

# 2013 Advanced Lithography

## Technical Program

[www.spie.org/al](http://www.spie.org/al)

### Location

San Jose Marriott and  
San Jose Convention Center  
San Jose, California, USA

### Conferences and Courses

24–28 February 2013

### Exhibition

26–27 February 2013



# Welcome

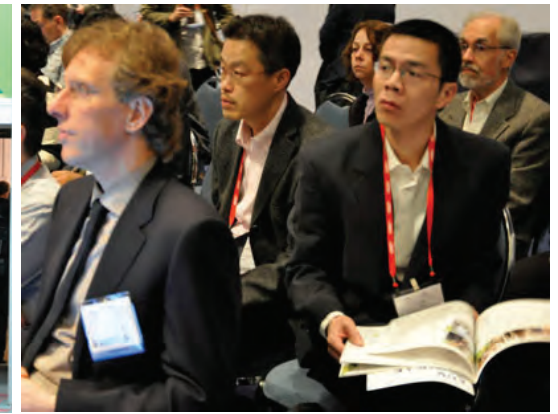
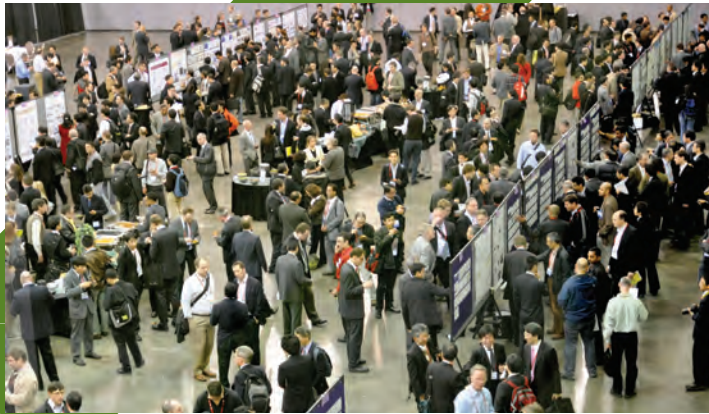
Your attendance at SPIE Advanced Lithography increases your company's success in the lithography industry through access to the latest research, networking opportunities, and technology on display.

**SPIE**   
Advanced Lithography  
**Technical Program**

**Conferences and Courses: 24–28 February 2013 · Exhibition: 26–27 February 2013**  
San Jose Marriott and San Jose Convention Center, San Jose, California, USA

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

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



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## Technical Conferences

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<b>Metrology, Inspection, and Process Control for Microlithography XXVII</b> (Starikov, Cain) .....	18-52
<b>Advances in Resist Materials and Processing Technology XXX</b> (Somervell, Wallow) .....	18-43
<b>Optical Microlithography XXVI</b> (Conley, Lai) .....	19-53
<b>Design for Manufacturability through Design-Process Integration VII</b> (Mason, Sturtevant) .....	19-53
<b>Advanced Etch Technology for Nanopatterning II</b> (Zhang, Oehrlein, Lin) .....	19-31

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# Welcome!

Today, lithographers are challenged with cost-effectively extending immersion lithography to physical limits using multi-exposure and multiple-etch processes, while striving to bring newer technologies, such as EUV lithography, to production readiness. Success will demand unprecedented ingenuity, cost efficiency, and communication within the lithography community and across interdisciplinary lines.

For the past 37 years, SPIE Advanced Lithography has played a key role in bringing the lithography community together to solve challenges required by the semiconductor industry. Symposium participants come from an extensive array of backgrounds to share and learn about state-of-the-art lithographic tools, resists, metrology, materials characterization, and design and process integration.

SPIE Advanced Lithography is organized into seven conferences:

- Alternative Lithographic Technologies
- Extreme Ultraviolet Lithography
- Metrology, Inspection, and Process Control for Microlithography
- Advances in Resist Materials and Processing Technology
- Optical Microlithography
- Design for Manufacturability through Design-Process Integration
- Advanced Etch Technology for Nanopatterning

All conferences are organized by current practitioners of the art, and numerous courses are taught by recognized industry experts. Additional information is available from the many manufacturers' exhibits, which allow tool makers and material and software suppliers to showcase new products while interacting one-on-one with customers. Through a series of thought-provoking panel discussions and seminars, the symposium further probes current issues to be faced as we extend these technologies or try to switch to alternative technologies.

We welcome you to the San Jose Convention Center, San Jose, California, for SPIE Advanced Lithography's 38th year!















