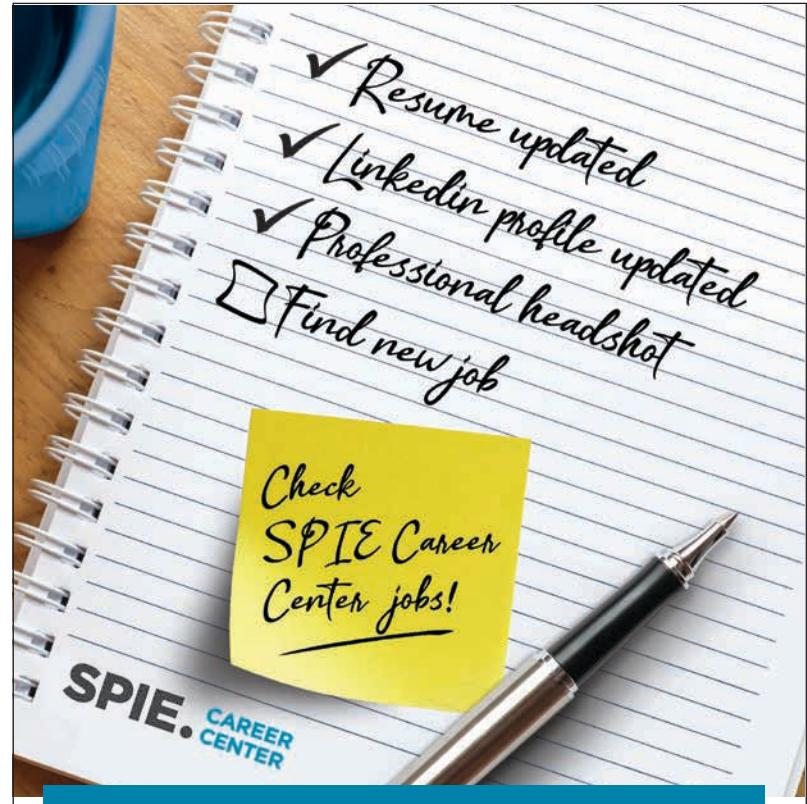
### Materials and Etch Integration

Session Chairs: **Eric A. Hudson,** Lam Research Corp. (USA); **Kaushik A. Kumar,** Tokyo Electron Ltd. (Japan)

4:00 pm: **Fabrication challenges and opportunities for high-mobility materials: from CMOS applications to emerging derivative technologies** *(Invited Paper)*, Nadine Collaert, Alireza Alian, Brice De Jaeger, Uthayasankararan Peralagu, Abhitosh Vais, Amey Walke, Liesbeth Witters, IMEC (Belgium); Hao Yu, IMEC (Belgium) and KU Leuven (Belgium); Elena Capogreco, Katia Devriendt, Toby Hopf, Karine Kenis, Geert Mannaert, Alexey P. Milenin, Antony Peter, Farid Sebaai, Lieve Teugels, Dennis van Dorp, Kurt Wostyn, Naoto Horiguchi, Niamh Waldron, IMEC (Belgium) . . . .[10963-4]

4:40 pm: **Metal organic cluster photoresists: new metal oxide systems** *(Invited Paper)*, Kazunori Sakai, Seok-Heon Jung, Wenyang Pan, Emmanuel Giannelis, Christopher K. Ober, Cornell Univ. (USA) . . . .[10963-5]

5:20 pm: **SPARC: a novel technology for depositing conformal dielectric thin films with compositional tuning for etch selectivity** *(Invited Paper)*, Bhadri Varadarajan, Lam Research Corp. (USA) . . . .[10963-6]

CONFERENCE 10957
Extreme Ultraviolet (EUV) Lithography X

SESSION 4

LOCATION: CONVENTION CENTER, GRAND BALLROOM 220A
TUE 8:00 AM TO 10:00 AM

Stochastics and Exposure Mechanisms:

Joint session with conferences 10960 and 10957

Session Chairs: **Florian Gstrein,** Intel Corp. (USA); **Thomas I. Wallow,** ASML San Jose (USA)

8:00 am: **Stochastic printing failures in EUV lithography** (*Invited Paper*), Peter De Bisschop, IMEC (Belgium) . . . .[10957-10]

8:20 am: **Fundamentals of resist stochastics effect for single-expose EUV patterning**, Anuja De Silva, Luciana Meli, Dario L. Goldfarb, Nelson M. Felix, IBM Corp. (USA) . . . .[10957-11]

8:40 am: **Then a miracle occurs: A description of the issues of EUV radiolysis process and the relationship to stochastic print failures**, John S. Petersen, IMEC (Belgium) . . . .[10960-5]

9:00 am: **Measuring extreme-ultraviolet secondary electron blur**, Steven Grzeskowiak, Robert L. Brainard, Gregory H. Denbeaux, SUNY CNSE/SUNYIT (USA) . . . .[10960-6]

9:20 am: **Multiscale approach for modeling EUV patterning of chemically amplified resist**, Hyungwoo Lee, Muyoung Kim, Junghwan Moon, Sungwoo Park, Seoul National Univ. (Korea, Republic of); Byunghoon Lee, Changyoung Jeong, SAMSUNG Electronics Co., Ltd. (Korea, Republic of); Maenghyo Cho, Seoul National Univ. (Korea, Republic of) . . . .[10960-7]

9:40 am: **The hidden energy tail of low energy electrons in EUV lithography**, Roberto Fallica, IMEC (Belgium) . . . .[10960-8]

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

CONFERENCE 10958
Novel Patterning Technologies for Semiconductors, MEMS/NEMS and MOEMS 2019

SESSION 2

LOCATION: CONVENTION CENTER, ROOM 210B
TUE 8:00 AM TO 10:00 AM

MEMS/NEMS and MOEMS I

Session Chairs: **J. Alexander Liddle,** National Institute of Standards and Technology (USA); **John G. Maltabes,** Applied Materials GmbH & Co. KG (Germany)

8:00 am: **Integration of metasurfaces onto micro electro mechanical systems for active control of visible and IR light** (*Keynote Presentation*), Daniel Lopez, Argonne National Lab. (USA) . . . . [10958-3]

8:40 am: **Single digit nanofabrication for photonics at nanoscale** (*Invited Paper*), Stefano Cabrini, Lawrence Berkeley National Laboratory (USA) . . . .[10958-4]

9:20 am: **3D printing functional nano-photonic devices by multi-photon lithography** (*Invited Paper*), Stephen M. Kuebler, Univ. of Central Florida (USA); Chun Xia, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA); Geng Yang, Rashi Sharma, Univ. of Central Florida (USA); Noel P Martinez, Raymond C. Rumpf, The Univ. of Texas at El Paso (USA); Jimmy Touma, Eglin Air Force Base (USA) . . . .[10958-5]

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

CONFERENCE 10959
Metrology, Inspection, and Process Control for Microlithography XXXIII

SESSION 4

LOCATION: CONVENTION CENTER, GRAND BALLROOM 220B
TUE 8:00 AM TO 10:00 AM

Inspection I

Session Chairs: **Timothy F. Crimmins,** Intel Corp. (USA); **Byoung-Ho Lee,** SK Hynix, Inc. (Korea, Republic of)

8:00 am: **Super-resolution fluorescence nanoscopy opportunities for EUV resist inspection and metrology** (*Invited Paper*), John S. Petersen, IMEC (Belgium) . . . . [10959-13]

8:40 am: **Machine learning for predictive electrical performance using OCD**, Sayantan Das, IMEC (Belgium); Joey Hung, Nova Measuring Instruments Ltd. (Israel); Guillaume Schelcher, Sandip Halder, IMEC (Belgium); Roy Koret, Igor Turovets, Nova Measuring Instruments Ltd. (Israel); Mohamed Saib, Anne-Laure Charley, IMEC (Belgium); Matthew Sandelbach, Nova Measuring Instruments Inc. (USA); Avron Ger, Nova Measuring Instruments Ltd. (Israel); Philippe Leray, IMEC (Belgium) . .[10959-14]

9:00 am: **Variable-wavelength tabletop-scale EUV ptychographic complex imaging reflectometry for 3D composition determination**, Michael Tanksalvala, Christina L. Porter, JILA (USA); Yuka Esashi, Univ. of Colorado Boulder (USA); Galen P. Miley, Northwestern Univ. (USA); Robert Karl Jr., Peter Johnsen, Nicholas W Jenkins, Charles S. Bevis, Bin Wang, Jeremy Thurston, JILA (USA); Xiaoshi Zhang, KMLabs (USA); Seth L Cousin, KM Labs (USA); Daniel E. Adams, Michael Gerrity, JILA (USA); Henry C. Kapteyn, KMLabs (USA) and JILA (USA); Margaret M. Murnane, JILA (USA) and KM Labs (USA). . . . .[10959-15]

9:20 am: **E-beam inspection of single exposure EUV direct print of M2 layer of N10 node test vehicle**, Yuichiro Yamazaki, NGR Inc. (Japan); Sayantan Das, IMEC (Belgium); Ryo Shimoda, NGR Inc. (Japan); Sandip Halder, IMEC (Belgium); Shinzi Mizutani, Kotaro Maruyama, NGR Inc. (Japan); Philippe Leray, IMEC (Belgium). . . . . [10959-16]

9:40 am: **Gas enhanced PFIB surface preparation enabled metrology and statistical analysis of 3D NAND devices,** Mark Biedrzycki, Micah Ledoux, James Clarke, Brett Avedisian, Chad Rue, Umesh P. S. Adiga, Thermo Fisher Scientific Inc. (USA) . . . .[10959-17]

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

CONFERENCE 10960
Advances in Patterning Materials and Processes XXXVI

SESSION 3

LOCATION: CONVENTION CENTER, GRAND BALLROOM 220A
TUE 8:00 AM TO 10:00 AM

Stochastics and Exposure Mechanisms:

Joint session with conferences 10960 and 10957

Session Chairs: **Florian Gstrein,** Intel Corp. (USA); **Thomas I. Wallow,** ASML San Jose (USA)

8:00 am: **Stochastic printing failures in EUV lithography** (*Invited Paper*), Peter De Bisschop, IMEC (Belgium) . . . .[10957-10]

8:20 am: **Fundamentals of resist stochastics effect for single-expose EUV patterning**, Anuja De Silva, Luciana Meli, Dario L. Goldfarb, Nelson M. Felix, IBM Corp. (USA) . . . .[10957-11]

8:40 am: **Then a miracle occurs: A description of the issues of EUV radiolysis process and the relationship to stochastic print failures**, John S. Petersen, IMEC (Belgium) . . . .[10960-5]

9:00 am: **Measuring extreme-ultraviolet secondary electron blur**, Steven Grzeskowiak, Robert L. Brainard, Gregory H. Denbeaux, SUNY CNSE/SUNYIT (USA). . . . .[10960-6]

9:20 am: **Multiscale approach for modeling EUV patterning of chemically amplified resist**, Hyungwoo Lee, Muyoung Kim, Junghwan Moon, Sungwoo Park, Seoul National Univ. (Korea, Republic of); Byunghoon Lee, Changyoung Jeong, SAMSUNG Electronics Co., Ltd. (Korea, Republic of); Maenghyo Cho, Seoul National Univ. (Korea, Republic of) . . . .[10960-7]

9:40 am: **The hidden energy tail of low energy electrons in EUV lithography**, Roberto Fallica, IMEC (Belgium) . . . .[10960-8]

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

CONFERENCE 10961
Optical Microlithography XXXII

LOCATION: CONVENTION CENTER, ROOM 210D
8:00 AM TO 8:20 AM

Opening Remarks
Session Chairs: **Jongwook Kye,** SAMSUNG Electronics Co., Ltd. (Korea, Republic of); **Soichi Owa,** Nikon Corp. (Japan)

SESSION 1

LOCATION: CONVENTION CENTER, ROOM 210D
TUE 8:20 AM TO 10:00 AM

Keynote Session and Late Breaking News
Session Chairs: **Jongwook Kye,** SAMSUNG Electronics Co., Ltd. (Korea, Republic of); **Soichi Owa,** Nikon Corp. (Japan)

8:20 am: **Edge placement error challenges in device scaling** *(Keynote Presentation)*, Mark C. Phillips, Intel Corp. (USA) . . . . [10961-1]
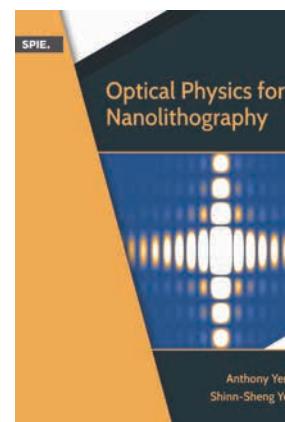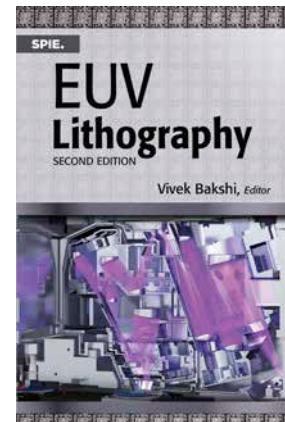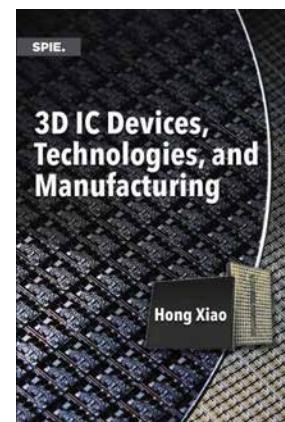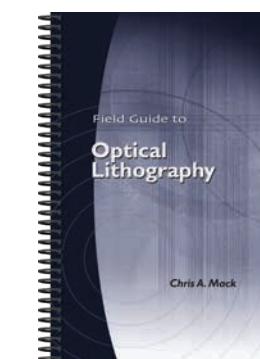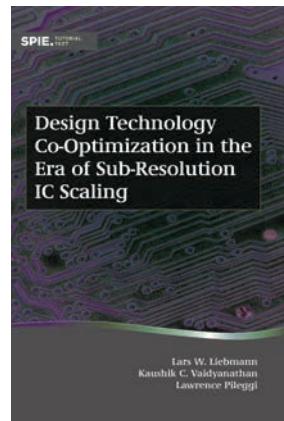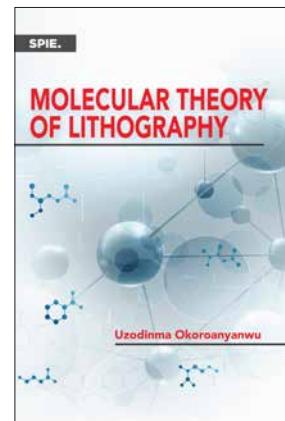
9:00 am: **Software in semiconductor manufacturing: peripeteias and prospects** *(Keynote Presentation)*, Yuri Granik, Mentor, a Siemens Business (USA) . . . . [10961-2]

9:40 am: **Enhancing ILT process window using curvilinear mask patterning: dual mask-wafer simulation** *(Invited Paper)*, Ryan Pearman, P. Jeffrey Ungar, Nagesh Shirali, Abhishek Shendre, Mariusz Niewczas, Linyong Pang, Aki Fujimura, D2S, Inc. (USA) . . . .[10961-36]

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

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How to Write a Good Scientific Paper — Chris A. Mack

Introduction to Metrology Applications in IC Manufacturing — Bo Su, Eric Solecky, Alok Vaid

Field Guide to Optical Lithography — Chris A. Mack

3D IC Devices, Technologies, and Manufacturing — Hong Xiao

EUV Lithography, SECOND EDITION — Vivek Bakshi, Editor

Optical Physics for Nanolithography — Anthony Yen, Shinn-Sheng Yu

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CONFERENCE 10957
Extreme Ultraviolet (EUV) Lithography X

SESSION 5

**LOCATION: CONVENTION CENTER, GRAND BALLROOM 220A
TUE 10:30 AM TO 11:50 AM**

Stochastics

Order from Chaos: Stochastic Modeling

Session Chairs: **Sonia Castellanos Ortega**, Advanced Research Ctr. for Nanolithography (Netherlands); **Shinji Okazaki**, ALITECS Co., Ltd. (Japan)

10:30 am: **Impact of asymmetrically localized and cascading secondary electron generation on stochastic defects in EUV lithography**, Hiroshi Fukuda, Hitachi High-Technologies Corp. (Japan). . . . . [10957-12]

10:50 am: **Impact of local variability on defect-aware process window degradation** *(Invited Paper)*, Mark John Maslow, ASML Netherlands B.V. (Netherlands); Hidetami Yaegashi, Tokyo Electron Ltd. (Japan); Andreas Frommhold, IMEC (Belgium); Guido Schiffelers, Felix Wahlisch, Gijsbert Rispens, Bram Slachter, ASML Netherlands B.V. (Netherlands); Keisuke Yoshida, Arisa Hara, Noriaki Oikawa, Tokyo Electron Ltd. (Japan); Abhinav Pathak, Eric Hendrickx, Joost Bekaert, IMEC (Belgium)[10957-13]

11:10 am: **Unraveling the EUV photoresist reactions: which reactions occur, how much, and how do they relate to printing performance?** *(Invited Paper)*, Ivan Pollentier, John S. Petersen, Peter De Bisschop, Danilo De Simone, Geert Vandenberghe, IMEC (Belgium) . . . . [10957-14]

11:30 am: **OPC strategies to reduce failure rates with rigorous resist model stochastic simulations in EUVL**, Alessandro Vaglio Pret, Trey Graves, David Blankenship, Stewart Robertson, Patrick Lee, John Biafore, KLA-Tencor Texas (USA) . . . . [10957-15]

**LOCATION: CONVENTION CENTER, GRAND BALLROOM 220A
11:50 AM TO 12:10 PM**

EUV Poster Preview Speed Talks I

Session Chairs: **Kenneth A. Goldberg**, Lawrence Berkeley National Lab. (USA); **Nelson M. Felix**, IBM Corp. (USA)

Previews from Posters: 10957-50; 10957-51; 10957-54; 10957-55

Lunch/Exhibition Break . . . Tue 12:10 pm to 1:40 pm

CONFERENCE 10958
Novel Patterning Technologies for Semiconductors, MEMS/NEMS and MOEMS 2019

SESSION 3

**LOCATION: CONVENTION CENTER, ROOM 210B
TUE 10:30 AM TO 12:10 PM**

MEMS/NEMS and MOEMS II

Session Chairs: **Hsinyu Tsai**, IBM Research - Almaden (USA); **Alan D. Brodie**, KLA-Tencor Corp. (USA)

10:30 am: **Emerging nanotechnology for streamlining the preparation of biological samples** *(Invited Paper)*, Joshua Smith, Benjamin H. Wunsch, IBM Thomas J. Watson Research Ctr. (USA); Chi-Chun Liu, Yann Mignot, Raghuveer Patlolla, Nelson M. Felix, Daniel A. Corliss, IBM Research (USA); Gustavo A. Stolovitzky, IBM Thomas J. Watson Research Ctr. (USA) . . . . [10958-6]

11:10 am: **Fully integrated ultra-compact 3D microtube devices** *(Invited Paper)*, Oliver G. Schmidt, Leibniz IFW Dresden (Germany) . [10958-7]

11:50 am: **Grayscale lithography process study for sub 5μm microlens patterns,** Nacima Allouti, CEA-Grenoble (France) . . . . [10958-8]

Lunch/Exhibition Break . . . Tue 12:10 pm to 1:40 pm

APPLICATION TRACKS

Easily find sessions on these three important topics within the program. Each conference has grouped the applicable presentations together and do not overlap with other conferences.

• **Machine Learning**

• **Stochastics**

• **Overlay**

CONFERENCE 10959
Metrology, Inspection, and Process Control for Microlithography XXXIII

SESSION 5

**LOCATION: CONVENTION CENTER, GRAND BALLROOM 220B
TUE 10:30 AM TO 12:10 PM**

Advances in Physical Characterization

Session Chairs: **Richard M. Silver**, National Institute of Standards and Technology (USA); **Hugo Cramer,** ASML Netherlands B.V. (Netherlands)

10:30 am: **Latent imaging of resists via resonant x-ray scattering: unraveling the effects of chain scission to chemical amplification**, Isvar A. Cordova, Guillaume Freychet, Scott D. Dhuey, Alexander Hexemer, Patrick P. Naulleau, Cheng Wang, Lawrence Berkeley National Lab. (USA) . . . . [10959-18]

10:50 am: **Improved sub-surface AFM using photothermal actuation,** Maarten E. van Reijzen, Sasan Keyvani, Mehmet S. Tamer, Maarten H. van Es, TNO (Netherlands); Hamed Sadeghian, TNO Science and Industry (Netherlands); Marco van der Lans, Martijn M. C. J. M. van Riel, TNO (Netherlands) . . . . [10959-19]

11:10 am: **Quantitative tomography with subsurface scanning ultrasound resonance force microscopy**, Maarten H. van Es, TNO Science and Industry (Netherlands); Laurent Fillinger, TNO (Netherlands); Hamed Sadeghian, TNO Science and Industry (Netherlands) . . . . [10959-20]

11:30 am: **Full structure transistor process monitoring of boron and germanium in PFET EPI using In-line XPS**, Jusang Lee, Ganesh Subramanian, Manasa Medikonda, Hossam Lazkani, Judson Holt, Churamani Gaire, GLOBALFOUNDRIES Inc. (USA); Paul Isbester, Mark Klare, Nova Measuring Instruments Inc. (USA). . . . . . . [10959-21]

11:50 am: **Nano-scale molecular analysis of photo-resist films with massive cluster secondary ion mass spectrometry**, Michael J. Eller, Texas A&M Univ. (USA); Mingqi Li, Xisen Hou, Dow Electronic Materials (USA); Stanislav V. Verkhoturov, Emile A. Schweikert, Texas A&M Univ. (USA); Peter Trefonas, Dow Electronic Materials (USA) . . . . [10959-22]

Lunch/Exhibition Break . . . Tue 12:10 pm to 1:30 pm

CONFERENCE 10960
Advances in Patterning Materials and Processes XXXVI

SESSION 4

**LOCATION: CONVENTION CENTER, GRAND BALLROOM 220C
TUE 10:30 AM TO 12:10 PM**

EUV Resists

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

10:30 am: **PSCAR optimization to reduce EUV resist roughness with sensitization**, Seiji Nagahara, Tokyo Electron Ltd. (Japan); Cong Que Dinh, Gosuke Shiraishi, Tokyo Electron Kyushu Ltd. (Japan); Yuya Kamei, Tokyo Electron Ltd. (Belgium); Michael A. Carcasi, Tokyo Electron America, Inc. (USA); Hiroyuki Ide, Yoshihiro Kondo, Yuichi Yoshida, Kosuke Yoshihara, Ryo Shimada, Masaru Tomono, Kazuhiro Takeshita, Tokyo Electron Kyushu Ltd. (Japan); Kathleen Nafus, Tokyo Electron America, Inc. (Belgium); Serge Biesemans, Tokyo Electron Europe Ltd. (Belgium); Hideo Nakashima, Tokyo Electron Ltd. (Japan); John S. Petersen, Danilo De Simone, Philippe Foubert, Geert Vandenberghe, IMEC (Belgium); Hans-Jürgen Stock, Balint Meliorisz, Synopsys GmbH (Germany) . . . . [10960-9]

10:50 am: **Advanced EUV negative tone resist and underlayer approaches exhibiting sub-20nm half-pitch resolution**, Thomas Gädda, Juha T. Rantala, Luong Nguyen Dang, Markus Laukkanen, Kimmo Karaste, Oskari Kähkönen, Emilia Kauppi, PiBond Oy (Finland); Dimitrios Kazazis, Yasin Ekinci, Paul Scherrer Institut (Switzerland) . . . . [10960-10]

11:10 am: **Multi-trigger resist: novel synthesis improvements for high resolution EUV lithography**, Greg O'Callaghan, Carmen Popescu, The Univ. of Birmingham (United Kingdom); Alex McClelland, Irresistible Materials Ltd. (United Kingdom); Dimitrios Kazazis, Paul Scherrer Institut (Switzerland); John Roth, Nano-C, Inc. (USA); Wolfgang Theis, The Univ. of Birmingham (United Kingdom); Yasin Ekinci, Paul Scherrer Institut (Switzerland); Alex P. G. Robinson, The Univ. of Birmingham (United Kingdom)[10960-11]

11:30 am: **Improvement of dual insolubilization resist performance through the incorporation of various functional units**, Satoshi Enomoto, Takumi Yoshino, Kohei Machida, Toyo Gosei Co., Ltd. (Japan); Takahiro Kozawa, Osaka Univ. (Japan). . . . . [10960-12]

11:50 am: **New PSCAR concept promising high sensitivity resist overcoming problems of RLS trade-off, LER and stochastic defects**, Seiichi Tagawa, Osaka Univ. (Japan) . . . . [10960-13]

Lunch/Exhibition Break . . . . Tue 12:10 pm to 1:40 pm

CONFERENCE 10961
Optical Microlithography XXXII

SESSION 2

LOCATION: CONVENTION CENTER, ROOM 210D
TUE 10:30 AM TO 12:10 PM

Machine Learning

Machine Learning and Computational Lithography I

Session Chairs: **Harsha Grunes,** Intel Corp. (USA); **Kunal N. Taravade,** Synopsys, Inc. (USA)

10:30 am: **Correction of lithography hotspots using a generative framework of deep learning** *(Invited Paper)*, Woojoo Sim, SAMSUNG Electronics Co., Ltd. (Korea, Republic of) and Univ. of Michigan (USA); Kibok Lee, Univ. of Michigan (USA); Dingdong Yang, Univ. of Michigan (USA) and Brown Univ. (USA); Honglak Lee, Univ. of Michigan (USA) . . . . [10961-3]

11:10 am: **Predicting etch proximity by adopting machine learning algorithm with VEB modeling**, YoungChang Kim, Sunwook Jung, DooHwan Kwak, Mentor Graphics Korea Co. Inc. (Korea, Republic of); Vlad Liubich, Germain Fenger, Mentor, a Siemens Business (USA) . . . . [10961-4]

11:30 am: **Machine-learning based OPC modeling enabled by high-volume metrology at advanced node**, Wei Yuan, Shanghai Integrated Circuit Research & Development Ctr. Co., Ltd. (China); Fang Wei, Shanghai Huali Microelectronics Corp. (China); Yueliang Yao, ASML (China); Yifei Lu, Shanghai Integrated Circuit Research & Development Ctr. Co., Ltd. (China); Chenming Zhang, Shanghai Huali Microelectronics Corp. (China); Hongmei Hu, Shanghai Integrated Circuit Research & Development Ctr. Co., Ltd. (China); Xichen Sheng, Yanjun Xiao, Liang Liu, Liang Liu, Mu Feng, ASML (China); Jun Lang, Shanghai Huali Microelectronics Corp. (China) . . . . [10961-5]

11:50 am: **Investigation on MBOPC convergence improvement with location-dependent correction factors aided by machine learning**, Sheng-Wei Chien, Jia-Syun Cai, Chien-Lin Lee, Kuen-Yu Tsai, National Taiwan Univ. (Taiwan); James P. Shiely, Matt St. John, Synopsys, Inc. (USA) . . . . . . [10961-6]

Lunch/Exhibition Break . . . Tue 12:10 pm to 1:40 pm

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APPLICATION TRACKS

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• **Machine Learning**

• **Stochastics**

• **Overlay**

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CONFERENCE 10957
Extreme Ultraviolet (EUV) Lithography X

SESSION 6

LOCATION: CONVENTION CENTER, GRAND BALLROOM 220A
TUE 1:40 PM TO 3:20 PM

EUV Mask Fidelity

Session Chairs: **Martin Burkhardt,** IBM Thomas J. Watson Research Ctr. (USA); **Bryan S. Kasprowicz,** Photronics, Inc. (USA)

1:40 pm: **Towards ultimate image placement accuracy for EUV mask writing with pattern shift process**, Vadim Sidorkin, Stephan Zimmermann, Stefan Proske, Michael Finken, G. R. Cantrell, Markus Bender, Advanced Mask Technology Ctr. GmbH Co. KG (Germany) . . . .[10957-16]

2:00 pm: **EUV mask challenges and requirements for ultimate single exposure interconnects** *(Invited Paper)*, Chris Progler, Michael Green, Henry Kamberian, Mohamed Ramadan, Young Ham, Yohan Choi, Bryan Kasprowicz, Photronics, Inc. (USA); Ravi K. Bonam, Daniel Corliss, Nelson M. Felix, Romain Lallement, Derren Dunn, IBM Corp. (USA) . . . .[10957-17]

2:20 pm: **Influence of mask line width roughness on programmed pattern defect printability**, Takeshi Yamane, Evolving Nano-process Infrastructure Development Ctr., Inc. (Japan). . . . .[10957-18]

2:40 pm: **Impact of EUV absorber variations on wafer patterning**, Lawrence S. Melvin III, Yudhishthir Kandel, Tim Fühner, Synopsys, Inc. (USA); Ulrich Welling, Synopsys Belgium BVBA (Belgium); Emily Gallagher, Andreas Frommhold, IMEC (Belgium); Yoshitake Shusuke, NuFlare Technology, Inc. (Japan) . . . .[10957-19]

3:00 pm: **Ion beam etching of advanced absorber materials for sub-5nm EUV masks**, Narasimhan Srinivasan, Katrina Rook, Vincent Ip, Meng H. Lee, Sandeep Kohli, Frank Cerio, Adrian J. Devasahayam, Veeco Instruments Inc. (USA) . . . .[10957-20]

Coffee Break . . . . Tue 3:20 pm to 3:50 pm

CONFERENCE 10958
Novel Patterning Technologies for Semiconductors, MEMS/ NEMS and MOEMS 2019

SESSION 4

Overlay

LOCATION: CONVENTION CENTER, ROOM 210B
TUE 1:40 PM TO 3:20 PM

Nanoimprint Lithography I: Technology

Session Chairs: **Chi-Chun Liu,** IBM Corp. (USA); **Chandrasekhar Sarma,** Intel Corp. (USA)

1:40 pm: **Updates on nano imprint lithography in the production and application of next devices** *(Invited Paper)*, Tatsuhiko Higashiki, Toshiba Memory Corp. (Japan). . . . .[10958-9]

2:20 pm: **Nanoimprint system alignment and overlay improvement for high volume semiconductor manufacturing**, Yukio Takabayashi, Canon Inc. (Japan) . . . .[10958-10]

2:40 pm: **Correcting topography induced overlay errors using drop compensation in nanoimprint lithography systems**, Jin Choi, Anshuman Cherala, Mario J. Meissl, Canon Nanotechnologies, Inc. (USA); Mitsuru Hiura, Iino Satoshi, Canon Inc. (Japan). . . . .[10958-11]

3:00 pm: **Substrate conformal imprint lithography: functional resists, overlay performance, and volume production**, Marc A. Verschuuren, Korneel Ridderbeek, Rob Voorkamp, Philips SCIL Nanoimprint Solutions (Netherlands). . . . .[10958-12]

Coffee Break . . . . Tue 3:20 pm to 3:50 pm

CONFERENCE 10959
Metrology, Inspection, and Process Control for Microlithography XXXIII

SESSION 6

LOCATION: CONVENTION CENTER, GRAND BALLROOM 220B
TUE 1:30 PM TO 3:10 PM

LWR

Session Chairs: **John C. Robinson,** KLA-Tencor Corp. (USA); **Matthew J. Sendelbach,** Nova Measuring Instruments Inc. (USA)

1:30 pm: **Understanding the role of scanning electron microscope image noise in the measurement of pattern roughness**, Chris A. Mack, Fractilia, LLC (USA) . . . .[10959-23]

1:50 pm: **Line width and roughness measurement of SAOP by using FIB and Planer-TEM as reference metrology**, Kiyoshi Takamasu, Satoru Takahashi, The Univ. of Tokyo (Japan); Hiroki Kawada, Masami Ikota, Hitachi High-Technologies Corp. (Japan); Stefan Decoster, Frederic Lazzarino, Gian F. Lorusso, IMEC (Belgium) . . . .[10959-24]

2:10 pm: **Using critical-dimension grazing-incidence small angle x-ray scattering to study line edge roughness**, Guillaume Freychet, Dinesh Kumar, Ron J. Pandolfi, Isvar A. Cordova, Patrick P. Naulleau, Alexander Hexemer, Lawrence Berkeley National Lab. (USA); Gian F. Lorusso, IMEC (Belgium) . . . .[10959-25]

2:30 pm: **LER and LWR measurements used for monitoring wiggling and stochastic-failure**, Hiroki Kawada, Yasushi Ebizuka, Takumichi Sutani, Takahiro Kawasaki, Hitachi High-Technologies Corp. (Japan). . . . .[10959-26]

2:50 pm: **Roughness decomposition: an on-wafer methodology to discriminate mask, metrology, and shot noise contributions**, Gian F. Lorusso, IMEC (Belgium) . . . .[10959-27]

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

CONFERENCE 10960
Advances in Patterning Materials and Processes XXXVI

SESSION 5

LOCATION: CONVENTION CENTER, GRAND BALLROOM 220C
TUE 1:40 PM TO 3:20 PM

Resist Fundamentals

Session Chairs: **Nobuyuki N. Matsuzawa,** Panasonic Corp. (Japan); **Douglas J. Guerrero,** Brewer Science, Inc. (Belgium)

1:40 pm: **Chemical amplification without a catalyst**, C. Grant Willson, The Univ. of Texas at Austin (USA) . . . .[10960-14]

2:00 pm: **Understanding photoacid generator distribution at nanoscale using massive cluster secondary ion mass spectroscopy**, Xisen Hou, Mingqi Li, Dow Electronic Materials (USA); Michael J. Eller, Stanislav V. Verkhoturov, Emile A. Schweikert, Texas A&M Univ. (USA); Peter Trefonas III, Dow Electronic Materials (USA). . . . .[10960-15]

2:20 pm: **Nanoscale polymer property measurement using single-molecule fluorescence**, J. Alexander Liddle, National Institute of Standards and Technology (USA); Muzhou Wang, Northwestern Univ. (USA); Stephen Stranick, Abhishek Kumar, Jeffrey W. Gilman, National Institute of Standards and Technology (USA) . . . .[10960-16]

2:40 pm: **Roughness power spectral density as a function of aerial image and basic process/resist parameter**, Charlotte A. Cutler, Choong Bong Lee, James W. Thackeray, John Nelson, Jason DeSisto, Mingqi Li, Emad Aqad, Xisen Hou, Tomas Marangoni, Joshua A. Kaitz, Rochelle Rena, DowDuPont Electronics & Imaging (USA); Chris A. Mack, Fractilia, LLC (USA) . . . .[10960-17]

3:00 pm: **Pitch division photolithography at I-line**, Paul Meyer, Ji Yeon Kim, Nathaniel A. Lynd, C. Grant Willson, The Univ. of Texas at Austin (USA)[10960-18]

Coffee Break . . . . Tue 3:20 pm to 3:50 pm

CONFERENCE 10961
Optical Microlithography XXXII

SESSION 3

Machine Learning

LOCATION: CONVENTION CENTER, ROOM 210D
TUE 1:40 PM TO 3:20 PM

Machine Learning and Computational Lithography II

Session Chairs: **John S. Peterson,** IMEC (Belgium); **Sachiko Kobayashi,** Toshiba Corp. (Japan)

1:40 pm: **Pairing wafer leveling metrology from a lithographic apparatus with deep learning to enable cost effective dense wafer alignment metrology** *(Invited Paper)*, Emil Schmitt-Weaver, Kaustuve Bhattacharyya, ASML Netherlands B.V. (Netherlands) . . . .[10961-7]

2:20 pm: **Improved wafer alignment model algorithm for better on-product overlay**, Ik-Hyun Jeong, Hyun-Sok Kim, Yeong-Oh Kong, Ji-Hyun Song, Jae-Wuk Ju, Young-Sik Kim, SK Hynix, Inc. (Korea, Republic of); Cees Lambregts, Miao Yu, Rizvi Rahman, Leendertjan Karssemeijer, Elliott McNamara, Paul Böcker, ASML Netherlands B.V. (Netherlands); Jong-Cheol Choi, Nang-Lyeom Oh, Hank Han, Jin-Seo Lee, ASML Korea Co., Ltd. (Korea, Republic of) . . . . [10961-8]

2:40 pm: **Efficient search of layout hotspot patterns for matching SEM images using multilevel pixelation**, Sean Shang-En Tseng, National Taiwan Univ. (Taiwan); Wei-Chun Chang, National Chiao Tung Univ. (Taiwan); Iris Hui-Ru Jiang, National Taiwan Univ. (Taiwan); Jun Zhu, James P. Shiely, Synopsys, Inc. (USA). . . . .[10961-9]

3:00 pm: **Integrated strategies to enhance predictive power of OPC model**, Hong Chen, XTAL Inc. (USA). . . . .[10961-10]

Coffee Break . . . . Tue 3:20 pm to 3:50 pm

APPLICATION TRACKS

Easily find sessions on these three important topics within the program. Each conference has grouped the applicable presentations together and do not overlap with other conferences.