**Harry J. Levinson**  
GLOBALFOUNDRIES Inc.  
2013 Symposium Chair

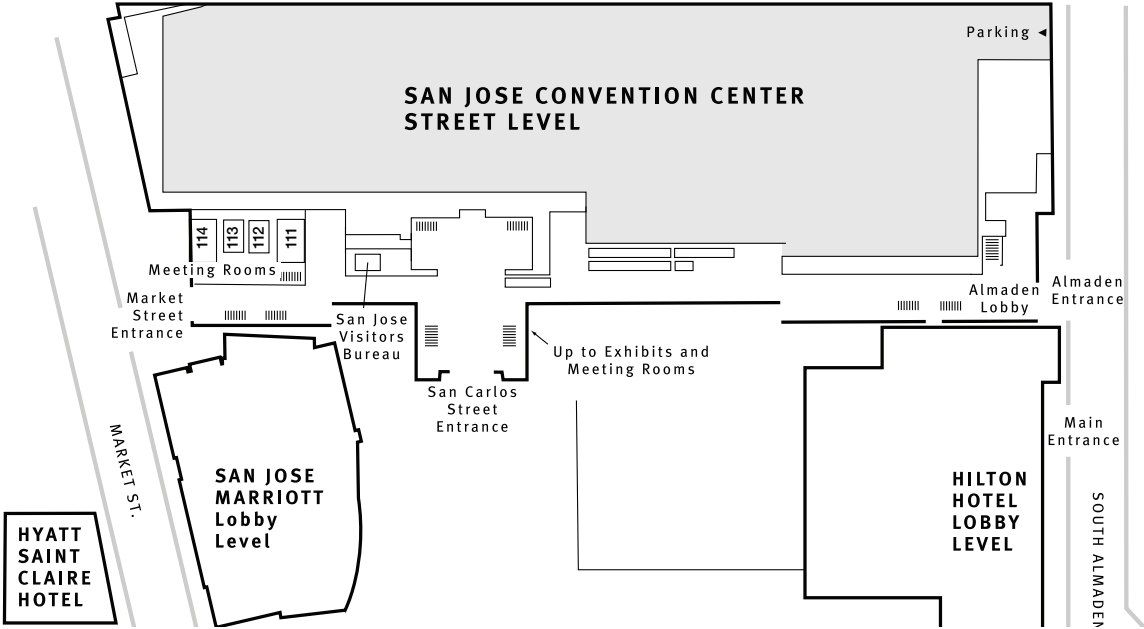
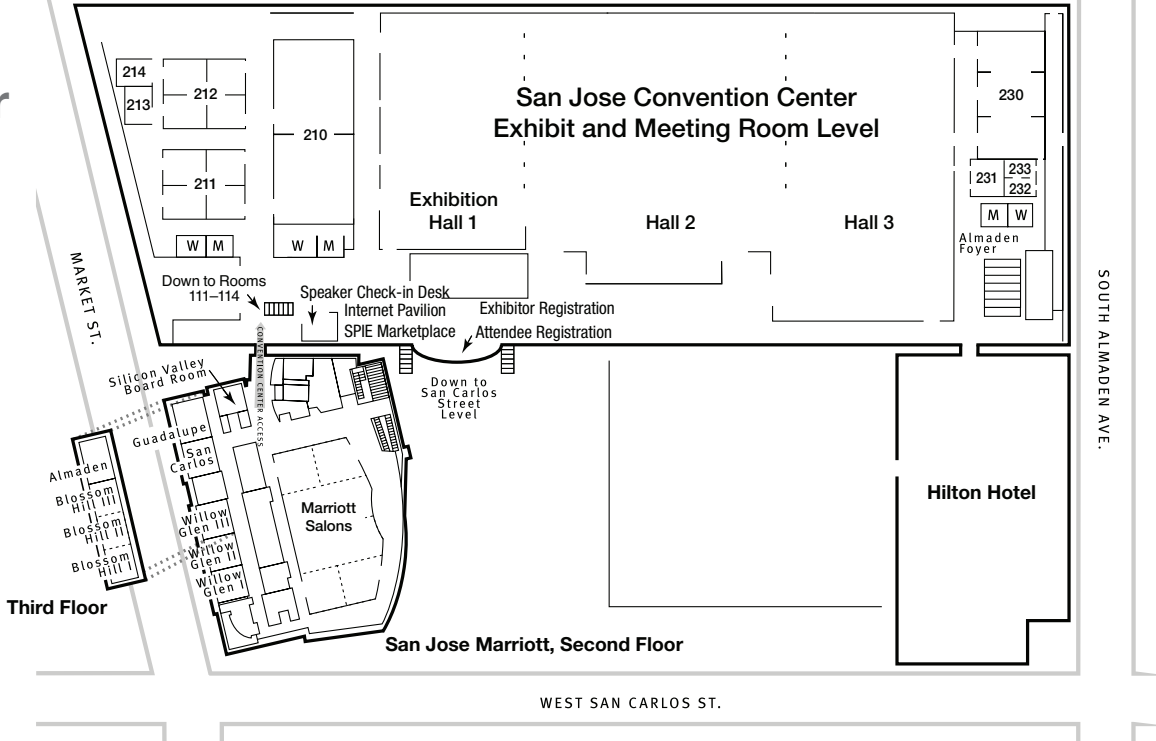


**Mircea V. Dusa**  
ASML US, Inc.  
2013 Symposium Co-Chair

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<p>Alternative Lithographic Technologies V Conference</p>  <p>ELECTRONIC MATERIALS www.azem.com</p>	<p>Conference Bag Pen</p>  <p>www.nikonprecision.com</p>	<p>Stairway Strips</p> <p><b>FUJIFILM</b> www.fujifilm-ffem.com</p>
<p>Coffee Break</p> <p><b>ASML</b> www.asml.com</p> <p><b>KLA Tencor</b> www.kla-tencor.com</p>	<p>Exhibitor Lounge</p> <p><b>HITACHI</b> Inspire the Next www.hitachi-hta.com</p>	<p>Banner</p> <p><b>HITACHI</b> Inspire the Next www.hitachi-hta.com</p> <p><b>KLA Tencor</b> www.kla-tencor.com</p>  <p>www.nikonprecision.com</p>
<p>Tuesday Poster Reception</p>  <p><b>TOKYO ELECTRON</b> www.tel.com</p>	<p>Exhibition Bag</p>  <p>www.smt.zeiss.com/sms</p>	<p>Breakfast Sponsor</p>  <p>www.appliedmaterials.com</p>
<p>Wednesday Poster Reception</p>  <p>ELECTRONIC MATERIALS www.azem.com</p> <p><b>tok</b> www.tokamerica.com</p>	<p>Luggage Tags</p>  <p>www.appliedmaterials.com</p> <p>Hotel Room Key</p> <p><b>CYMER</b><sup>®</sup> www.cymer.com</p>	<p>General Refreshments</p> <p>ASML Hitachi High Technologies Micro Lithography Inc. Solid State Technology TNO Science and Industry</p>
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# San Jose Convention Center and Marriott Hotel



# Daily Schedule

SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY
Special Events	<b>Welcome and Announcements</b> (Levinson), 8:00 to 8:40 am, p. 6	<b>EXHIBITION</b> , p. 10 10:00 am to 5:00 pm		<b>Presentation of the Best Student Paper Award in Microlithography</b> , 10:30 to 10:40 am, p. 9
	<i>Plenary presentation: Contact Printing to EUV: Lessons Learned from the Art of Lithography</i> (Siegle) 8:40 to 9:10 am, p. 6	<b>Panel Discussion on Challenges for Directed Self-Assembly</b> (Cheng, Tong) 5:00 to 7:00 pm, p. 8	<b>Poster Reception</b> (Conferences 8681, 8682, 8685) 6:00 to 8:00 pm, p. 8	<b>2013 Best Student Paper Award in Metrology</b> , 10:30 to 10:40 am, p. 9
	<i>Plenary presentation: The Evolution of EDA Alongside Rapid Silicon Technology Innovation</i> (Ko) 9:10 to 9:50 am, p. 7	<b>Joint Panel Discussion</b> (Joint Panel with confs. 8679, 8680, 8682, 8683, 8684), 7:30 to 9:00 pm, p. 8	<b>Panel Discussion on Making a Business Case for Disruptive Metrology Technologies: What Should We Invest In?</b> (Vaid, Bunday, Sendelbach) 7:30 to 9:00 pm, p. 8	
	<i>Plenary presentation: The New U.S. Patent Law: What You Need to Know and How It Will Affect Your Strategy</i> (Szmada, Shelnut) 9:50 to 10:30 am, p. 7	<b>Poster Reception</b> (Conferences 8679, 8680, 8683, 8684) 6:00 to 8:00 pm, p. 8		
	<b>Award Announcements for Conference on Metrology, Inspection, and Process Control for Microlithography</b> , 11:00 to 11:20 am, p. 9			
	<b>Award Announcements for Conference on Advances in Resist Materials and Processing Technology</b> , 11:00 to 11:20 am, p. 9			
	<b>Nanotechnology in Microlithography Panel Discussion, Approaching the Limits of 3D Metrology: Are There Any Solutions Beyond 14 nm?</b> (Silver, Barnes, Bunday) 6:00 to 7:30 pm, p. 8			
Conferences	Conf. 8679 <b>Extreme Ultraviolet (EUV) Lithography IV</b> (Naulleau) p. 18-48			
	Conf. 8680 <b>Alternative Lithographic Technologies V</b> (Tong) p. 18-52			
	Conf. 8681 <b>Metrology, Inspection, and Process Control for Microlithography XXVII</b> (Starikov) p. 18-52			
	Conf. 8682 <b>Advances in Resist Materials and Processing Technology XXX</b> (Somervell) p. 18-43			
	Conf. 8683 <b>Optical Microlithography XXVI</b> (Conley) p. 19-53			
	Conf. 8685 <b>Advanced Etch Technology for Nanopatterning II</b> (Zhang) p. 19-31		Conf. 8684 <b>Design for Manufacturability through Design-Process Integration VII</b> (Mason) p. 19-53	