• **Machine Learning**

• **Stochastics**

• **Overlay**

CONFERENCE 10963
Advanced Etch Technology for Nanopatterning VIII

SESSION 3

LOCATION: CONVENTION CENTER, ROOM 211B
TUE 1:30 PM TO 3:10 PM

Patterning Process Control and Computational Patterning

Session Chairs: **Ricardo Ruiz,** HGST, Inc. (USA); **Yuyang Sun,** Mentor, a Siemens Business (USA)

1:30 pm: **Scanner and etch co-optimized corrections for better overlay and CD control**, Ik-Hyun Jeong, Seung-Woo Koo, Hyun-Sok Kim, Jae-Wuk Ju, Young-Sik Kim, Yong-Tae Cho, Heung-Joo Kim, SK Hynix, Inc. (Korea, Republic of); Katja Viatkina, Tom van Hemert, Ruud de Wit, David Deckers, Owen Chen, Nang-Lyeom Oh, ASML Netherlands B.V. (Netherlands); Marcus Musselman, Marcus Carbery, Ssuwei Chen, Lucian Schmidt, Heidi Kwon, Jae Gyoo Lee, Lam Research Corp. (USA) . . . .[10963-7]

1:50 pm: **Predicting and optimizing etch recipes for across the wafer uniformity,** Meghali Chopra, Sofia Helpert, Roger Bonnecaze, SandBox Semiconductor (USA) . . . .[10963-8]

2:10 pm: **Effective metal cleaning to increase MTBC by scanning ECR plasma**, Kosa Hirota, Nanako Tamari, Shigeru Shirayone, Masahiro Sumiya, Hitachi High-Technologies Corp. (Japan). . . . .[10963-9]

2:30 pm: **Integrated atomic scale CD control and local variability reduction techniques**, Toru Hisamatsu, Takayuki Katsunuma, Yoshihide Kihara, Masanobu Honda, Tokyo Electron Miyagi Ltd. (Japan). . . . .[10963-10]

2:50 pm: **Using machine learning technology to accelerate the development of plasma etching processes**, Alexandre Derville, Guillaume Gey, Julien Baderot, Sergio Martinez, Guilhem Bernard, Johann Foucher, POLLEN Metrology (France) . . .[10963-11]

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

CONFERENCE 10957
Extreme Ultraviolet (EUV) Lithography X

SESSION 7

LOCATION: CONVENTION CENTER, GRAND BALLROOM 220A
TUE 3:50 PM TO 5:10 PM

Printing at the Edge: EUV Patterning Applications

Session Chairs: **Christopher S. Ngai,** Applied Materials, Inc. (USA); **Luciana Meli,** IBM Corp. (USA)

3:50 pm: **Printability study of EUV double patterning for CMOS metal layers**, Danilo De Simone, IMEC (Belgium); Arjun Singh, GLOBALFOUNDRIES Europe Ltd. (Belgium); Geert Vandenberghe, IMEC (Belgium) . . . .[10957-21]

4:10 pm: **LCDU optimization of STT-MRAM 50nm pitch MTJ pillars for process window improvement**, Murat Pak, Davide Crotti, Farrukh Yasin, Monique Ercken, Sandip Halder, Danilo De Simone, Pieter Vanelderen, Laurent Souriau, Hubert Hody, Gouri Sankar Kar, IMEC (Belgium) . [10957-22]

4:30 pm: **Impact of sequential infiltration synthesis (SIS) on roughness and stochastic nano-failures for EUVL patterning**, Pieter Vanelderen, Victor Blanco, Ming Mao, IMEC (Belgium); Yoann Tomczak, David de Roest, ASM Belgium N.V. (Belgium); Nicola Kissoon, Gijsbert Rispens, Guido Schiffelers, ASML Netherlands B.V. (Netherlands); Abhinav Pathak, Frederic Lazzarino, Danilo De Simone, IMEC (Belgium); Etienne de Poortere, Moyra McManus, ASML Netherlands B.V. (Netherlands); Daniele Piumi, Gosia Jurczak, ASM Belgium N.V. (Belgium); Eric Hendrickx, Geert Vandenberghe, IMEC (Belgium) . . . .[10957-23]

4:50 pm: **Progress on 0.33 NA EUV systems for high-volume manufacturing,** Marcel Mastenbroek, Roel Moors, Geert Fisser, Christophe Smeets, Roderik van Es, Harrie van Dijck, Guido Salmaso, Richard Oostveen, Eric Verhoeven, ASML Netherlands B.V. (Netherlands) . . . .[10957-69]

CONFERENCE 10958
Novel Patterning Technologies for Semiconductors, MEMS/ NEMS and MOEMS 2019

SESSION 5

LOCATION: CONVENTION CENTER, ROOM 210B
TUE 3:50 PM TO 5:50 PM

Nanoimprint Lithography II: Manufacturing

Session Chairs: **Douglas J. Resnick,** Canon Nanotechnologies, Inc. (USA); **Tatsuhiko Higashiki,** Toshiba Memory Corp. (Japan)

3:50 pm: **Limits of size and shape control in nanoimprint resist patterns and pattern transfer** *(Invited Paper)*, S. V. Sreenivasan, The Univ. of Texas at Austin (USA) . . . .[10958-13]

4:30 pm: **Template fabrication with multi-beam mask writer for 1x-nm direct NIL for DRAM and logic application** *(Invited Paper)*, Koji Ichimura, Koichi Kanno, Masaaki Kurihara, Naoya Hayashi, Dai Nippon Printing Co., Ltd. (Japan) . . . .[10958-14]

5:10 pm: **Advantages of nanoimprint lithography for semiconductor device manufacturing**, Keita Sakai, Canon Inc. (Japan) . . . .[10958-15]

5:30 pm: **Half-pitch 14nm direct patterning with nanoimprint lithography**, Takuya Kono, Masayuki Hatano, Hiroshi Tokue, Tetsuro Nakasugi, Toshiba Memory Corp. (Japan). . . . .[10958-16]

CONFERENCE 10959
Metrology, Inspection, and Process Control for Microlithography XXXIII

SESSION 7

LOCATION: CONVENTION CENTER, GRAND BALLROOM 220B
TUE 3:40 PM TO 5:20 PM

New Methods: Student Session

Session Chairs: **Alok Vaid,** GLOBALFOUNDRIES Inc. (USA); **Timothy F. Crimmins,** Intel Corp. (USA)

3:40 pm: **Application of PSD for the extraction of programmed line roughness from SAXS**, Jérôme Reche, CEA-LETI (France) and CNRS (France) and Univ. Grenoble Alpes (France); Maxime Besacier, Patrice Gergaud, MINATEC (France) and Univ. Grenoble Alpes (France) and CEA-LETI (France); Yoann Blancquaert, CEA-LETI (France) and Univ. Grenoble Alpes (France) . . . .[10959-28]

4:00 pm: **Surface effects in simulations of scanning electron microscopy images**, Luc van Kessel, Cornelis Hagen, Pieter Kruit, Technische Univ. Delft (Netherlands) . . . .[10959-29]

4:20 pm: **Progress on sub-wavelength nanoimaging with a coherent tabletop EUV source**, Charles S. Bevis, Robert Karl Jr., Bin Wang, Peter Johnsen, Michael Tanksalvala, Christina L. Porter, Yuka Esashi, Henry Kapteyn, JILA (USA) . . . .[10959-30]

4:40 pm: **Optical characterization of multi-NST nanowire test structures using Muller matrix spectroscopic ellipsometry (MMSE) based scatterometry for sub 5nm nodes**, Madhulika S. Korde, SUNY Polytechnic Institute (USA); Aelan Mosden, Subhadeep Kal, Cheryl Pereira, TEL Technology Ctr., America, LLC (USA); Nick Keller, Nanometrics Inc. (USA); Alain C. Diebold, SUNY Polytechnic Institute (USA) . . . .[10959-31]

5:00 pm: **Tilted beam SEM, 3D metrology for industry**, Charles Valade, STMicroelectronics S.A. (France); Jérôme Hazart, Sébastien Bérard-Bergery, CEA-LETI (France); Elodie Sungauer, STMicroelectronics S.A. (France); Maxime Besacier, Cécile Gourgon, Lab. des Technologies de La Microélectronique (France) . . . .[10959-32]

CONFERENCE 10960
Advances in Patterning Materials and Processes XXXVI

SESSION 6

LOCATION: CONVENTION CENTER, GRAND BALLROOM 220C
TUE 3:50 PM TO 5:10 PM

Integration

Session Chairs: **Yoshio Kawai,** Shin-Etsu Chemical Co., Ltd. (Japan); **Ryan Callahan,** FUJIFILM Electronic Materials U.S.A., Inc. (USA)

3:50 pm: **Addressing challenges in the mitigation of stochastic effects**, Hidetami Yaegashi, Arisa Hara, Tokyo Electron Ltd. (Japan). . . . . . .[10960-19]

4:10 pm: **Exploration of EUV-based self-aligned multipatterning (SAMP) options targeting pitches below 20nm**, Stefan Decoster, Frederic Lazzarino, Diziana Vangoidsenhoven, Victor M. Blanco Carballo, Els Kesters, Christophe Lorant, IMEC (Belgium) . . . .[10960-20]

4:30 pm: **A novel methodology of litho-etch fidelity correction for logic and memory applications**, Shr-Jia Chen, Yu-Cheng Chang, Pei-Shan Shih, Powerchip Technology Corp. (Taiwan); Arthur Lin, KLA-Tencor Corp. (Taiwan); Yi-Shiang Chang, Chia-Chi Lin, Jun-Cheng N. Lai, Powerchip Technology Corp. (Taiwan) . . . .[10960-21]

4:50 pm: **Self-aligned fin cut last patterning scheme for fin arrays of 24nm pitch and beyond**, Sylvain Baudot, Semiconductor Technology and Systems (Belgium); Assawer Soussou, Coventor, Inc. (France); Alexey P. Milenin, IMEC (Belgium); Joseph Ervin, Coventor, Inc. (France); Steven Demuynck, IMEC (Belgium) . . . .[10960-22]

CONFERENCE 10961
Optical Microlithography XXXII

SESSION 4

**LOCATION: CONVENTION CENTER,
ROOM 210D
TUE 3:50 PM TO 5:30 PM**

Resist Modeling and Process Control

Session Chairs: **Geert Vandenberghe,** IMEC (Belgium); **Daniel Sarlette,** Infineon Technologies Dresden GmbH (Germany)

3:50 pm: **Analytical solutions for the deformation of a photoresist film**, Yuri Granik, Mentor, a Siemens Business (USA) . . . . [10961-11]

4:10 pm: **Physical and compact modeling of resist deformation**, Gurdaman Khaira, Yuri Granik, Kostas Adam, Germain Fenger, Mentor, a Siemens Business (USA) . . . . [10961-12]

4:30 pm: **Compact modeling of negative tone development resist with photo decomposable quencher**, Ao Chen, Kar Kit Koh, Yee Mei Foong, GLOBALFOUNDRIES Singapore Pte. Ltd. (Singapore); Bradley Morgenfeld, Shuhai Fan, Guanchen He, GLOBALFOUNDRIES Inc. (USA); Jun Chen, Sandra Lee, Xi Chen, Hesham Omar, Mu Feng, ChangAn Wang, Keith Gronlund, Jun Lang, James Guerrero, Yiqiong Zhao, ASML Brion Technologies (USA) . . . . [10961-13]

4:50 pm: **Improved validation and optimization of physics-based NTD compact modeling flows**, Folarin Latinwo, Delian Yang, Synopsys, Inc. (USA); Cheng-En Wu, Synopsys Taiwan Co., Ltd. (Taiwan); Peter Brooker, Hua Song, Kevin Lucas, Synopsys, Inc. (USA). . . . . [10961-14]

5:10 pm: **Thin film characterization for advanced patterning**, Zhimin Zhu, Brewer Science, Inc. (USA) . . . . [10961-15]

CONFERENCE 10963
Advanced Etch Technology for Nanopatterning VIII

SESSION 4

**LOCATION: CONVENTION CENTER,
ROOM 211B
TUE 3:40 PM TO 5:20 PM**

Atomic Layer Etching and Novel Plasma Techniques

Session Chairs: **Jake O'Gorman,** Hitachi High Technologies America, Inc. (USA); **Catherine Labelle,** Intel Corp. (USA)

3:40 pm: **Opportunities and challenges utilizing atomic layer etch for 10nm half pitch metal patterning** *(Invited Paper)*, Michael Koltonski, Micron Technology, Inc. (USA); Wenbing Yang, Lam Research Corp. (USA); Craig Huffman, Ying Rui, Micron Technology, Inc. (USA); Mohand Brouri, Samantha Tan, Lam Research Corp. (USA)[10963-12]

4:20 pm: **Peculiarities of selective isotropic Si etch to SiGe for nanowire and GAA transistors**, Christopher Catano, TEL Technology Ctr., America, LLC (USA) . . . . [10963-13]

4:40 pm: **Isotropic atomic layer etching of ZnO using acetylacetone and O2 plasma**, Alfredo Mameli, Marcel A. Verheijen, Adrie Mackus, Fred Roozeboom, Erwin W.M. M. Kessels, Technische Univ. Eindhoven (Netherlands) . . . . [10963-14]

5:00 pm: **Across-wafer sub-1 nm critical dimension uniformity control by etch tool correction**, Changwoo Lee, Lam Research (USA) . . . . [10963-16]

CONFERENCE 10957
Extreme Ultraviolet (EUV) Lithography X

SESSION 8

LOCATION: CONVENTION CENTER, GRAND BALLROOM 220A WED 8:20 AM TO 10:00 AM

EUV Patterning and Etch:

Joint session with conferences 10957 and 10963

Session Chairs: **Rich S. Wise**, Lam Research Corp. (USA); **Anna Lio**, Intel Corp. (USA)

8:20 am: **EUV line-space pattern defect mitigation simulation using Coventor SEMulator3D to enable exposure dose reduction**, Daniel Sobieski, Rich Wise, Yang Pan, David Fried, Nader Shamma, Lam Research Corp. (USA) . . . . [10963-17]

8:40 am: **Line roughness improvements on EUV 36nm pitch pattern by plasma treatment method**, Toshiharu Wada, Akiteru Ko, Peter Biolsi, TEL Technology Ctr., America, LLC (USA) . . . . [10963-18]

9:00 am: **Staggered pillar patterning using 0.33NA EUV lithography**, Danilo De Simone, Lieve van Look, Nouredine Rassoul, Frederic Lazzarino, Pieter Vanelderen, Gian Lorusso, Nadia Vandenbroeck, Frieda van Roey, Anne-Laure Charley, Geert Vandenberghe, Kurt Ronse, IMEC (Belgium); Kilyoung Lee, Junghyung Lee, Sarohan Park, Chang-Moon Lim, SK Hynix, Inc. (Korea, Republic of) . . [10957-25]

9:20 am: **Post-lithography roughness and stochastic failures mitigation study for 32nm pitch EUV L/S** *(Invited Paper)*, Frederic Lazzarino, Romuald Blanc, Ming Mao, Danilo De Simone, Nadia Vandenbroeck, Pieter Vanelderen, Victor Blanco, Philippe Foubert, Christophe Beral, Amir-Hossein Tamaddon, Alain Moussa, Anne-Laure Charley, Sandip Halder, Philippe Leray, Kurt Ronse, IMEC (Belgium) . . . . [10963-19]

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

CONFERENCE 10958
Novel Patterning Technologies for Semiconductors, MEMS/NEMS and MOEMS 2019

SESSION 6

LOCATION: CONVENTION CENTER, ROOM 210B WED 8:00 AM TO 10:00 AM

Multi-beam Lithography: Invited Session

Session Chairs: **Ines A. Stolberg**, Vistec Electron Beam GmbH (Germany); **Hans Loeschner**, IMS Nanofabrication GmbH (Austria)

8:00 am: **Performance validation of Mapper's FLX-1200** *(Invited Paper)*, Marco Wieland, MAPPER Lithography (Netherlands); Jonathan Pradelles, Stéfan Landis, Laurent Pain, Guido Rademaker, Isabelle Servin, CEA-LETI (France); Guido De Boer, Pieter Brandt, Remco J. A. Jager, Stijn W. H. K. Steenbrink, MAPPER Lithography (Netherlands) . . . . [10958-17]

8:40 am: **Multi-beam mask writer MBM-1000** *(Invited Paper)*, Hiroshi Matsumoto, Hayato Kimura, Takao Tamura, Kenji Otoshi, NuFlare Technology, Inc. (Japan) . . . . [10958-18]

9:20 am: **MBMW-201: The next generation multi-beam mask writer** *(Invited Paper)*, Christof Klein, Hans Loeschner, Elmar Platzgummer, IMS Nanofabrication GmbH (Austria) . . . . [10958-19]

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

CONFERENCE 10959
Metrology, Inspection, and Process Control for Microlithography XXXIII

SESSION 8

LOCATION: CONVENTION CENTER, GRAND BALLROOM 220B WED 8:00 AM TO 10:00 AM

Machine Learning

Session Chairs: **Narender Rana**, Western Digital Corp. (USA); **Benjamin D. Bunday**, Abeam Technologies, Inc. (USA)

8:00 am: **Applications of machine learning at the limits of form-dependent scattering for defect metrology** *(Invited Paper)*, Mark-Alexander Henn, Bryan M. Barnes, Hui Zhou, Richard M Silver, National Institute of Standards and Technology (USA) . . . . [10959-33]

8:40 am: **Engineering neural networks for improved defect detection and classification**, Ravi K. Bonam, IBM Corp. (USA); Assad Oberai, Dhruv Patel, The Univ. of Southern California (USA) . . . . [10959-34]

9:00 am: **Employing machine learning methods for parameter reconstruction**, Philipp-Immanuel Schneider, Martin Hammerschmidt, Lin Zschiedrich, Sven Burger, JCMwave GmbH (Germany) [10959-35]

9:20 am: **Deep learning's impact on contour extraction for design based metrology**, Ryo Yumiba, Masayoshi Ishikawa, Shinichi Shinoda, Shigetoshi Sakimura, Yasutaka Toyoda, Hitachi, Ltd. (Japan); Hiroyuki Shindo, Masayuki Izawa, Hitachi High-Technologies Corp. (Japan) . . . . [10959-36]

9:40 am: **OPC model accuracy study using high volume contour based gauges and deep learning on memory device**, Young-Seok Kim, ASML Korea Co., Ltd. (Korea, Republic of); Seil Lee, ASML (Korea, Republic of); Meng Liu, ASML (China); Yunan Zheng, ASML (USA); Qian Zhao, ASML San Jose (USA); Daekwon Kang, ASML (Korea, Republic of); Lei Wang, ASML (USA); Mark Simmons, Mu Feng, ASML San Jose (USA); Jun Lang, Byoung-il Choi, ASML US, Inc. (USA); Gilbert Kim, ASML Korea Co., Ltd. (Korea, Republic of); Gyun Yoo, JeonKyu Lee, Sung-woo Ko, Cheolkyun Kim, Chanha Park, SK Hynix, Inc. (Korea, Republic of) . . . . [10959-37]

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

CONFERENCE 10960
Advances in Patterning Materials and Processes XXXVI

SESSION 7

LOCATION: CONVENTION CENTER, GRAND BALLROOM 220C WED 8:10 AM TO 10:00 AM

Monolayer Materials in Device Fabrication

Session Chairs: **Ralph R. Dammel**, EMD Performance Materials Corp. (USA); **James W. Thackeray**, Dow Electronic Materials (USA)

8:10 am: **Using molecular monolayers to achieve selective atomic layer deposition** *(Invited Paper)*, Stacey F. Bent, Stanford Univ. (USA) . . . . [10960-23]

8:40 am: **Defectivity reduction in area selective atomic layer deposition by monolayer design**, Rudy J. Wojtecki, Magi A. Mettry, Noah Frederick Fine Nathel, Alexander M. Friz, IBM Research - Almaden (USA); Anuja De Silva, IBM Corp. (USA); Noel Arellano, IBM Research - Almaden (USA); Hosadurga Shobha, IBM Corp. (USA) . . . . [10960-24]

9:00 am: **Selective spin-on deposition enabled by imperfect self-assembled monolayers**, Yuanyi Zhang, Univ. of California, Santa Barbara (USA); Reika Katsumata, Univ. of Massachusetts Amherst (USA); Mark H. Somervell, Ryan L. Burns, Tokyo Electron America, Inc. (USA); Rachel A. Segalman, Craig J. Hawker, Christopher Bates, Univ. of California, Santa Barbara (USA) . . . . [10960-25]

9:20 am: **Ultra-thin conformal coating for spin-on doping applications**, Mingqi Li, DowDuPont Specialty Product Div. (USA); Peter Trefonas III, Bhooshan Popere, DowDuPont Electronics & Imaging (USA); Andrew T. Heitsch, Dow Chemical Co. (USA); Ratchana Limary, Lam Research Corp. (USA); Reika Katsumata, Yuanyi Zhang, Rachel A. Segalman, Univ. of California, Santa Barbara (USA) . . . . . . [10960-26]

9:40 am: **Design of selective brush chemistry and surface functionalization for directed self-assembly of block copolymers**, Ji Yeon Kim, The Univ. of Texas at Austin (USA); Natsuko Ito, The Univ. of Texas at Austin (USA) and JSR Corp. (Japan); XiaoMin Yang, Seagate Technology LLC (USA); Stephen M. Sirard, Lam Research Corp. (USA); Austin P. Lane, The Univ. of Texas at Austin (USA); Gregory Blachut, The Univ. of Texas at Austin (USA) and Lam Research Corp. (USA); Yusuke Asano, The Univ. of Texas at Austin (USA) and JSR Corp. (Japan); Christopher J. Ellison, Univ. of Minnesota, Twin Cities (USA); Nathaniel A. Lynd, C. Grant Willson, The Univ. of Texas at Austin (USA) . . . . [10960-27]

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

CONFERENCE 10961
Optical Microlithography XXXII

SESSION 5

LOCATION: CONVENTION CENTER, ROOM 210D
WED 8:00 AM TO 9:40 AM

Lithography Equipment

Session Chairs: **Bernd Geh,** Carl Zeiss SMT GmbH (USA); **Reinhard Voelkel,** SUSS MicroOptics SA (Switzerland)

8:00 am: **A study on stepper's performance enhancements**, Ken-Ichiro Mori, Atsushi Shigenobu, Junichi Motojima, Hiromi Suda, Canon Inc. (Japan) . . . .[10961-16]

8:20 am: **Quantifying global and local CD variation for an advanced 3D NAND layer**, Will Conley, Cymer, LLC (USA); Yaobin Feng, Zhiyang Song, Moran Guo, Jun He, Longxia Guo, Gang Xu, Yangtze Memory Technologies Co., Ltd. (China); Simon Hsieh, James Bonafede, Cymer, LLC (USA); Stephen Hsu, Austin Peng, ASML San Jose (USA); Jun Wei Lu, Victor Peng, ASML Intl. Trading Co., Ltd. (China); Beeri Nativ, Fei Jia, Herman Nicolai, Ijen van Mil, ASML Netherlands B.V. (Netherlands) . . . .[10961-17]

8:40 am: **Holistic feedforward control for process control for the 5nm node and below**, Henry Megens, Ralph Brinkhof, ASML Netherlands B.V. (Netherlands); Igor Aarts, ASML US, Inc. (USA); Haico Kok, Leendertjan Karssemeijer, Gijs ten Haaf, ASML Netherlands B.V. (Netherlands); Shawn Lee, ASML US, Inc. (USA); Daan Slotboom, Chris de Ruiter, Irina Lyulina, Simon Huisman, Stefan Keij, Evert Mos, Wim Tel, Manouk Rijpstra, Emil Schmitt-Weaver, Kaustuve Bhattacharyya, ASML Netherlands B.V. (Netherlands); Robert Socha, Boris Menchtchikov, ASML US, Inc. (USA); Michael Kubis, Jan Mulkens, ASML Netherlands B.V. (Netherlands) . . . .[10961-18]

9:00 am: **Next generation ArF lightsource "T65A" for cutting-edge immersion lithography providing both high in productivity and performance**, Tommy Oga, Taku Yamazaki, Takeshi Ohta, Hiroaki Tsushima, Satoru Bushida, Gigaphoton Inc. (Japan) .[10961-19]

9:20 am: **Automatic parameter setting for lens aberration control during product lot exposure**, Yutaka Kanakutsu, Yukio Koizumi, Hironori Ikezawa, Shigeru Eto, Junji Ikeda, Takenori Takeuchi, Tomoyuki Matsuyama, Nikon Corp. (Japan); Edward Stan, Ronald Hiltunen, Nikon Precision Inc. (USA)[10961-20]

CONFERENCE 10962
Design-Process-Technology Co-optimization for Manufacturability XIII

SESSION 1

LOCATION: CONVENTION CENTER, ROOM 210C
WED 8:00 AM TO 10:00 AM

Design-Technology Co-optimization

Session Chairs: **Jason P. Cain,** Advanced Micro Devices, Inc. (USA); **Chi-Min Yuan,** NXP Semiconductors (USA)

8:00 am: **Standard-cell design architecture options below 5nm node: The ultimate scaling of FinFET and Nanosheet** *(Invited Paper)*, Syed Muhammad Yasser Sherazi, Miroslav Cupak, Peter Debacker, Diederik Verkest, Anda C. Mocuta, Ryoung-Han R. Kim, Alessio Spessot, Julien Ryckaert, IMEC (Belgium) . . . .[10962-1]

8:40 am: **Optimization of read and write performance of SRAMs for node 5nm and beyond**, Khaja Ahmad Shaik, Mohit Gupta, Pieter Weckx, Alessio Spessot, IMEC (Belgium) . . . .[10962-2]

9:00 am: **A novel design-for-yield solution based on interconnect level layout improvements at 7nm technology node**, Jaehwan Kim, Sangah Lee, Byungchul Shin, Junsu Jeon, Jin Kim, Byung-Moo Kim, Jae-Hyun Kang, Seung Weon Paek, SAMSUNG Electronics Co., Ltd. (Korea, Republic of); Piyush Pathak, Frank E. Gennari, Philippe Hurat, Ya-Chieh Lai, Cadence Design Systems, Inc. (USA) .[10962-3]

9:20 am: **Backside power delivery as a scaling knob for future systems**, Bharani Chava, Khaja Ahmad Shaik, Anne Jourdain, Peter Debacker, IMEC (Belgium); Sofiane Guissi, Coventor, SARL (France); Julien Ryckaert, Geert Van Der Plaas, Alessio Spessot, Eric Beyne, Anda C. Mocuta, Diederik Verkest, IMEC (Belgium) . . . .[10962-4]

9:40 am: **CFET Standard-cell design down to 3Track height for node 3nm and below**, Syed Muhammad Yasser Sherazi, Alessio Spessot, Julien Ryckaert, Ryoung-Han R. Kim, IMEC (Belgium) . . . .[10962-5]

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

CONFERENCE 10963
Advanced Etch Technology for Nanopatterning VIII

SESSION 5

LOCATION: CONVENTION CENTER, GRAND BALLROOM 220A
WED 8:20 AM TO 10:00 AM

EUV Patterning and Etch

Joint session with conferences 10957 and 10963

Session Chairs: **Rich S. Wise,** Lam Research Corp. (USA); **Anna Lio,** Intel Corp. (USA)

8:20 am: **EUV line-space pattern defect mitigation simulation using Coventor SEMulator3D to enable exposure dose reduction**, Daniel Sobieski, Rich Wise, Yang Pan, David Fried, Nader Shamma, Lam Research Corp. (USA) . . . .[10963-17]

8:40 am: **Line roughness improvements on EUV 36nm pitch pattern by plasma treatment method**, Toshiharu Wada, Akiteru Ko, Peter Biolsi, TEL Technology Ctr., America, LLC (USA). . . .[10963-18]

9:00 am: **Staggered pillar patterning using 0.33NA EUV lithography**, Danilo De Simone, Lieve van Look, Nouredine Rassoul, Frederic Lazzarino, Pieter Vanelderen, Gian Lorusso, Nadia Vandenbroeck, Frieda van Roey, Anne-Laure Charley, Geert Vandenberghe, Kurt Ronse, IMEC (Belgium); Kilyoung Lee, Junghyung Lee, Sarohan Park, Chang-Moon Lim, SK Hynix, Inc. (Korea, Republic of) . . . .[10957-25]

9:20 am: **Post-lithography roughness and stochastic failures mitigation study for 32nm pitch EUV L/S** *(Invited Paper)*, Frederic Lazzarino, Romuald Blanc, Ming Mao, Danilo De Simone, Nadia Vandenbroeck, Pieter Vanelderen, Victor Blanco, Philippe Foubert, Christophe Beral, Amir-Hossein Tamaddon, Alain Moussa, Anne-Laure Charley, Sandip Halder, Philippe Leray, Kurt Ronse, IMEC (Belgium) . . . .[10963-19]

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

APPLICATION TRACKS

Easily find sessions on these three important topics within the program. Each conference has grouped the applicable presentations together and do not overlap with other conferences.

• **Machine Learning**

• **Stochastics**

• **Overlay**

CONFERENCE 10957
Extreme Ultraviolet (EUV) Lithography X

SESSION 9

LOCATION: CONVENTION CENTER, GRAND BALLROOM 220A
WED 10:30 AM TO 12:10 PM

EUV Masks, Defects, and Pellicles

Session Chairs: **Emily E. Gallagher,** IMEC (Belgium); **Moshe E. Preil,** KLA-Tencor Corp. (USA)

10:30 am: **Advanced particle contamination control in EUV scanners**, Mark A. van de Kerkhof, Vadim E. Banine, Antoine Kempen, Tjarko van Empel, Christian Cloin, Andrey Nikipelov, ASML Netherlands B.V. (Netherlands) . . . . [10957-27]

10:50 am: **Upgrades to the SHARP EUV mask microscope**, Markus P. Benk, Weilun Chao, Ryan H. Miyakawa, Kenneth Goldberg, Patrick Naulleau, Lawrence Berkeley National Lab. (USA) . . . . [10957-28]

11:10 am: **Amplitude and phase defect inspection on EUV reticles using RESCAN**, Iacopo Mochi, Rajendran Rajeev, Sara Fernandez, Dimitrios Kazazis, Li-Ting Tseng, Patrick Helfenstein, Yasin Ekinci, Paul Scherrer Institut (Switzerland) . . . . [10957-29]

11:30 am: **Actinic metrology platform for defect review and mask qualification: flexibility and performance**, Renzo Capelli, Martin Dietzel, Dirk Hellweg, Grizelda Kersteen, Conrad Wolke, Carl Zeiss SMT GmbH (Germany) . . . . [10957-66]

11:50 am: **EUV pellicle qualification on transmission and reflectance**, Rainer Lebert, Christian Pampfer, Andreas Biermanns-Foeth, Thomas Missalla, Christoph Phiesel, Christian Piel, RI Research Instruments GmbH (Germany) . . . . [10957-31]

Lunch/Exhibition Break . . . . . . 12:10 to 1:40 pm

CONFERENCE 10958
Novel Patterning Technologies for Semiconductors, MEMS/NEMS and MOEMS 2019

SESSION 7

LOCATION: CONVENTION CENTER, GRAND BALLROOM 220C
WED 10:30 AM TO 12:10 PM

Directed Self-assembly I

Joint session with conferences 10960 and 10958

Session Chairs: **Raluca Tiron,** CEA-LETI (France); **Ricardo Ruiz,** HGST, Inc. (USA)

10:30 am: **Electrical validation of the integration of 193i and DSA for metal cut patterning**, Chi-Chun Liu, IBM Research - Albany NanoTech (USA); Richard A. Farrell, TEL Technology Ctr., America, LLC (USA); Kafai Lai, IBM Thomas J. Watson Research Ctr. (USA); Yann Mignot, IBM Research - Albany NanoTech (USA); Eric Liu, TEL Technology Ctr., America, LLC (USA); Jing Guo, IBM Research - Albany NanoTech (USA); Yasuyuki Ido, Makoto Muramatsu, Tokyo Electron Kyushu Ltd. (Japan); Nelson M. Felix, IBM Research - Albany NanoTech (USA); David R. Hetzer, Akiteru Ko, TEL Technology Ctr., America, LLC (USA); Daniel A. Corliss, IBM Research - Albany NanoTech (USA) . . . . [10958-20]

10:50 am: **Selective grafting of polymer brushes for directed self-assembly of high-χ block copolymers**, Jai Hyun Koh, Ji Yeon Kim, Qingjun Zhu, The Univ. of Texas at Austin (USA); Natsuko Ito, The Univ. of Texas at Austin (USA) and JSR Corp. (Japan); Ryuta Mizuochi, The Univ. of Texas at Austin (USA) and Nissan Chemical Industries, Ltd. (Japan); Gregory Blachut, The Univ. of Texas at Austin (USA) and Lam Research Corp. (USA); Jan Doise, IMEC (Belgium); Stephen M. Sirard, Lam Research Corp. (USA); Christopher J. Ellison, Univ. of Minnesota, Twin Cities (USA); Nathaniel A. Lynd, C. Grant Willson, The Univ. of Texas at Austin (USA) . . . .[10960-28]

11:10 am: **Spacer patterning lithography as a new process to induce block copolymer alignment by chemo-epitaxy**, Anne Paquet, Ahmed Gharbi, Patricia Pimenta-Barros, Marie-Line Pourteau, Gaëlle Elequet, Aurélie Le Pennec, CEA-LETI (France); Christophe Navarro, Célia Nicolet, Xavier Chevalier, Arkema S.A. (France); Laurent Pain, CEA-LETI (France); Ian Cayrefourcq, Arkema S.A. (France); Paul F. Nealey, The Univ. of Chicago (USA); Raluca Tiron, CEA-LETI (France) . . . .[10958-21]

11:30 am: **LCDU improvement of EUV-patterned vias with DSA**, Jing Guo, IBM Corp. (USA); Dustin W. Janes, SCREEN SPE USA, LLC (USA); Yann Mignot, Richard C. Johnson, Cheng Chi, Chi-Chun Liu, Luciana Meli, IBM Corp. (USA); Takuya Kuroda, Domenico A. DiPaola, SCREEN SPE USA, LLC (USA); Masahiko Harumoto, SCREEN Semiconductor Solutions Co., Ltd. (Japan); Nelson M. Felix, Daniel A. Corliss, IBM Corp. (USA) . . . .[10958-22]

Post-polymerization modification of PS-b-PMMA for achieving directed self-assembly with sub-10nm feature size, Takuya Isono, Kohei Yoshida, Hokkaido Univ. (Japan); Hiroaki Mamiya, National Institute for Materials Science (Japan); Ken Miyagi, Akiyoshi Yamazaki, Tokyo Ohka Kogyo Co., Ltd. (Japan); Toshifumi Satoh, Hokkaido Univ. (Japan) . . .[10960-50]

Lunch/Exhibition Break . . . . Wed 12:10 pm to 2:00 pm

CONFERENCE 10959
Metrology, Inspection, and Process Control for Microlithography XXXIII

SESSION 9

LOCATION: CONVENTION CENTER, GRAND BALLROOM 220B
WED 10:30 AM TO 12:10 PM

SEM

Session Chairs: **Benjamin D. Bunday,** Abeam Technologies, Inc. (USA); **Shunsuke Koshihara,** Hitachi High-Technologies Corp. (Japan)

10:30 am: **What is prevalent CD-SEM's role in EUV era?**, Zhigang Wang, Yoshinori Momonoi, Katsumi Setoguchi, Makoto Suzuki, Satoru Yamaguchi, Hitachi High-Technologies Corp. (Japan) . . . [10959-38]

10:50 am: **High voltage CD-SEM based metrology for 3D-profile measurement using depth-correlated BSE signal**, Wei Sun, Yasunari Sohda, Hiroya Ohta, Hitachi, Ltd. (Japan); Taku Ninomiya, Yasunori Goto, Hitachi High-Technologies Corp. (Japan) . . . . [10959-39]

11:10 am: **Deep-learning-based SEM image denoiser**, Dorin Cerbu, Sandip Halder, Philippe Leray, IMEC (Belgium) . . . . [10959-40]

11:30 am: **Development of automatic aberration correction method for in-line SEM**, Hideto Dohi, Hitachi High-Technologies Corp. (Japan); Zhaohui Cheng, Shingo Hayashi, Kotoko Hirose, Hitachi, Ltd. (Japan); Hideyuki Kazumi, Hitachi High-Technologies Corp. (Japan) . . . . [10959-41]

11:50 am: **FEM simulation of SEM metrology for artificial generation of SEM pictures**, Duy Duc Nguyen, ASELTA Nanographics (France); Jean-Hervé Tortai, Univ. Grenoble Alpes, CNRS (France) and CEA/LETI Minatec, LTM (France); Patrick Schiavone, ASELTA Nanographics (France) . . . . [10959-42]

Lunch/Exhibition Break . . 12:10 to 1:30 pm

CONFERENCE 10960
Advances in Patterning Materials and Processes XXXVI

SESSION 8

LOCATION: CONVENTION CENTER, GRAND BALLROOM 220C
WED 10:30 AM TO 12:10 PM

Directed Self-assembly I

Joint session with conferences 10960 and 10958

Session Chairs: **Raluca Tiron,** CEA-LETI (France); **Ricardo Ruiz,** HGST, Inc. (USA)

10:30 am: **Electrical validation of the integration of 193i and DSA for metal cut patterning**, Chi-Chun Liu, IBM Research - Albany NanoTech (USA); Richard A. Farrell, TEL Technology Ctr., America, LLC (USA); Kafai Lai, IBM Thomas J. Watson Research Ctr. (USA); Yann Mignot, IBM Research - Albany NanoTech (USA); Eric Liu, TEL Technology Ctr., America, LLC (USA); Jing Guo, IBM Research - Albany NanoTech (USA); Yasuyuki Ido, Makoto Muramatsu, Tokyo Electron Kyushu Ltd. (Japan); Nelson M. Felix, IBM Research - Albany NanoTech (USA); David R. Hetzer, Akiteru Ko, TEL Technology Ctr., America, LLC (USA); Daniel A. Corliss, IBM Research - Albany NanoTech (USA) . . . . [10958-20]

10:50 am: **Selective grafting of polymer brushes for directed self-assembly of high-χ block copolymers**, Jai Hyun Koh, Ji Yeon Kim, Qingjun Zhu, The Univ. of Texas at Austin (USA); Natsuko Ito, The Univ. of Texas at Austin (USA) and JSR Corp. (Japan); Ryuta Mizuochi, The Univ. of Texas at Austin (USA) and Nissan Chemical Industries, Ltd. (Japan); Gregory Blachut, The Univ. of Texas at Austin (USA) and Lam Research Corp. (USA); Jan Doise, IMEC (Belgium); Stephen M. Sirard, Lam Research Corp. (USA); Christopher J. Ellison, Univ. of Minnesota, Twin Cities (USA); Nathaniel A. Lynd, C. Grant Willson, The Univ. of Texas at Austin (USA) . . . .[10960-28]

11:10 am: **Spacer patterning lithography as a new process to induce block copolymer alignment by chemo-epitaxy**, Anne Paquet, Ahmed Gharbi, Patricia Pimenta-Barros, Marie-Line Pourteau, Gaëlle Elequet, Aurélie Le Pennec, CEA-LETI (France); Christophe Navarro, Célia Nicolet, Xavier Chevalier, Arkema S.A. (France); Laurent Pain, CEA-LETI (France); Ian Cayrefourcq, Arkema S.A. (France); Paul F. Nealey, The Univ. of Chicago (USA); Raluca Tiron, CEA-LETI (France) . . . .[10958-21]

11:30 am: **LCDU improvement of EUV-patterned vias with DSA**, Jing Guo, IBM Corp. (USA); Dustin W. Janes, SCREEN SPE USA, LLC (USA); Yann Mignot, Richard C. Johnson, Cheng Chi, Chi-Chun Liu, Luciana Meli, IBM Corp. (USA); Takuya Kuroda, Domenico A. DiPaola, SCREEN SPE USA, LLC (USA); Masahiko Harumoto, SCREEN Semiconductor Solutions Co., Ltd. (Japan); Nelson M. Felix, Daniel A. Corliss, IBM Corp. (USA) . . . . [10958-22]

11:50 am: **Post-polymerization modification of PS-b-PMMA for achieving directed self-assembly with sub-10nm feature size**, Takuya Isono, Kohei Yoshida, Hokkaido Univ. (Japan); Hiroaki Mamiya, National Institute for Materials Science (Japan); Ken Miyagi, Akiyoshi Yamazaki, Tokyo Ohka Kogyo Co., Ltd. (Japan); Toshifumi Satoh, Hokkaido Univ. (Japan) . . . [10960-50]

Lunch/Exhibition Break . . . . .Wed 12:10 pm to 2:00 pm

CONFERENCE 10962
Design-Process-Technology Co-optimization for Manufacturability XIII

SESSION 2

LOCATION: CONVENTION CENTER, ROOM 210C
WED 10:30 AM TO 12:10 PM

Layout Analytics

Session Chairs: **Lars W. Liebmann,** TEL Technology Ctr., America, LLC (USA); **Ru-Gun Liu,** Taiwan Semiconductor Manufacturing Co. Ltd. (Taiwan)

10:30 am: **Persistent homology analysis of complex high-dimensional layout configurations for IC physical designs**, Yacoub Kureh, Univ. of California, Los Angeles (USA) and Motivo, Inc. (USA); Vito Dai, Luigi Capodieci, Motivo, Inc. (USA) . . . .[10962-6]

10:50 am: **Machine learning based wafer defect detection and repair**, Yuansheng Ma, Mentor, a Siemens Business (USA). . . . .[10962-7]

11:10 am: **Pattern-aware diagnostics: using high-performance pattern analysis to identify defect root cause**, Jason P. Cain, Abdullah Yassine, Moutaz Fakhry, Advanced Micro Devices, Inc. (USA); Piyush Pathak, Jeffrey E. Nelson, Frank E. Gennari, Ya-Chieh Lai, Cadence Design Systems, Inc. (USA) . . . .[10962-8]

11:30 am: **Fast detection of largest repeating layout pattern**, Jingsong Chen, Evangeline F.Y. Young, The Chinese Univ. of Hong Kong (Hong Kong, China); James Shiely, Charles Chiang, Synopsys Inc. (USA) . . . .[10962-9]

11:50 am: **Process window-based feature and die failure rate prediction,** John L. Sturtevant, Lianghong Yin, Young Chang Kim, Shumay Shang, Andrew Burbine, Sara Khalaf, Germain Fenger, Mentor Graphics Corp. (USA) . . . .[10962-10]

Lunch/Exhibition Break . . Wed 12:10 pm to 1:40 pm

CONFERENCE 10963
Advanced Etch Technology for Nanopatterning VIII

SESSION 6

LOCATION: CONVENTION CENTER, ROOM 211B
WED 10:30 AM TO 12:10 PM

Patterning Solutions for Emerging Applications

Session Chairs: **Nihar Mohanty,** Oculus VR, LLC (USA); **Maxime Darnon,** LN2 CNRS (Canada)

10:30 am: **Neuromorphic computing: new circuits and integration challenges** *(Invited Paper)*, Fabien Alibart, Lab Nanotechnologies Nanosystemes (LN2) (Canada) . . . .[10963-20]

11:10 am: **Enabling complimentary FET (CFET) fabrication: selective, isotropic etch of Group IV semiconductors,** Subhadeep Kal, TEL Technology Ctr., America, LLC (USA); Yusuke Oniki, IMEC (Belgium); Matthew Falugh, Cheryl Pereira, Qi Wang, TEL Technology Ctr., America, LLC (USA); Frank Holsteyns, IMEC (Belgium); Jeffrey T. Smith, Aelan Mosden, Kaushik A. Kumar, TEL Technology Ctr., America, LLC (USA); Juergen Boemmels, Julien Ryckaert, IMEC (Belgium); Peter Biolsi, Trace Q. Hurd, TEL Technology Ctr., America, LLC (USA) . . . .[10963-21]

11:30 am: **Ultrahigh selective etching of Si3N4 over SiO$_2$ using plasma-less dry process for 3D-NAND device applications**, Chih-Yu Hsu, Peng Shen, Air Liquide Labs. (Japan); Nathan Stafford, Air Liquide Electronics (USA). . . . .[10963-22]

11:50 am: **Promises of metasurfaces and challenges in scaling to mass production**, Robert C. Devlin, John W. Graff, Pawel Latawiec, Metalenz Inc. (USA). . . . .[10963-23]

Lunch/Exhibition Break . . Wed 12:10 pm to 1:40 pm

CONFERENCE 10957
Extreme Ultraviolet (EUV) Lithography X

SESSION 10

LOCATION: CONVENTION CENTER, GRAND BALLROOM 220A
WED 1:40 PM TO 3:00 PM

EUV Imaging Enhancement I

Session Chairs: **Andreas Erdmann,** Fraunhofer-Institut für Integrierte Systeme und Bauelementetechnologie IISB (Germany); **Eric Hendrickx,** IMEC (Belgium)

1:40 pm: 3D mask effects in high NA EUV imaging, Andreas Erdmann, Peter Evanschitzky, Fraunhofer-Institut für Integrierte Systeme und Bauelementetechnologie IISB (Germany); Gerardo Bottiglieri, Eelco van Setten, Timon Fliervoet, ASML Netherlands B.V. (Netherlands) . . . . [10957-32]

2:00 pm: Investigation of phase effects in EUV lithography *(Invited Paper)*, Martin Burkhardt, IBM Thomas J. Watson Research Ctr. (USA) . . [10957-33]

2:20 pm: Fabrication and evaluation of phase shift mask using platinum for high numerical aperture extreme ultraviolet lithography, Jung Sik Kim, Gon Woo Dong, Dong Min Jeong, Hanyang Univ. (Korea, Republic of); Gil Woo Kong, Min Ki Choi, Jonghwa Lee, S&S TECH (Korea, Republic of); Jinho Ahn, Hanyang Univ. (Korea, Republic of) . . . . . [10957-34]

2:40 pm: Implementation of different cost functions for EUV mask optimization for next generation beyond 7nm, Fan Jiang, Mentor, a Siemens Business (USA); Vivian Wei Guo, GLOBALFOUNDRIES Inc. (USA); Alexander Tritchkov, Mentor, a Siemens Business (USA); Alex Wei, Srividya Jayaram, Mentor Graphics Corp. (USA); Scott Mansfield, Larry Zhuang, GLOBALFOUNDRIES Inc. (USA); Yuyang Sun, Xima Zhang, Mentor Graphics Corp. (USA); Todd Bailey, GLOBALFOUNDRIES Inc. (USA); James Word, Mentor Graphics Corp. (USA) . . . .[10957-35]

LOCATION: CONVENTION CENTER, GRAND BALLROOM 220A
3:00 PM TO 3:20 PM

EUV Poster Preview Speed Talks II

Session Chairs: **Kenneth A. Goldberg,** Lawrence Berkeley National Lab. (USA); **Nelson M. Felix,** IBM Corp. (USA)

Previews from Posters: 10957-48, 10957-49, 10957-61, 10957-56

Coffee Break . . . . Wed 3:20 pm to 3:50 pm

CONFERENCE 10958
Novel Patterning Technologies for Semiconductors, MEMS/NEMS and MOEMS 2019

SESSION 8

LOCATION: CONVENTION CENTER, ROOM 210B
WED 1:40 PM TO 3:20 PM

Novel Patterning and Applications I

Session Chairs: **Naoya Hayashi,** Dai Nippon Printing Co., Ltd. (Japan); **Erik R. Hosler,** GLOBALFOUNDRIES Inc. (USA)

1:40 pm: Insights on reflection: new ideas gained from comparing femtosecond laser development, microscopy, and patterning *(Invited Paper)*, Brennan L. Peterson, KMLabs, Inc. (USA) [10958-23]

2:20 pm: Nanofabrication in extended areas on the basis of nanopositioning and nanomeasuring machines *(Invited Paper)*, Eberhard Manske, Technische Univ. Ilmenau (Germany) . . . . [10958-24]

3:00 pm: Next-generation heated atomic force microscope cantilever for nanolithography: modelling, simulation, and fabrication, Mohammadreza Soleymaniha, Jonathan R. Felts, Texas A&M Univ. (USA) . . . .[10958-25]

Coffee Break . . . . Wed 3:20 pm to 3:50 pm

CONFERENCE 10959
Metrology, Inspection, and Process Control for Microlithography XXXIII

SESSION 10

LOCATION: CONVENTION CENTER, GRAND BALLROOM 220B
WED 1:30 PM TO 3:10 PM

SEM and e-Beam Metrology

Session Chairs: **Christopher J. Raymond,** Nanometrics Inc. (USA); **Philippe Leray,** IMEC (Belgium)

1:30 pm: 3D-SEM challenges: How can we profile in-die 3D geometry of the integrated circuits?, Makoto Suzuki, Ayumi Doi, Hitachi High-Technologies Corp. (Japan) . . . . [10959-43]

1:50 pm: Investigating process variability at ppm level using advanced massive e-beam CD metrology, Stefan Hunsche, ASML US, Inc. (USA); Bertrand Le-Gratiet, Olivier Mermet, STMicroelectronics S.A. (France); Fuming Wang, Yongjun Wang, ASML US, Inc. (USA); Ton Kiers, Wim Tel, ASML Netherlands B.V. (Netherlands) . . . .[10959-44]

2:10 pm: Depth measurement technique for extreme deep holes using back-scattered electron images with high voltage CD-SEM, Takahiro Nishihata, Mayuka Osaki, Maki Tanaka, Hitachi, Ltd. (Japan); Takuma Yamamoto, Hitachi High-Technologies Corp. (Japan); Akira Hamaguchi, Chihiro Ida, Yusaku Suzuki, Toshiba Memory Corp. (Japan) . . . . [10959-45]

2:30 pm: Evaluation of the accuracy and precision of STEM and EDS metrology on horizontal GAA nanowire devices, Hayley Johanesen, Michael Strauss, Anne Kenslea, Chris Hakala, Thermo Fisher Scientific Inc. (USA); Laurens Kwakman, Thermo Fisher Scientific Inc. (Netherlands); Werner Boullart, Hans Mertens, Yong Kong Siew, Kathy Barla, IMEC (Belgium) . . . .[10959-46]

2:50 pm: High-resolution low-shrinkage CD metrology for EUV resist using high voltage CD-SEM, Daisuke Bizen, Hitachi High-Technologies Corp. (Japan) and Hitachi, Ltd. (Japan); Shunsuke Mizutani, Makoto Suzuki, Hitachi High-Technologies Corp. (Japan); Makoto Sakakibara, Hitachi, Ltd. (Japan); Yoshinori Momonoi, Hitachi High-Technologies Corp. (Japan) . . . . [10959-47]

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

CONFERENCE 10960
Advances in Patterning Materials and Processes XXXVI

SESSION 9

LOCATION: CONVENTION CENTER, GRAND BALLROOM 220C
WED 1:40 PM TO 3:20 PM

Directed Self-assembly II: Defectivity

Session Chairs: **Mark H. Somervell,** Tokyo Electron America, Inc. (USA); **Joy Y. Cheng,** Taiwan Semiconductor Manufacturing Co. Ltd. (Taiwan)

1:40 pm: Kinetics of defect annihilation in chemo-epitaxy directed self-assembly, Jiajing Li, The Univ. of Chicago (USA); Paulina A. Rincon-Delgadillo, Hyo Seon Suh, Geert Mannaert, IMEC (Belgium); Paul F. Nealey, The Univ. of Chicago (USA) . . . . . [10960-30]

2:00 pm: Pattern defect reduction for chemo-epitaxy DSA process, Makoto Muramatsu, Takanori Nishi, Gen You, Yasuyuki Ido, Tokyo Electron Kyushu Ltd. (Japan); Takahiro Kitano, Tokyo Electron Ltd. (Japan). . . . .[10960-31]

2:20 pm: Bridge defect control with the topography of chemical pattern in directed self-assembly process, Hyo Seon Suh, IMEC (Belgium); Dajeong Bae, IMEC (Belgium) and KAIST (Korea, Republic of); Jiajing Li, IMEC (Belgium) and Univ. of Chicago (USA); Paulina A. Rincon-Delgadillo, Tae-Gon Kim, IMEC (Belgium) . . . . [10960-32]

2:40 pm: Defect mitigation in sub-20nm patterning with high-chi, silicon containing block copolymers, Jan Doise, Geert Mannaert, Hyo Seon Suh, Paulina A. Rincon-Delgadillo, IMEC (Belgium); Jai Hyun Koh, Ji Yeon Kim, The Univ. of Texas at Austin (USA); Geert Vandenberghe, IMEC (Belgium); C. Grant Willson, The Univ. of Texas at Austin (USA); Christopher J. Ellison, Univ. of Minnesota, Twin Cities (USA) . . . .[10960-33]

3:00 pm: Accelerate the analysis and optimization of lamellar BCP process using machine learning, Alexandre Derville, Johann Foucher, Guilhem Bernard, Guillaume Gey, Julien Baderot, POLLEN Metrology (France); Xavier Chevalier, Ian Cayrefourcq, ARKEMA France (France) . . . . [10960-34]

Coffee Break . . . . Wed 3:20 pm to 3:50 pm

CONFERENCE 10962

Design-Process-Technology Co-optimization for Manufacturability XIII

SESSION 3

Machine Learning

LOCATION: CONVENTION CENTER, ROOM 210C
WED 1:40 PM TO 3:20 PM

Machine Learning

Session Chairs: **Luigi Capodieci,** Motivo, Inc. (USA); **Lynn T. N. Wang,** GLOBALFOUNDRIES Inc. (USA)

1:40 pm: **Applications of machine learning in EDA** *(Invited Paper)*, Paul D. Franzon, North Carolina State Univ. (USA) . . . . [10962-11]

2:20 pm: **Optical proximity correction using bidirectional recurrent neural network (BRNN)**, Yonghwi Kwon, KAIST (Korea, Republic of); Youngsoo Song, SAMSUNG Electronics Co., Ltd. (Korea, Republic of); Youngsoo Shin, KAIST (Korea, Republic of) . . . . [10962-12]

2:40 pm: **Investigation of machine learning for dual OPC and assist feature printing optimization**, Kevin Hooker, Marco Guajardo, Synopsys, Inc. (USA); Rich Wu, Synopsys Taiwan Co., Ltd. (Taiwan); Peter Brooker, Kevin Lucas, Synopsys, Inc. (USA) . . . . [10962-13]

3:00 pm: **Using machine learning in the physical modeling of lithographic processes**, Kostas Adam, Shashidhara K. Ganjugunte, Mentor, a Siemens Business (USA); Clement Moyroud, Mentor Graphics (Ireland) Ltd. French Branch (France); Kanstantsin Shchehlik, Michael C. Lam, Andrew Burbine, Germain L. Fenger, Mentor, a Siemens Business (USA) . . . . [10962-14]

Coffee Break . . . . Wed 3:20 pm to 3:50 pm

CONFERENCE 10963

Advanced Etch Technology for Nanopatterning VIII

SESSION 7

LOCATION: CONVENTION CENTER, ROOM 211B
WED 1:40 PM TO 3:20 PM

Advanced Patterning Integration

Session Chairs: **Julie Bannister,** Tokyo Electron America, Inc. (USA); **Nicolas Possémé,** CEA-LETI (France)

1:40 pm: **Scaling below 3nm node: the 3D CMOS integration paradigm** *(Invited Paper)*, Julien Ryckaert, imec (Belgium). . . . . [10963-24]

2:20 pm: **Plasma etch selectivity study and material screening for self-aligned gate contact (SAGC)**, Dunja Radisic, IMEC (Belgium); Marc Demand, Shihsheng Chang, Tokyo Electron Ltd. (Japan); Steven Demuynck, IMEC (Belgium); Kaushik A. Kumar, Tokyo Electron Ltd. (Japan); Lieve Teugels, IMEC (Belgium); Andrew W. Metz, Junling Sun, Jeffrey T. Smith, Tokyo Electron Ltd. (Japan); Soon Aik Chew, Farid Sebaai, Toby Hopf, Efrain Altamirano-Sánchez, IMEC (Belgium) . . . . [10963-25]

2:40 pm: **Self-aligned quadruple patterning assessment for 16nm half-pitch metal 2 BEOL using virtual fabrication**, Benjamin Vincent, Coventor (France); Stephane Lariviere, Chris Wilson, Ryan Kim, imec (Belgium); Joseph Ervin, Coventor (France) . . . . [10963-26]

3:00 pm: **Integrated self-aligned quadruple patterning flow for sub-7nm application**, Eric Liu, Akiteru Ko, Peter Biolsi, TEL Technology Ctr., America, LLC (USA). . . . . [10963-27]

Coffee Break . . . . Wed 3:20 pm to 3:50 pm

APPLICATION TRACKS

Easily find sessions on these three important topics within the program. Each conference has grouped the applicable presentations together and do not overlap with other conferences.

• **Machine Learning**

• **Stochastics**

• **Overlay**

CONFERENCE 10957
Extreme Ultraviolet (EUV) Lithography X

SESSION 11

**LOCATION: CONVENTION CENTER, GRAND BALLROOM 220A
WED 3:50 PM TO 4:50 PM**

EUV Imaging Enhancement II
Session Chairs: **Naoya Hayashi,** Dai Nippon Printing Co., Ltd. (Japan); **Kurt G. Ronse,** IMEC (Belgium)

3:50 pm: **Compatibility assessment of novel reticle absorber materials for use in EUV lithography systems**, Jetske Stortelder, Arnold Storm, Veronique de Rooij-Lohmann, Chien-Ching Wu, TNO (Netherlands); Willem van Schaik, ASML Netherlands B.V. (Netherlands) . . . .[10957-36]

4:10 pm: **Experimental Investigation of a high-κ reticle absorber system for EUV lithography**, Jo Finders, Frank Timmermans, Robbert de Kruif, ASML Netherlands B.V. (Netherlands); Bríd M. Connolly, Toppan Photomasks, Inc. (Germany); Markus Bender, Advanced Mask Technology Ctr. GmbH Co. KG (Germany); Takahiro Onoue, Yohei Ikebe, Dave Farrar, HOYA Corp. (Japan) . . . .[10957-37]

4:30 pm: **Advanced multilayer mirror design to mitigate EUV shadowing**, Stuart Sherwin, Andrew R. Neureuther, Laura Waller, Univ. of California, Berkeley (USA); Patrick Naulleau, Lawrence Berkeley National Lab. (USA) . . . .[10957-38]

**LOCATION: CONVENTION CENTER, GRAND BALLROOM 220A
4:50 PM TO 5:10 PM**

EUV Poster Preview Speed Talks III
Session Chairs: **Kenneth A. Goldberg,** Lawrence Berkeley National Lab. (USA); **Nelson M. Felix,** IBM Corp. (USA)

Previews from Posters: 10957-58, 10957-6, 10957-64, 10957-67

CONFERENCE 10958
Novel Patterning Technologies for Semiconductors, MEMS/NEMS and MOEMS 2019

SESSION 9

**LOCATION: CONVENTION CENTER, ROOM 210B
WED 3:50 PM TO 5:10 PM**

3-D Printing and Structures: Invited Session
Session Chairs: **Ivo W. Rangelow,** Technische Univ. Ilmenau (Germany); **Richard A. Farrell,** TEL Technology Ctr., America, LLC (USA)

3:50 pm: **Additive manufacturing and architected materials** *(Invited Paper)*, Christopher M. Spadaccini, Lawrence Livermore National Lab. (USA) .[10958-26]

4:30 pm: **How Carbon's digital light synthesis is enabling digital manufacturing of polymeric products** *(Invited Paper)*, Matthew Menyo, Carbon (USA) . . . .[10958-27]

CONFERENCE 10959
Metrology, Inspection, and Process Control for Microlithography XXXIII

SESSION 11

**LOCATION: CONVENTION CENTER, GRAND BALLROOM 220B
WED 3:40 PM TO 5:20 PM**

Overlay

Overlay
Session Chairs: **Hugo Cramer,** ASML Netherlands B.V. (Netherlands); **Richard M. Silver,** National Institute of Standards and Technology (USA)

3:40 pm: **Improved accuracy and robustness for advanced DRAM with tunable multi-wavelength imaging and scatterometry overlay metrology**, John C. Robinson, KLA-Tencor Corp. (USA); Honggoo Lee, Sangjun Han, Minhyung Hong, Jieun Lee, Dongyoung Lee, Ahlin Choi, Chanha Park, SK Hynix, Inc. (Korea, Republic of); Dohwa Lee, Seongjae Lee, Jungtae Lee, Jeongpyo Lee, DongSub Choi, Sanghuck Jeon, Zephyr Liu, Hao Mei, KLA-Tencor Korea (Korea, Republic of); Eran Amit, Anna Golotsvan, Wayne Zhou, Eitan Herzel, Roie Volkovich, KLA-Tencor Israel (Israel) [10959-48]

4:00 pm: **Edge placement error and line edge roughness**, Vassilios Constantoudis, Institute of Nanoscience and Nanotechnology (Greece) and Nanimetrisis p.c. (Greece); George Papavieros, Institute of Nanoscience and Nanotechnology (Greece) and Nanometrisis p.c. (Greece) and Aristotle Univ. of Thessaloniki (Greece); Evangelos Gogolides, Institute of Nanoscience and Nanotechnology (Greece) and Nanomatrisis p.c. (Greece) [10959-111]

4:20 pm: **Color mixing in overlay metrology for greater accuracy and robustness**, Simon Mathijssen, ASML Netherlands B.V. (Netherlands) . . . .[10959-50]

4:40 pm: **Smart implant-layer overlay metrology to enable fab cycle time reduction**, Leon van Dijk, Faegheh Hasibi, Maialen Larrañaga, ASML Netherlands B.V. (Netherlands); Anne Pastol, ASML France S.a.r.l. (France); Auguste Lam, STMicroelectronics S.A. (France); Richard J. F. van Haren, ASML Netherlands B.V. (Netherlands) . . . .[10959-51]

5:00 pm: **Intra-field stress impact on global wafer deformation**, Richard J. F. van Haren, Ronald Otten, Subodh Singh, Amandev Singh, ASML Netherlands B.V. (Netherlands); Leon van Dijk, ASML (Netherlands); Jeffrey Mileham, Yajun Gu, Ultratech, a division of Veeco (USA); Jan Hermans, imec (Belgium) . . . .[10959-52]

CONFERENCE 10960
Advances in Patterning Materials and Processes XXXVI

SESSION 10

**LOCATION: CONVENTION CENTER, GRAND BALLROOM 220C
WED 3:50 PM TO 4:50 PM**

Student Session
Session Chairs: **Scott W. Jessen,** Texas Instruments Inc. (USA); **Robert D. Allen,** IBM Research - Almaden (USA)

3:50 pm: **ToF-SIMS analysis of antimony carboxylate photoresists**, Michael Murphy, Shaheen Hasan, Gregory H. Denbeaux, Robert L. Brainard, SUNY Polytechnic Institute (USA) . . . .[10960-35]

4:10 pm: **Modeling of novel resist technologies**, Luke Long, Andrew R. Neureuther, Univ. of California, Berkeley (USA); Patrick P. Naulleau, Lawrence Berkeley National Lab. (USA) . . . .[10960-36]

4:30 pm: **Imaging behavior of highly fluorinated molecular resists under extreme UV radiation**, Hyuntaek Oh, Inha Univ. (Korea, Republic of); Seok-Heon Jung, Cornell Univ. (USA); Jeong-Seok Mun, Inha Univ. (Korea, Republic of); Kanghyun Kim, Sangsul Lee, Pohang Accelerator Lab. (Korea, Republic of); Jin-Kyun Lee, Inha Univ. (Korea, Republic of) . . . .[10960-37]

**LOCATION: CONVENTION CENTER, GRAND BALLROOM 220C
4:50 PM TO 5:20 PM**

Poster Preview Speed Talks
Session Chairs: **Scott W. Jessen,** Texas Instruments Inc. (USA); **Robert D. Allen,** IBM Research - Almaden (USA)

CONFERENCE 10962
Design-Process-Technology Co-optimization for Manufacturability XIII

SESSION 4

LOCATION: CONVENTION CENTER, ROOM 210C
WED 3:50 PM TO 5:30 PM

Process Modeling and Layout Optimization

Session Chairs: **Neal V. Lafferty,** Mentor, a Siemens Business (USA); **Shigeki Nojima,** Toshiba Corp. (Japan)

3:50 pm: **Design for manufacturability for analog, radio frequency, and millimeter wave designs**, Lynn T. N. Wang, Gail Katzman, GLOBALFOUNDRIES Inc. (USA); Yongfu Li, GLOBALFOUNDRIES Singapore Pte. Ltd. (USA); Vikas Mehrotra, Janam Bakshi, Ahmed Abdulghany, Michael Simcoe, Rais Huda, Vijay Kanagala, Don Blackwell, GLOBALFOUNDRIES Inc. (USA); Thomas Hermann, GLOBALFOUNDRIES Dresden Module One LLC & Co. KG (USA); Uwe Paul Schroeder, Thomas McKay, Sriram Madhavan, GLOBALFOUNDRIES Inc. (USA). . . . . [10962-15]

4:10 pm: **3D resist reflow compact model for imagers microlens shape optimization**, Sébastien Bérard-Bergery, Jérôme Hazart, Patrick Quéméré, Jean-Baptiste Henry, CEA-LETI (France); Charlotte Beylier, STMicroelectronics S.A. (France); Nacima Allouti, Maryline Cordeau, Raphaël Eleouet, Florian Tomaso, CEA-LETI (France); Valérie Rousset, Alain Ostrovsky, STMicroelectronics S.A. (France) . . . . [10962-16]

4:30 pm: **Accuracy improvement of electrical characteristics estimation for sub-20nm FDSOI devices with non-rectangular gates**, Jia-Syun Cai, Chien-Lin Lee, Sheng-Wei Chien, Kuen-Yu Tsai, National Taiwan Univ. (Taiwan) . . . . [10962-17]

4:50 pm: **Optimizing DFM scores by using a genetic evolution algorithm**, Uwe Paul Schroeder, GLOBALFOUNDRIES Inc. (USA). . . . . [10962-18]

5:10 pm: **Full-chip layout optimization for photo process window improvement of 3D NAND metal routing level**, Jennefir L. Digaum, Hung-Eil Kim, Eric L. Christensen, Hamilton Sanchez, Moydul Islam, Micron Technology, Inc. (USA) . . . . [10962-19]

CONFERENCE 10963
Advanced Etch Technology for Nanopatterning VIII

SESSION 8

LOCATION: CONVENTION CENTER, ROOM 211B
WED 3:50 PM TO 5:10 PM

Patterning Solutions for Emerging Applications II

Session Chairs: **Jake O'Gorman,** Hitachi High Technologies America, Inc. (USA); **Qinghuang Lin,** ASML US, Inc. (USA)

3:50 pm: **Line edge roughness increase in DSA patterning due to shrink of PMMA etching residue** *(Invited Paper)*, Makoto Satake, Hitachi High Technologies America, Inc. (USA); Naoyuki Kofuji, Hitachi, Ltd. (Japan); Kenji Maeda, Hitachi High Technologies America, Inc. (USA). . . . . . . [10963-28]

4:30 pm: **Simulation and optimization of etch on flexible substrates for roll-to-roll processing**, Meghali Chopra, Roger Bonnecaze, SandBox Semiconductor (USA) . . . . [10963-29]

4:50 pm: **Blazed x-ray reflection gratings using electron-beam lithography and ion milling**, Drew M. Miles, Randall L. McEntaffer, Fabien Grise, Chad Eichfeld, Ross McCurdy, The Pennsylvania State Univ. (USA) . . . . [10963-30]

Conference End.

APPLICATION TRACKS

Easily find sessions on these three important topics within the program. Each conference has grouped the applicable presentations together and do not overlap with other conferences.

• **Machine Learning**

• **Stochastics**

• **Overlay**

POSTER SESSION
Wednesday 27 February | 5:30 to 7:30 pm

Posters will be on display from 10:00 am to 5:00 pm, and again from 5:30 pm to 7:30 pm during the poster session. Come to view the high-quality papers that are presented in this alternative format, and interact with the poster authors who will be present during the poster session. Enjoy light refreshments while networking with your colleagues.