See Course Daily Schedule, page 15.



# Special Events

## Welcome and Announcements

Convention Center Hall 3

Monday 25 February . . . . . 8:00 to 8:40 am

Symposium Chair: **Harry J. Levinson**,  
GLOBALFOUNDRIES

## Introduction of New SPIE Fellows

### 10th Frits Zernike Award for Advances in Optical Microlithography

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## PLENARY PRESENTATIONS · Convention Center Hall 3

8:40 to 9:10 am

### Contact Printing to EUV: Lessons Learned from the Art of Lithography



**William T. Siegle**, Independent Consultant and ASML Advisory Board Member

We have all had the privilege of working in an electronics industry that has shown stunning advances. Over the last 50 years, we have watched a progression from discrete transistors and simple ICs, to powerful computers we all carry in our pockets. This progress would not have been possible without equally remarkable progress in semiconductor lithography, the art of creating patterns on silicon to form these circuit patterns.

Through my career at IBM, AMD, and Board memberships at Etec, DuPont Photomasks, and ASML, I have been both observer, participant, and user of lithography. The enormous progress in both the IC technology and the accompanying lithography techniques has provided many “teaching moments”. It is my privilege to share some of the lessons gleaned from this experience. While some of these lessons are peculiar to our arcane art, others may be more broadly applicable.

The first era of lithography practiced “1 to 1” printing. That is, mask patterns and wafer images were dimensioned in a one-to-one relationship. Initially practiced through contact printing in the 60s, moving to 1x projection in the 70s, this practice served well until demands on mask fidelity became too great, and reduction alternatives became available. As wafer sizes grew, and feature sizes shrank, optical reduction techniques and “step and repeat” of sub wafer field sizes ruled the day. Once robust steppers became widely available, the race turned to reducing wavelength and “wave front engineering” to deliver smaller features. With exposure wavelengths currently limited to 193nm, exhausted litho engineers are resorting to multiple patterning to escape the trauma of ridiculously low k1 values.

EUV with its 13.5nm wavelength promises relief from 193nm limits. While prototype machines are operating in a number of customer fabs, the productivity required for economical manufacturing insertion has not yet been demonstrated. Other alternatives, such as e- beam or nanoimprint have shown promising laboratory results, and show lots of activity at this conference each year. But a viable path to production insertion for these alternatives is not visible, and substantial industrialization investment would be required.

Never-the-less, the dedication and ingenuity of our worldwide talents always seems to find a way. Many lessons have been learned, with in all likelihood, more to come.

**Bill (William T.) Siegle** attended Rensselaer Polytechnic, and he received his Ph. D. in Electrical Engineering in 1964. He enjoyed a 25 year career at IBM where he became the Director of the Advanced Technology Center in East Fishkill. He joined Advanced Micro Devices in Sunnyvale in 1990 as Vice President of Technology, and retired in 2005 as Sr. VP of Technology and Manufacturing. He has served on the boards of SRC and Sematech, and the public companies Etec, DuPont Photomasks and currently ASML. He has been involved with lithography throughout his career, as both an enabler and a user.



9:10 to 9:50 am

## The Evolution of EDA Alongside Rapid Silicon Technology Innovation



**Howard Ko**, Senior VP and General Manager, Synopsys' Silicon Engineering Group

The overall product design and manufacturing flow needed to create a new advanced semiconductor device is one of the most economically successful and most complex industrial ecosystems in the world. The ongoing economic success is especially amazing when one considers the enormous changes which occurs in this complex ecosystem every technology generation. SPIE attendees know full well the many important difficulties and challenges involved in continuing the rapid pace of cost-effective lithography and silicon process development. Just as critical, however, are the challenges which designers and EDA suppliers face to modify and re-architect their design flows and design tools to best incorporate the outcomes of this rapid technology improvement. The goal of this talk is to provide high level insight into the continuing evolution which the EDA industry has done and must continue to do in order to keep pace with the hectic pace of silicon technology innovation.

**Dr. Howard Ko** joined Synopsys in June 2002 and is currently Senior Vice President and General Manager of the Silicon Engineering Group. He manages products and solutions that address semiconductor manufacturing technology needs. These solutions include TCAD, yield management, failure analysis, mask data preparation, Optical design and analysis, Photonics design, lithography simulation, and mask patterning. In his previous role as Vice President of Sales, Asia Pacific, Dr. Ko built a continuously increasing revenue stream, improved Synopsys' leadership position in the region, and increased collaboration with leading foundries. Before joining Synopsys, Dr. Ko served as Avant!'s executive operating officer since July 2001. Previously, he was general manager of Avant!'s mixed technology division and head of the system product line. Dr. Ko has also held senior management roles at Analogy, Inc. and Mentor Graphics. Dr. Ko received his Ph.D. in Electrical Engineering and Computer Science from UC Berkeley, and graduated with a B.S. degree in Electrical Engineering from the National Taiwan University.

9:50 to 10:30 am

## The New U.S. Patent Law: What You Need to Know and How It Will Affect Your Strategy



**Charles R. Szmanda, James G. Shelnut**, The Patent Practice of Szmanda, Shelnut, LLC

Over the years, the electronic patterning arts have been characterized by a business environment that incorporates features of pre-competitive cooperation during the early phases of development and intense competition during the later phases. Cooperative activities such as pre-competitive development, joint development agreements, road-mapping activities, and the sharing of resources are commonplace. Moreover, while the electronics industry is intensely competitive during later stages of development and production, the willingness of many industry players to license and cross license patented technologies has promoted rapid technological development for decades in ways not seen in other industries. This business environment, and the old patent laws based on "first-to-invent" priority, have formed a basis for many current intellectual property strategies.

In this talk, we review briefly what a patent is and what is required to get one. We then describe the most important aspects of the new patent law. These include: (1) the "first inventor to file" system, which takes effect on March 16, 2013 and replaces the "first to invent" system in current law; (2) new ways to challenge issued patents such as "Post Grant Review" and "Inter Partes" review; (3) prior art submission during prosecution of another inventor's patent application; (4) prioritized examination of applications; and (5) prior user rights. We go on to discuss how these new elements of the law will alter the competitive environment but will also present a number of opportunities for formulating a successful patent strategy within that new environment.

We conclude by offering several suggestions for formulating a practical patent strategy in view of the new laws. We show how publishing at the wrong time can destroy your right to get a patent but publishing at the proper time can enhance your competitive position. We further show how you can protect your right to practice trade secrets that you choose not to patent. Finally, we show how the law provides opportunities to challenge patent claims submitted by competitors both before and after the patent is granted.

**Charles R. Szmanda** is a principal partner at the Patent Practice of Szmanda & Shelnut, LLC. He has been a patent agent, for over 12 years and is registered to practice before the United States Patent and Trademark Office and the Canadian Intellectual Property Office.

Szmanda spent many years in research and development, most recently as a Research Fellow at the Dow Electronic Materials Company, where he worked on electronic applications of nanotechnology and did research on photoresist materials. During his career, he designed processes for making silicon devices at Bell Labs, did polymer research for micro and nanolithography, helped found a startup company called Aspect Systems, did fundamental research on electron transfer during molecular collisions, practiced the wonderful art of x-ray crystallography and generally had a lot of fun. He holds 31 U.S. patents and is the author of over 60 scientific publications.

Szmanda holds a B.S. in chemistry from Loyola University and a Ph.D. in physical chemistry from the University of Wisconsin.

In his off hours, he continues to blow the hell out of his flugelhorn whenever he can put a band together.

# Technical Events

## Nanotechnology in Microlithography Panel Discussion

Convention Center Room 210 B

Monday 25 February . . . . . 6:00 to 7:30 pm

### Approaching the Limits of 3D Metrology: Are There Any Solutions Beyond 14 nm?

Moderators: **Richard M. Silver**, Bryan Barnes, National Institute of Standards and Technology; **Benjamin Bunday**, International SEMATECH

## Poster Receptions

Convention Center Hall 2

Tuesday 26 February . . . . . 6:00 to 8:00 pm

(Conferences 8679, 8680, 8683, 8684)

Tuesday Poster Reception Sponsor



**TOKYO ELECTRON**

The Exhibition will be open during the Poster Reception on Tuesday only. Be sure to visit the exhibit booths during this time for insight on what is new or coming soon!

Convention Center Hall 2

Wednesday 27 February . . . . . 6:00 to 8:00 pm

(Conferences 8681, 8682, 8685)

Wednesday Poster Reception Sponsors



All registered attendees are invited to attend the poster sessions. Come view the high-quality papers that are presented in this alternative format, and interact with the poster authors who will be available for discussion. Enjoy light refreshments while networking with colleagues in your field.

Attendees and authors are required to wear their conference registration badges to the poster sessions.

## Panel Discussion on Challenges for Directed Self-Assembly

Convention Center Hall 3

Tuesday 26 February . . . . . 5:00 to 7:00 pm

Moderators: **William M. Tong**, KLA-Tencor Corp. and **Joy Y. Cheng**, IBM Almaden Research Ctr.

Directed self-assembly (DSA), which combines lithography-defined pre-patterns with self-assembled phase-separated polymers, has become a promising path to continue the scaling of semiconductor devices. As a materials-based resolution enhancement technique, DSA has been demonstrated to augment the patterning capability of 193i, EUV and E-beam lithography, and has begun to transition from research labs to development lines in past two years. While there have been important advances on the materials and process fronts, to enable DSA as a resolution enhancement technology, more efforts are required in areas such as DSA-aware design and low defectivity. The characteristic length and nature of phase-separated polymers impose DSA-specific design restrictions and design-related defectivities. The integration of compact DSA model into design and computational lithography may facilitate the co-optimization of design, materials, and processes. On the defectivity front, more experimental data on inspection, metrology and unit process monitoring are needed to identify the defect sources and intrinsic DSA defects. Please join experts in design, DFM, metrology, and other critical areas in DSA to discuss these critical challenges for DSA.

## Joint Panel Discussion

Convention Center Hall 3

Tuesday 26 February . . . . . 7:30 to 9:00 pm

Joint Panel with conferences 8679, 8680, 8682, 8683, 8684

## Panel Discussion on Making a Business Case for Disruptive Metrology Technologies: What Should We Invest In?

Convention Center Room 230 B

Wednesday 27 February . . . . . 7:30 to 9:00 pm

Moderators: **Alok Vaid**, GLOBALFOUNDRIES, Inc.; **Benjamin D. Bunday**, SEMATECH North; **Matthew J. Sendelbach**, Nova Measuring Instruments, Inc.

Continuing decrease in the device dimensions, combined with complex disruptive materials and 3D architectures have placed increasing demands on metrology tools. Over the years, the industry has implemented several innovative solutions to alleviate these challenges, but most of them have been incremental improvements rather than revolutionary. There seems to be inertia preventing the adoption of revolutionary and disruptive measurement techniques, some of which have been in the limelight for about a decade. The panel will focus on three key disruptive solutions which have been identified as potential next-generation metrology and inspection technologies for some time – CD-SAXS, Multi-ebeam-based inspection, and He-ion imaging. Our panel of experts will come from a mix of IC manufacturers, suppliers, academia, research consortia and venture capitalist firms. Panelists will review the technical, business and financial aspects of these technologies and also try to form a consensus on whether they are really needed to meet current industry requirements. The panel will recommend whether the industry should continue to invest in these technologies, and if so, then what it will “actually” take to get them implemented in HVM.