CONFERENCE 10957
Extreme Ultraviolet (EUV) Lithography X

EUV resist hardening and laser annealing for LER improvement, Jennifer W. Church, IBM Thomas J. Watson Research Ctr. (USA); Yongan Xu, IBM Corp. (USA) . . . .[10957-24]

An analysis method for the topography of phase defect in the extreme ultraviolet mask, Wei Cheng, Sikun Li, Xiangzhao Wang, Heng Zhang, Zejiang Meng, Shanghai Institute of Optics and Fine Mechanics (China). . . . .[10957-30]

Actinic inband EUV reflectometry AIMER compared to ALS blank qualification and applied to structured masks, Rainer Lebert, Andreas Biermanns-Foeth, Christoph Phiesel, Jennifer Arps, Thomas Missalla, Christian Piel, RI Research Instruments GmbH (Germany). . . . .[10957-47]

Table-top EUV/soft x-ray source for metrological applications, Klaus Mann, Jonathan Holburg, Simon Lange, Matthias Müller, Bernd Schäfer, Laser-Lab. Göttingen e.V. (Germany) . . . .[10957-48]

High-precision MoSi multilayer coatings at high-volume for continued EUVL infrastructure development, Michael D. Kriese, Yang Li, Jeffery Steele, Yuriy Platonov, Rigaku Innovative Technologies, Inc. (USA) . . . .[10957-49]

The defect mitigation on EUV stack by track based technology, Naoki Shibata, Lior Huli, Corey Lemley, Yuichiro Miyata, Dave Hetzer, Toshiharu Wada, Akiteru Ko, TEL Technology Ctr., America, LLC (USA); Shinichiro Kawakami, Takahiro Shiozawa, Hidetsugu Yano, Kenichi Ueda, Tokyo Electron Kyushu Ltd. (Japan); Akihiro Sonoda, Tokyo Electron Ltd. (Japan); Karen Petrillo, Luciana Meli, Nelson M. Felix, Cody Murray, Alex Hubbard, IBM Corp. (USA) . . . .[10957-50]

EUV-LET 2.0: a compact exposure tool for industrial research at a wavelength of 13.5nm, Sascha Brose, Serhiy Danylyuk, Lukas Bahrenberg, RWTH Aachen Univ. (Germany); Rainer Lebert, RI Research Instruments GmbH (Germany); Jochen Stollenwerk, Peter Loosen, RWTH Aachen Univ. (Germany) and Fraunhofer-Institut für Lasertechnik (Germany); Larissa Juschkin, RWTH Aachen Univ. (Germany) . . . .[10957-51]

Photon detector calibration in the EUV spectral range at PTB, Christian Laubis, Frank Scholze, Ayhan Babalik, Anja Babuschkin, Annett Barboutis, Christian Buchholz, Andreas Fischer, Sina Jaroslawzew, Jana Lehnert, Heiko Mentzel, Jana Puls, Anja Schönstedt, Michael Sintschuk, Christian Stadelhoff, Claudia Tagbo, Physikalisch-Technische Bundesanstalt (Germany) . . . .[10957-52]

EUV specific test keys for technology nodes below 5nm, Hemant Vats, Yasser Sherazi, Ryan Ryoung Han Kim, Kurt Ronse, IMEC (Belgium) . . . .[10957-53]

Line-edge roughness on fin-field-effect-transistor performance for below 10nm patterns, Sang-Kon Kim, So-Won Yoon, Hongik Univ. (Korea, Republic of) . . . .[10957-54]

Calibrated PSCAR stochastic simulation, Cong Que Dinh, Tokyo Electron Kyushu Ltd. (Japan); Seiji Nagahara, Tokyo Electron Ltd. (Japan); Gousuke Shiraishi, Yuya Kamei, Tokyo Electron Kyushu Ltd. (Japan); Michael Carcasi, Tokyo Electron America, Inc. (USA); Hiroyuki Ide, Yoshihiro Kondo, Yuichi Yoshida, Kosuke Yoshihara, Ryo Shimada, Masaru Tomono, Kazuhiro Takeshita, Tokyo Electron Kyushu Ltd. (Japan); Kathleen Nafus, Tokyo Electron America, Inc. (USA); Serge Biesemans, Tokyo Electron Europe Ltd. (Belgium); John S. Petersen, Danilo De Simone, Philippe Foubert, Peter De Bisschop, Geert Vandenberghe, IMEC (Belgium); Hans-Jurgen Stock, Balint Meliorisz, Synopsys GmbH (Germany) . . . .[10957-56]

Novel technologies in coater/developer to enhance the CD stability and to improve the defectivity toward N7 and smaller nodes, Yuya Kamei, Tomoya Onitsuka, Tokyo Electron Ltd. (Belgium); Shinichiro Kawakami, Masahide Tadokoro, Yohei Sano, Masashi Enomoto, Tokyo Electron Kyushu Ltd. (Japan); Kathleen Nafus, Tokyo Electron Ltd. (Belgium); Akihiro Sonoda, Tokyo Electron Ltd. (Japan); Marc Demand, Tokyo Electron Europe Ltd. (Belgium); Philippe Foubert, IMEC (Belgium) . . . .[10957-57]

Simulation of statistical effects in exposure and development of EUV photoresists using the percolation and diffusion limited aggregation model, Akira Sasaki, National Institutes for Quantum and Radiological Science and Technology (Japan). . . . .[10957-58]

Fundamental study on dissolution kinetics of poly(4-hydroxystyrene) for development of high-resolution resists, Ayako Nakajima, Kyoko Watanabe, Kyoko Matsuoka, Takahiro Kozawa, Osaka Univ. (Japan); Yoshitaka Komuro, Daisuke Kawana, Akiyoshi Yamazaki, Tokyo Ohka Kogyo Co., Ltd. (Japan). . . . .[10957-60]

Update of the development progress of the high power LPP-EUV light source using a magnetic field, Atsushi Ueda, Shinji Nagai, Tatsuya Yanagida, Tsukasa Hori, Yutaka Shiraishi, Kenichi Miyao, Hideyuki Hayashi, Yukio Watanabe, Takeshi Okamoto, Tamotsu Abe, Takeshi Kodama, Hiroaki Nakarai, Takashi Saito, Hakaru Mizoguchi, Gigaphoton Inc. (Japan) . . . .[10957-61]

Beam quality of pulsed high power CO_2-lasers for EUV lithography, Jonathan Mueller, Johannes Kaschke, TRUMPF Lasersystems for Semiconductor Manufacturing GmbH (Germany) . . . .[10957-62]

Computer modeling of physical processes in EUV sources for lithography, Slava Medvedev, Dmitry Astakhov, Ilya Popov, ISTEQ B.V. (Netherlands); Vladimir Ivanov, Konstantin Koshelev, Institute of Spectroscopy (Russian Federation); Ilya Vichev, Ilya Tsygvintsev, M. V. Keldysh Institute of Applied Mathematics of the RAS (Russian Federation) . . . .[10957-63]

Litho-performance expansion with new SOC made from Hemicellulose, Masahiko Harumoto, Yuji Tanaka, Chisayo Nakayama, Yo Arisawa, Masaya Asai, Charles Pieczulewski, SCREEN Semiconductor Solutions Co Ltd (Japan); Harold Stokes, SCREEN SPE Germany GmbH (Germany); Kimiko Yamamoto, Kazuyo Morita, Yasuaki Tanaka, Oji Holdings Corporation (Japan) . . . .[10957-64]

Interferometric measurement of etch-depth in etched phase shift masks, Wenhua Zhu, Ryan Miyakawa, Patrick Naulleau, Lawrence Berkeley National Lab. (USA) . . . .[10957-65]

Achieving diffraction-limited performance on the 0.5NA Berkeley MET5 platform, Ryan H. Miyakawa, Christopher N. Anderson, Geoff Gaines, Jeff Gamsby, Carl Cork, Gideon Jones, Michael Dickenson, Seno Rekawa, Wenhua Zhu, Patrick Naulleau, Lawrence Berkeley National Lab. (USA) . . . .[10957-67]

Investigating EUV photoelectrons with condensed phase photoemission, Jonathan Ma, Univ. of California, Berkeley (USA); Andrew R. Neureuther, Univ. of California, Berkeley (USA) and Lawrence Berkeley National Lab. (USA); Patrick P. Naulleau, Lawrence Berkeley National Lab. (USA) . .[10957-68]

CONFERENCE 10958
Novel Patterning Technologies for Semiconductors, MEMS/NEMS and MOEMS 2019

Photoactive surfaces: self-assembled surfaces, Magi A. Mettry, Rudy J. Wojtecki, Anuja De Silva, IBM Corp. (USA) . . . .[10958-38]

Oxygen effects in thin films for high-resolution three-color lithography, Sandra A. Gutierrez Razo, Adam Pranda, Nikolaos Liaros, John T. Fourkas, Daniel J. Jovinelli, Gottlieb Oehrlein, Univ. of Maryland, College Park (USA); John Petersen, Periodic Structures (USA) . . . .[10958-39]

Large-scale nanofabrication of complex photonic crystal structures using a hybrid ALD-nanoimprint method, Aju S. Jugessur, Andrew Textor, Connor Grierson, The Univ. of Iowa (USA). . . . . . .[10958-40]

Evaluation of adhesion layers performances for soft UV nanoimprint lithography, Florian Delachat, Hubert Teyssedre, Laurent Pain, CEA-LETI (France); Xavier Chevalier, Célia Nicolet, Christophe Navarro, Ian Cayrefourcq, Arkema S.A. (France). . .[10958-41]

Full wafer scale nanoimprint and maskless lithography status and synergies for advanced manufacturing and pre prototyping at LETI, Hubert Teyssedre, Jonathan Pradelles, Isabelle Servin, Florian Delachat, Michael J. May, Guido Rademaker, Philippe Essomba, Stéfan Landis, CEA-Grenoble (France) . . . .[10958-42]

Gas permeable mold for defect reduction in nanoimprint lithography, Kento Mizui, Makoto Hanabata, Satoshi Takei, Toyama Prefectural Univ. (Japan). . . . .[10958-43]

Integrated soft UV-nanoimprint lithography in a nanopositioning and nanomeasuring machine for accurate positioning of stamp to substrate, Shraddha Supreeti, Johannes Kirchner, Rostyslav Mastylo, Eberhard Manske, Technische Univ. Ilmenau (Germany); Martin Hoffmann, Ruhr-Univ. Bochum (Germany); Stefan Sinzinger, Technische Univ. Ilmenau (Germany) . . . .[10958-44]

Advanced mechanical characterization of the EVG AS1 nanoimprint soft stamp material using atomic force microscopy, Denis Mariolle, Florian Delachat, CEA-Grenoble (France); Manuela Stirner, Jonas Khan, EV Group (Austria); Hubert Teyssedre, CEA-Grenoble (France) . . . .[10958-45]

Investigation of dose-based proximity effect corrections for helium ion- beam lithography, Chien-Lin Lee, Sheng-Wei Chien, Jia-Synn Cai, Kuen-Yu Tsai, National Taiwan Univ. (Taiwan) . . . . [10958-46]

Recent advances in quantum optical lithography, Eugen Pavel, Storex Technologies Inc. (Romania) . . . .[10958-47]

Spatial coherence properties of an LED-based illumination system for mask-aligner lithography, Johana Bernasconi, Ecole Polytechnique Fédérale de Lausanne (Switzerland); Raoul Kirner, Wilfried Noell, SUSS MicroOptics SA (Switzerland); Toralf Scharf, Hans Peter Herzig, Ecole Polytechnique Fédérale de Lausanne (Switzerland); Reinhard Voelkel, SUSS MicroOptics SA (Switzerland) . . . . [10958-48]

Beyond contrast curve approach: a grayscale model applied to sub-5μm patterns, Chevalier Pierre, STMicroelectronics S.A. (France). . [10958-49]

Tilted ion implantation of spin-coated SiARC films for sub-lithographic and two-dimensional patterning, Thomas Rembert, Daniel Connelly, Univ. of California, Berkeley (USA); Shalini Sharma, JSR Micro, Inc. (USA); Tsu-Jae King Liu, Univ. of California, Berkeley (USA) . . . . [10958-50]

New methods for fabricating x-ray reflection gratings with custom groove profiles, Ningxiao Zhang, Randall L. McEntaffer, Pennsylvania State Univ. (USA) . . . . [10958-51]

Astronomical x-ray gratings fabricated by e-beam and nanoimprint, Jake A. McCoy, Randall L. McEntaffer, Chad Eichfeld, The Pennsylvania State Univ. (USA); Marc A. Verschuuren, Philips SCIL Nanoimprint Solutions (Netherlands); Drew Miles, Fabien Grisé, The Pennsylvania State Univ. (USA) . . . . [10958-52]

Optimizing 100kV electron beam lithography for x-ray grating fabrication, Ross McCurdy, Randall L. McEntaffer, Fabien Grise, Chad Eichfeld, The Pennsylvania State Univ. (USA). . . . . [10958-53]

Progress on parallel patterning using plasmon-excited electron beamlets, Liang Pan, Zhidong Du, Purdue Univ. (USA) . . . . [10958-54]

Zero-width lines used in electron beam lithography to fabricate periodic nanowires, Xuecou Tu, Ruiying Xu, Xu Tao, Lin Kang, Peiheng Wu, Nanjing Univ. (China) . . . . [10958-55]

Defects in nano-imprint lithographics line patterns: computational modelling and measurement accuracy, Vassilios Constantoudis, Institute of Nanoscience and Nanotechnology (Greece) and Nanometrisis p.c. (Greece); Guy L. Whitworth, Catalan Institute of Nanoscience and Nanotechnology (Spain); Nikolaos Kehagias, Institute of Nanoscience and Nanotechnology (Spain); George Papavieros, Institute of Nanoscience and Nanotechnology (Greece) and Nanometrisis p.c. (Greece) and Aristotle Univ. of Thessalonkiki (Spain); Clivia M. Sotomoyor Torres, Catalan Institute of Nanoscience and Nanotechnology (Spain); Evangelos Gogolides, Institute of Nanoscience and Nanotechnology (Greece) and Nanometrisis p.c. (Greece). . . . . [10958-56]

CONFERENCE 10959
Metrology, Inspection, and Process Control for Microlithography XXXIII

Application of aberration corrected low voltage SEM for metrology, Zhaohui Cheng, Hitachi, Ltd. (Japan); Hideto Dohi, Hitachi High-Technologies Corp. (Japan); Shingo Hayashi, Kotoko Hirose, Hitachi, Ltd. (Japan); Hideyuki Kazumi, Hitachi High-Technologies Corp. (Japan) . . . . [10959-70]

An optimized parameter guidance system for line/space CD metrology, Nan Zhao, Lingling Pu, Teng Wang, Wentian Zhou, Ming Xu, Wei Fang, Hermes-Microvision Inc., USA (USA); Brian Lee, Hermes-Microvision, Inc. USA (USA) . . . . [10959-71]

Metrology of 3D NAND in electron micrographs by scale space snakes, Umesh P. S. Adiga, Michael Strauss, Ashley Tilson, Jason Arjavac, Jack Hagger, Dan Nelson, Thermo Fisher Scientific Inc. (USA) . . . . [10959-72]

Prediction of pattern defect probabilities based on joint distribution model by high-throughput e-beam metrology, Chuan Li, ASML (USA) . . . . [10959-73]

Development of standard samples with programmed defects for evaluation of pattern inspection tools, Susumu Iida, Takamitsu Nagai, Takayuki Uchiyama, Evolving Nano-process Infrastructure Development Ctr., Inc. (Japan). . . . . [10959-74]

Sensitivity analysis of the through-focus scanning optical microscopy by the coherence degree of incident light, Shin-Woong Park, Hwi Kim, Korea Univ. Sejong Campus (Korea, Republic of)[10959-75]

Measurement system of film structure by interferometry and ellipsometry, Ki-Nam Joo, Young Ho Yun, Chosun Univ. (Korea, Republic of) . . . . [10959-76]

Process monitoring and control with tunable wavelength overlay coupled with simulation-to-measurement analysis, Pedro Herrera, KLA-Tencor New York (USA); Kun Gao, KLA-Tencor China (China); Vidya Ramanathan, KLA-Tencor New York (USA); Chen Dror, KLA-Tencor Israel (Israel); Victoria Naipak, KLA-Tencor Corp. (USA); Tal Yaziv, Renan Milo, Nir BenDavid, KLA-Tencor Israel (Israel); Meng Wang, KLA-Tencor New York (USA); Hao Mei, Weihua Li, Xindong Gao, KLA-Tencor China (China); Dongyue Yang, Cheuk Wun Wong, Karsten Gutjahr, Xueli Hao, Tony Joung, Md. Motasim Bellah, DeNeil Park, Abhishek Gottipati, Yue Zhou, GLOBALFOUNDRIES Inc. (USA). . . . . [10959-77]

Parallel active cantilever AFM tool for high-throughput inspection and metrology, Mathias Holz, nano analytik GmbH (Germany) . . . . [10959-79]

Detection of particle defect components on silicon wafer with laser induced breakdown spectroscopy combined laser cleaning technology, Lituo Liu, Academy of Opto-Electronics (China); Xiaoya Yu, The Institute of Survival Technology and Effectiveness Evaluation of Flying Vehicle (China); Weihu Zhou, Xiaomei Chen, Rongyi Ji, Guannan Li, Academy of Opto-Electronics (China) . . . . [10959-81]

Accurate vertical sidewall measurement by a metrological tilting-AFM for reference metrology of line edge roughness, Ryosuke Kizu, Ichiko Misumi, Akiko Hirai, Satoshi Gonda, National Institute of Advanced Industrial Science and Technology (Japan). . . . . [10959-82]

Casual modeling of yield, Jeffrey Weintraub, Scott P. Warrick, Cirrus Logic, Inc. (USA). . . . . [10959-83]

Monitoring and characterization of post etch overlay performance in relation to post lithography overlay performance (non-zero offset monitoring) in DRAM HVM, Georg Erley, Steven Tottewitz, Qoniac GmbH (Germany); Kuoyao Chou, Eva Liu, Frank Yang, Harlan Hwang, Micron Technology Taiwan, Inc. (Taiwan); Patrick Lomtscher, Qoniac GmbH (Germany); Rex H. Liu, Afu Chiu, Hsiao-Lin Hsu, Qoniac Taiwan Ltd. (Taiwan). . . . . . . [10959-84]

First results from the large dynamic range atomic force microscope for overlay metrology, Gert Witvoet, TNO (Netherlands) and Technische Univ. Eindhoven (Netherlands); Joost Peters, Stefan Kuiper, Sasan Keyvani, Rob Willekers, TNO (Netherlands) . . . . [10959-85]

CD and OCD sampling scheme optimization for HVM environment, Georg Erley, Wan-Soo Kim, Qoniac GmbH (Germany); Hongoo Lee, SK Hynix, Inc. (Korea, Republic of); Stefan Buhl, Steffen Guhlemann, Philip Groeger, Qoniac GmbH (Germany); Seop Kim, Qoniac Korea Ltd. (Korea, Republic of). . .[10959-86]

Deep learning's impact on pattern matching for design based metrology and design based inspection, Shuyang Dou, Shinichi Shinoda, Masayoshi Ishikawa, Ryou Yumiba, Yasutaka Toyoda, Hitachi, Ltd. (Japan); Hiroyuki Shindo, Masayuki Izawa, Hitachi High-Technologies Corp. (Japan). . . . . [10959-87]

New imaging technique that enables detection of buried defects, Vadim Kuchik, Dror Shemesh, Applied Materials Israel, Ltd. (Israel); Shinsuke Mizuno, Kenji Aoyama, Applied Materials Japan, Inc. (Japan); Oren Shua, Applied Materials Israel, Ltd. (Israel) . . . . [10959-88]

Study on a feasibility of dark-field illumination for the near-field microscope, Hangyeong Oh, Woojun Han, Myongji Univ. (Korea, Republic of); Yungi Lee, FST (Korea, Republic of); Jaisoon Kim, Myongji Univ. (Korea, Republic of) . . . . [10959-89]

The effect of the underlayer roughness on the roughness of the ultrathin hafnium oxide film, Jung-Hwan Kim, Korea Basic Science Institute (Korea, Republic of); Seunghyun Moon, Seoul National Univ. (Korea) Advanced Institutes of Convergence Technology (Korea, Republic of); Youn Sang Kim, ChoeHo Shin, Basic Science Institute (Korea, Republic of) . . . . [10959-90]

Enhanced wafer overlay residuals control; deep sub-nanometer at sub-millimeter lateral resolution, Avi Cohen, Carl Zeiss SMS Ltd. (Israel); Philippe Leray, Eren Canga, IMEC (Belgium); Vladimir Dmitriev, Kujan Gorhad, Yael Sufrin, Carl Zeiss SMS Ltd. (Israel) . . . . [10959-91]

Area-framing optical defect review under optical resolution using multi-NA dark-field microscopy images, Jun Ho Lee, Kongju National Univ. (Korea, Republic of); Junhee Jeong, Chirs Park, Nextin Inc. (Korea, Republic of). . . . .[10959-92]

POSTER SESSION
Wednesday 27 February | 5:30 to 7:30 pm

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YieldStar uDBO overlay metrology in Samsung D1y DRAM volume production, Jang-Sun Kim, SAMSUNG Electronics Co., Ltd. (Korea, Republic of); Jin-Moo Byun, ASML Korea Co., Ltd. (Korea, Republic of); Remco Lancee, ASML Netherlands B.V. (Netherlands); Jong-Hyun Hwang, Hyeon-Jun Ha, SAMSUNG Electronics Co., Ltd. (Korea, Republic of); Kwang Young Hu, ASML Korea Co., Ltd. (Korea, Republic of); Se-Ra Jeon, ASML Netherlands B.V. (Korea, Republic of); Won-Jae Jang, Hyung-Sub Son, ASML Korea Co., Ltd. (Korea, Republic of); Vidar van der Meijden, Marc Noot, Bartosz Foltynski, Lukasz Macht, Grzegorz Grzela, Cedric Grouwstra, ASML Netherlands B.V. (Netherlands) . . . . [10959-93]

Process stochastic noise and SEM image noise, Shinji Kobayashi, Satoru Shimura, Masashi Enomoto, Tokyo Electron Kyushu Ltd. (Japan); Robert Kern, Timothy Diller, Tony McDaniel, Nan Qin, Matthew Reay, Roger Serwy, Enthought, Inc. (USA) . . . . [10959-94]

Alignment sampling by thorough run-to-run simulation, Georg Erley, Norman Birnstein, Qoniac GmbH (Germany); Alex Ren, Ding Kai, Gaolong Chen, Intel Semiconductor (Dalian) Ltd. (China); Boris Habets, Qoniac GmbH (Germany); Rex H. Liu, Qoniac Taiwan Ltd. (Taiwan) . . . . [10959-95]

Overlay Run-2-Run control based on device structure measured overlay in DRAM HVM, Georg Erley, Steven Tottewitz, Qoniac GmbH (Germany); Hsiao Lun Chu, Foster Huang, Nanya Technology Corp. (Taiwan); Boris Habets, Patrick Lomtscher, Qoniac GmbH (Germany); Hsiao-Lin Hsu, Afu Chiu, Rex H. Liu, Qoniac Taiwan Ltd. (Taiwan) . [10959-96]

Data science on design GDS and silicon PWG data for intra-die nano-topography prediction and analysis, Mehdi Kessar, Bertrand Le-Gratiet, STMicroelectronics S.A. (France); Pierre Lemaire, Lab. des Sciences pour la Conception, l'Optimisation et la Production de Grenoble (France) . . . . [10959-97]

Uniformity analysis of three-dimensional characteristics by CD-SEM for improving process development, Yuki Ojima, Hitachi High-Technologies Corp. (Japan); Wataru Nagatomo, Hitachi High-Technologies America, Inc. (USA); Katsumi Setoguchi, Daisuke Hibino, Hitachi High-Technologies Corp. (Japan) . . . . [10959-98]

Macro CDSEM 2D metrology supporting advance DRAM patterning process, Roman Kris, Ishai Schwarzband, Grigory Klebanov, Elad Sommer, Liraz Gershtein, Bobin Mathew, Efrat Noifeld, Shimon Levy, Ran Alkoken, Olga Novak, Applied Materials Israel, Ltd. (Israel); Hiroshi Miroku, Applied Materials, Inc. (Japan); Dhananjay Rathore, Applied Materials, Inc. (USA); Sharon Duvdevani-Bar, Applied Materials, Inc. (Israel) . . . . [10959-99]

Intra-field alignment for overlay feed-forward simulation with sampling optimization, Georg Erley, Boris Habets, Qoniac GmbH (Germany); Cheng Hao Yang, Charlie Chen, En Chuan Lio, Chun Chi Yu, United Microelectronics Corp. (Taiwan); Patrick Lomtscher, Martin Freitag, Qoniac GmbH (Germany); Rex H. Liu, Qoniac Taiwan Ltd. (Taiwan) [10959-101]

In-depth analysis and research of additional components of the uncertainty budget using the finite element method, Volodymyr V. Skliarov, National Scientific Ctr. "Institute of Metrology" (Ukraine) and O.M. Beketov National Univ. of Urban Economy in Kharkiv (Ukraine) . . . . [10959-102]

Characterization of STEM alignments and their automation, Ashley Tilson, Thermo Fisher Scientific Inc. (USA); Silvia Aerts, Thermo Fisher Scientific Inc. (Netherlands) . . . . [10959-103]

Analyze line roughness sources using power spectral density (PSD), Lingling Pu, Teng Wang, Hermes-Microvision Inc., USA (USA); Thomas J. Huisman, Ruben Maas, Maikel Goosen, Harm Dillen, ASML Netherlands B.V. (Netherlands); Philippe Leray, IMEC (Belgium); Wei Fang, Hermes-Microvision Inc., USA (USA) . . . . [10959-104]

A diffraction-based overlay model based on FDTD method, Buqing Xu, Ling Ma, Univ. of Chinese Academy of Sciences (China); Lisong Dong, Yayi Wei, Institute of Microelectronics (China) [10959-105]

Verification and analysis of FEM for measurement of temperature distribution through the multilayer wall, Volodymyr V. Skliarov, Pavel Neyezhmakov, National Scientific Ctr. "Institute of Metrology" (Ukraine) and O.M. Beketov National Univ. of Urban Economy in Kharkiv (Ukraine); Alexander Prokopov, National Scientific Ctr. "Institute of Metrology" (Ukraine) . . . . [10959-106]

A large field of view metrology SEM for massive CD measurement, Fei Wang, Hermes-Microvision Inc., USA (USA); Nicola Kissoon, ASML (Belgium); Yi-Hsin Chang, Lingling Pu, Hermes-Microvision Inc., USA (USA); Stijn Schoofs, imec (Belgium); Harm Dillen, ASML Netherlands B.V. (Netherlands); Marc Kea, Amit Siany, Hermes-Microvision Inc., USA (USA) . . . . [10959-108]

Denoising line edge roughness measurement using hidden Markov models, George Papavieros, Institute of Nanoscience and Nanotechnology (Greece) and Nanometrisis p.c. (Greece) and Aristotle Univ. of Thessaloniki (Greece); Ioannis Kontoyiannis, Univ. of Cambridge (United Kingdom) and Athens Univ. of Economics and Business (Greece); Vassilios Constantoudis, Evangelos Gogolides, Institute of Nanoscience and Nanotechnology (Greece) and Nanometrisis p.c. (Greece) . . . . [10959-112]

Defect learning with predictive sampling for process improvement, Ian Tolle, Julie Lee, Dave Salvador, GLOBALFOUNDRIES Inc. (USA); Barry Saville, KLA-Tencor New York (USA); Poh Boon Yong, KLA-Tencor Corp. (USA); Gino Marcuccilli, KLA-Tencor England (United Kingdom) . [10959-113]

First demonstration of 331-beam SEM, C. Riedesel, I. Müller, N. Kaufmann, A. Adolf, N. Kämmer, H. Fritz, A. L. Eberle, D. Zeidler, Carl Zeiss Microscopy GmbH (Germany) . . . . [10959-114]

CONFERENCE 10960
Advances in Patterning Materials and Processes XXXVI

DSA

Synthesis of Si-containing diblock copolymers for directed self-assembly, Qingjun Zhu, Jai Hyun Koh, Gregory Blachut, Austin P. Lane, The Univ. of Texas at Austin (USA); Yusuke Asano, JSR Corp. (Japan); William J. Durand, The Univ. of Texas at Austin (USA); Christopher J. Ellison, Univ. of Minnesota, Twin Cities (USA); Nathaniel A. Lynd, C. Grant Willson, The Univ. of Texas at Austin (USA)[10960-49]

PSD analysis as a tool to characterize directed self-assembly of block copolymers, Aurelie Le Pennec, Maxime Argoud, Patricia Pimenta-Barros, Zdenek Chalupa, Jérôme Rêche, CEA-LETI (France); Rémi Le Tiec, Applied Material, Inc. (Israel); Arthur Bernadac, Konan Kouame, Gaëlle Eleouet, Ahmed Gharbi, CEA-LETI (France); Anne Paquet, CEA-LETI (France) and ARKEMA FRANCE (France); Xavier Chevalier, Christophe Navarro, Célia Nicolet, ARKEMA FRANCE (France); Raluca Tiron, CEA-LETI (France) . . . . [10960-51]

Microphase separation behavior study of the same system of a novel block copolymer (PS-b-PC), Baolin Zhang, Guizhou Univ. (China) and Institute of Microelectronics (China); Weichen Liu, Institute of Microelectronics (China) and Univ. of Chinese Academy of Sciences (China); Zheng-ping Zhang, Guizhou Univ. (China); Lingkuan Meng, Integrated Circuit Materials & Components Industry Technology Innovative Alliance (ICMTIA) (China) . . . . . [10960-53]

Hemicellulose block copolymer for wide-range directed self-assembly lithography enabling high fabrication property, Kazuyo Morita, Kimiko Yamamoto, Oji Holdings Corp. (Japan); Masahiko Harumoto, Yuji Tanaka, Chisayo Nakayama, You Arisawa, Masaya Asai, Charles Pieczulewski, SCREEN Semiconductor Solutions Co., Ltd. (Japan)[10960-54]

Process management of block copolymers manufacturing apparatus using residual gas analyzer, Ryota Matsuki, Yukio Kawaguchi, Terumasa Kosaka, Ryosuke Ogaki, HORIBA STEC, Co., Ltd. (Japan). . . . . [10960-55]

Phase behavior of polymer blend materials for polystyrene-b-polycarbonate (PS-b-PC) block copolymers and corresponding homopolymer polystyrene, Weichen Liu, Institute of Microelectronics (China) and Univ. of Chinese Academy of Sciences (China); Baolin Zhang, Institute of Microelectronics (China) and Guizhou Univ. (China); Libin Zhang, Xiaobin He, Yayi Wei, Institute of Microelectronics (China); Xin Wu, Junyan Dai, Ruicheng Ran, Guoping Mao, Jiangsu HanTop Photo-Materials Co., Ltd. (China). . . . . [10960-56]

Pillars fabrication by DSA for SET application: self-assembly kinetics and etching optimization, Ahmed Gharbi, Gabriel Reynaud, Patricia Pimenta-Barros, Khatia Benotmane, CEA-LETI (France); Christophe Navarro, Celia Nicolet, Arkema S.A. (France); Johannes von Borany, Helmholtz-Zentrum Dresden-Rossendorf e. V. (Germany); Karl-Heinz Heinig, Helmholtz-Zentrum Dresden-Rossendorf e.V. (Germany); Hans-Juergen Engelmann, Helmholtz-Zentrum Dresden-Rossendorf e. V. (Germany);

Michele Perego, MDM-CNR (Italy); Francesc Perez-Murano, Consejo Superior de Investigaciones Científicas (Spain); Masahiko Harumoto, SCREEN Semiconductor Solutions Co., Ltd. (Japan); Raluca Tiron, CEA-LETI (France). . . . . [10960-57]

Effect of block stiffness on line edge roughness and line width roughness in directed self-assembly patterning processes, Caleb L. Breaux, Georgia Institute of Technology (USA); Jakin B. Delony, Univ. of South Florida (USA); Peter J. Ludovice, Clifford L. Henderson, Georgia Institute of Technology (USA) . . . . [10960-80]

Mitigation of line edge roughness and line width roughness in block copolymer directed self-assembly through polymer composition molecular weight manipulation . . . . [10960-81]

EUV

Defect conscious approaches in EUV patterning, Arisa Hara, Tokyo Electron Kyushu Ltd. (Japan); Hidetami Yaegashi, Tokyo Electron Ltd. (Japan). . . . . [10960-58]

On-chip characterization of n-butylSnOOH clusters for nanopatterning, Nizan Kenane, Douglas A. Keszler, Oregon State Univ. (USA) . . . . [10960-59]

Robustness of interactive pattern fidelity error as a quality metric for integrated patterning, Soichiro Okada, Shinji Kobayashi, Satoru Shimura, Masashi Enomoto, Tokyo Electron Kyushu Ltd. (Japan); Shota Yoshimura, Kiyohito Ito, Shinya Morikita, Tokyo Electron Miyagi Ltd. (Japan) . . . . [10960-60]

Molecular organometallic resists for EUV (MORE): polymerization photomechanism, Shaheen Hasan, Michael Murphy, Robert L. Brainard, SUNY Polytechnic Institute (USA) . . . . [10960-61]

Novel zinc-based nanoparticle EUV photoresists, Kou Yang, Hong Xu, Kazunori Sakai, Vasiliki Kosma, Emmanuel P. Giannelis, Christopher K. Ober, Cornell Univ. (USA) . . . . [10960-62]

Non-ionic photo-acid generators (PAGs) for EUV lithography, Rudy Wojtecki, Ratnam Sooriyakumaran, Hoa D. Truong, Daniel Sanders, IBM Research - Almaden (USA) . . . . [10960-64]

Active brushes for combatting underlayer photoacid depletion, Alexander Hess, Rudy Wojtecki, IBM Research - Almaden (USA); Anuja De Silva, Luciana Meli, Jing Guo, Nelson M. Felix, IBM Corp. (USA); Dario L. Goldfarb, Bharat Kumar, IBM Thomas J. Watson Research Ctr. (USA); Hoa D. Truong, IBM Research - Almaden (USA). . [10960-65]

Filtration

An exploration of the use of fluoropolymers in photofiltration, Aiwen Wu, Annie Xia, Entegris, Inc. (USA) . . . . [10960-66]

Bridging the defect gap in EUV photoresist, Tetsu Kohyama, Nihon Entegris K.K. (Japan); Alketa Gjoka, Jad Jaber, Entegris, Inc. (USA); Fumiya Kaneko, Nihon Entegris K.K. (Japan). . . . . [10960-67]

Bulk chemical filters selection and process screening for complex bottom anti-reflective coatings (BARC) formulations, Rahman Almusafir, Brewer Science, Inc. (USA); Mona Bavarian, Pall Corp. (USA); Brandon Abeln, Brewer Science, Inc. (USA); Rao Varanasi, Pall Corp. (USA); Tim Limmer, Steve Rivers, Brewer Science, Inc. (USA); Michael Mesawich, Glenn Dado, Pall Corp. (USA); Nick L. Brakensiek, Levi Gildehaus, Brewer Science, Inc. (USA) . . . . [10960-68]

Filter technology developments to address defectivity in leading-edge photoresists, Tetsu Kohyama, Fumiya Kaneko, Kozue Miura, Nihon Entegris K.K. (Japan); Alketa Gjoka, Jad Jaber, Entegris, Inc. (USA) . . . . [10960-69]

A new tailored point-of-use filter to reduce immersion lithography downtime and defects, Aiwen Wu, Annie Xia, Entegris, Inc. (USA); Hareen Bayana, Entegris GmbH (Germany) . . . . . [10960-70]

Fundamentals

Patterning of storage stable polyphthalaldehyde copolymer films, Chola Bhargava Dandamudi, The Univ. of Texas at Austin (USA); Anthony Engler, Georgia Institute of Technology (USA); Nathaniel A. Lynd, The Univ. of Texas at Austin (USA); Paul A. Kohl, Georgia Institute of Technology (USA); C. Grant Willson, The Univ. of Texas at Austin (USA)[10960-71]

Copolymer solubility for 193nm photoresists: Fundamental studies for solution stability and defect reduction, Michael Landry, Stefan J. Caporale, DowDuPont Specialty Products Div. (USA) . . . . [10960-72]

Study on outgas from ArF chemically amplified resist in ArF (193nm) exposure, Atsushi Sekiguchi, Litho Tech Japan Co., Ltd. (Japan) . . . . . . [10960-73]

Contact hole shrink of 193nm NTD immersion resist, Joshua Kaitz, Janet Wu, Vipul Jain, Iou-Sheng Ke, Amy Kwok, Mingqi Li, Jin Wuk Sung, Jong Keun Park, James Park, Cong Liu, Dupont Electronics and Imaging (USA) . . . . [10960-74]

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Full author or technical registration is required for entry to the poster session. Please wear your registration badge.