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# Award Announcements

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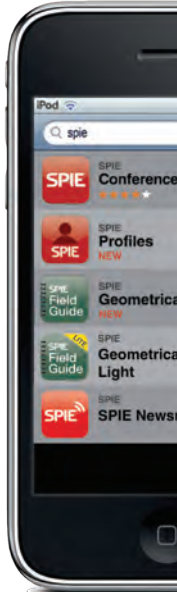
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### Award Announcements for Conference on Metrology, Inspection, and Process Control for Microlithography

Convention Center Room 230 B

Monday 25 February . . . . . 11:00 to 11:20 am

#### Presentation of the 2012 Diana Nyssonen Memorial Award for Best Paper in Metrology

Award Sponsored by



#### Presentation of the 2013 Best Student Paper Award in Metrology

Convention Center Room 230 B

Thursday 28 February . . . . . 10:30 to 10:40 am

Award Sponsored by



### Award Announcements for Conference on Advances in Resist Materials and Processing Technology

Convention Center Hall 3

Monday 25 February . . . . . 11:00 to 11:20 am

#### Presentation of the 2012 C. Grant Willson Award for Best Paper in Resist

#### Presentation of the 2012 Hiroshi Ito Memorial Award for the Best Student Paper in Resist

These Awards Sponsored by



#### Presentation of the 2012 Jeffrey Byers Memorial Best Poster Award in Resist

Award Sponsored by



### Award Announcement for Conference 8683—Optical Microlithography

Convention Center Room 210 C

Thursday 28 February . . . . . 10:30 to 10:40 am

#### Presentation of the 2013 Best Student Award in Microlithography

Award Sponsored by



# Visit the exhibition. See the latest lithography research and development, devices, tools, fabrication, and services.

## Exhibition

Convention Center Hall 1

Tuesday 26 February  
10:00 am to 5:00 pm;  
Poster reception:  
6:00 to 8:00 pm

Wednesday 27 February  
10:00 am to 4:00 pm

## Exhibition Technologies

**Lithography: immersion, double patterning, e-beam, EUV, optical/laser, and RET**

**Metrology, inspection, OPC, and process control**

**Design and manufacturing software**

**Materials and chemicals**

**Imaging equipment**

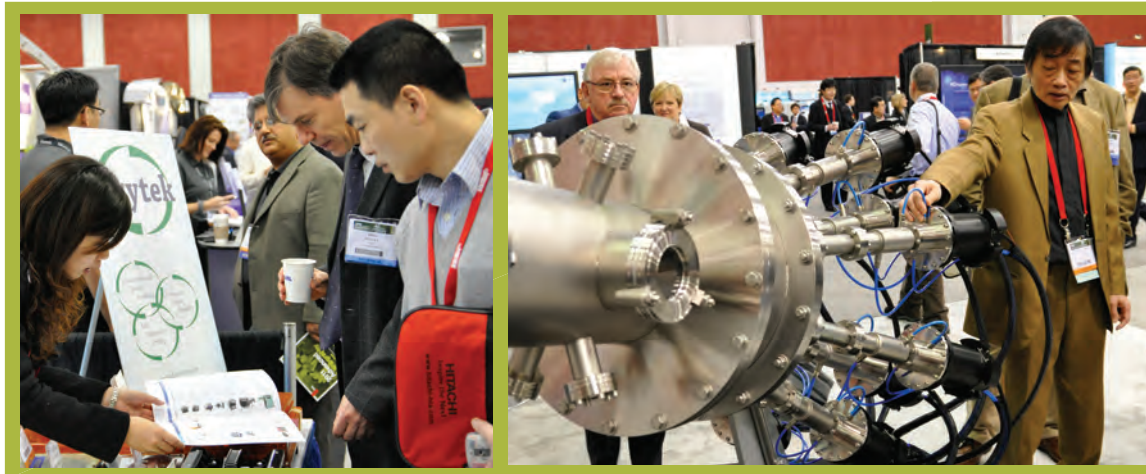
**Lasers**

**Resist materials and processing**

**Nano-imprint**

**IC and chip fabrication**

**Nanoscale imaging**



### 2013 Exhibiting Company list

*(Current as of 1/21/2013)*

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Benchmark Technologies

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Brion Technologies

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Xyalis  
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## Registration

### Onsite Registration and Badge Pick-up Hours

*Location – San Jose Convention Center Concourse 2 Level*

Sunday 24 February . . . . .	7:00 am to 5:00 pm
Monday 25 February . . . . .	7:00 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 . . . . .	7:30 am to 4:00 pm

### Conference Registration

Includes admission to all conference sessions, plenaries, panels, and poster sessions, admission to the Exhibition, coffee breaks, SPIE hosted lunches Tuesday and Wednesday, and a choice of proceedings. Student pricing does not include proceedings.

- 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 a 50% discount on all 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.

### 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 Pickup after you pick up your badge. Multiple facilities may be used for courses; allow yourself enough time to register, pick up your materials and possibly walk to a nearby facility before your course begins.

### Exhibition Registration

Exhibition-Only visitor registration is complimentary.

### Press Registration

For credentialed press and media representatives only. Please email contact information, title, and organization to [media@spie.org](mailto:media@spie.org)

### SPIE Cashier

*Registration Area*

Open during registration hours

### Registration Payments

If you are paying by cash or check as part of your onsite registration, wish to add a course, workshop, or special event requiring payment, or have questions regarding your registration, visit the SPIE Cashier.

### Receipts 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\$40 service charge for processing refunds. Requests for refunds must be received by 15 February, 2013; all registration fees will be forfeited after this date. Membership dues, reception tickets, and SPIE Digital Library subscriptions are not refundable.

## Author / Presenter Information

### Speaker Check-In and Preview Station

*Convention Center Ballroom Concourse*

Sunday . . . . .	2:00 pm to 6:00 pm
Monday through Thursday . . . . .	7:30 am to 5:00 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 Set-up Instructions

Authors of poster papers will be present and at their posters during these sessions to answer questions and provide in-depth discussion concerning their posters.

Poster authors may set up their posters after 10:00 am on the day of their poster session. Poster supplies (push-pins) will be available. Posters can be previewed during the day until one hour before the formal poster sessions begin at 6:00 pm.

It is the authors' responsibility to remove their posters and all other materials at the conclusion of the poster reception for that day. Posters and all 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 reception.

Attendees and authors are required to wear their conference registration badges to the poster sessions.

# General Information

## Onsite Services

### Internet Access

Convention Center Concourse

### Internet Pavilion

Sponsored by 

SPIE will have a complimentary Internet Pavilion at the Convention Center from Sunday through Thursday during registration hours. Attendees can use provided workstations or hook up their laptop to an Ethernet connection to access the Internet.

### Complimentary Internet Wireless Access

Sponsored by

   
Inspire the Next

SPIE is pleased to provide complimentary wireless access to the Internet for all conference attendees bringing 802.11b wireless-enabled laptops or PDAs. Coverage will be available Sunday through Thursday in the Convention Center Ballroom Concourse.