Underlayer

Polymer-based spin-on dopants, Bhooshan Popere, DowDuPont Specialty Products Div. (USA) . . . .[10960-75]

Development of new maleimides applied to spin-on carbon hardmask with characteristics of high heat resistance and good planarization, Junya Horiuchi, Takashi Makinoshima, Takashi Sato, Yasushi Miki, Masatoshi Echigo, Mitsubishi Gas Chemical Co., Inc. (Japan) . . . .[10960-76]

New silicon hard mask material development for sub-5nm node, Tomoaki Seko, JSR Corporation (Japan); Tatsuya Kasai, Ryuuichi Serizawa, JSR Corp. (Japan); Satoshi Dei, JSR Micro N.V. (Belgium); Tatsuya Sakai, JSR Corp. (Japan). . . . . . .[10960-77]

Application of downstream plasma generated radical methylation treatment to passive amorphous Si surface from TMAH etching during lithography process, Haochen Li, Xinliang Lu, Ting Xie, Qi Zhang, Hua Chung, Shawming Ma, MIchael Yang, Mattson Technology, Inc. (USA) . . .[10960-78]

Charge dissipation by use of a novel aqueous based quaternary ammonium compound for use in electron beam lithography on non-conductive substrates, Gerald Lopez, Glen de Villafranca, Grant Shao, Meiyue Zhang, Univ. of Pennsylvania (USA); Andrew Thompson, DisChem, Inc. (USA) .[10960-79]

CONFERENCE 10961
Optical Microlithography XXXII

Optimal feature vector design for computational lithography, Xuelong Shi, Yuhang Zhao, Shoumian Cheng, Ming Li, Wei Yuan, Shanghai Integrated Circuit Research & Development Ctr. Co., Ltd. (China); Leon Yao, Wenhao Zhao, Yanjun Xiao, Xiaohui Kang, ASML Brion Technologies (China) . . . .[10961-21]

SRAF rule extraction and insertion based on inverse lithography technology, Xiaojing Su, Pengzheng Gao, Yayi Wei, Institute of Microelectronics (China); Weijie Shi, Dongfang Jingyuan Electron Ltd. (China) . . . .[10961-23]

Comparison of different lithographic source optimization methods based on compressive sensing, Zhiqiang Wang, Xu Ma, Qile Zhao, Hao Zhang, Beijing Institute of Technology (China); Gonzalo R. Arce, Univ. of Delaware (USA) [10961-24]

Localized source and mask optimization with narrow-band level-set method, Yijiang Shen, Guangdong Univ. of Technology (China) .[10961-25]

An OPC approach to improve logic gate features corner fidelity, PingHung Lin, TzuChi Chao, ShinShing Yeh, YungChing Mai, ChiaChi Lin, JunCheng Lai, Powerchip Technology Corp. (Taiwan) . . . .[10961-27]

A programmable UVLED array with a collimated optics as transform lens as light field adjustable source, Jiun-Woei Huang, Instrument Technology Research Ctr. (Taiwan) . . . .[10961-28]

Prism-based laser interference lithography system for fabrication of nano-patterned cylindrical mold, Jun Han Park, Bo Sung Shin, Dan Hee Yun, Yong Won Ma, Dong Binyou, Pusan National Univ. (Korea, Republic of) . . . . . .[10961-29]

Modeling of dynamic image performance for lithographic projection lens, Zhiyong Yang, Yating Shi, Shiyuan Liu, Hao Jiang, Huazhong Univ. of Science and Technology (China). . . . .[10961-30]

Productivity improvement by module life extension with software approach using AMAX (Availability MAXimization) functionality, Sophia Hu, Toshihiro Oga, Gigaphoton Inc. (Japan). . . . .[10961-32]

Extremely long life excimer laser chamber technology for multi-patterning lithography, Hiroaki Tsushima, Yousuke Fujimaki, Yasuaki Kiyota, Makoto Tanaka, Takashi Itou, Takeshi Asayama, Akihiko Kurosu, Satoshi Tanaka, Takeshi Ohta, Satoru Bushida, Takashi Saitou, Hakaru Mizoguchi, Gigaphoton Inc. (Japan) . . . .[10961-33]

Biomechanical properties of 3D nanostructured co-polymers, Boris Buchroithner, Upper Austria Univ. of Applied Sciences (Austria) . . . . . .[10961-34]

Gigaphoton's 2× improvement spectral measurement accuracy by newly designed spectrometer technology, Masakazu Hattori, Sophia Hu, Hayato Kondo, Gigaphoton Inc. (Japan). . . . .[10961-35]

CONFERENCE 10962
Design-Process-Technology Co-optimization for Manufacturability XIII

SALELE process from theory to fabrication, Youssef Drissi, IMEC (Belgium); Ahmed Hamed Fatehy, Rehab K. Ali, Mentor Graphics Egypt (Egypt); Germain Fenger, Mentor, a Siemens Business (USA); Werner Gillijns, IMEC (Belgium); James Word, Mentor, a Siemens Business (USA); Jae Uk Lee, Ryan Ryoung han Kim, IMEC (Belgium) . . . .[10962-30]

Pareto exploration of STT-MRAM footprint as a last-level caches in high-performance computing domain, Sushil Sakhre, Khaja Ahmad Shaik, Youssef Drissi, Jae Uk Lee, Yasser Sherazi, Trong Huynh Bao, Manu Perumkunnil, Anda Mocuta, Arnaud Furnemont, Ryan Ryoung han Kim, Gouri Sankar Kar, IMEC (Belgium) . . . .[10962-31]

Sample patterns extraction from layout automatically based on hierarchical cluster algorithm for lithography process optimization, Tianyang Gai, Ying Chen, Pengzheng Gao, Xiaojing Su, Institute of Microelectronics (China) and Univ. of Chinese Academy of Sciences (China); Lisong Dong, Institute of Microelectronics (China); Yayi Wei, Institute of Microelectronics (China) and Univ. of Chinese Academy of Sciences (China); Yajuan Su, Institute of Microelectronics (China); Tianchun Ye, Institute of Microelectronics (China) and Univ. of Chinese Academy of Sciences (China) . . .[10962-32]

Incorporating process variation contours in design rule calculation and SRAM design optimization, Dongbing Shao, IBM Corp. (USA) . . . .[10962-33]

Practical lithography hotspot identification using mask process model, Yohan Choi, Photronics, Inc. (USA); Pai Chi Chen, Chain Ting Huang, Shang Feng Weng, Cloud Cheng, United Microelectronics Corp. (Taiwan); Colbert Lu, Photronics DNP Semiconductor Mask Corp. (Taiwan); Young Ham, Michael Green, Mohamed Ramadan, Photronics, Inc. (USA); Hong Jen Lee, Photronics DNP Semiconductor Mask Corp. (Taiwan); Chris Progler, Photronics, Inc. (USA) . . . .[10962-34]

Copper interconnect topography simulation method in 3D NAND design for manufacturing flow, Bifeng Li, Yang Li, Jinxin Li, Peng Jiang, Yangtze Memory Technologies Co., Ltd. (China); Zhengfang Liu, Chunshan Du, Mentor Graphics Shanghai Electronic Technology Co. (China); Ruben Ghulghazaryan, Mentor Graphics Corp. (Armenia); Qijian Wan, Xinyi Hu, Mentor Graphics Shanghai Electronic Technology Co. (China) . . . . . .[10962-35]

FEOL CMP modeling challenge and solution in 3D NAND, Bifeng Li, Yang Li, Jinxin Li, Peng Jiang, Yangtze Memory Technologies Co., Ltd. (China); Zhengfang Liu, Mentor Graphics Shanghai Electronic Technology Co. (China); Chunshan Du, Yangtze Memory Technologies Co., Ltd. (China); Ruben Ghulghazaryan, Mentor Graphics Corp. (Armenia); Qijian Wan, Xinyi Hu, Mentor Graphics Shanghai Electronic Technology Co. (China) . . . . . .[10962-36]

Design rule exploration for width sensitive zone for metal layers in advanced nodes, Xiaojing Su, Lisong Dong, Yayi Wei, Yajuan Su, Institute of Microelectronics (China); Chunshan Du, Mentor Graphics Shanghai Electronic Technology Co. (China) . . . .[10962-37]

Experimental study of the strong halation-effect of a fully PGMEA-based under-layer on a highly etched topography in the dual Damascene via-first approach, Valentina Dall'Asta, STMicroelectronics SRL (Italy) . . . .[10962-38]

An efficient way of automatic layout decomposition and pattern classification, Qijian Wan, Xinyi Hu, Zhengfang Liu, Chunshan Du, Mentor Graphics Corp. (China) . . . .[10962-39]

A smart approach for fast lithography hotspots detection, Xinyi Hu, Qijian Wan, Zhengfang Liu, Chunshan Du, Mentor Graphics Corp. (China) . . . .[10962-40]

Machine learning to improve accuracy of fast lithographic hotspot detection, Namjae Kim, KiHeung Park, Jiwon Oh, Sangwoo Jung, Sangah Lee, Jae-Hyun Kang, Seung Weon Paek, SAMSUNG Electronics Co., Ltd. (Korea, Republic of); Kareem Madkour, Mentor Graphics Egypt (Egypt); Wael ElManhawy, Mentor Graphics Corp. (USA); Aliaa Kabeel, Ahmed ElGhoroury, Marwah Shafee, Asmaa Rabie, Mentor Graphics Egypt (Egypt); Joe Kwan, Mentor Graphics Corp. (USA) . . . .[10962-41]

Novel pattern-centric solution for high performance 3D NAND VIA dishing metrology, Si-Cong Wang, Jian Mi, Yangtze Memory Technologies Co., Ltd. (China); Abhishek Vikram, Anchor Semiconductor, Inc. (India); Gao Xu, Guojie Cheng, Anchor Semiconductor, Inc. (China) . . . . .[10962-42]

CONFERENCE 10957
Extreme Ultraviolet (EUV) Lithography X

SESSION 12

LOCATION: CONVENTION CENTER, GRAND BALLROOM 220A
THU 8:00 AM TO 10:00 AM

Progress in EUV Sources

Session Chairs: **Akiyoshi Suzuki,** Gigaphoton Inc. (Japan); **Allen H. Gabor,** GLOBALFOUNDRIES Inc. (USA)

8:00 am: **High power LPP-EUV source with long collector mirror lifetime for semiconductor high volume manufacturing**, Hakaru Mizoguchi, Gigaphoton Inc. (Japan) . . . . [10957-39]

8:20 am: **A high brightness LPP EUV source based on continuous liquid metal target for actinic mask inspection**, Slava Medvedev, ISTEQ B.V. (Netherlands); Konstantin Koshelev, RnD-ISAN/ EUV Labs, Ltd. (Russian Federation); Alexander Vinokhodov, Oleg Yakushev, Alexey Yakushkin, EUV Labs, Ltd. (Russian Federation); Dmitry Abramenko, Institute of Spectroscopy (Russian Federation); Alexander Lash, RnD-ISAN/EUV Labs, Ltd. (Russian Federation); Mikhail Krivokorytov, Yuri Sidelnikov, Vladimir Ivanov, Vladimir Krivtsun, Institute of Spectroscopy (Russian Federation); Denis Glushkov, Pavel Seroglazov, Samir Ellwi, ISTEQ B.V. (Netherlands) . . . . [10957-40]

8:40 am: **Colliding plasmas as potential EUV sources towards higher conversion efficiency**, Tatyana Sizyuk, John P. Oliver, Purdue Univ. (USA) . . . . [10957-41]

9:00 am: **Laser produced plasma EUV sources for HVM 7nm node lithography: progress in availability and prospects of power scaling**, Igor V. Fomenkov, ASML US, LP (USA) . . . . [10957-42]

9:20 am: **Optimization of LPP systems performance for achieving high power EUV sources,** Ahmed Hassanein, Tatyana Sizyuk, Purdue Univ. (USA) . . . . [10957-43]

9:40 am: **Ongoing investigation of collector cleaning by surface wave plasma in the Illinois NXE:3100 chamber**, Gianluca A. Panici, Dren Qerimi, David N. Ruzic, Univ. of Illinois (USA) . . . . [10957-44]

Coffee Break . . . . Thu 10:00 am to 10:25 am

CONFERENCE 10958
Novel Patterning Technologies for Semiconductors, MEMS/ NEMS and MOEMS 2019

SESSION 10

LOCATION: CONVENTION CENTER, ROOM 210B
THU 8:00 AM TO 10:00 AM

Neuromorphic Computing: Invited Session

Session Chairs: **Laurent Pain,** CEA-LETI (France); **Marco Wieland,** MAPPER Lithography (Netherlands)

8:00 am: **Neuromorphic computing and directed self-assembly: a new pairing for old technologies** *(Invited Paper)*, Brian D. Hoskins, Jabez J. McClelland, National Institute of Standards and Technology (USA) . . . . [10958-28]

8:40 am: **Analog memory-based techniques for accelerating the training of fully-connected deep neural networks** *(Invited Paper)*, Hsinyu Tsai, Stefano Ambrogio, Pritish Narayanan, Robert M. Shelby, Charles Mackin, Geoffrey W. Burr, IBM Research - Almaden (USA) . . . . [10958-29]

9:20 am: **Unconventional computing with memristor crossbar arrays** *(Invited Paper)*, Can Li, Hao Jiang, Zhongrui Wang, Rivu Midya, Mingyi Rao, Navnidhi K. Upadhyay, Shuang Pi, Peng Lin, J.Joshua Yang, Qiangfei Xia, Univ. of Massachusetts Amherst (USA) . . . . [10958-30]

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

CONFERENCE 10959
Metrology, Inspection, and Process Control for Microlithography XXXIII

SESSION 12

LOCATION: CONVENTION CENTER, GRAND BALLROOM 220B
THU 8:00 AM TO 10:00 AM

Design Interactions with Metrology

Joint session with conferences 10959 and 10962

Session Chairs: **John A. Allgair,** BRIDG (USA); **Ryoung-Han R. Kim,** IMEC (Belgium)

8:00 am: **AI: from deep learning to in-memory computing** *(Keynote Presentation)*, Hsiang-Lan Lung, Macronix (USA) . . . .[10959-53]

8:40 am: **Critical defect detection, monitoring and fix through process integration engineering by using D2DB pattern monitor solution**, Abhishek Vikram, Anchor Semiconductor, Inc. (USA); Baojun Zhao, Ming Tian, Yu Zhang, Tiapeng Guan, Jianghua Leng, Lei Yan, Wei Hua, Shanghai Huali Microelectronics Corp. (China); Guojie Chen, Hui Wang, Gary Zhang, Wenkui Liao, Anchor Semiconductor, Inc. (China) . . . . [10962-20]

9:00 am: **Massive metrology and failure identification for DRAM applications**, Harm Dillen, Dorothe Oorschot, Marleen Kooiman, Willem van Mierlo, Ziyang Wang, ASML Netherlands B.V. (Netherlands); Kang-San Lee, Jin-Woo Lee, ASML Korea Co., Ltd. (Korea, Republic of); Ruochong Fei, Shu-Yu Lai, Marc Kea, Hermes-Microvision Inc., USA (USA); Inhwan Lee, Hwan Kim, Junghyun Kang, Jaehee Hwang, Chang-Moon Lim, SK Hynix, Inc. (Korea, Republic of). . . . . [10959-54]

9:20 am: **Mark sensitivity of uDBO and IBO in advanced DRAM node**, Chun-Wei Chen, Li-Hsin Kan, Ching-Yao Tang, ASML Taiwan Ltd. (Taiwan); Kuo-Yao Chou, Venky Subramony, Szu-Fan Yang, Micron Technology Taiwan (Taiwan); Chung-Yi Yu, Jia-Jung Wu, Tsu-Hung Lin, ASML Taiwan Ltd. (Taiwan); Bob Verheijen, Robin Janssen, Oncu Otar, Juan Vanegas Acosta, ASML Netherlands B.V. (Netherlands) . . . . [10962-21]

9:40 am: **3D optical proximity model optimization using inline 3DSEM metrology**, Shimon Levi, Applied Materials Israel, Ltd. (Israel); Hans-Jurgen Stock, Wolfgang Demmerle, Synopsys GmbH (Germany) . . . . [10959-55]

Coffee Break . . . . Thu 10:00 am to 10:20 am

CONFERENCE 10960
Advances in Patterning Materials and Processes XXXVI

SESSION 11

LOCATION: CONVENTION CENTER, GRAND BALLROOM 220C
THU 8:00 AM TO 10:00 AM

Material Supplier

Session Chairs: **Christoph K. Hohle,** Fraunhofer-Institut für Photonische Mikrosysteme (Germany); **Gilles R. Amblard,** SAMSUNG Austin Semiconductor LLC (USA)

8:00 am: **Evolution of lithographic materials enabling the semiconductor industry**, James W. Thackeray, Chengbai Xu, James F. Cameron, Dow Electronic Materials (USA). . . . . [10960-38]

8:20 am: **Aqueous materials for advanced lithography**, Yi Cao, EMD Performance Materials Corp. (USA); Tatsuro Nagahara, Taku Hirayama, Merck Performance Materials, Ltd. (Japan). . . . . [10960-39]

8:40 am: **Development of metal organic cluster EUV photoresists**, Kazunori Sakai, JSR Corp. (Japan) and Cornell Univ. (USA) . . . . [10960-40]

9:00 am: **Advances in metal oxide resist performance and production**, Jason K. Stowers, Peter de Schepper, Michael Kocsis, Andrew Grenville, Inpria Corp. (USA) . . . . [10960-41]

9:20 am: **Expanding the lithographer's toolkit to reduce variability: Filtration considerations**, Jennifer Braggin, Vinay Goel, Entegris, Inc. (USA); Aiwen Wu, Entegris (USA) . . . . [10960-42]

9:40 am: **Start-up performance and pattern defectivity improvement using 2nm rated nylon filter developed with lithography filtration expertise**, Toru Umeda, Nihon Pall Ltd. (Japan); Eric Shiu, Pall Corp. (USA); Takehito Mizuno, Hisashi Nakagawa, Tetsuya Murakami, Shuichi Tsuzuki, Nihon Pall Ltd. (Japan) . . . . [10960-43]

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

CONFERENCE 10962
Design-Process-Technology Co-optimization for Manufacturability XIII

SESSION 5

LOCATION: CONVENTION CENTER, GRAND BALLROOM 220B THU 8:00 AM TO 10:00 AM

Design Interactions with Metrology

Joint session with conferences 10959 and 10962

Session Chairs: **John A. Allgair,** BRIDG (USA); **Ryoung-Han R. Kim,** IMEC (Belgium)

8:00 am: **AI: from deep learning to in-memory computing** *(Keynote Presentation)*, Hsiang-Lan Lung, Macronix (USA) . . . . [10959-53]

8:40 am: **Critical defect detection, monitoring and fix through process integration engineering by using D2DB pattern monitor solution**, Abhishek Vikram, Anchor Semiconductor, Inc. (USA); Baojun Zhao, Ming Tian, Yu Zhang, Tiapeng Guan, Jianghua Leng, Lei Yan, Wei Hua, Shanghai Huali Microelectronics Corp. (China); Guojie Chen, Hui Wang, Gary Zhang, Wenkui Liao, Anchor Semiconductor, Inc. (China) . . . . [10962-20]

9:00 am: **Massive metrology and failure identification for DRAM applications**, Harm Dillen, Dorothe Oorschot, Marleen Kooiman, Willem van Mierlo, Ziyang Wang, ASML Netherlands B.V. (Netherlands); Kang-San Lee, Jin-Woo Lee, ASML Korea Co., Ltd. (Korea, Republic of); Ruochong Fei, Shu-Yu Lai, Marc Kea, Hermes-Microvision Inc., USA (USA); Inhwan Lee, Hwan Kim, Junghyun Kang, Jaehee Hwang, Chang-Moon Lim, SK Hynix, Inc. (Korea, Republic of). . . . . [10959-54]

9:20 am: **Mark sensitivity of uDBO and IBO in advanced DRAM node**, Chun-Wei Chen, Li-Hsin Kan, Ching-Yao Tang, ASML Taiwan Ltd. (Taiwan); Kuo-Yao Chou, Venky Subramony, Szu-Fan Yang, Micron Technology Taiwan (Taiwan); Chung-Yi Yu, Jia-Jung Wu, Tsu-Hung Lin, ASML Taiwan Ltd. (Taiwan); Bob Verheijen, Robin Janssen, Oncu Otar, Juan Vanegas Acosta, ASML Netherlands B.V. (Netherlands) . . . . [10962-21]

9:40 am: **3D optical proximity model optimization using inline 3DSEM metrology**, Shimon Levi, Applied Materials Israel, Ltd. (Israel); Hans-Jurgen Stock, Wolfgang Demmerle, Synopsys GmbH (Germany) . . . . [10959-55]

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

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CONFERENCE 10957
Extreme Ultraviolet (EUV) Lithography X

LOCATION: CONVENTION CENTER, GRAND BALLROOM 220A
THU 10:25 AM TO 10:30 AM

Award Announcement
Presentation of the 2019 ASML-Cymer Leadership Best Student Paper Award

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SESSION 13
LOCATION: CONVENTION CENTER, GRAND BALLROOM 220A
THU 10:30 AM TO 12:10 PM

EUV OPC and Modeling:

Joint session with conferences 10957 and 10962

Session Chairs: **Kevin Lucas,** Synopsys, Inc. (USA); **Soichi Inoue,** Toshiba Corp. (Japan)

10:30 am: **Development of fast rigorous simulators for large-area EUV lithography simulation**, Michael Yeung, Fastlitho Inc. (USA); Eytan Barouch, Boston Univ. (USA) . . . . [10957-45]

10:50 am: **Mask 3D effect reduction and defect printability of etched multilayer EUV mask**, Takashi Kamo, Takeshi Yamane, Yasutaka Morikawa, Susumu Iida, Takayuki Uchiyama, Shunko Magoshi, Satoshi Tanaka, Evolving Nano-process Infrastructure Development Ctr., Inc. (Japan). . . . . [10957-46]

11:10 am: **SAQP spacer merge and EUV self-aligned block decomposition at 28nm metal pitch on imec 7nm node,** Jae Uk Lee, Syed Muhammad Yasser Sherazi, IMEC (Belgium); Soo-Han Choi, Synopsys, Inc. (USA); Ryoung-Han R. Kim, IMEC (Belgium)[10962-22]

11:30 am: **EUV computational lithography using accelerated topographic mask simulation**, Vitaly Domnenko, Synopsys SPb, LLC (Russian Federation); Bernd Küchler, Wolfgang Hoppe, Jürgen Preuninger, Ulrich Klostermann, Wolfgang Demmerle, Martin Bohn, Dietmar Krüger, Synopsys GmbH (Germany); Ryoung-Han R. Kim, Ling Ee Tan, IMEC (Belgium) . [10962-23]

11:50 am: **EUV mask synthesis with rigorous ILT for process window improvement**, Kyle Braam, Guangming Xiao, Synopsys, Inc. (USA); Wolfgang Hoppe, Ulrich Klostermann, Synopsys GmbH (Germany); Kevin Lucas, Synopsys, Inc. (USA). . . . . [10962-24]

Conference End.

CONFERENCE 10958
Novel Patterning Technologies for Semiconductors, MEMS/NEMS and MOEMS 2019

SESSION 11
LOCATION: CONVENTION CENTER, ROOM 210B
THU 10:30 AM TO 12:10 PM

Novel Patterning and Applications II
Session Chairs: **Martha I. Sanchez,** IBM Research - Almaden (USA); **Eric M. Panning,** Intel Corp. (USA)

10:30 am: **Diffractive augmented reality (AR) waveguides: manufacturing challenges and novel fabrication approaches** *(Invited Paper)*, Arseny Alexeev, WaveOptics, Ltd. (United Kingdom). . . . . [10958-31]

11:10 am: **Opening the road to custom astronomical UV gratings**, Fabien Grise, Randall L. McEntaffer, The Pennsylvania State Univ. (USA); Nicholas E. Kruczek, Kevin C. France, Univ. of Colorado Boulder (USA); Eduard R. Muslimov, Jean-Claude Bouret, Amandine Caillat, Lab. d'Astrophysique de Marseille (France); Brian T. Fleming, Univ. of Colorado Boulder (USA) . . . . [10958-32]

11:30 am: **Patterning challenges for beyond 3nm logic devices: example of an interconnected magnetic tunnel junction**, Ndeye Arame Thiam, IMEC (Belgium)[10958-33]

11:50 am: **Integration techniques for next-generation memory device**, Kazuo Kibi, Tokyo Electron Technology Solutions Ltd. (Japan). . . . . [10958-34]

Lunch Break . . . . . . Thu 12:10 pm to 1:30 pm

CONFERENCE 10959
Metrology, Inspection, and Process Control for Microlithography XXXIII

LOCATION: CONVENTION CENTER, GRAND BALLROOM 220B
10:20 AM TO 10:30 AM

2019 Karel Urbánek Best Student Paper Award Presentation
Session Chairs: **Vladimir A. Ukraintsev,** Qorvo (USA); **Ofer Adan,** Applied Materials Israel, Ltd. (Israel)

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SESSION 13
LOCATION: CONVENTION CENTER, GRAND BALLROOM 220B
THU 10:30 AM TO 12:10 PM

Process Control
Session Chairs: **Philippe Leray,** IMEC (Belgium); **Alexander Starikov,** I&I Consulting (USA)

10:30 am: **Contour based metrology: getting more from a SEM image**, Bertrand Le-Gratiet, Julien Ducoté, Regis Bouyssou, Christophe Dezauzier, Alain Ostrovsky, Charlotte Beylier, STMicroelectronics S.A. (France); Paolo Petroni, Patrick Schiavone, Alexandre Chagoya-Garzon, Matthieu Milléquant, ASELTA Nanographics (France) . . . . .[10959-56]

10:50 am: **Scatterometry and AFM measurement combination for area selective deposition process characterization**, Mohamed Saib, Alain Moussa, IMEC (Belgium); Joey Hung, Roy Koret, Nova Measuring Instruments Ltd. (Israel); Shaoren Deng, Andrea Illiberi, Jan Willem Maes, ASM Belgium N.V. (Belgium); Anne-Laure Charley, Philippe Leray, IMEC (Belgium). . . . .[10959-57]

11:10 am: **Localized power spectral density analysis on atomic force microscopy images for advanced patterning applications**, Alain Moussa, Mohamed Saib, Sara Paolillo, Frederic Lazzarino, IMEC (Belgium); Andrea Illiberi, Shaoren Deng, Jan Willem Maes, ASM Belgium N.V. (Belgium); Anne-Laure Charley, Philippe Leray, IMEC (Belgium). . .[10959-58]

11:30 am: **Focus budget improvement using optimized wafer edge settings**, Georg Erley, Qoniac GmbH (Germany); Lucas Lamonds, Bryan Orf, Micron Technology, Inc. (USA); Xaver Thrun, Philip Groeger, Boris Habets, Qoniac GmbH (Germany) . . . .[10959-59]

11:50 am: **New approach for APC and measurement sampler interaction in a complex process mix logic fab**, Laurent Lecarpentier, Aymen Mili, Bertrand Le-Gratiet, Jean De-Caunes, STMicroelectronics S.A. (France) . . .[10959-60]

Lunch Break . . . . Thu 12:10 pm to 1:30 pm

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CONFERENCE 10960
Advances in Patterning Materials and Processes XXXVI

SESSION 12
LOCATION: CONVENTION CENTER, GRAND BALLROOM 220C
THU 10:30 AM TO 12:10 PM

Underlayers
Session Chairs: **Ryusuke Uchida,** Tokyo Ohka Kogyo America, Inc. (USA); **Ramakrishnan Ayothi,** JSR Micro, Inc. (USA)

10:30 am: **High temperature spin on carbon materials with excellent planarization and CVD compatibility**, Keren Zhang, Li Cui, Shintaro Yamada, James F. Cameron, Sabrina Wong, Lawrence Chen, Suzanne M. Coley, Dan Greene, Joshua A. Kaitz, Iou-Sheng Ke, DowDuPont Electronics & Imaging (USA) . . . . [10960-44]

10:50 am: **Improved hemicellulose spin on carbon hardmask**, Kazuyo Morita, Kimiko Yamamoto, Hiroki Tanaka, Yasuaki Tanaka, Oji Holdings Corp. (Japan); Masahiko Harumoto, Yuji Tanaka, Chisayo Nakayama, You Arisawa, Masaya Asai, SCREEN Semiconductor Solutions Co., Ltd. (Japan); Harold W. Stokes, SCREEN SPE Germany GmbH (Germany); Charles Pieczulewski, SCREEN Semiconductor Solutions Co., Ltd. (Japan) . . . . [10960-45]

11:10 am: **Towards pure carbon: ultra-high carbon fullerene based spin-on organic hardmasks**, Alan G. Brown, Irresistible Materials Ltd. (United Kingdom); Guy Dawson, The Univ. of Birmingham (United Kingdom); Alex L. McClelland, Irresistible Materials Ltd. (United Kingdom); James Bowen, The Open Univ. (United Kingdom); Tom Lada, Nano-C, Inc. (USA); Warren Montgomery, Irresistible Materials Ltd. (United Kingdom); Alex P. G. Robinson, The Univ. of Birmingham (United Kingdom) . . . . [10960-46]

11:30 am: **Design of under layer materials to enhance the performance for EUV lithography**, Ryuta Mizuochi, Yasunobu Someya, Mamoru Tamura, Hiroyuki Wakayama, Sho Shimizu, Rikimaru Sakamoto, Nissan Chemical Corp. (Japan)[10960-47]

11:50 am: **Development of novel thick spin-on carbon hardmask**, Byeri Yoon, Seungwook Shin, Youngmin Kim, Yumi Heo, Soyeon Park, Sungho Choi, Sanghak Lim, SAMSUNG SDI Co., Ltd. (Korea, Republic of) . . . . [10960-48]

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

CONFERENCE 10962
Design-Process-Technology Co-optimization for Manufacturability XIII

SESSION 6

LOCATION: CONVENTION CENTER, GRAND BALLROOM 220A THU 10:30 AM TO 12:10 PM

EUV OPC and Modeling

Joint session with conferences 10957 and 10962

Session Chairs: **Kevin Lucas,** Synopsys, Inc. (USA); **Soichi Inoue,** Toshiba Corp. (Japan)

10:30 am: **Development of fast rigorous simulators for large-area EUV lithography simulation**, Michael Yeung, Fastlitho Inc. (USA); Eytan Barouch, Boston Univ. (USA) . . . . [10957-45]

10:50 am: **Mask 3D effect reduction and defect printability of etched multilayer EUV mask**, Takashi Kamo, Takeshi Yamane, Yasutaka Morikawa, Susumu Iida, Takayuki Uchiyama, Shunko Magoshi, Satoshi Tanaka, Evolving Nano-process Infrastructure Development Ctr., Inc. (Japan) . . . . [10957-46]

11:10 am: **SAQP spacer merge and EUV self-aligned block decomposition at 28nm metal pitch on imec 7nm node,** Jae Uk Lee, Syed Muhammad Yasser Sherazi, IMEC (Belgium); Soo-Han Choi, Synopsys, Inc. (USA); Ryoung-Han R. Kim, IMEC (Belgium) . . . . [10962-22]

11:30 am: **EUV computational lithography using accelerated topographic mask simulation**, Vitaly Domnenko, Synopsys SPb, LLC (Russian Federation); Bernd Küchler, Wolfgang Hoppe, Jürgen Preuninger, Ulrich Klostermann, Wolfgang Demmerle, Martin Bohn, Dietmar Krüger, Synopsys GmbH (Germany); Ryoung-Han R. Kim, Ling Ee Tan, IMEC (Belgium) . . . . [10962-23]

11:50 am: **EUV mask synthesis with rigorous ILT for process window improvement**, Kyle Braam, Guangming Xiao, Synopsys, Inc. (USA); Wolfgang Hoppe, Ulrich Klostermann, Synopsys GmbH (Germany); Kevin Lucas, Synopsys, Inc. (USA) . . . . [10962-24]

Lunch Break . . . . Thu 12:10 pm to 1:30 pm

CONFERENCE 10958
Novel Patterning Technologies for Semiconductors, MEMS/NEMS and MOEMS 2019

SESSION 12

LOCATION: CONVENTION CENTER, ROOM 210B
THU 1:30 PM TO 2:30 PM

Novel Materials/Novel Directed Self-assembly
Session Chairs: **Martha I. Sanchez,** IBM Research - Almaden (USA); **Eric M. Panning,** Intel Corp. (USA)

1:30 pm: **Sub 10nm patterning using DNA origami**, Raluca Tiron, Marie Marmiesse, Guillaume Thomas, Hubert Teyssedre, Xavier Baillin, CEA-LETI (France) . . . .[10958-35]

1:50 pm: **Novel approach to sub-5nm patterning**, Hemali Rathnayake, The Univ. of North Carolina at Greensboro (USA) . . . .[10958-36]

2:10 pm: **An alternative line/space shrink: EUVL plus complementary DSA lithography**, Mary Ann J. Hockey, Brewer Science Inc (USA) . .[10958-37]

Conference End.

CONFERENCE 10959
Metrology, Inspection, and Process Control for Microlithography XXXIII

SESSION 14

LOCATION: CONVENTION CENTER, GRAND BALLROOM 220B
THU 1:30 PM TO 3:10 PM

Inspection II
Session Chairs: **Masafumi Asano,** Tokyo Electron Ltd. (Japan); **Xiaomeng Chen,** Taiwan Semiconductor Manufacturing Co. Ltd. (Taiwan)

1:30 pm: **Multiple beam inspection(MBI) for 7nm node and beyond: technologies and applications,** Eric Long Ma, Kevin Chou, Martin Ebert, Xuedong Liu, Weiming Ren, Xuerang Hu, Martijn Maassen, Weihua Yin, Aiden Chen, Fei Wang, Hermes-Microvision Inc., USA (USA) . . . .[10959-61]

1:50 pm: **Optical and SEM inspection methods addressing EUV pattern fidelity challenges**, Shimon Levi, Aner Avakrat, Applied Materials Israel, Ltd. (Israel). . . . .[10959-62]

2:10 pm: **Prediction of signal characteristics for defect inspection using SEM image simulator**, Toshiyuki Yokosuka, Chahn Lee, Hitachi, Ltd. (Japan); Koichi Kurosawa, Hajime Kawano, Hideyuki Kazumi, Hitachi High-Technologies Corp. (Japan) . . . .[10959-63]

2:30 pm: **Voltage contrast edge placement estimation for overlay, CD, and local uniformity metrology**, Cyrus E. Tabery, ASML US, Inc. (USA); Vito Rutigliani, IMEC (Belgium); Simon Hastings, ASML US (USA); Etienne de Poortere, ASML US (Netherlands); Luke Wang, Hermes Microvision (USA); Philippe Leray, Guillaume Schelcher, IMEC (Belgium); Yongjun Wang, ASML US (USA) . . . .[10959-64]

2:50 pm: **Process window discovery methodology for extreme ultraviolet (EUV) lithography**, Sandip Halder, IMEC (Belgium); Kaushik Sah, Andrew Cross, KLA-Tencor Corp. (USA); Christophe Beral, IMEC (Belgium); Antonio Mani, KLA-Tencor Corp. (USA); Philippe Leray, Dieter Van den Heuvel, IMEC (Belgium); Vidyasagar Anantha, KLA-Tencor Corp. (USA) . . . .[10959-65]

Coffee Break . . . . Thu 3:10 pm to 3:40 pm

CONFERENCE 10960
Advances in Patterning Materials and Processes XXXVI

LOCATION: CONVENTION CENTER, GRAND BALLROOM 220C
1:40 PM TO 5:00 PM

Tribute to C. Grant Willson (retiring in 2019)
Session Chairs: **Qinghuang Lin,** ASML US, Inc. (USA); **Roel Gronheid,** KLA-Tencor/ ICOS Belgium (Belgium)

In the late 1970s and early 1980s, researchers in the semiconductor industry realized that the then mainstream DNQ/Novolac photoresist platforms would not be extendible to shorter wavelength lithographies that were under development at that time. Materials with higher transparency at low wavelength and higher photospeed were required.

Dr. C. Grant Willson, in collaboration with Professor Jean Fréchet and the late Dr. Hiroshi Ito at the IBM San Jose Research Lab, invented a radically new form of photoresist used to print integrated circuits. This new class of photoresists, called chemically amplified photoresists, would become the workhorse for the entire semiconductor industry to print ever smaller, faster, cheaper and more powerful microchips. The chemically amplified resists have been the cornerstone for 248 and 193 nm lithography and today are still being researched for introduction into EUV lithography. These materials have therefore enabled modern microchips and fundamentally changed how we work, learn, communicate, interact and do business.

In 1993, Dr. Willson moved to the Univ. of Texas at Austin as a professor and he, together with his students, continued to make monumental contributions to patterning materials. This special session is organized on the occasion of his planned retirement in 2019 to celebrate his illustrious career and the many seminal contributions he has made to the semiconductor industry and our community.

We invite all SPIE participants to attend this Special Session and join us in this special event. Presenters in this session will highlight Professor Willson's career and accomplishments. They include, collaborators, colleagues, and former students:

In alphabetical order: **Bob Allen** (IBM Almaden); **Yan Borodovsky** (retired from Intel); **Ralph Dammel** (EMD); **Chris Ellison** (Univ. of Minnesota); **Cliff Henderson** (Univ. of South Florida); **Chris Mack** (Fractilia); **Dave Medeiros** (Globalfoundries); **Doug Resnick** (Canon); **Mark Somervell** (Tokyo Electron)

Confernece End.

CONFERENCE 10962
Design-Process-Technology Co-optimization for Manufacturability XIII

SESSION 7

LOCATION: CONVENTION CENTER, ROOM 210C
THU 1:30 PM TO 3:30 PM

Hotspot Detection
Session Chairs: **Vivek K. Singh,** Intel Corp. (USA); **Piyush Pathak,** Cadence Design Systems, Inc. (USA)

1:30 pm: **Lithography hotspot candidate detection using coherence map** (*Invited Paper*), Tetsuaki Matsunawa, Taiki Kimura, Shigeki Nojima, Toshiba Memory Corp. (Japan). . . . .[10962-25]

2:10 pm: **CAPP: context analyzer and printability predictor**, Vikas Tripathi, Yongfu Li, I-Lun Tseng, Valerio Perez, Zhao Chuan Lee, Jonathan Ong, GLOBALFOUNDRIES Singapore Pte. Ltd. (Singapore); Shobhit Malik, GLOBALFOUNDRIES Inc. (USA). . . . .[10962-26]

2:30 pm: **Hotspot detection using squish-net**, Haoyu Yang, Piyush Pathak, Frank E. Gennari, Ya-Chieh Lai, Cadence Design Systems, Inc. (USA); Bei Yu, The Chinese Univ. of Hong Kong (Hong Kong, China) . . . .[10962-27]

2:50 pm: **Multi-criteria hotspot detection using pattern classification**, Kazufumi Shiozawa, Taiki Kimura, Tetsuaki Matsunawa, Shigeki Nojima, Toshiya Kotani, Toshiba Memory Corp. (Japan). . . . .[10962-28]

3:10 pm: **Multilayer CMP hotspot modeling through deep learning**, Luis Francisco, North Carolina State Univ. (USA); Rui Mao, GLOBALFOUNDRIES Inc. (USA); Ushasree Katakamsetty, GLOBALFOUNDRIES Singapore Pte. Ltd. (Singapore); Piyush Verma, Robert C. Pack, GLOBALFOUNDRIES Inc. (USA)[10962-29]

Conference End.