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

### SPIE Bookstore

Convention Center Concourse 1

The SPIE Bookstore is your source for the latest SPIE Press Books, Proceedings, and Education and Professional Development materials. Become an SPIE Member, explore the Digital Library, take home a free SPIE poster, or buy a souvenir (tie, t-shirt, educational toys, and more).

### SPIE Education Services

San Jose Convention Center, Bookstore, Near Registration

Browse course offerings and the other education services available: SPIE courses, videos, and CDs as well as customized in-company courses.

### SPIE Press Room

Marriott Think Tank Room

Open during Registration hours. For Registered Press only. The Press Room provides meeting space, refreshments, access to exhibitor press releases, and Internet connections. Press are urged to register before the meeting by emailing name, contact information, and name of publication to [media@spie.org](mailto:media@spie.org)

Preregistration closes approximately 10 days before the start of the event.

### Child Care Services

Bay Area 2nd MOM Inc., Hotel Nanny Service  
Toll Free Phone: 1-888-926-3666, or 650-858-2469 or 650-787-6518

Email: [bayarea2ndmom@gmail.com](mailto:bayarea2ndmom@gmail.com)  
Website: [www.2ndmom.com](http://www.2ndmom.com)

Sitters Unlimited

Toll Free Phone: (408) 452-0225  
E-mail: [info@bayareasittersunlimited.com](mailto:info@bayareasittersunlimited.com)  
Website: [www.bayareasittersunlimited.com](http://www.bayareasittersunlimited.com)

SPIE does not imply an endorsement or recommendation of this service. It is provided on an "information only" basis for your further analysis and decision. Other services may be available.


### Urgent Message Line

An urgent message line is available during registration hours:  
+ 408-271-6279

## Food + Beverage Services

### Coffee Breaks | Breakfast Breads

7:30 to 8:30 am Monday–Thursday (Breakfast Breads)

Tuesday breakfast sponsored by 

10:00 am and 3:00 pm, Sunday – Thursday (Coffee Breaks)  
Convention Center Ballroom Concourse/Exhibition Hall

Sponsored by  

Complimentary coffee will be served daily, at 7:30 am, 10:00 am and 3:00 pm. Check individual conference listings for exact times and locations.

### Food & Refreshments for Purchase

Convention Center Concourse and Exhibition Hall Concession Stand

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.

### SPIE-Hosted Lunches

Exhibition Hall 1

Hosted lunches will be served in the Exhibition Hall at the following times:

Tuesday and Wednesday . . . . . 11:30 am to 1:00 pm

Tuesday lunch co-sponsored by  Electronic Materials

Please check the individual technical conference listings for exact times.

Complimentary tickets for these lunches will be included with full conference registrations. Exhibitors and students may purchase tickets at the Cashier located in Concourse 1.

### Desserts

Complimentary tickets for dessert snacks are included in course and conference attendee registration packets.

## Transportation

### Airport Shuttles

- SuperShuttle with Discount for SPIE attendees
- South & East Bay Airport Shuttle
- Airport Commuter Limo Service

### Taxi from San Jose Airport

Complimentary Park & Ride Parking Lots  
Free regular Park & Ride parking is limited to 72 hours.

### Airport Flyer & Light Rail

From SJC, take the free Airport Flyer #10 toward Metro Light Rail and transfer at Metro/Airport Light Rail Station. Go southbound on Santa Teresa Line or Winchester Line to Convention Center Station. San Jose Convention Center is adjacent to the Convention Center Station on San Carlos Street.

## Fares

### Driving Directions & Parking

- Driving Directions (PDF)
- Parking at San Jose McEnery Convention Center
- Alternate Parking Nearby Convention Center
- Parking Lot Map (PDF)
- Contracted Hotels' parking rates range from \$21 - \$26 per day for overnight guests. Non-guests can pay hourly. Rates subject to change. Parking at the Ramada is complimentary.

## Car Rental

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# 029B0018. 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. CV029B0018.

- In the United States call 1-800-654-2240.
  - In Canada call 1-800-263-0600, or 1-416-620-9620 in Toronto.
  - In Europe and Asia call the nearest Hertz Reservation Center or travel agent.
  - Outside of these areas call 1-405-749-4434.
  - Book Online at Hertz
- Information: visit the Team San Jose website.

## Policies

### 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.

### Granting Attendee Registration and Admission

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 remove any individual whether registered or not, be they attendees, exhibitors, representatives, or vendors, who in their sole opinion are not, or 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 any attendee, exhibitor, representative, or vendor 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.

### Misconduct Policy

SPIE is a professional, not-for-profit society committed to providing valuable conference and exhibition experiences. SPIE is dedicated to equal opportunity and treatment for all its members and meeting attendees. Attendees are expected to be respectful to other attendees, SPIE staff, and contractors. Harassment and other misconduct will not be tolerated; violators will be asked to leave the event.

### Capture and Use of a Person's Image

By registering for this event, I grant full permission to SPIE to capture, store, use, and/or reproduce my image or likeness by any audio and/or visual recording technique (including electronic/digital photographs or videos), 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.

By registering for this event, I waive any right to inspect or approve the use of the images or recordings or of any written copy. I also waive any right to royalties or other compensation arising from or related to the use of the images, recordings, or materials. By registering, I release, defend, indemnify and hold harmless SPIE from and against any claims, damages or liability arising from or related to the use of the images, recordings or materials, including but not limited to claims of defamation, invasion of privacy, or rights of publicity or copyright infringement, or any misuse, distortion, blurring, alteration, optical illusion or use in composite form that may occur or be produced in taking, processing, reduction or production of the finished product, its publication or distribution.

### Audio, Video, Digital Recording Policy

Conferences, courses, and poster sessions: For copyright reasons, recordings of any kind are prohibited without prior written consent of the presenter. Attendees may not capture nor use the materials presented in any meeting room without written permission. Consent forms are available at Speaker Check-In. Individuals not complying with this policy will be asked to leave a given session and asked to surrender their recording media.

Exhibition Hall: For security and courtesy reasons, recordings of any kind are prohibited unless one has 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.

Your registration signifies your agreement to be photographed or videotaped by SPIE in the course of normal business. Such photos and video may be used in SPIE marketing materials or other SPIE promotional items.

### 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 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. Come to Speaker Check-In and test your laser pointer on our power meter. You are required to sign a waiver releasing SPIE of any liability for use of potentially non-safe, personal laser pointers. Misuse of any laser pointer can lead to eye damage.

### Underage Persons on Exhibition Floor Policy

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

### Unauthorized Solicitation Policy

Unauthorized solicitation in the Exhibition Hall is prohibited. Any non-exhibiting 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.

### 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.

# General Information

## Wireless Internet Service Policy

At SPIE events where wireless is included with your registration, SPIE provides wireless access for attendees during the conference and exhibition but cannot guarantee full coverage in all locations, all of the time. Please be respectful of your time and usage so that all attendees are able to access the internet.

Excessive usage (e.g., streaming video, gaming, multiple devices) reduces bandwidth and increases cost for all attendees. No routers may be attached to the network. Properly secure your computer before accessing the public wireless network. Failure to do so may allow unauthorized access to your laptop as well as potentially introduce viruses to your computer and/or presentation. SPIE is not responsible for computer viruses or other computer damage.

## Mobile Phones and Related Devices Policy

Mobile phones, tablets, laptops, pagers, and any similar electronic devices should be silenced during conference sessions. Please exit the conference room before answering or beginning a phone conversation.

## Smoking

For the health and consideration of all attendees, smoking is not permitted at any event elements, such as but not limited to: plenaries, conferences, workshops, courses, poster sessions, hosted meal functions, receptions, and in the exhibit hall. Most facilities also prohibit smoking in all or specific areas. Attendees should obey any signs preventing or authorizing smoking in specified locations.

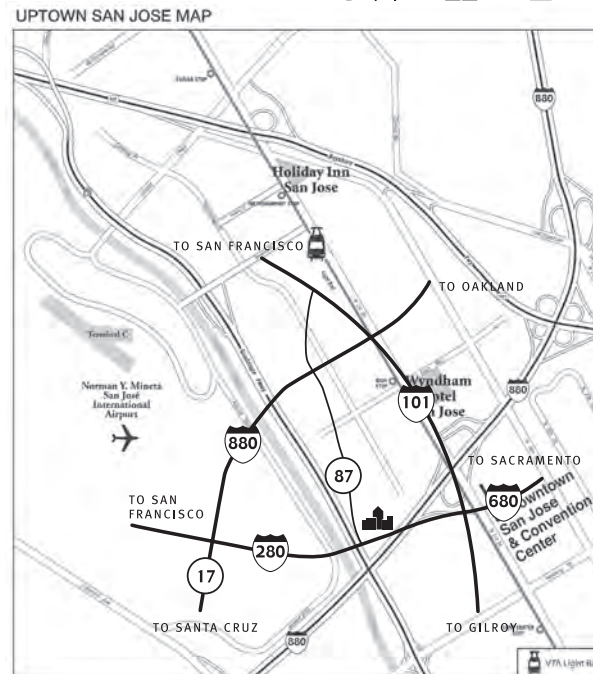
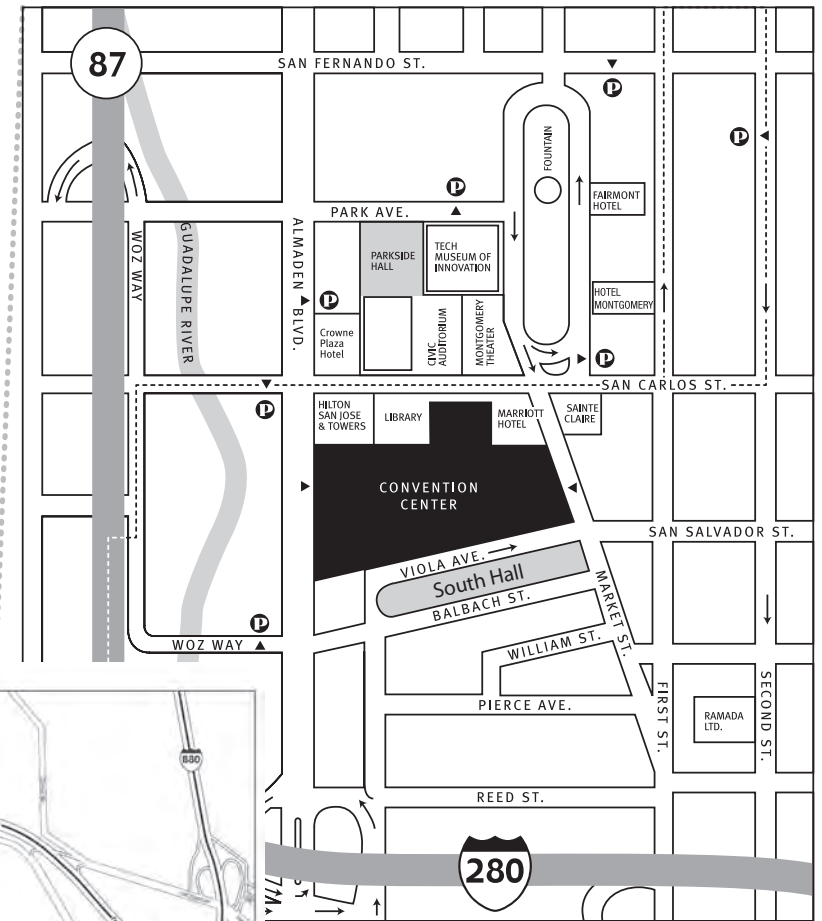
## Hold Harmless

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.

### SPIE International Headquarters

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 Tel: +44 29 2089 4747  
 Fax: +44 29 2089 4750  
 info@spieeurope.org  
 www.SPIE.org







# Get Smart with Courses at SPIE Advanced Lithography

Relevant training | Proven instructors | Education you need to stay competitive in today's job market

- Choose from 14 courses and learn current approaches in EUV lithography, DSA, optical lithography, FEOL/MOL/BEOL lithography, and more
- SPIE Student Members receive 50% off course registration
- New courses in 2013 include Scatterometry and Applications in CD, OV and Focus Control; Chemistry and Lithography; Understanding Design-Pattern Interactions
- Earn CEUs to fulfill continuing professional education requirements