CONFERENCE 10959
**Metrology, Inspection,
and Process Control for
Microlithography XXXIII**

SESSION 15

**LOCATION: CONVENTION CENTER,
GRAND BALLROOM 220B
THU 3:40 PM TO 5:40 PM**

Optical Metrology and Late News

Session Chairs: **Ofer Adan,** Applied Materials Israel, Ltd. (Israel); **Vladimir A. Ukraintsev,** Qorvo (USA)

3:40 pm: **Effect of aperture stop location, illumination wavelength, and objective design for improved illumination in optical microscopes**, Ravi Kiran Attota, Emil Agocs, National Institute of Standards and Technology (USA) . . . .[10959-66]

4:00 pm: **Influence of sidewall perturbations of CD-SEM line roughness metrology**, Benjamin D. Bunday, aBeam Technologies, Inc. (USA); Chris A. Mack, Lithiguru.com (USA) . . . .[10959-67]

4:20 pm: **Spectroscopic reflectometry in the EUV for critical dimension metrology**, Lukas Bahrenberg, Serhiy Danylyuk, Moein Ghafoori, RWTH Aachen Univ. (Germany); Robert Michels, Fraunhofer-Institut für Lasertechnik (Germany); Sven Glabisch, Sascha Brose, RWTH Aachen Univ. (Germany); Jochen Stollenwerk, Peter Loosen, Fraunhofer-Institut für Lasertechnik (Germany) . . . .[10959-68]

4:40 pm: **Visualization of 3D structure of semiconductor device by Dig and See using GFIS-SIM**, Shinichi Matsubara, Hitachi, Ltd. (Japan). . . . .[10959-69]

5:00 pm: **Deep learning nanometrology of line edge roughness**, Vassilios Constantoudis, Institute of Nanoscience and Nanotechnology (Greece) and Nanometrisis p.c. (Greece); George Papavieros, Institute of Nanoscience and Nanotechnology (Greece) and Nanometrisis p.c. (Greece) and Univ. of Thessaloniki (Greece); Eva Giannatou, Harris Papagrorgiou, Institute for Language and Speech Processing (Greece); Gian Francesco Lorusso, Vito Rutigliani, Frieda van Roey, IMEC (Belgium); Evangelos Gogolides, Institute of Nanoscience and Nanotechnology (Greece) and Nanometrisis p.c. (Greece). . . . .[10959-109]

5:20 pm: **Novel method to achieve CD modeling in the presence of higher diffraction orders**, Liequan Lee, Shankar Krishnan, KLA-Tencor Corp. (USA); Chi-Fu Yen, Shyh-Shii Pai, Taiwan Semiconductor Manufacturing Co. Ltd. (Taiwan); Chu-Han Chiu, KLA-Tencor Taiwan (Taiwan). . . . .[10959-110]

Conference End.

INDEX OF AUTHORS, CHAIRS AND COMMITTEE MEMBERS
Bold = SPIE Member

A

Aarts, Igor [10961-18] S5
Abdulghany, Ahmed [10962-15] S4
Abe, Tamotsu [10957-61] SPS1
Abeln, Brandon [10960-68] SPS3
Abramenko, Dimitri [10957-40] S12
Adam, Kostas [10961-12] S4, [10962-14] S3
Adams, Daniel E. [10959-15] S4
Adan, Ofer 10959 Conference CoChair, 10959 S1 Session Chair, 10959 S15 Session Chair, [10959-3] S2, SC1133
Adiga, Umesh P. S. [10959-17] S4, [10959-72] SPS1
Aerts, Silvia [10959-103] SPS1
Agocs, Emil [10959-66] S15
Ahn, Jin-ho [10957-34] S10, SC888
Aitken, Robert 10962 Program Committee
Alexeev, Arseny [10958-31] S11
Ali, Rehab Kotb [10962-30] SPS1
Alian, Alireza [10963-4] S2
Alibart, Fabien [10963-20] S6
Alkoken, Ran [10959-99] SPS1
Allen, Robert D. 10960 Program Committee, 10960 S10 Session Chair
Allgair, John A. 10959 Program Committee, 10959 S12 Session Chair, 10962 S5 Session Chair
Allouti, Nacima [10958-8] S3, [10962-16] S4
Almusafir, Rahman [10960-68] SPS3
Altamirano-Sánchez, Efrain 10963 Program Committee, 10963 S1 Session Chair, [10963-25] S7
Amblard, Gilles R. 10960 Program Committee, 10960 S11 Session Chair
Ambrogio, Stefano [10958-29] S10
Amit, Eran [10959-48] S11
Anantha, Vidyasagar [10959-65] S14
Anderson, Christopher Neil [10957-4] S2, [10957-67] SPS1
Ando, Satoshi [10959-7] S2
Aoyama, Kenji [10959-88] SPS1
Aqad, Emad [10960-17] S5
Arce, Gonzalo R. [10961-24] SPS1
Arceo de la peña, Abraham [10959-9] S3
Arellano, Noel [10960-24] S7, [10960-3] S2, [10960-3] S3
Argoud, Maxime [10960-51] SPS1

Arisawa, You [10957-64] SPS1, [10960-45] S12, [10960-54] SPS1
Arjavac, Jason [10959-72] SPS1
Arps, Jennifer [10957-47] SPS1
Asai, Masaya [10957-64] SPS1, [10960-45] S12, [10960-54] SPS1
Asano, Masafumi 10959 Program Committee, 10959 S14 Session Chair
Asano, Yusuke [10960-27] S7, [10960-49] SPS1
Asayama, Takeshi [10961-33] SPS1
Astakhov, Dmitry [10957-63] SPS1
Attota, Ravi Kiran [10959-66] S15
Avakrat, Aner [10959-62] S14
Avedisian, Brett [10959-17] S4
Ayothi, Ramakrishnan 10960 Program Committee, 10960 S12 Session Chair

B

Babalik, Ayhan [10957-52] SPS1
Babuschkin, Anja [10957-52] SPS1
Baderot, Julien [10960-34] S9, [10963-11] S3
Bae, Dajeong [10960-32] S9
Bahrenberg, Lukas [10957-51] SPS1, [10959-68] S15
Bai, Keun Hee 10963 Program Committee, 10963 S1 Session Chair
Bailey, Andrew [10963-2] S1
Bailey, Todd [10957-35] S10
Baillin, Xavier [10958-35] S12
Bakshi, Janam [10962-15] S4
Bakshi, Vivek SC888
Bannister, Julie 10963 Program Committee, 10963 S7 Session Chair
Barboutis, Annett [10957-52] SPS1
Barla, Kathy [10959-11] S3, [10959-46] S10
Barnes, Bryan M. [10959-33] S8
Barouch, Eytan [10957-45] S13, [10957-45] S6
Basu, Atashi [10963-2] S1
Bates, Christopher [10960-25] S7
Baudot, Sylvain [10960-22] S6
Bavarian, Mona [10960-68] SPS3
Bayana, Hareen [10960-70] SPS3
Bekaert, Joost [10957-13] S5
Bellah, Md. Motasim [10959-77] SPS1
Belmonte, Guilherme K. [10957-55] SPS1

BenDavid, Nir [10959-77] SPS1
Bender, Markus [10957-16] S6, [10957-37] S11
Benk, Markus P. [10957-28] S9
Benotmane, Khatia [10960-57] SPS1
Benschop, Jos P. 10957 Program Committee, 10957 S2 Session Chair
Bent, Stacey F. [10960-23] S7
Beral, Christophe [10959-65] S14, [10963-19] S5, [10963-19] S8
Bérard-Bergery, Sébastien [10959-32] S7, [10962-16] S4
Bernadac, Arthur [10960-51] SPS1
Bernard, Guilhem [10960-34] S9, [10963-11] S3
Bernasconi, Johana [10958-48] SPS1
Besacier, Maxime [10959-28] S7, [10959-32] S7
Bevis, Charles S. [10959-15] S4, [10959-30] S7
Beylier, Charlotte [10959-56] S13, [10962-16] S4
Beyne, Eric [10962-4] S1
Bhattacharyya, Kaustuve [10959-1] S1, [10961-18] S5, [10961-7] S3
Biafore, John J. [10957-15] S5
Biedrzycki, Mark [10959-17] S4
Biermanns-Foeth, Andreas [10957-31] S9, [10957-47] SPS1
Biesemans, Serge [10957-56] SPS1, [10960-9] S4
Biolsi, Peter [10963-18] S5, [10963-18] S8, [10963-21] S6, [10963-27] S7
Birnstein, Norman [10959-49] S11, [10959-95] SPS1
Bizen, Daisuke [10959-47] S10
Blachut, Gregory [10960-27] S7, [10960-28] S7, [10960-28] S8, [10960-49] SPS1
Blackwell, Don [10962-15] S4
Blanc, Romuald [10963-19] S5, [10963-19] S8
Blanco Carballo, Victor M. [10957-23] S7, [10960-20] S6, [10963-19] S5, [10963-19] S8
Blancquaert, Yoann [10959-28] S7
Blankenship, David [10957-15] S5
Böcker, Paul [10961-8] S3
Boemmels, Juergen [10963-21] S6
Bohn, Martin [10962-23] S13, [10962-23] S6
Bonafede, James F. [10961-17] S5
Bonam, Ravi K. [10957-17] S6, [10959-34] S8
Bonnecaze, Roger T. [10963-29] S8, [10963-8] S3

Bornebroek, Frank [10957-3] S2
Bottiglieri, Gerardo [10957-32] S10, [10957-5] S2
Boullart, Werner [10959-11] S3, [10959-46] S10
Bouret, Jean-Claude [10958-32] S11
Bouyssou, Regis [10959-56] S13
Bowden, Murrae J. SC101
Bowen, James [10960-46] S12
Braam, Kyle [10962-24] S13, [10962-24] S6
Braggin, Jennifer [10960-42] S11
Brainard, Robert L. 10957 Program Committee, 10957 S3 Session Chair, 10960 S2 Session Chair, [10960-1] S1, [10960-35] S10, [10960-6] S3, [10960-6] S4, [10960-61] SPS2
Brakensiek, Nickolas L. [10960-68] SPS3
Brandt, Pieter [10958-17] S6
Breton, Mary A. [10959-9] S3
Brinkhof, Ralph [10961-18] S5
Brodie, Alan D. 10958 Program Committee, 10958 S3 Session Chair
Brooker, Peter D. [10961-14] S4, [10962-13] S3
Brose, Sascha [10957-51] SPS1, [10959-68] S15
Brouri, Mohand [10963-12] S4
Brown, Alan G. [10960-46] S12
Buchholz, Christian [10957-52] SPS1
Buchroithner, Boris [10961-34] SPS1
Buhl, Stefan [10959-100] SPS1, [10959-78] SPS1, [10959-86] SPS1
Bunday, Benjamin D. 10959 Program Committee, 10959 S8 Session Chair, 10959 S9 Session Chair, [10959-67] S15
Burbine, Andrew [10962-10] S2, [10962-14] S3
Burger, Sven [10959-35] S8
Burkhardt, Martin 10957 Program Committee, 10957 S6 Session Chair, [10957-33] S10
Burns, Ryan L. [10960-25] S7
Bushida, Satoru [10961-19] S5, [10961-33] SPS1
Buxbaum, Alex [10959-80] SPS1
Byun, Jin-Moo [10959-93] SPS1

C

Cabrini, Stefano [10958-4] S2
Cai, Jia-Syun [10958-46] SPS1, [10961-6] S2, [10962-17] S4

Caillat, Amandine [10958-32] S11
Cain, Jason P. 10959 Program Committee, 10962 Conference Chair, 10962 S1 Session Chair, [10962-8] S2
Callahan, Ryan 10960 Program Committee, 10960 S6 Session Chair
Cameron, James F. [10960-38] S11, [10960-44] S12
Canga, Eren [10959-91] SPS1
Cantrell, Rusty [10957-16] S6
Cao, Yi [10960-39] S11
Capelli, Renzo [10957-66] S9
Capodieci, Luigi 10962 Program Committee, 10962 S3 Session Chair, [10962-6] S2
Capogreco, Elena [10963-4] S2
Caporale, Stefan J. [10960-72] SPS4
Carbery, Marcus [10963-2] S1, [10963-7] S3
Carcasi, Michael A. [10957-56] SPS1, [10960-9] S4
Castellanos Ortega, Sonia 10957 Program Committee, 10957 S5 Session Chair, [10957-7] S2, [10957-7] S3, [10957-9] S2, [10957-9] S3
Catano, Christopher [10963-13] S4
Cayrefourcq, Ian [10958-21] S7, [10958-21] S8, [10958-41] SPS1, [10960-34] S9
Cendron, Suelen W. [10957-55] SPS1
Cepler, Aron J. [10959-9] S3
Cerbu, Dorin [10959-40] S9
Cerio, Frank [10957-20] S6
Chagoya-Garzon, Alexandre [10959-56] S13
Chalupa, Zdenek [10960-51] SPS1
Chang, Lifu 10962 Program Committee
Chang, Shihsheng [10963-25] S7
Chang, Wei-Chun [10961-9] S3
Chang, Yi-Hsin [10959-108] SPS1
Chang, Yi-Shiang [10960-21] S6
Chang, Yu-Cheng [10960-21] S6
Chao, TzuChi [10961-27] SPS1
Chao, Weilun [10957-28] S9
Charley, Anne-Laure [10957-25] S5, [10957-25] S8, [10959-14] S4, [10959-57] S13, [10959-58] S13, [10963-19] S5, [10963-19] S8
Chava, Bharani [10962-4] S1
Chen, Aiden [10959-61] S14
Chen, Ao [10961-13] S4
Chen, Charlie [10959-101] SPS1
Chen, Chun-Wei [10962-21] S12, [10962-21] S5

INDEX OF AUTHORS, CHAIRS AND COMMITTEE MEMBERS

Bold = SPIE Member

Chen, Gaolong [10959-95] SPS1
Chen, Guojie [10962-20] S12, [10962-20] S5
Chen, Hong [10961-10] S3
Chen, Jingsong [10962-9] S2
Chen, Jun [10961-13] S4
Chen, Lawrence [10960-44] S12
Chen, Owen [10963-7] S3
Chen, Pai Chi [10962-34] SPS1
Chen, Shr-Jia [10960-21] S6
Chen, Suwei [10963-7] S3
Chen, Xi [10961-13] S4
Chen, Xiaomei [10959-81] SPS1
Chen, Xiaomeng 10959 Program Committee, 10959 S14 Session Chair
Chen, Xuemei 10957 Program Committee
Chen, Ying [10962-32] SPS1
Cheng, Guojie [10962-42] SPS1
Cheng, Joy Y. 10960 Program Committee, 10960 S9 Session Chair
Cheng, Shoumian [10961-21] SPS1
Cheng, Wei [10957-30] SPS1
Cheng, Yung-Feng [10962-34] SPS1
Cheng, Zhaohui [10959-41] S9, [10959-70] SPS1
Cherala, Anshuman [10958-11] S4
Chevalier, Xavier [10958-21] S7, [10958-21] S8, [10958-41] SPS1, [10960-34] S9, [10960-51] SPS1
Chew, Soon Aik [10963-25] S7
Chi, Cheng [10958-22] S7, [10958-22] S8
Chiang, Charles [10962-9] S2
Chien, Sheng-Wei [10958-46] SPS1, [10961-6] S2, [10962-17] S4
Chiu, Afu [10959-84] SPS1, [10959-96] SPS1
Chiu, Chu-Han [10959-110] S15
Cho, Maenghyo [10960-7] S3, [10960-7] S4
Cho, Yong-Tae [10963-7] S3
Choe, Jeongdong Plenary
Choi, Ahlin [10959-48] S11
Choi, Byoung-il [10959-37] S8
Choi, Byung Jin [10958-11] S4
Choi, DongSub [10959-48] S11
Choi, Min Ki [10957-34] S10
Choi, Jong-Cheol [10961-8] S3
Choi, Soo Han [10962-22] S13, [10962-22] S6
Choi, Sungho [10960-48] S12
Choi, Yohan [10957-17] S6, [10962-34] SPS1

Chopra, Meghali J. [10963-29] S8, [10963-8] S3
Chou, Kevin [10959-61] S14
Chou, Kuoyao [10959-84] SPS1, [10962-21] S12, [10962-21] S5
Chu, Hsiao Lun [10959-96] SPS1
Chung, Hua [10960-78] SPS5
Church, Jennifer W. [10957-24] SPS1
Civay, Deniz Elizabeth 10957 Program Committee
Clarke, James [10959-17] S4
Cloin, Christian [10957-27] S9
Cohen, Avi [10959-91] SPS1
Coley, Suzanne M. [10960-44] S12
Collaert, Nadine [10963-4] S2
Conley, Will Symposium Chair, 10961 Program Committee, [10961-17] S5
Connelly, Daniel [10958-50] SPS1
Connolly, Bríd M. [10957-37] S11
Constantoudis, Vassilios [10958-56] SPS1, [10959-109] S15, [10959-111] SPS1, [10959-112] SPS1
Cordeau, Maryline [10962-16] S4
Cordova, Isvar A. [10959-18] S5, [10959-25] S6
Cork, Carl W. [10957-67] SPS1
Corliss, Daniel A. 10957 Program Committee, [10957-17] S6, [10958-20] S7, [10958-20] S8, [10958-22] S7, [10958-22] S8, [10958-6] S3
Cousin, Seth L [10959-15] S4
Cramer, Hugo 10959 Program Committee, 10959 S11 Session Chair, 10959 S5 Session Chair, SC1100
Cramer, Jillian [10959-11] S3
Crimmins, Timothy F. 10959 Program Committee, 10959 S4 Session Chair, 10959 S7 Session Chair
Cromwijk, Jan Willem Plenary
Cross, Andrew J. [10959-65] S14
Crotti, Davide [10957-22] S7
Cui, Li [10960-44] S12
Cupak, Miroslav [10962-1] S1
Custers, Rolf [10957-6] S2
Cutler, Charlotte A. [10960-17] S5

D

Dado, Glenn [10960-68] SPS3
Dai, Junyan [10960-56] SPS1
Dai, Vito [10962-6] S2
Dall'Asta, Valentina [10962-38] SPS1
Dammel, Ralph R. 10960 Program Committee, 10960 S7 Session Chair, SC101, SC616
Dandamudi, Chola Bhargava [10960-71] SPS4
Dang, Luong Nguyen [10960-10] S4
Danylyuk, Serhiy [10957-51] SPS1, [10959-68] S15
Darnon, Maxime 10963 Program Committee, 10963 S6 Session Chair
Das, Sayantan [10959-14] S4, [10959-16] S4
Dawson, Guy [10960-46] S12
De Bisschop, Peter [10957-10] S3, [10957-10] S4, [10957-14] S5, [10957-56] SPS1
De Boer, Guido [10958-17] S6
De Jaeger, Brice [10963-4] S2
de Kruif, Robert C. [10957-37] S11
de Pablo, Juan J. 10958 Program Committee
De Poortere, Etienne [10957-23] S7, [10959-64] S14
De Roest, David [10957-23] S7
de Rooij-Lohmann, Veronique [10957-36] S11
de Ruiter, Chris [10961-18] S5
de Schepper, Peter [10960-41] S11
De Silva, Anuja [10957-11] S3, [10957-11] S4, [10958-38] SPS1, 10960 Program Committee, 10960 S4 Session Chair, [10960-24] S7, [10960-65] SPS2
De Simone, Danilo [10957-14] S5, [10957-21] S7, [10957-22] S7, [10957-23] S7, [10957-25] S5, [10957-25] S8, [10957-56] SPS1, 10960 Program Committee, 10960 S4 Session Chair, [10960-9] S4, [10963-19] S5, [10963-19] S8
de Villafranca, Glen [10960-79] SPS5
de Wit, Ruud [10963-7] S3
Debacker, Peter [10962-1] S1, [10962-4] S1
De-Caunes, Jean [10959-60] S13
Deckers, David [10963-7] S3
Decoster, Stefan [10959-24] S6, [10960-20] S6
Dei, Satoshi [10960-77] SPS5
Delachat, Florian [10958-41] SPS1, [10958-42] SPS1, [10958-45] SPS1

Demand, Marc [10957-57] SPS1, [10963-25] S7
Demmerle, Wolfgang [10959-55] S12, [10959-55] S5, [10962-23] S13, [10962-23] S6
Demuynck, Steven [10960-22] S6, [10963-25] S7
Denbeaux, Gregory H. [10960-35] S10, [10960-6] S3, [10960-6] S4
Deng, Shaoren [10959-57] S13, [10959-58] S13
Derville, Alexandre [10960-34] S9, [10963-11] S3
DeSisto, Jason [10960-17] S5
Devasahayam, Adrian J. [10957-20] S6
Devlin, Robert C. [10963-23] S6
Devriendt, Katia [10963-4] S2
Dezauzier, Christophe [10959-56] S13
Dhuey, Scott D. [10959-18] S5
Dickenson, Michael [10957-67] SPS1
Diebold, Alain C. [10959-31] S7
Dietzel, Martin [10957-66] S9
Digaum, Jennefir L. [10962-19] S4
Dillen, Harm [10959-104] SPS1, [10959-108] SPS1, [10959-54] S12, [10959-54] S5
Diller, Timothy [10959-94] SPS1
Dinh, Cong Que [10957-56] SPS1, [10960-9] S4
DiPaola, Domenico A. [10958-22] S7, [10958-22] S8
Dmitriev, Vladimir [10959-91] SPS1
Dohi, Hideto [10959-41] S9, [10959-70] SPS1
Doi, Ayumi [10959-43] S10
Doise, Jan [10960-28] S7, [10960-28] S8, [10960-33] S9
Domnenko, Vitaly [10962-23] S13, [10962-23] S6
Dong, Lisong [10959-105] SPS1, [10962-32] SPS1, [10962-37] SPS1
Dou, Shuyang [10959-87] SPS1
Drissi, Youssef [10962-30] SPS1
Dror, Chen [10959-77] SPS1
Du, Chunshan [10962-35] SPS1, [10962-36] SPS1, [10962-37] SPS1, [10962-39] SPS1, [10962-40] SPS1
Du, Zhidong [10958-54] SPS1
Ducoté, Julien [10959-56] S13
Dunn, Derren N. [10957-17] S6
Durand, William J. [10960-49] SPS1
Dusa, Mircea V. [10963-1] S1, SC885
Duvdevani-Bar, Sharon [10959-99] SPS1

E

Ebert, Martin [10959-61] S14
Ebizuka, Yasushi [10959-26] S6
Echigo, Masatoshi [10960-76] SPS5
Eichfeld, Chad [10958-52] SPS1, [10958-53] SPS1, [10963-30] S8
Ekinci, Yasin 10957 Program Committee, [10957-29] S9, [10957-6] S2, [10960-10] S4, [10960-11] S4
Eleouet, Raphael [10962-16] S4
ElGhoroury, Ahmed [10962-41] SPS1
Eller, Michael J. [10959-22] S5, [10960-15] S5
Ellison, Christopher J. [10960-27] S7, [10960-28] S7, [10960-28] S8, [10960-33] S9, [10960-49] SPS1
Ellwi, Samir [10957-40] S12
ElManhawy, Wael [10962-41] SPS1
Engelmann, Hans-Juergen [10960-57] SPS1
Engelmann, Sebastian U. 10963 Program Committee
Engler, Anthony [10960-71] SPS4
Enomoto, Masashi [10957-57] SPS1, [10959-94] SPS1, [10960-60] SPS2
Enomoto, Satoshi [10960-12] S4
Ercken, Monique [10957-22] S7
Erdmann, Andreas 10957 Program Committee, 10957 S10 Session Chair, [10957-32] S10
Erley, Georg [10959-100] SPS1, [10959-101] SPS1, [10959-49] S11, [10959-59] S13, [10959-78] SPS1, [10959-84] SPS1, [10959-86] SPS1, [10959-95] SPS1, [10959-96] SPS1
Ervin, Joseph [10960-22] S6, [10963-26] S7
Esashi, Yuka [10959-15] S4, [10959-30] S7
Essomba, Philippe [10958-42] SPS1
Eto, Shigeru [10961-20] S5
Evanschitzky, Peter [10957-32] S10

F

Fakhry, Moutaz [10962-8] S2
Fallica, Roberto [10960-8] S3, [10960-8] S4
Falugh, Matthew [10963-21] S6
Fan, Shuhai [10961-13] S4
Fang, Wei [10959-104] SPS1, [10959-71] SPS1
Farrar, David [10957-37] S11

THIS PROGRAM IS CURRENT AS OF 7 JANUARY 2019. Find the latest on the **SPIE CONFERENCE APP**.

51

INDEX OF AUTHORS, CHAIRS AND COMMITTEE MEMBERS

Bold = SPIE Member

Farrell, Richard A. 10958 Program Committee, 10958 S9 Session Chair, [10958-20] S7, [10958-20] S8

Fei, Ruochong [10959-54] S12, [10959-54] S5

Felix, Nelson M. 10957 Conference CoChair, 10957 S1 Session Chair, [10957-11] S3, [10957-11] S4, [10957-17] S6, [10957-50] SPS1, [10958-20] S7, [10958-20] S8, [10958-22] S7, [10958-22] S8, [10958-6] S3, [10960-65] SPS2

Felts, Jonathan R. [10958-25] S8

Feng, Mu [10959-37] S8, [10961-13] S4, [10961-5] S2

Feng, Yaobin [10961-17] S5

Feng, Ye [10963-2] S1

Fenger, Germain L. [10961-12] S4, [10961-4] S2, [10962-10] S2, [10962-14] S3, [10962-30] SPS1

Fernandez, Sara [10957-29] S9

Fillinger, Laurent [10959-20] S5

Finders, Jo [10957-3] S2, [10957-37] S11

Fine Nathel, Noah Frederick [10960-24] S7

Finken, Michael [10957-16] S6

Fischer, Andreas [10957-52] SPS1

Fleming, Brian T. [10958-32] S11

Fliervoet, Timon F. [10957-32] S10, [10957-5] S2

Foca, Eugen [10959-80] SPS1

Foltynski, Bartosz [10959-93] SPS1

Fomenkov, Igor V. [10957-42] S12

Fonseca, Carlos 10961 Program Committee

Foong, Yee Mei [10961-13] S4

Foubert, Philippe [10957-56] SPS1, [10957-57] SPS1, [10960-9] S4, [10963-19] S5, [10963-19] S8

Foucher, Johann [10960-34] S9, [10963-11] S3

Fourkas, John T. [10958-39] SPS1

France, Kevin C. [10958-32] S11

Francisco, Luis [10962-29] S7

Franzon, Paul D. [10962-11] S3

Freitag, Martin [10959-101] SPS1

Freychet, Guillaume [10959-18] S5, [10959-25] S6

Fried, David M. [10963-17] S5, [10963-17] S8, [10963-2] S1

Friz, Alexander M. [10960-24] S7, [10960-3] S2, [10960-3] S3

Frommhold, Andreas [10957-13] S5, [10957-19] S6

Führer, Tim [10957-19] S6

Fujimaki, Yousuke [10961-33] SPS1

Fujimura, Aki [10961-36] S1

Fukuda, Hiroshi [10957-12] S5

Fukuto, Masafumi [10959-8] S3

G

Gabor, Allen H. 10957 Program Committee, 10957 S12 Session Chair

Gädda, Thomas [10960-10] S4

Gai, Tianyang [10962-32] SPS1

Gaines, Geoffrey A. [10957-67] SPS1

Gaire, Churamani [10959-21] S5

Gallagher, Emily E. 10957 Program Committee, 10957 S9 Session Chair, [10957-19] S6

Gamsby, Jeffrey F. [10957-67] SPS1

Ganjugunte, Shashidhara K. [10962-14] S3

Gao, Kun [10959-5] S2, [10959-77] SPS1

Gao, Lisheng [10963-2] S1

Gao, Pengzheng [10961-23] SPS1, [10962-32] SPS1

Gao, Xindong [10959-77] SPS1

Gaudiello, John [10959-9] S3

Geh, Bernd [10957-1] S1, 10961 Program Committee, 10961 S5 Session Chair

Gennari, Frank E. [10962-27] S7, [10962-3] S1, [10962-8] S2

Ger, Avron [10959-14] S4, [10959-9] S3

Gergaud, Patrice [10959-28] S7

Gerrity, Michael [10959-15] S4

Gershtein, Liraz [10959-99] SPS1

Gey, Guillaume [10960-34] S9, [10963-11] S3

Ghafoori, Moein [10959-68] S15

Gharbi, Ahmed [10958-21] S7, [10958-21] S8, [10960-51] SPS1, [10960-57] SPS1

Ghulghazaryan, Ruben Gurgen [10962-35] SPS1, [10962-36] SPS1

Giannatou, Eva [10959-109] S15

Giannelis, Emmanuel P. [10960-62] SPS2, [10963-5] S2

Gil, Dario Plenary

Gildehaus, Levi [10960-68] SPS3

Gillijns, Werner [10962-30] SPS1

Gilman, Jeffrey W. [10960-16] S5

Gjoka, Alketa [10960-67] SPS3, [10960-69] SPS3

Glabisch, Sven [10959-68] S15

Glushkov, Denis [10957-40] S12

Goel, Vinay [10960-42] S11

Gogolides, Evangelos [10958-56] SPS1, [10959-109] S15, [10959-111] SPS1, [10959-112] SPS1

Goldberg, Kenneth A. 10957 Conference Chair, 10957 S1 Session Chair, [10957-28] S9

Goldfarb, Dario L. [10957-11] S3, [10957-11] S4, [10960-65] SPS2

Golotsvan, Anna [10959-48] S11

Gonda, Satoshi [10959-82] SPS1

Gonsalves, Kenneth Emmanuel [10957-55] SPS1

Goosen, Maikel [10959-104] SPS1

Gorhad, Kujan [10959-91] SPS1

Gothan, Steffen [10959-100] SPS1

Goto, Yasunori [10959-39] S9

Gottipati, Abhishek [10959-77] SPS1

Gottscho, Richard A. [10963-2] S1

Gourgon, Cécile [10959-32] S7

Graeupner, Paul [10957-3] S2, [10957-5] S2

Graff, John W. [10963-23] S6

Granik, Yuri 10961 Program Committee, [10961-11] S4, [10961-12] S4, [10961-2] S1

Graves, Trey [10957-15] S5

Green, Michael [10957-17] S6, [10962-34] SPS1

Greene, Daniel [10960-44] S12

Grenville, Andrew [10960-41] S11

Grierson, Connor [10958-40] SPS1

Grise, Fabien [10958-32] S11, [10958-52] SPS1, [10958-53] SPS1, [10963-30] S8

Groeger, Philip [10959-59] S13, [10959-78] SPS1, [10959-86] SPS1

Gronheid, Roel [10959-4] S2, 10960 Conference Chair, 10960 S1 Session Chair

Gronlund, Keith D. [10961-13] S4

Grouwstra, Cedric [10959-93] SPS1

Grunes, Harsha 10961 Program Committee, 10961 S2 Session Chair

Grzela, Grzegorz [10959-93] SPS1

Grzeskowiak, Steven [10960-6] S3, [10960-6] S4

Gstrein, Florian 10957 Program Committee, 10957 S4 Session Chair, 10960 S3 Session Chair

Guajardo, Marco [10962-13] S3

Guan, Tiapeng [10962-20] S12, [10962-20] S5

Guerrero, Douglas J. 10960 Program Committee, 10960 S5 Session Chair

Guerrero, James [10961-13] S4

Guhlemann, Steffen [10959-86] SPS1

Guissi, Sofiane [10962-4] S1

Guo, Jing [10958-20] S7, [10958-20] S8, [10958-22] S7, [10958-22] S8, [10960-65] SPS2

Guo, Longxia [10961-17] S5

Guo, Moran [10961-17] S5

Guo, Wei [10957-35] S10

Gupta, Mohit [10962-2] S1

Gutierrez Razo, Sandra A. [10958-39] SPS1

Gutjahr, Karsten [10959-77] SPS1

H

Ha, Hyeon-Jun [10959-93] SPS1

Habets, Boris [10959-100] SPS1, [10959-101] SPS1, [10959-49] S11, [10959-59] S13, [10959-78] SPS1, [10959-95] SPS1, [10959-96] SPS1

Hagen, Cornelis W. [10959-29] S7

Hagger, Jack [10959-72] SPS1

Hakala, Chris [10959-46] S10

Halder, Sandip [10957-22] S7, [10959-14] S4, [10959-16] S4, [10959-40] S9, [10959-65] S14, [10963-19] S5, [10963-19] S8

Ham, Young Mog [10957-17] S6, [10962-34] SPS1

Hamaguchi, Akira [10959-45] S10

Hamed Fatehy, Ahmed [10962-30] SPS1

Hammerschmidt, Martin [10959-35] S8

Han, Minsub Hank [10961-8] S3

Han, Sangjun [10959-48] S11, [10959-6] S2

Han, Woojun [10959-89] SPS1

Hanabata, Makoto [10958-43] SPS1

Hao, Xueli [10959-77] SPS1

Hara, Arisa [10957-13] S5, [10960-19] S6, [10960-58] SPS2

Harumoto, Masahiko [10957-64] SPS1, [10958-22] S7, [10958-22] S8, [10960-45] S12, [10960-54] SPS1, [10960-57] SPS1

Hasan, Shaheen [10960-35] S10, [10960-61] SPS2

Hasibi, Faegheh [10959-51] S11

Hassanein, Ahmed [10957-43] S12

Hastings, Simon [10959-64] S14

Hatano, Masayuki [10958-16] S5

Hattori, Masakazu [10961-35] SPS1

Hawker, Craig J. [10960-25] S7

Hayashi, Hideyuki [10957-61] SPS1

Hayashi, Naoya 10957 Program Committee, 10957 S11 Session Chair, 10958 Program Committee, 10958 S8 Session Chair, [10958-14] S5

Hayashi, Shingo [10959-41] S9, [10959-70] SPS1

Hazart, Jérôme [10959-32] S7, [10962-16] S4

He, Guanchen [10961-13] S4

He, Jun [10961-17] S5

He, Xiaobin [10960-56] SPS1

Heinig, Karl-Heinz [10960-57] SPS1

Heitsch, Andrew T. [10960-26] S7

Helfenstein, Patrick [10957-29] S9

Hellweg, Dirk [10957-66] S9

Helpert, Sofia [10963-8] S3

Henderson, Clifford L. 10960 Program Committee

Hendrickx, Eric 10957 Program Committee, 10957 S10 Session Chair, [10957-13] S5, [10957-23] S7

Henn, Mark-Alexander [10959-33] S8

Henry, Jean-Baptiste [10962-16] S4

Heo, Yumi [10960-48] S12

Hermans, Jan V. [10959-52] S11

Herrera, Pedro P. [10959-77] SPS1

Herrmann, Thomas [10962-15] S4

Herzel, Eitan [10959-48] S11

Herzig, Hans Peter [10958-48] SPS1

Hess, Alexander [10960-65] SPS2

Hetzer, David R. [10957-50] SPS1, [10958-20] S7, [10958-20] S8

Hexemer, Alexander [10959-18] S5, [10959-25] S6

Hibino, Daisuke [10959-98] SPS1

Higashibata, Satomi [10959-4] S2

Higashiki, Tatsuhiko 10958 Program Committee, 10958 S5 Session Chair, [10958-9] S4

Higgins, Craig D. 10960 Program Committee

Hiltunen, Ronald P. [10961-20] S5

Hirai, Akiko [10959-82] SPS1

Hirayama, Taku [10960-39] S11

Hirose, Kotoko [10959-41] S9, [10959-70] SPS1

Hirota, Kosa [10963-9] S3

Hisamatsu, Toru [10963-10] S3

Hiura, Mitsuru [10958-11] S4

Hockey, Mary Ann J. [10958-37] S12

Hody, Hubert [10957-22] S7

Hoefnagels, Rik [10957-6] S2

Höer, Tobias [10959-100] SPS1

Hoffmann, Martin [10958-44] SPS1

Hofmann, Detlef [10959-78] SPS1

INDEX OF AUTHORS, CHAIRS AND COMMITTEE MEMBERS

Bold = SPIE Member

Hohle, Christoph K. 10960 Program Committee, 10960 S11 Session Chair
Holburg, Jonathan [10957-48] SPS1
Holsteyns, Frank [10963-21] S6
Holt, Judson [10959-21] S5
Holz, Mathias [10959-79] SPS1
Honda, Masanobu [10963-10] S3
Hong, Minhyung [10959-48] S11
Hooker, Kevin [10962-13] S3
Hopf, Toby [10963-25] S7, [10963-4] S2
Hoppe, Wolfgang [10962-23] S13, [10962-23] S6, [10962-24] S13, [10962-24] S6
Hori, Tsukasa [10957-61] SPS1
Horiguchi, Naoto [10963-4] S2
Horiuchi, Junya [10960-76] SPS5
Hosler, Erik R. 10958 Program Committee, 10958 S8 Session Chair
Hou, Xisen [10959-22] S5, [10960-15] S5, [10960-17] S5
Hsieh, Simon [10961-17] S5
Hsu, Chih-Yu [10963-22] S6
Hsu, Hsiao Lin [10959-84] SPS1, [10959-96] SPS1
Hsu, Stephen D. [10957-5] S2, [10961-17] S5, SC885
Hu, Hongmei [10961-5] S2
Hu, Jiangtao [10963-2] S1
Hu, Kwang-Young [10959-93] SPS1
Hu, Sophia [10961-32] SPS1, [10961-35] SPS1
Hu, Xinyi [10962-35] SPS1, [10962-36] SPS1, [10962-39] SPS1, [10962-40] SPS1
Hu, Xuerang [10959-61] S14
Hua, Wei [10962-20] S12, [10962-20] S5
Huang, Chain-Ting [10962-34] SPS1
Huang, Foster [10959-96] SPS1
Huang, Huai [10959-9] S3
Huang, Jiun-Woei [10961-28] SPS1
Huang, Shang-Chieh [10959-12] S3
Hubbard, Alex [10957-50] SPS1
Huda, Rais [10962-15] S4
Hudson, Eric A. 10963 Program Committee, 10963 S2 Session Chair
Huffman, Craig [10963-12] S4
Huisman, Simon [10961-18] S5
Huisman, Thomas J. [10959-104] SPS1
Huli, Lior [10957-50] SPS1
Hung, Joey [10959-14] S4, [10959-57] S13
Hunsche, Stefan [10959-44] S10
Hurat, Philippe [10962-3] S1

Hurd, Trace Q. [10963-21] S6
Hwang, Harlan [10959-84] SPS1
Hwang, Jae-Hee [10959-54] S12, [10959-54] S5
Hwang, Jong-hyun [10959-93] SPS1

I

Ichimura, Koji [10958-14] S5
Ida, Chihiro [10959-45] S10
Ide, Hiroyuki [10957-56] SPS1, [10960-9] S4
Ido, Yasuyuki [10958-20] S7, [10958-20] S8, [10960-31] S9
Iida, Susumu [10957-46] S13, [10957-46] S6, [10959-74] SPS1
Ikebe, Yohei [10957-37] S11
Ikeda, Junji [10961-20] S5
Ikezawa, Hironori [10961-20] S5
Ikota, Masami [10959-24] S6
Illiberi, Andrea [10959-57] S13, [10959-58] S13
Inoue, Soichi 10957 Program Committee, 10957 S13 Session Chair, 10962 S6 Session Chair
Ip, Vincent [10957-20] S6
Isbester, Paul K. [10959-21] S5
Ishikawa, Jun [10959-7] S2
Ishikawa, Masayoshi [10959-36] S8, [10959-87] SPS1
Islam, Moydul [10962-19] S4
Isono, Takuya [10960-50] SPS1
Itani, Toshiro [10957-8] S2, [10957-8] S3
Ito, Kiyohito [10960-60] SPS2
Ito, Natsuko [10960-27] S7, [10960-28] S7, [10960-28] S8
Itou, Takashi [10961-33] SPS1
Ivanov, Vladimir V. [10957-40] S12, [10957-63] SPS1
Izawa, Masayuki [10959-36] S8, [10959-87] SPS1

J

Jaber, Jad [10960-67] SPS3, [10960-69] SPS3
Jager, Remco J. A. [10958-17] S6
Jain, Vipul [10960-74] SPS4
Jamiolkowski, Michael [10963-2] S1
Janbakhan, Aliasghar Keyvani [10959-19] S5, [10959-85] SPS1
Janes, Dustin W. [10958-22] S7, [10958-22] S8
Jang, Wonjae [10959-93] SPS1

Jaroslawzew, Sina [10957-52] SPS1
Jayaram, Srividya [10957-35] S10
Jenkins, Nicholas W. [10959-15] S4
Jeon, Junsu [10962-3] S1
Jeon, Sanghuck [10959-48] S11
Jeon, Se-Ra [10959-93] SPS1
Jeong, Changyoung [10960-7] S3, [10960-7] S4
Jeong, Dongmin [10957-34] S10
Jeong, Ik-Hyun [10961-8] S3, [10963-7] S3
Jeong, Junhee [10959-92] SPS1
Jessen, Scott W. 10960 Program Committee, 10960 S10 Session Chair
Ji, Rongyi [10959-81] SPS1
Jia, Fei [10961-17] S5
Jiang, Fan [10957-35] S10
Jiang, Hao [10958-30] S10, [10961-30] SPS1
Jiang, Iris Hui-Ru [10961-9] S3
Jiang, Peng [10962-35] SPS1, [10962-36] SPS1
Johanesen, Hayley [10959-11] S3, [10959-46] S10
Johnsen, Peter [10959-15] S4, [10959-30] S7
Johnson, Richard C. [10958-22] S7, [10958-22] S8
Jones, Gideon [10957-67] SPS1
Joo, Ki-Nam [10959-76] SPS1
Joung, Tony [10959-77] SPS1
Jourdain, Anne [10962-4] S1
Jovinelli, Daniel J. [10958-39] SPS1
Ju, Jae-Wuk [10961-8] S3, [10963-7] S3
Jugessur, Aju S. [10958-40] SPS1
Jung, Sangwoo [10962-41] SPS1
Jung, Seok-Heon [10960-37] S10, [10963-5] S2
Jung, Sunwook [10961-4] S2
Jurczak, Gosia [10957-23] S7
Juschkin, Larissa [10957-51] SPS1

K

Kabeel, Aliaa [10962-41] SPS1
Kähkönen, Oskari [10960-10] S4
Kai, Ding [10959-49] S11, [10959-95] SPS1
Kaitz, Joshua A. [10960-17] S5, [10960-44] S12, [10960-74] SPS4
Kal, Subhadeep [10959-31] S7, [10963-21] S6
Kamberian, Henry H. [10957-17] S6

Kamei, Yuya [10957-56] SPS1, [10957-57] SPS1, [10960-9] S4
Kamo, Takashi [10957-46] S13, [10957-46] S6
Kanagala, Vijay [10962-15] S4
Kanakutsu, Yutaka [10961-20] S5
Kandel, Yudhishthir P. [10957-19] S6
Kaneko, Fumiya [10960-67] SPS3, [10960-69] SPS3
Kang, Daekwon [10959-37] S8
Kang, Jae-Hyun [10962-3] S1, [10962-41] SPS1
Kang, Jung-Hyun [10959-54] S12, [10959-54] S5
Kang, Lin [10958-55] SPS1
Kang, Xiaohui [10961-21] SPS1
Kang, Young Seog 10961 Program Committee, 10961 S3 Session Chair
Kanno, Koichi [10958-14] S5
Kapteyn, Henry C. [10959-15] S4, [10959-30] S7
Kar, Gouri Sankar [10957-22] S7
Karaste, Kimmo [10960-10] S4
Karl, Robert [10959-15] S4, [10959-30] S7
Karssemeijer, Leendertjan [10961-18] S5, [10961-8] S3
Karssenberg, Jaap [10959-6] S2
Kasai, Tatsuya [10960-77] SPS5
Kaschke, Johannes [10957-62] SPS1
Kasprowicz, Bryan S. 10957 Program Committee, 10957 S6 Session Chair, [10957-17] S6
Katakamsetty, Ushasree [10962-29] S7
Katsumata, Reika [10960-25] S7, [10960-26] S7
Katsunuma, Takayuki [10963-10] S3
Katzman, Gail [10962-15] S4
Katrouw, Hans Plenary
Kauppi, Emilia [10960-10] S4
Kawada, Hiroki [10959-24] S6, [10959-26] S6
Kawaguchi, Yukio [10960-55] SPS1
Kawai, Yoshio 10960 Program Committee, 10960 S6 Session Chair
Kawakami, Shinichiro [10957-50] SPS1, [10957-57] SPS1
Kawana, Daisuke [10957-60] SPS1
Kawano, Hajime [10959-63] S14
Kawasaki, Takahiro [10959-26] S6
Kazazis, Dimitrios [10957-29] S9, [10960-10] S4, [10960-11] S4
Kazumi, Hideyuki [10959-41] S9, [10959-63] S14, [10959-70] SPS1
Ke, Iou-Sheng [10960-44] S12, [10960-74] SPS4

Kea, Marc [10959-108] SPS1, [10959-54] S12, [10959-54] S5
Kehagias, Nikolaos [10958-56] SPS1
Keij, Stefan C. J. A. [10961-18] S5
Keller, Nick [10959-31] S7
Kempen, Antoine [10957-27] S9
Kenane, Boaz [10963-2] S1
Kenane, Nizan [10960-59] SPS2
Kenis, Karine [10963-4] S2
Kenslea, Anne [10959-11] S3, [10959-46] S10
Kern, Robert [10959-94] SPS1
Kersteen, Grizelda [10957-66] S9
Kessar, Mehdi [10959-97] SPS1
Kessels, Erwin W.M.M. [10963-14] S4
Kesters, Els [10960-20] S6
Keszler, Douglas A. [10960-59] SPS2
Khaira, Gurdaman [10961-12] S4
Khalaf, Sara [10962-10] S2
Khan, Jonas [10958-45] SPS1
Kibi, Kazuo [10958-34] S11
Kiers, Ton [10959-44] S10
Kihara, Yoshihide [10963-10] S3
Kim, Byung-Moo [10962-3] S1
Kim, Cheolkyun [10959-37] S8
Kim, Gilbert [10959-37] S8
Kim, Heung-Joo [10963-7] S3
Kim, Hung-Eil [10962-19] S4
Kim, Hwan [10959-54] S12, [10959-54] S5
Kim, Hwi [10959-75] SPS1
Kim, Hyun-Sok [10961-8] S3, [10963-7] S3
Kim, Insung 10957 Program Committee
Kim, Jaehwan [10962-3] S1
Kim, Jaisoon [10959-89] SPS1
Kim, Jang-Sun Sunny [10959-93] SPS1
Kim, Ji Yeon [10960-18] S5, [10960-27] S7, [10960-28] S7, [10960-28] S8, [10960-33] S9
Kim, Jin [10962-3] S1
Kim, Jung Sik [10957-34] S10
Kim, Jun-Yeob [10959-6] S2
Kim, Kanghyun [10960-37] S10
Kim, Muyoung [10960-7] S3, [10960-7] S4
Kim, Namjae [10962-41] SPS1
Kim, Ryoung-Han R. [10957-2] S1, [10957-53] SPS1, 10959 S12 Session Chair, 10962 Program Committee, 10962 S5 Session Chair, [10962-1] S1, [10962-22] S13, [10962-22] S6, [10962-23] S13, [10962-23] S6, [10962-5] S1, [10963-26] S7
Kim, Sang-Kon [10957-54] SPS1

THIS PROGRAM IS CURRENT AS OF 7 JANUARY 2019. Find the latest on the **SPIE CONFERENCE APP**.

53

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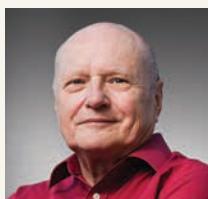
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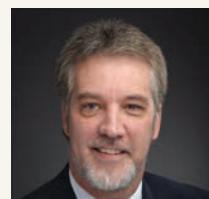
John Dudley
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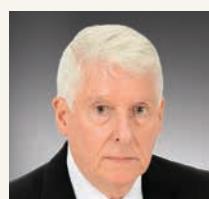
Rick Trebino
Maria J. Yzuel Educator Award

John Pendry
Mozi Award
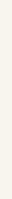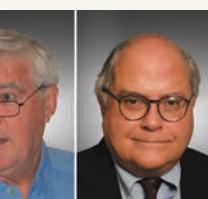
Akiyoshi Suzuki
Frits Zernike Award for Microlithography

Obert R. Wood II
Frits Zernike Award for Microlithography

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Harrison H. Barrett Award IN Medical Imaging

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INDEX OF AUTHORS, CHAIRS AND COMMITTEE MEMBERS

Bold = SPIE Member

THIS PROGRAM IS CURRENT AS OF 7 JANUARY 2019. Find the latest on the **SPIE CONFERENCE APP**.

55

INDEX OF AUTHORS, CHAIRS AND COMMITTEE MEMBERS

Bold = SPIE Member

Li, Yongfu [10962-15] S4, [10962-26] S7
Liang, Ted 10957 Program Committee
Liao, Wenkui [10962-20] S12, [10962-20] S5
Liaros, Nikolaos [10958-39] SPS1
Liddle, J. Alexander 10958 Program Committee, 10958 S2 Session Chair, [10960-16] S5
Liebmann, Lars W. 10962 Program Committee, 10962 S2 Session Chair
Lim, Chang-Moon 10957 Program Committee, [10957-25] S5, [10957-25] S8, [10959-54] S12, [10959-54] S5
Lim, Sanghak [10960-48] S12
Limary, Ratchana [10960-26] S7
Limmer, Tim [10960-68] SPS3
Lin, Arthur [10960-21] S6
Lin, Chia-Chi [10960-21] S6, [10961-27] SPS1
Lin, Peng [10958-30] S10
Lin, PingHung [10961-27] SPS1
Lin, Qinghuang 10960 Program Committee, 10963 Program Committee, 10963 S8 Session Chair, SC992
Lio, Anna 10957 Program Committee, 10957 S8 Session Chair, 10963 S5 Session Chair
Lio, En Chuan [10959-101] SPS1
Liu, Chi-Chun 10958 Program Committee, 10958 S4 Session Chair, [10958-20] S7, [10958-20] S8, [10958-22] S7, [10958-22] S8, [10958-6] S3
Liu, Cong [10960-74] SPS4
Liu, Eric [10958-20] S7, [10958-20] S8, [10963-27] S7
Liu, Eva [10959-84] SPS1
Liu, Liang [10961-5] S2
Liu, Lituo [10959-81] SPS1
Liu, Meng [10959-37] S8
Liu, Rex H. [10959-101] SPS1, [10959-49] S11, [10959-84] SPS1, [10959-95] SPS1, [10959-96] SPS1
Liu, Ru-Gun 10962 Program Committee, 10962 S2 Session Chair, 10963 Program Committee
Liu, Shiyuan [10961-30] SPS1
Liu, Weichen [10960-53] SPS1, [10960-56] SPS1
Liu, Xuedong [10959-61] S14
Liu, Zephyr [10959-48] S11
Liu, Zhengfang [10962-35] SPS1, [10962-36] SPS1, [10962-39] SPS1, [10962-40] SPS1

Liubich, Vlad [10961-4] S2
Loeschner, Hans 10958 Program Committee, 10958 S6 Session Chair, [10958-19] S6
Lok, Sjoerd [10957-3] S2
Lomtscher, Patrick [10959-100] SPS1, [10959-101] SPS1, [10959-84] SPS1, [10959-96] SPS1
Long, Luke [10960-36] S10
Loosen, Peter [10957-51] SPS1, [10959-68] S15
Lopez, Daniel [10958-3] S2
Lopez, Gerald [10960-79] SPS5
Lorant, Christophe [10960-20] S6
Lorusso, Gian Francesco [10957-25] S5, [10957-25] S8, [10959-109] S15, [10959-24] S6, [10959-25] S6, [10959-27] S6
Lu, Colbert [10962-34] SPS1
Lu, Jun-Wei [10961-17] S5
Lu, Xinliang [10960-78] SPS5
Lu, Yifei [10961-5] S2
Lucas, Kevin 10957 S13 Session Chair, [10961-14] S4, 10962 Program Committee, 10962 S6 Session Chair, [10962-13] S3, [10962-24] S13, [10962-24] S6
Lugier, Olivier [10957-7] S2, [10957-7] S3
Lung, Hsiang-Lan [10959-53] S12, [10959-53] S5
Lynd, Nathaniel A. [10960-18] S5, [10960-27] S7, [10960-28] S7, [10960-28] S8, [10960-49] SPS1, [10960-71] SPS4
Lyulina, Irina [10961-18] S5

M

Ma, Eric Long [10959-61] S14
Ma, Jonathan Han Son [10957-68] SPS1
Ma, Ling [10959-105] SPS1
Ma, Shawming [10960-78] SPS5
Ma, Xu [10961-24] SPS1
Ma, Yong-Won [10961-29] SPS1
Ma, Yuansheng [10962-7] S2
Maas, Ruben [10959-104] SPS1
Maassen, Martijn [10959-61] S14
Machida, Kohei [10960-12] S4
Macht, Lukasz J. [10959-93] SPS1
Mack, Chris A. [10958-2] S1, [10959-23] S6, [10959-67] S15, [10960-17] S5, SC1263
Mackin, Charles [10958-29] S10
Mackus, Adrie [10963-14] S4

Madhavan, Sriram [10962-15] S4
Madkour, Kareem [10962-41] SPS1
Maeda, Kenji [10963-28] S8
Maes, Jan Willem [10959-57] S13, [10959-58] S13
Magoshi, Shunko [10957-46] S13, [10957-46] S6
Mai, Yung-Ching [10961-27] SPS1
Makinoshima, Takashi [10960-76] SPS5
Malik, Shobhit [10962-26] S7
Maltabes, John G. 10958 Program Committee, 10958 S2 Session Chair
Mameli, Alfredo [10963-14] S4
Mamiya, Hiroaki [10960-50] SPS1
Mani, Antonio [10959-65] S14
Mann, Klaus [10957-48] SPS1
Mannaert, Geert [10960-30] S9, [10960-33] S9, [10963-4] S2
Mansfield, Scott [10957-35] S10
Manske, Eberhard [10958-24] S8, [10958-44] SPS1
Mao, Guoping [10960-56] SPS1
Mao, Ming [10957-23] S7, [10963-19] S5, [10963-19] S8
Mao, Rui [10962-29] S7
Marangoni, Tomas [10960-17] S5
Marcuccilli, Gino [10959-113] SPS1
Mariolle, Denis [10958-45] SPS1
Marmiesse, Marie [10958-35] S12
Martinez, Noel P. [10958-5] S2
Martinez, Sergio [10963-11] S3
Maruyama, Kotaro [10959-12] S3, [10959-16] S4
Maslow, Mark John [10957-13] S5
Mastylo, Rostyslav [10958-44] SPS1
Mathew, Bobin [10959-99] SPS1
Mathijssen, Simon [10959-50] S11
Matsubara, Shinichi [10959-69] S15
Matsuki, Ryota [10960-55] SPS1
Matsumoto, Hiroshi [10958-18] S6
Matsunawa, Tetsuaki [10962-25] S7, [10962-28] S7
Matsuoka, Kyoko [10957-60] SPS1
Matsuyama, Tomoyuki [10961-20] S5
Matsuzawa, Nobuyuki N. 10960 Program Committee, 10960 S5 Session Chair
May, Michael J. [10958-42] SPS1
McClelland, Alexandra L. [10960-11] S4, [10960-46] S12
McClelland, Jabez J. [10958-28] S10
McCoy, Jake A. [10958-52] SPS1
McCurdy, Ross [10958-53] SPS1, [10963-30] S8
McDaniel, Tony [10959-94] SPS1

McEntaffer, Randall L. [10958-32] S11, [10958-51] SPS1, [10958-52] SPS1, [10958-53] SPS1, [10963-30] S8
McKay, Thomas [10962-15] S4
McManus, Moyra K. [10957-23] S7
McNamara, Elliott [10961-8] S3
McNamara, John [10957-5] S2
Medikonda, Manasa [10959-21] S5
Medvedev, Vyacheslav [10957-40] S12, [10957-63] SPS1
Meeuwissen, Marieke [10957-6] S2
Megens, Henry [10961-18] S5
Mehrotra, Vikas [10962-15] S4
Mei, Hao [10959-48] S11, [10959-77] SPS1
Meiling, Hans [10957-3] S2
Meissl, Mario J. [10958-11] S4
Meli, Luciana 10957 Program Committee, 10957 S7 Session Chair, [10957-11] S3, [10957-11] S4, [10957-50] SPS1, [10958-22] S7, [10958-22] S8, [10960-65] SPS2
Meliorisz, Balint [10957-56] SPS1, [10960-9] S4
Melvin, Lawrence S. 10957 Program Committee, [10957-19] S6
Menchtchikov, Boris [10961-18] S5
Mendoza, Brock [10959-9] S3
Meng, Lingkuan [10960-53] SPS1
Meng, Zejiang [10957-30] SPS1
Mentzel, Heiko [10957-52] SPS1
Menyo, Matthew [10958-27] S9
Mermet, Olivier [10959-44] S10
Mertens, Hans [10959-11] S3, [10959-46] S10
Mesawich, Michael [10960-68] SPS3
Mettry, Magi A. [10958-38] SPS1, [10960-24] S7
Metz, Andrew W. [10963-25] S7
Meyer, Paul [10960-18] S5
Mi, Jian [10962-42] SPS1
Michels, Robert [10959-68] S15
Midoh, Yoshihiro [10959-10] S3
Midya, Rivu [10958-30] S10
Mignot, Yann [10958-20] S7, [10958-20] S8, [10958-22] S7, [10958-22] S8, [10958-6] S3
Miki, Yasushi [10960-76] SPS5
Mileham, Jeffrey [10959-52] S11
Milenin, Alexey P. [10960-22] S6, [10963-4] S2
Miles, Drew M. [10958-52] SPS1, [10963-30] S8
Miley, Galen P. [10959-15] S4
Mili, Aymen [10959-60] S13
Milléquant, Matthieu [10959-56] S13

Milo, Renan [10959-77] SPS1
Miroku, Hiroshi [10959-99] SPS1
Missalla, Thomas [10957-31] S9, [10957-47] SPS1
Misumi, Ichiko [10959-82] SPS1
Miura, Kozue [10960-69] SPS3
Miyagi, Ken [10960-50] SPS1
Miyakawa, Ryan H. [10957-28] S9, [10957-65] SPS1, [10957-67] SPS1
Miyao, Kenichi [10957-61] SPS1
Miyata, Yuichiro [10957-50] SPS1
Mizoguchi, Hakaru [10957-39] S12, [10957-61] SPS1, [10961-33] SPS1
Mizui, Kento [10958-43] SPS1
Mizuno, Shinsuke [10959-88] SPS1
Mizuno, Takehito [10960-43] S11
Mizuochi, Ryuta [10960-47] S12
Mizuochi, Ryuta [10960-28] S7, [10960-28] S8
Mizutani, Shinji [10959-16] S4
Mizutani, Shunsuke [10959-47] S10
Mochi, Iacopo [10957-29] S9, [10957-6] S2
Mocuta, Anda C. [10962-1] S1, [10962-31] SPS1, [10962-4] S1
Mohanty, Nihar 10963 Program Committee, 10963 S6 Session Chair
Momonoi, Yoshinori [10959-38] S9, [10959-47] S10
Montgomery, Warren [10960-46] S12
Moon, Junghwan [10960-7] S3, [10960-7] S4
Morgenfeld, Bradley [10961-13] S4
Mori, Ken-Ichiro 10961 Program Committee, [10961-16] S5
Morikawa, Yasutaka [10957-46] S13, [10957-46] S6
Morikita, Shinya [10960-60] SPS2
Morimoto, Hiroaki 10957 Program Committee
Morita, Kazuyo [10957-64] SPS1, [10960-45] S12, [10960-54] SPS1
Morita, Masahiro [10959-7] S2
Mos, Evert C. [10961-18] S5
Mosden, Aelan [10959-31] S7, [10963-21] S6
Motojima, Junichi [10961-16] S5
Motoyama, Koichi [10959-9] S3
Moussa, Alain [10959-57] S13, [10959-58] S13, [10963-19] S5, [10963-19] S8
Moyroud, Clement [10962-14] S3
Muehle, Alexander [10959-49] S11
Mueller, Jonathan [10957-62] SPS1

THIS PROGRAM IS CURRENT AS OF 7 JANUARY 2019. Find the latest on the **SPIE CONFERENCE APP**.

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THIS PROGRAM IS CURRENT AS OF 7 JANUARY 2019. Find the latest on the **SPIE CONFERENCE APP**.

57

INDEX OF AUTHORS, CHAIRS AND COMMITTEE MEMBERS

Bold = SPIE Member

Ruiz, Ricardo 10958 Program Committee, 10958 S7 Session Chair, 10960 S8 Session Chair, 10963 Program Committee, 10963 S3 Session Chair

Rumpf, Raymond C. [10958-5] S2

Rutigliani, Vito Daniele [10959-109] S15, [10959-64] S14

Ruzic, David N. [10957-44] S12

Ryckaert, Julien [10962-1] S1, [10962-4] S1, [10962-5] S1, [10963-21] S6, [10963-24] S7

S

Sadeghian, Hamed [10959-19] S5, [10959-20] S5

Sah, Kaushik [10959-65] S14

Saib, Mohamed [10959-14] S4, [10959-57] S13, [10959-58] S13

Sainy, Amit [10959-108] SPS1

Saitou, Takashi [10957-61] SPS1, [10961-33] SPS1

Sakai, Kazunori [10960-40] S11, [10960-62] SPS2, [10963-5] S2

Sakai, Keita [10958-15] S5

Sakai, Tatsuya [10960-77] SPS5

Sakakibara, Makoto [10959-47] S10

Sakamoto, Rikimaru [10960-47] S12

Sakimura, Shigetoshi [10959-36] S8

Salvador, Dave [10959-113] SPS1

Sanchez, Hamilton [10962-19] S4

Sanchez, Martha I. 10958 Conference Chair, 10958 S1 Session Chair, 10958 S11 Session Chair, 10958 S12 Session Chair, 10959 Program Committee, [10960-3] S2, [10960-3] S3, [10960-4] S2, [10960-4] S3

Sandelbach, Matthew [10959-14] S4

Sanders, Daniel P. 10960 Conference CoChair, 10960 S1 Session Chair, [10960-4] S2, [10960-4] S3, [10960-64] SPS2

Sano, Yohei [10957-57] SPS1

Santillan, Julius Joseph S. [10957-8] S2, [10957-8] S3

Sarlette, Daniel 10961 Program Committee, 10961 S4 Session Chair

Sarma, Chandrasekhar 10958 Program Committee, 10958 S4 Session Chair

Sasaki, Akira [10957-58] SPS1

Satake, Makoto [10963-28] S8

Sato, Takashi [10960-76] SPS5

Sato, Yoshishige [10959-12] S3

Satoh, Toshifumi [10960-50] SPS1

Satoshi, Iino [10958-11] S4

Saville, Barry [10959-113] SPS1

Sawamura, Junpei [10959-7] S2

Schäfer, Bernd [10957-48] SPS1

Scharf, Toralf [10958-48] SPS1

Schelcher, Guillaume [10959-14] S4, [10959-64] S14

Schiavone, Patrick [10959-42] S9, [10959-56] S13

Schiffelers, Guido [10957-13] S5, [10957-23] S7

Schmidt, Lucian [10963-7] S3

Schmidt, Oliver G. [10958-7] S3

Schmitt-Weaver, Emil [10961-18] S5, [10961-7] S3

Schneider, Philipp-Immanuel [10959-35] S8

Scholze, Frank [10957-52] SPS1

Schönstedt, Anja [10957-52] SPS1

Schoofs, Stijn [10959-108] SPS1

Schroeder, Uwe Paul [10962-15] S4, [10962-18] S4

Schwarzband, Ishai [10959-99] SPS1

Schweikert, Emile A. [10959-22] S5, [10960-15] S5

Sebaai, Farid [10963-25] S7, [10963-4] S2

Segalman, Rachel A. [10960-25] S7, [10960-26] S7

Sekiguchi, Atsushi [10960-73] SPS4

Seko, Tomoaki [10960-77] SPS5

Sendelbach, Matthew J. 10959 Program Committee, 10959 S6 Session Chair, [10959-9] S3

Serizawa, Ryuuichi [10960-77] SPS5

Seroglazov, Pavel [10957-40] S12

Servin, Isabelle [10958-17] S6, [10958-42] SPS1

Serwy, Roger [10959-94] SPS1

Setoguchi, Katsumi [10959-38] S9, [10959-98] SPS1

Shafee, Marwah [10962-41] SPS1

Shah, Kavita [10959-9] S3

Shahrjerdy, Mir Homayoun [10959-6] S2

Shaik, Khaja Ahmad [10962-2] S1, [10962-31] SPS1, [10962-4] S1

Shamma, Nader [10963-17] S5, [10963-17] S8

Shang, Shumay [10962-10] S2

Shao, Dongbing [10962-33] SPS1

Shao, Grant [10960-79] SPS5

Sharma, Rashi [10958-5] S2

Sharma, Shalini [10958-50] SPS1

Shchehlik, Kanstantsin [10962-14] S3

Shelby, Robert M. [10958-29] S10

Shemesh, Dror [10959-88] SPS1

Shen, Peng [10963-22] S6

Shen, Yijiang [10961-25] SPS1

Shendre, Abhishek [10961-36] S1

Sheng, Xichen [10961-5] S2

Sherazi, Syed Muhammad Yasser [10957-53] SPS1, [10962-1] S1, [10962-22] S13, [10962-22] S6, [10962-31] SPS1, [10962-5] S1

Sherwin, Stuart [10957-38] S11

Shi, Weijie [10961-23] SPS1

Shi, Xuelong 10961 Program Committee, [10961-21] SPS1

Shi, Yating [10961-30] SPS1

Shiba, Yuji [10959-7] S2

Shibata, Naoki [10957-50] SPS1

Shibazaki, Yuichi [10959-7] S2

Shields, Jason R. [10963-2] S1

Shiely, James P. [10961-6] S2, [10961-9] S3, [10962-9] S2, SC1264

Shigenobu, Atsushi [10961-16] S5

Shih, Pei-Shan [10960-21] S6

Shimada, Ryo [10957-56] SPS1, [10960-9] S4

Shimizu, Sho [10960-47] S12

Shimoda, Ryo [10959-16] S4

Shimura, Satoru [10959-94] SPS1, [10960-60] SPS2

Shin, Bo Sung [10961-29] SPS1

Shin, Byungchul [10962-3] S1

Shin, ChaeHo [10959-90] SPS1

Shin, Seungwook [10960-48] S12

Shin, Youngsoo [10962-12] S3

Shindo, Hiroyuki [10959-36] S8, [10959-87] SPS1

Shinoda, Shinichi [10959-36] S8, [10959-87] SPS1

Shiozawa, Kazufumi [10962-28] S7

Shiozawa, Takahiro [10957-50] SPS1

Shiraishi, Gosuke [10957-56] SPS1, [10960-9] S4

Shiraishi, Yutaka [10957-61] SPS1

Shirali, Nagesh [10961-36] S1

Shirayone, Shigeru [10963-9] S3

Shiu, Eric [10960-43] S11

Shobha, Hosadurga [10959-9] S3, [10960-24] S7

Shua, Oren [10959-88] SPS1

Sidelnikov, Yurri [10957-40] S12

Sidorkin, Vadim [10957-16] S6

Siew, Yong Kong [10959-11] S3, [10959-46] S10

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Silver, Richard M. 10959 Program Committee, 10959 S11 Session Chair, 10959 S5 Session Chair, [10959-2] S1, [10959-33] S8

Sim, Woojoo [10961-3] S2

Simcoe, Michael [10962-15] S4

Simmons, Mark C. [10959-37] S8

Simon, Dan [10963-2] S1

Singh, Arjun [10957-21] S7

Singh, Vivek K. 10962 Program Committee, 10962 S7 Session Chair

Sintschuk, Michael [10957-52] SPS1

Sinzinger, Stefan [10958-44] SPS1

Sirard, Stephen M. [10960-27] S7, [10960-28] S7, [10960-28] S8

Sizyuk, Tatyana [10957-41] S12, [10957-43] S12

Skliarov, Volodymyr V. [10959-102] SPS1, [10959-106] SPS1

Slachter, Bram [10957-13] S5

Slaughter, Daniel S. [10960-3] S2, [10960-3] S3, [10960-4] S2, [10960-4] S3

Slotboom, Daan [10961-18] S5

Smith, Bruce W. 10961 Program Committee

Smith, Jeffrey T. [10963-21] S6, [10963-25] S7

Smith, Joshua [10958-6] S3

Sobieski, Daniel [10963-17] S5, [10963-17] S8

Socha, Robert J. [10961-18] S5

Soco, Aileen [10959-6] S2

Sohda, Yasunari [10959-39] S9

Solecky, Eric 10959 Program Committee, SC1133

Soleymaniha, Mohammadreza [10958-25] S8

Somervell, Mark H. 10960 Program Committee, 10960 S9 Session Chair, [10960-25] S7

Someya, Yasunobu [10960-47] S12

Sommer, Elad [10959-99] SPS1

Son, Hyung-Sub [10959-93] SPS1

Song, Hua [10961-14] S4

Song, Ji-Hyun [10961-8] S3

Song, Sonyong [10959-7] S2

Song, Youngsoo [10962-12] S3

Song, Zhiyang [10961-17] S5

Sonoda, Akihiro [10957-50] SPS1, [10957-57] SPS1

Sooriyakumaran, Ratnam [10960-64] SPS2

Sotomoyor Torres, Clivia M. [10958-56] SPS1

Souriau, Laurent [10957-22] S7

Soussou, Assawer [10960-22] S6

Spadaccini, Christopher M. [10958-26] S9

Speed, David [10960-2] S1

Spessot, Alessio [10962-1] S1, [10962-2] S1, [10962-4] S1, [10962-5] S1

Sreenivasan, S. V. [10958-13] S5

Srinivasan, Narasimhan [10957-20] S6

St. John, Matthew M. [10961-6] S2

Stadelhoff, Christian [10957-52] SPS1

Stafford, Nathan [10963-22] S6

Stan, Edward [10961-20] S5

Starikov, Alexander 10959 Program Committee, 10959 S13 Session Chair, 10959 S2 Session Chair, SC1158

Steele, Jeffery [10957-49] SPS1

Steen, Steven E. Plenary

Steenbrink, Stijn W. H. K. [10958-17] S6

Stirner, Manuela [10958-45] SPS1

Stock, Hans-Jurgen [10957-56] SPS1, [10959-55] S12, [10959-55] S5, [10960-9] S4

Stoeldraijer, Judon [10957-3] S2

Stokes, Harold W. [10957-64] SPS1, [10960-45] S12

Stolberg, Ines A. 10958 Program Committee, 10958 S6 Session Chair

Stollenwerk, Jochen [10957-51] SPS1, [10959-68] S15

Stolovitzky, Gustavo A. [10958-6] S3

Storm, Arnold J. [10957-36] S11

Stortelder, Jetske [10957-36] S11

Stowers, Jason K. 10957 S3 Session Chair, 10960 Program Committee, 10960 S2 Session Chair, [10960-41] S11

Stranick, Stephen [10960-16] S5

Strauss, Michael [10959-11] S3, [10959-46] S10, [10959-72] SPS1

Sturtevant, John L. [10962-10] S2

Su, Xiaojing [10961-23] SPS1, [10962-32] SPS1, [10962-37] SPS1

Su, Yajuan [10962-32] SPS1, [10962-37] SPS1

Subramanian, Ganesh [10959-21] S5

Subramony, Venkatram [10962-21] S12, [10962-21] S5

Suda, Hiromi [10961-16] S5

Sufrin, Yael [10959-91] SPS1

Suh, Hyo Seon [10960-30] S9, [10960-32] S9, [10960-33] S9

Sumiya, Masahiro [10963-9] S3

Sun, Junling [10963-25] S7

Sun, Wei [10959-39] S9

Sun, Yuyang [10957-35] S10, 10963 Program Committee, 10963 S3 Session Chair

Sunday, Daniel F. [10959-8] S3

Sung, Jin Wuk [10960-74] SPS4

Sungauer, Elodie [10959-32] S7

Supreeti, Shraddha [10958-44] SPS1

Sutani, Takumichi [10959-26] S6

Suzuki, Akiyoshi 10957 Program Committee, 10957 S12 Session Chair

Suzuki, Makoto [10959-38] S9, [10959-43] S10, [10959-47] S10

Suzuki, Masaru [10959-4] S2

Suzuki, Yusaku [10959-45] S10

T

Tabery, Cyrus E. [10959-64] S14

Tadokoro, Masahide [10957-57] SPS1

Tagawa, Seiichi [10960-13] S4

Tagbo, Claudia [10957-52] SPS1

Takabayashi, Yukio [10958-10] S4

Takahashi, Satoru [10959-24] S6

Takamasu, Kiyoshi [10959-24] S6

Takei, Satoshi [10958-43] SPS1

Takeshita, Kazuhiro [10957-56] SPS1, [10960-9] S4

Takeuchi, Takenori [10961-20] S5

Tamaddon, Amir-Hossein [10963-19] S5, [10963-19] S8

Tamari, Nanako [10963-9] S3

Tamer, Mehmet Selman [10959-19] S5

Tamura, Mamoru [10960-47] S12

Tamura, Takao [10958-18] S6

Tan, Ling Ee [10962-23] S13, [10962-23] S6

Tan, Samantha [10963-12] S4

Tanaka, Hiroki [10960-45] S12

Tanaka, Maki [10959-45] S10

Tanaka, Makoto [10961-33] SPS1

Tanaka, Satoshi [10961-33] SPS1

Tanaka, Satoshi [10957-46] S13, [10957-46] S6

Tanaka, Sayuri [10959-7] S2

Tanaka, Yasuaki [10957-64] SPS1, [10960-45] S12

Tanaka, Yuji [10957-64] SPS1, [10960-45] S12, [10960-54] SPS1

Tanaka, Yusuke [10959-4] S2

Tanksalvala, Michael [10959-15] S4, [10959-30] S7

Tao, Xu [10958-55] SPS1

Taravade, Kunal N. 10961 Program Committee, 10961 S2 Session Chair

Tasdemir, Zuhal [10957-6] S2

Tel, Wim [10959-44] S10, [10961-18] S5

ten Haaf, Gijs [10961-18] S5

Tennant, Donald M. [10958-1] S1

Teugels, Lieve [10963-25] S7, [10963-4] S2

Textor, Andrew [10958-40] SPS1

Teyssedre, Hubert [10958-35] S12, [10958-41] SPS1, [10958-42] SPS1, [10958-45] SPS1

Thackeray, James W. 10960 Program Committee, 10960 S7 Session Chair, [10960-17] S5, [10960-38] S11

Thakur, Neha [10957-7] S2, [10957-7] S3, [10957-9] S2, [10957-9] S3

Theis, Wolfgang [10960-11] S4

Thiam, Ndeye Arame [10958-33] S11

Thomas, Guillaume [10958-35] S12

Thompson, Andrew [10960-79] SPS5

Thornley, Wyatt [10960-3] S2, [10960-3] S3, [10960-4] S2, [10960-4] S3

Thrun, Xaver [10959-59] S13

Thurston, Jeremy [10959-15] S4

Tian, Ming [10962-20] S12, [10962-20] S5

Tilson, Ashley [10959-103] SPS1, [10959-72] SPS1

Timmermans, Frank J. [10957-37] S11

Tiron, Raluca 10958 S7 Session Chair, [10958-21] S7, [10958-21] S8, [10958-35] S12, 10960 Program Committee, 10960 S8 Session Chair, [10960-51] SPS1, [10960-57] SPS1

Tokue, Hiroshi [10958-16] S5

Tolle, Ian [10959-113] SPS1

Tomaso, Florian [10962-16] S4

Tomczak, Yoann [10957-23] S7

Tomono, Masaru [10957-56] SPS1, [10960-9] S4

Tortai, Jean-Hervé [10959-42] S9

Tottewitz, Steven [10959-84] SPS1, [10959-96] SPS1

Touma, Jimmy [10958-5] S2

Toyoda, Yasutaka [10959-36] S8, [10959-87] SPS1

Trefonas, Peter [10959-22] S5, [10960-15] S5, [10960-26] S7

Tripathi, Vikas [10962-26] S7

Tritchkov, Alexander [10957-35] S10

Troost, Kars [10957-3] S2, [10957-5] S2

Truong, Hoa D. [10960-3] S2, [10960-3] S3, [10960-4] S2, [10960-4] S3, [10960-64] SPS2, [10960-65] SPS2

Tsai, Hsinyu 10958 Program Committee, [10958-29] S10, S3 Session Chair

Tsai, Kuen-Yu [10958-46] SPS1, [10961-6] S2, [10962-17] S4

Tseng, I-Lun [10962-26] S7

Tseng, Li-Ting [10957-29] S9

Tseng, Sean Shang-En [10961-9] S3

Tsushima, Hiroaki [10961-19] S5, [10961-33] SPS1

Tsuzuki, Shuichi [10960-43] S11

Tsygvintsev, Ilya [10957-63] SPS1

Tu, Xuecou [10958-55] SPS1

Turner, Kevin T. 10958 Program Committee

Turovets, Igor [10959-14] S4, SC1100

Tvermoes, Brooke [10960-2] S1

U

Uchida, Ryusuke 10960 Program Committee, 10960 S12 Session Chair

Uchiyama, Takayuki [10957-46] S13, [10957-46] S6, [10959-74] SPS1

Ueda, Atsushi [10957-61] SPS1

Ueda, Kenichi [10957-50] SPS1

Ukraintsev, Vladimir A. 10959 Conference Chair, 10959 S1 Session Chair, 10959 S15 Session Chair

Umeda, Toru [10960-43] S11

Ungar, P. Jeffrey [10961-36] S1

Upadhyay, Navnidhi K. [10958-30] S10

V

Vaglio Pret, Alessandro [10957-15] S5

Vaid, Alok 10959 Program Committee, 10959 S7 Session Chair

Vais, Abhitosh [10963-4] S2

Valade, Charles [10959-32] S7

van Ballegoij, Rob [10957-3] S2

van de Kerkhof, Mark A. [10957-27] S9

Van den Heuvel, Dieter [10959-65] S14

van der Lans, Marco [10959-19] S5

van der Meijden, Vidar [10959-93] SPS1

Van Der Plaas, Geert [10962-4] S1

van Dijk, Leon [10959-51] S11, [10959-52] S11

van Dorp, Dennis [10963-4] S2

van Empel, Tjarko [10957-27] S9

van Es, Maarten H. [10959-19] S5, [10959-20] S5

van Haren, Richard J. F. [10959-51] S11, [10959-52] S11

van Hemert, Tom [10963-7] S3

van Kessel, Luc [10959-29] S7

van Leest, Arno J. [10959-6] S2

van Lent-Protasova, Lidia [10957-6] S2

van Look, Lieve [10957-25] S5, [10957-25] S8

van Mierlo, Willem [10959-54] S12, [10959-54] S5

van Mil, Ijen L. [10961-17] S5

van Reijzen, Maarten E. [10959-19] S5

van Riel, Martijn M. C. J. M. [10959-19] S5

van Roey, Frieda [10957-25] S5, [10957-25] S8, [10959-109] S15

van Schaik, Willem [10957-36] S11

van Schoot, Jan [10957-3] S2, [10957-5] S2

van Schravendijk, Bart Plenary

van Setten, Eelco [10957-3] S2, [10957-32] S10, [10957-5] S2

Vandenberghe, Geert [10957-14] S5, [10957-21] S7, [10957-23] S7, [10957-25] S5, [10957-25] S8, [10957-56] SPS1, [10960-33] S9, [10960-9] S4, 10961 Program Committee, 10961 S4 Session Chair

Vandenbroeck, Nadia [10957-25] S5, [10957-25] S8, [10963-19] S5, [10963-19] S8

Vanelderen, Pieter [10957-22] S7, [10957-23] S7, [10957-25] S5, [10957-25] S8, [10963-19] S5, [10963-19] S8

Vangoidsenhoven, Diziana [10960-20] S6

Varadarajan, Bhadri [10963-6] S2

Varanasi, Rao [10960-68] SPS3

Vats, Hemant [10957-53] SPS1

Ventzek, Peter [10963-3] S1

Verheijen, Marcel A. [10963-14] S4

Verkest, Diederik [10962-1] S1, [10962-4] S1

Verkhoturov, Stanislav V. [10959-22] S5, [10960-15] S5

Verma, Piyush [10962-29] S7

Verschuuren, Marc A. [10958-12] S4, [10958-52] SPS1

Viatkina, Katja [10963-7] S3

Vichev, Ilya [10957-63] SPS1

Vikram, Abhishek [10962-20] S12, [10962-20] S5, [10962-42] SPS1

Vincent, Benjamin [10963-26] S7

Vinokhodov, Alexander [10957-40] S12

Voelkel, Reinhard [10958-48] SPS1, 10961 Program Committee, 10961 S5 Session Chair

Volkovich, Roie [10959-48] S11

von Borany, Johannes [10960-57] SPS1

Voorkamp, Rob [10958-12] S4

W

Wada, Toshiharu [10957-50] SPS1, [10963-18] S5, [10963-18] S8

Wahlisch, Felix [10957-13] S5

Wakayama, Hiroyuki [10960-47] S12

Waldron, Niamh [10963-4] S2

Walke, Amey [10963-4] S2

Waller, Laura [10957-38] S11

Wallow, Thomas I. 10957 Program Committee, 10957 S4 Session Chair, 10960 Program Committee, 10960 S3 Session Chair

Wallraff, Gregory M. [10960-3] S2, [10960-3] S3, [10960-4] S2, [10960-4] S3

Wan, Qijian [10962-35] SPS1, [10962-36] SPS1, [10962-39] SPS1, [10962-40] SPS1

Wang, Bin [10959-15] S4, [10959-30] S7

Wang, ChangAn [10961-13] S4

Wang, Cheng [10959-18] S5

Wang, Fei [10959-108] SPS1, [10959-61] S14

Wang, Fuming [10959-44] S10

Wang, Hui [10962-20] S12, [10962-20] S5

Wang, Lei [10959-37] S8

Wang, Luke [10959-64] S14

Wang, Lynn T. N. 10962 Program Committee, 10962 S3 Session Chair, [10962-15] S4

Wang, Meng [10959-77] SPS1

Wang, Muzhou [10960-16] S5

Wang, Qi [10963-21] S6

Wang, Si-Cong [10962-42] SPS1

Wang, Teng [10959-104] SPS1, [10959-71] SPS1

Wang, Xiangzhao [10957-30] SPS1

Wang, Xiaolong [10957-6] S2

Wang, Yongjun [10959-44] S10, [10959-64] S14

Wang, Zhigang [10959-38] S9

Wang, Zhiqiang [10961-24] SPS1

Wang, Zhongrui [10958-30] S10

Wang, Ziyang [10959-54] S12, [10959-54] S5

Warrick, Scott P. [10959-83] SPS1

Watanabe, Kyoko [10957-60] SPS1

Watanabe, Yukio [10957-61] SPS1

Weckx, Pieter [10962-2] S1

Wei, Alexander C. [10957-35] S10

Wei, Fang [10961-5] S2

Wei, Yayi [10959-105] SPS1, [10960-56] SPS1, [10961-23] SPS1, [10962-32] SPS1, [10962-37] SPS1

Weibel, Daniel E. [10957-55] SPS1

Weintraub, Jeffrey [10959-83] SPS1

Welling, Ulrich [10957-19] S6

Weng, Shang Feng [10962-34] SPS1

Whitworth, Guy L. [10958-56] SPS1

Wieland, Marco 10958 Program Committee, 10958 S10 Session Chair, [10958-17] S6

Willekers, Rob [10959-85] SPS1

Willson, C. Grant [10960-14] S5, [10960-18] S5, [10960-27] S7, [10960-28] S7, [10960-28] S8, [10960-33] S9, [10960-49] SPS1, [10960-71] SPS4, SC101

Wilson, Chris J. [10963-26] S7

Wise, Rich S. 10957 S8 Session Chair, 10963 Conference Chair, 10963 S5 Session Chair, [10963-17] S5, [10963-17] S8

Witters, Liesbeth [10963-4] S2

Witvoet, Gert [10959-85] SPS1

Wojtecki, Rudy J. [10958-38] SPS1, [10960-24] S7, [10960-64] SPS2, [10960-65] SPS2

Wolfing, Shay [10959-9] S3

Wolke, Conrad [10957-66] S9

Wong, Cheuk Wun [10959-77] SPS1

Wong, Sabrina [10960-44] S12

Woo, Dong Gon [10957-34] S10

Wood II, Obert R. 10957 Program Committee

Word, James [10957-35] S10, [10962-30] SPS1

Wostyn, Kurt [10963-4] S2

Wu, Aiwen [10960-42] S11, [10960-66] SPS3, [10960-70] SPS3

Wu, Cheng-En R. [10961-14] S4, [10962-13] S3

Wu, Chien-Ching [10957-36] S11

Wu, Janet [10960-74] SPS4

Wu, Lianjia [10957-7] S2, [10957-7] S3

Wu, Peiheng [10958-55] SPS1

Wu, Wei 10958 Program Committee

Wu, Xin [10960-56] SPS1

Wunsch, Benjamin H. [10958-6] S3

THIS PROGRAM IS CURRENT AS OF 7 JANUARY 2019. Find the latest on the **SPIE CONFERENCE APP**.

61

INDEX OF AUTHORS, CHAIRS AND COMMITTEE MEMBERS
Bold = SPIE Member

X

Xia, Annie [10960-66] SPS3, [10960-70] SPS3
Xia, Chun [10958-5] S2
Xia, Qiangfei [10958-30] S10
Xiao, Guangming [10962-24] S13, [10962-24] S6
Xiao, Yanjun [10961-21] SPS1, [10961-5] S2
Xie, Ting [10960-78] SPS5
Xu, Buqing [10959-105] SPS1
Xu, Chengbai [10960-38] S11
Xu, Gang [10961-17] S5
Xu, Gao [10962-42] SPS1
Xu, Hong [10960-62] SPS2
Xu, Ming [10959-71] SPS1
Xu, Ruiying [10958-55] SPS1
Xu, Yongan [10957-24] SPS1

Y

Yaegashi, Hidetami [10957-13] S5, [10960-19] S6, [10960-58] SPS2
Yahiro, Takehisa [10959-7] S2
Yakushev, Oleg F. [10957-40] S12
Yakushkin, Alexey [10957-40] S 12
Yamada, Shintaro [10960-44] S12
Yamada, Teppei [10957-8] S2, [10957-8] S3
Yamaguchi, Satoru [10959-38] S9
Yamamoto, Kimiko [10957-64] SPS1, [10960-45] S12, [10960-54] SPS1
Yamamoto, Takuma [10959-45] S10
Yamane, Takeshi [10957-18] S6, [10957-46] S13, [10957-46] S6
Yamazaki, Akiyoshi [10957-60] SPS1, [10960-50] SPS1
Yamazaki, Taku [10961-19] S5
Yamazaki, Yuichiro [10959-12] S3, [10959-16] S4
Yan, Lei [10962-20] S12, [10962-20] S5
Yanagida, Tatsuya [10957-61] SPS1
Yang, Cheng Hao [10959-101] SPS1
Yang, Da 10961 Program Committee
Yang, Delian [10961-14] S4
Yang, Dingdong [10961-3] S2
Yang, Dongyue [10959-77] SPS1
Yang, Frank [10959-84] SPS1, [10962-21] S12, [10962-21] S5
Yang, Geng [10958-5] S2
Yang, Haoyu [10962-27] S7

Yang, Jianhua [10958-30] S10
Yang, Kou [10960-62] SPS2
Yang, Michael [10960-78] SPS5
Yang, Wenbing [10963-12] S4
Yang, XiaoMin [10960-27] S7
Yang, Zhiyong [10961-30] SPS1
Yano, Hidetsugu [10957-50] SPS1
Yao, Leon [10961-21] SPS1
Yao, Yueliang [10961-5] S2
Yasin, Farrukh Qayyum [10957-22] S7
Yassine, Abdullah [10962-8] S2
Yaziv, Tal [10959-77] SPS1
Ye, Tianchun [10962-32] SPS1
Yeh, Shin-Shing [10961-27] SPS1
Yen, Chi-Fu [10959-110] S15
Yeung, Michael [10957-45] S13, [10957-45] S6
Yin, Lianghong [10962-10] S2
Yin, Weihua [10959-61] S14
Yokosuka, Toshiyuki [10959-63] S14
Yong, Poh Boon [10959-113] SPS1
Yoo, Gyun [10959-37] S8
Yoon, Byeri [10960-48] S12
Yoon, So-Won [10957-54] SPS1
Yoshida, Keisuke [10957-13] S5
Yoshida, Kohei [10960-50] SPS1
Yoshida, Yuichi [10957-56] SPS1, [10960-9] S4
Yoshihara, Kosuke [10957-56] SPS1, [10960-9] S4
Yoshimura, Shota [10960-60] SPS2
Yoshino, Takumi [10960-12] S4
Yoshitake, Shusuke [10957-19] S6
You, Gen [10960-31] S9
Young, Evangeline F. Y. [10962-9] S2
Yu, Bei [10962-27] S7
Yu, Chun Chi [10959-101] SPS1
Yu, Hao [10963-4] S2
Yu, Miao [10961-8] S3
Yu, Xiaoya [10959-81] SPS1
Yuan, Chi-Min 10962 Conference CoChair, 10962 S1 Session Chair, SC1030
Yuan, Wei [10961-21] SPS1, [10961-5] S2
Yumiba, Ryo [10959-36] S8, [10959-87] SPS1
Yun, DanHee [10961-29] SPS1
Yun, Young Ho [10959-76] SPS1

Z

Zeitner, Uwe D. 10961 Program Committee
Zekry, Joseph [10957-5] S2
Zhang, Baolin [10960-53] SPS1, [10960-56] SPS1
Zhang, Chenming [10961-5] S2
Zhang, Gary [10962-20] S12, [10962-20] S5
Zhang, Heng [10957-30] SPS1
Zhang, Keren [10960-44] S12
Zhang, Libin [10960-56] SPS1
Zhang, Meiyue [10960-79] SPS5
Zhang, Ningxiao [10958-51] SPS1
Zhang, Qi [10960-78] SPS5
Zhang, Xiaoshi [10959-15] S4
Zhang, Xima [10957-35] S10
Zhang, Ying 10963 Program Committee
Zhang, Ying SC992
Zhang, Yu [10962-20] S12, [10962-20] S5
Zhang, Yuanyi [10960-25] S7, [10960-26] S7
Zhang, Zheng-ping [10960-53] SPS1
Zhao, Baojun [10962-20] S12, [10962-20] S5
Zhao, Nan [10959-71] SPS1
Zhao, Qian [10959-37] S8
Zhao, Qile [10961-24] SPS1
Zhao, Wenhao [10961-21] SPS1
Zhao, Yiqiong [10961-13] S4
Zhao, Yuhang [10961-21] SPS1
Zheng, Yunan [10959-37] S8
Zhou, Hui [10959-33] S8
Zhou, Wayne [10959-48] S11
Zhou, Weihu [10959-81] SPS1
Zhou, Wentian [10959-71] SPS1
Zhou, Yue [10959-77] SPS1
Zhu, Jun [10961-9] S3
Zhu, Qingjun [10960-28] S7, [10960-28] S8, [10960-49] SPS1
Zhu, Wenhua [10957-65] SPS1, [10957-67] SPS1
Zhu, Zhimin [10961-15] S4
Zhuang, Lei [10957-35] S10
Zimmermann, Joerg [10957-3] S2, [10957-5] S2
Zimmermann, Stephan [10957-16] S6
Zschiedrich, Lin [10959-35] S8

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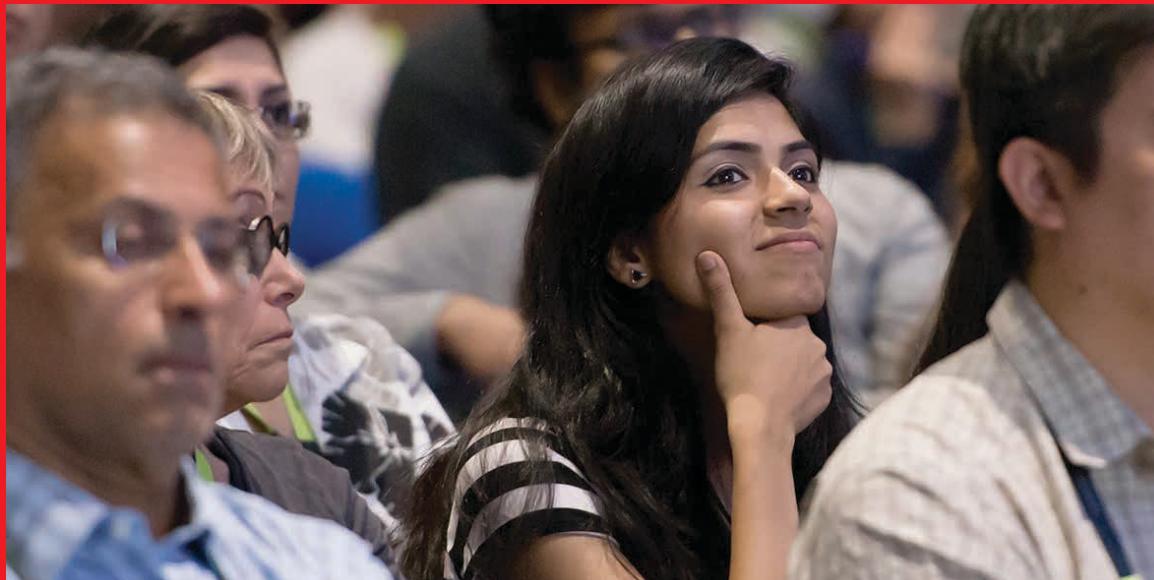
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GENERAL INFORMATION

Registration

Onsite Registration and Badge Pick-Up Hours

San Jose Convention Center

Sunday 24 February · 7:15 am to 5:00 pm
Monday 25 February · 7:15 am to 4:00 pm
Tuesday 26 February · 7:30 am to 5:00 pm
Wednesday 27 February · 7:30 am to 4:00 pm
Thursday 28 February · 7:45 am to 4:00 pm
(Thursday is conference registration only)

CONFERENCE REGISTRATION

Includes admission to all conference sessions, plenaries, panels, technical events, and poster session/reception; admission to the SPIE exhibition; welcome reception; and a choice of proceedings.

COURSE AND WORKSHOP REGISTRATION

Courses and workshops are priced separately. Course-only registration includes your selected course(s), course notes, coffee breaks, and admittance to the exhibition. Course prices include applicable taxes. Onsite, please go to Course Materials Desk after you pick up your badge.

EXHIBITION REGISTRATION

Exhibition Only visitor registration is complimentary and is open Tuesday and Wednesday only.

SPIE MEMBER, SPIE STUDENT MEMBER, AND STUDENT PRICING

• SPIE Members receive conference and course registration discounts. Discounts are applied at the time of registration.
• SPIE Student Members receive up to 60% off courses.
• Student registration rates are available only to undergraduate and graduate students who are enrolled full time and have not yet received their Ph.D. Post-docs may not register as students. A student ID number or proof of student status is required with your registration.

PRESS REGISTRATION

For credentialed press and media representatives only. Please email contact information, title, and organization to media@spie.org.

SPIE Cashier

Registration Area · Open during registration hours

REGISTRATION PAYMENTS

If you are planning to register onsite, your credit card payment will be processed at the onsite station. If you wish to pay with cash or check, register at the onsite stations and you will be directed to the Cashier once you have completed registration except final payment. If you have already registered and wish to add a course, workshop or special event, you may do so at onsite registration.

RECEIPT AND CERTIFICATE OF ATTENDANCE

Preregistered attendees who did not receive a receipt or attendees who need a Certificate of Attendance may obtain those from the SPIE Cashier.

BADGE CORRECTIONS

Badge corrections can be made by the SPIE Cashier. Please have your badge removed from the badge holder and marked with your changes before approaching the counter.

REFUND INFORMATION

There is a US$50 service charge for processing refunds. Requests for refunds must be received by 14 February 2019; all registration fees will be forfeited after this date. Membership dues, SPIE Digital Library subscriptions, or Special Events purchased are not refundable.

U.S. GOVERNMENT CREDIT CARDS

U.S. Government credit card users: have your purchasing officer contact the credit card company and get prior authorization before attempting to register. Advise your purchasing agent that SPIE is considered a 5968 company for authorization purposes.

Author / Presenter Information

Speaker Check-In and Preview Station

Convention Center, Ballroom Concourse

Sunday · 12:00 pm to 5:00 pm
Monday–Wednesday · 7:30 am to 5:00 pm
Thursday · 7:30 am to 4:00 pm

All conference rooms have a computer workstation, projector, screen, lapel microphone, and laser pointer. All presenters are requested to come to Speaker Check-In with their memory devices or laptops to confirm their presentation display settings.

Poster Setup Instructions and Poster Previewing Hours

Convention Center Hall 2

Wednesday 27 February · 10:00 am to 5:00 pm

Poster authors to be present and at their posters during the session 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 the day of their poster session. Paper numbers will be posted on the poster boards in numerical order. Push pins will be provided. Posters can be previewed during the day until 5:00 pm.
• Presenters who have not placed their papers on their assigned board by 5:00 pm on the day of their presentation 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 for that day. 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 each night's poster session.

Your technical or participant registration badge is required to be worn to attend the poster sessions.

Onsite Services

Internet Options

WIRELESS ACCESS

Convention Center Upper Level Concourse

Complimentary wireless access is available; instructions will be posted onsite.

West end WiFi sponsored by

HITACHI
Inspire the Next
Hitachi High Technologies America, Inc.

East end and Exhibition Hall WiFi sponsored by

TEL

CHARGING STATION

Convention Center Concourse
Open during registration hours

Charging Station sponsored by **KLA+**

SPIE Conference and Exhibition App

Search and browse the program, special events, participants, exhibitors, courses, and more. Free Conference App available for iPhone and Android phones.

Sponsored by

TEL

SPIE Bookstore

Convention Center Lobby near Registration

Stop by the SPIE Bookstore to browse the latest SPIE Press Books, proceedings, and educational materials. While there, get a t-shirt or educational toy to bring home to the family.

SPIE Education Services

Course Materials Pick-Up located near SPIE Registration and open during registration hours

Sunday: Course Desk, Monday-Thursday: Bookstore

If you have registered to attend a course, please stop by the Course Materials Desk (Sunday) or Bookstore (Monday-Thursday) AFTER you pick up your badge. Turn in your course ticket to get your course materials and location of your course.

Browse course offerings and other education services available: SPIE courses at conferences, online, and customized in-company.

Child Care Services

Bay Area Sitters Unlimited

Rachael Osorio

Phone: 408.452.0225

Email: rfosorio15@gmail.com

Website: www.bayareasittersunlimited.com

Check out urbansitter.com to hand pick your child care provider online.

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

Urgent Message Line

An urgent message line is available during registration hours: 408.271.6005.

Quiet Room

San Jose Convention Center, Grand Ballroom Foyer
Marriott Hotel, Guadalupe Room

Open during registration hours.

The Quiet Room is intended for silent meditation, reflection, or prayer. No mobile device or computer use, and no food or beverages allowed.

Privacy Room

San Jose Convention Center, Grand Ballroom Foyer
Marriott Hotel, Think Tank

Open during registration hours.

The Privacy Room is a lockable room intended for nursing mothers. Please note that there is no running water or refrigeration in this space.

Lost and Found

SPIE Cashier

Open During Registration Hours

Found items will be kept at the SPIE Registration Cashier. At the end of the meeting, all found items will be turned over to the San Jose Convention Center Security: 408.277.3500

Food and Beverage Services

Coffee Breaks

Served daily – 7:30 am, 10:00 am and 3:00 pm

Check individual conference listings for exact times and locations.

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Breakfast Breads

Convention Center, Ballroom Concourse

Monday – Thursday, 7:30 am

Sponsored by **APPLIED MATERIALS** make possible   **ASML**

Food and Refreshments for Purchase

Convention Center, Ballroom Concourse

Monday – Thursday, 7:30 am to 4:00 pm

Hot and cold snacks, hot entrees, deli sandwiches, salads, and pastries are available for purchase. Cash and credit cards accepted.

Exhibition Hall Concession Stand

Tuesday – Wednesday, 11:00 am to 2:00 pm

Hot and cold snacks, hot entrees, deli sandwiches, salads, and pastries are available for purchase. Cash and credit cards accepted.

GENERAL INFORMATION

SPIE Hosted Lunches

Exhibition Hall

Tuesday – Wednesday, 11:30 am to 1:00 pm

Check individual conference listings for exact times

Complimentary tickets for these lunches will be included with full conference registrations. Students may purchase tickets at the Cashier Desk.

Sponsored by **GIGAPHOTON**

Desserts

Exhibition Hall 1

Tuesday and Wednesday

Complimentary tickets for the dessert snacks will be included in conference attendee registration packets.

Discounts for conference attendees

The City of San Jose offers many discounts to conference attendees. Visit the website to learn more.

Car Rental

Hertz Hertz Car Rental has been selected as the official car rental agency for this Symposium. To reserve a car, identify yourself as an Advanced Lithography Conference attendee using the Hertz Meeting Code CV# 029B0024. Discount rates apply to roundtrip rentals up to one week prior through one week after the conference dates. Note: When booking from International Hertz locations, the CV # must be entered with the letters CV before the number, i.e. CV029B0024.

- In the United States call 1-800-654-2240.
- In Canada call 1-800-263-0600, or 1-416-620-9620 in Toronto.
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Acceptance of Policies and Registration Conditions

The following Policies and Conditions apply to all SPIE Events. As a condition of registration, you will be required to acknowledge and accept the SPIE Registration Policies and Conditions contained herein.

Attendee Registration and Admission Policy

SPIE, or their officially designated event management, in their sole discretion, reserves the right to accept or decline an individual's registration for an event. Further, SPIE, or event management, reserves the right to prohibit entry or to remove any individual whether registered or not, be they attendees, exhibitors, representatives, or vendors, whose conduct is not in keeping with the character and purpose of the event. Without limiting the foregoing, SPIE and event management reserve the right to remove or refuse entry to anyone who has registered or gained access under false pretenses, provided false information, or for any other reason whatsoever that they deem is cause under the circumstances.

Payment Policy

Registrations must be fully paid before access to the conference is allowed. SPIE accepts VISA, MasterCard, American Express, Discover, Diner's Club, checks and wire transfers. Onsite registrations can also be paid with cash.

SPIE Safe Meeting Policy | Code of Conduct

SPIE is committed to providing a harassment- and discrimination-free experience for everyone at our events, an experience that embraces the richness of diversity where participants may exchange ideas, learn, network, and socialize in the company of colleagues in an environment of mutual respect.

SPIE does not tolerate harassment of event participants, attendees, exhibitors, speakers, volunteers, contractors, service providers, venue staff, or SPIE staff. This Code of Conduct applies to all SPIE meeting-related events, including those sponsored by other organizations but held in conjunction with SPIE events, in public or private facilities.

The SPIE Anti-Harassment Policy may be found at http://spie.org/policy (PDF)

The SPIE Code of Conduct may be found at http://spie.org/conduct (PDF)

In addition, SPIE Members and authors of SPIE publications must adhere to the SPIE Code of Ethics, found at http://spie.org/ethics (PDF)

Reporting of Unethical or Inappropriate Behavior

Onsite at an SPIE meeting, contact any SPIE Staff with concerns or questions for thorough follow-up. If you feel in immediate danger, please dial the local emergency number for police intervention.

SPIE has established a confidential reporting system for staff and all meetings participants to raise concerns about possible unethical or inappropriate behavior within our community. Complaints may be filed by phoning toll-free to +1-888-818-6898 from within the United States and Canada, or online at www.SPIE.ethicspoint.com and may be made anonymously.

Identification Requirement Policy

To verify registered participants and provide a measure of security, SPIE will ask attendees to present a government-issued photo identification at registration to collect registration materials.

Individuals are not allowed to pick up badges for other attendees. Further, attendees may not have some other person participate in their place at any conference-related activity. Such other individuals will be required to register on their own behalf to participate.

Access to Conference Events / Access for Children Younger than 18

All conference technical and networking events require a badge for admission. Registered attendees may bring children with them as long as they have been issued a badge. Registration badges for children under 18 are free and available at the SPIE registration desk onsite. Children under 14 years of age must be accompanied by an adult at all times, and guardians are asked to help maintain a professional, disturbance-free conference environment.

Exhibition Hall Access / Access for Children Younger than 18

Everyone who attends the exhibition must be registered and have a badge. Badges for children are free and available onsite at the registration desk. Children under 14 years of age must be accompanied by an adult at all times. Guardians are asked to help maintain a professional, disturbance-free exhibition environment. Children under 18 are not allowed in the exhibition area during exhibition move-in and move-out.

Unauthorized Solicitation Policy

Unauthorized solicitation in the Exhibition Hall is prohibited. Any nonexhibiting manufacturer or supplier observed to be distributing information or soliciting business in the aisles, or in another company's booth, will be asked to leave immediately.

Recording Policy

Conferences, courses, and poster sessions: For copyright reasons, recordings of any kind are prohibited without prior written consent of the presenter or instructor. Attendees may not capture or use materials presented in any meeting/course room or in course notes on display without written permission. Consent forms are available at Speaker Check-In or SPIE Registration. Individuals not complying with this policy will be asked to leave a given session and/or asked to surrender their recording media. Refusal to comply with such requests is grounds for expulsion from the event.

Exhibition Hall: Recordings of any kind are prohibited without explicit permission from on-site company representatives. Individuals not complying with this policy will be asked to surrender their recording media and to leave the exhibition hall. Refusal to comply with such requests is grounds for expulsion from the event.

Capture and Use of a Person's Image

By registering for an SPIE event, you grant full permission to SPIE to capture, store, use, and/or reproduce your image or likeness by any audio and/or visual recording technique and create derivative works of these images and recordings in any SPIE media now known or later developed, for any legitimate SPIE marketing or promotional purpose.

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Laser Pointer Safety Information/Policy

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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Journal of
Micro/Nanolithography, MEMS, and MOEMS

Chris A. Mack, Lithoguru.com
Editor-in-Chief
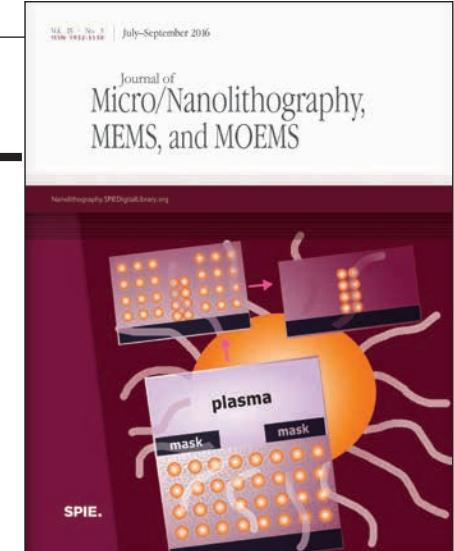
The *Journal of Micro/Nanolithography, MEMS, and MOEMS* (JM3) publishes peer-reviewed papers on the development of lithographic, fabrication, packaging, and integration technologies necessary to address the needs of the electronics, micro-optoelectromechanical systems, and photonics industries. The scope is broad to facilitate synergy and interest between the communities served by the journal.

TOPICAL AREAS COVERED INCLUDE:

– Lithography
– Microelectromechanical systems (MEMS)
– Micro-optoelectromechanical systems (MOEMS)
– Microfabrication
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Paid conference registration includes online Proceedings of SPIE. In the tables below you will find product order numbers to use on the registration form.

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- **Online Proceedings Collection**—access to multiple related proceedings volumes via the SPIE Digital Library. Available as papers are published.

> **Conference Attendees may purchase additional online collections or volumes with registration—see pricing below.**
>
> **Print *Proceedings of SPIE* volumes from this conference may be purchased at www.Proceedings.com.**

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Product Order Number	Volume Title	Price
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DL 10963	Advanced Etch Technology for Nanopatterning VIII	$60.00

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71