SUNDAY	MONDAY	TUESDAY	THURSDAY
SC1099 <b>Chemistry and Lithography</b> (Okoroanyanwu) 8:30 am to 5:30 pm, \$670 / \$780	SC1030 <b>Interaction of Physical Design and Lithography</b> (Yuan) 1:30 pm to 5:30 pm, \$350 / \$405	SC1101 <b>Understanding Design-Patterning Interactions</b> (Gupta, Mallik, Torres) 1:30 pm to 5:30 pm, \$350 / \$405	SC103 <b>Chemically Amplified Resists</b> (Willson) 8:30 am to 5:30 pm, \$575 / \$685
SC1009 <b>Electron Beam Inspection - Principles and Applications in IC and Mask Manufacturing</b> (Xiao) 8:30 am to 12:30 pm, \$350 / \$405			SC616 <b>Practical Photoresist Processing</b> (Dammel) 8:30 am to 12:30 pm, \$350 / \$405
SC888 <b>EUV Lithography</b> (Bakshi, Ahn, Naulleau) 8:30 am to 5:30 pm, \$715 / \$825			
SC101 <b>Introduction to Microlithography: Theory, Materials, and Processing</b> (Willson, Bowden) 8:30 am to 5:30 pm, \$575 / \$685			
SC116 <b>Lithographic Optimization: A Theoretical Approach</b> (Mack) 8:30 am to 5:30 pm, \$655 / \$765			
SC992 <b>Lithography Integration for Semiconductor FEOL &amp; BEOL Fabrication</b> (Lin, Zhang) 8:30 am to 5:30 pm, \$575 / \$685			
SC1066 <b>Practical Modeling and Computational Lithography</b> (Lai) 8:30 am to 5:30 pm, \$575 / \$685			
SC885 <b>Principles and Practical Implementation of Multiple Patterning</b> (Dusa, Hsu) 8:30 am to 5:30 pm, \$575 / \$685			
SC1067 <b>Directed Self Assembly and its Application to Nanoscale Fabrication</b> (de Pablo, Nealey, Ruiz) 1:30 pm to 5:30 pm, \$350 / \$405			
SC1100 <b>Scatterometry and Applications in CD, OV and Focus Control</b> (Cramer, Turovets) 1:30 pm to 5:30 pm, \$350 / \$405			

[www.spie.org/education](http://www.spie.org/education)

## Money-back Guarantee

We are confident that once you experience an SPIE course for yourself you will look to us for your future education needs. However, if for any reason you are dissatisfied, we will gladly refund your money. We just ask that you tell us what you did not like; suggestions for improvement are always welcome.



## Continuing Education Units

SPIE has been approved as an authorized provider of CEUs by IACET, The International Association for Continuing Education and Training (Provider #1002091). In obtaining this approval, SPIE has demonstrated that it complies with the ANSI/IACET Standards which are widely recognized as standards of good practice.

**SPIE reserves the right to cancel a course due to insufficient advance registration.**



# Technical Conference Session Schedule

	Conference 8679 <b>Extreme Ultraviolet (EUV) Lithography IV</b>	Conference 8680 <b>Alternative Lithographic Technologies V</b>	Conference 8681 <b>Metrology, Inspection, and Process Control for Microlithography XXVII</b>
<b>Monday 25 February</b>	<p>Session 1 · Mon 1:30 to 3:30 pm Invited I</p> <p>Session 2 · Mon 4:00 to 6:00 pm EUV Resists: Joint Session with Conferences 8679 and 8682</p>	<p>Opening Remarks and Introduction · 3:30 to 3:35 pm</p> <p>Session 1 · Mon 3:35 to 5:35 pm Keynote Session</p>	<p>Opening Remarks and Award Presentations · 11:00 to 11:20 am</p> <p>Session 1 · Mon 11:20 am to 12:00 pm Keynote Session</p> <p>Session 2 · Mon 1:30 to 3:20 pm Metrology for Process Control</p> <p>Session 3 · Mon 3:50 to 5:40 pm Design-based Metrology and Process Control</p>
<b>Tuesday 26 February</b>	<p>Session 3 · Tue 8:00 to 9:40 am Sources</p> <p>Session 4 · Tue 10:30 am to 12:10 pm Mask I</p> <p>Session 5 · Tue 1:40 to 3:20 pm Resist Outgassing</p> <p>Session 6 · Tue 3:50 to 5:30 pm Optics and Metrology</p>	<p>Session 2 · Tue 8:20 to 10:10 am DSA Materials and Applications</p> <p>Session 3 · Tue 10:30 am to 12:00 pm UV Imprint Lithography</p> <p>Session 4 · Tue 1:20 to 3:10 pm DSA Materials and Processing: Joint Session with Conference 8680 and 8682</p> <p>Session 5 · Tue 3:30 to 5:00 pm E-Beam Direct-Write for High-Volume Manufacturing I</p>	<p>Session 4 · Tue 8:00 to 10:10 am Inspection</p> <p>Session 5 · Tue 10:40 am to 12:00 pm Accelerated Development of Materials and Processes: Joint Session with Conference 8681 and 8682</p> <p>Session 6 · Tue 1:30 to 3:10 pm New Horizons</p> <p>Session 7 · Tue 3:40 to 5:40 pm Scatterometry</p>
<b>Wednesday 27 February</b>	<p>Session 7 · Wed 8:00 to 9:40 am OPC and Modeling</p> <p>Session 8 · Wed 10:10 am to 12:10 pm EUV Resist</p> <p>Session 9 · Wed 1:40 to 3:20 pm High NA and Magnification</p> <p>Session 10 · Wed 3:50 to 5:50 pm Mask II</p>	<p>Session 6 · Wed 8:00 to 9:50 am DSA Metrology and Inspection: Joint Session with Conferences 8680 and 8681</p> <p>Session 7 · Wed 10:30 am to 12:00 pm E-Beam Direct-Write for High-Volume Manufacturing II</p> <p>Session 8 · Wed 1:20 to 3:10 pm Nanoimprint Applications</p> <p>Session 9 · Wed 3:30 to 5:20 pm Design for Manufacturability for DSA: Joint Session with Conferences 8680 and 8684</p>	<p>Session 8 · Wed 8:00 to 9:50 am DSA Metrology and Inspection: Joint Session with Conferences 8680 and 8681</p> <p>Session 9 · Wed 10:40 am to 12:00 pm Optical Extensions</p> <p>Session 10 · Wed 1:20 to 3:10 pm LER/LWR</p> <p>Session 11 · Wed 3:40 to 5:40 pm Overlay</p>
<b>Thursday 28 February</b>	<p>Session 11 · Thu 8:30 am to 12:00 pm Invited II</p>	<p>Session 10 · Thu 8:00 to 10:10 am DSA Vias</p> <p>Session 11 · Thu 10:40 am to 11:50 am Nanoprobe Array Direct-Write Technologies</p> <p>Session 12 · Thu 1:20 to 3:10 pm E-Beam Direct-Write for High-Volume Manufacturing III</p> <p>Session 13 · Thu 3:30 to 5:00 pm DSA Lines-Spaces</p>	<p>Session 12 · Thu 8:00 to 9:50 am SEM, AFM, SPM</p> <p>Awards · Thu 10:30 to 10:40 am</p> <p>Session 13 · Thu 10:40 to 12:10 pm Cross-technology Comparisons, Hybrids, and Accuracy</p> <p>Session 14 · Thu 1:40 to 3:20 pm Process Control</p> <p>Session 15 · Thu 3:50 to 5:00 pm Late Breaking News</p>

## Technical Conference Session Schedule

<p>Conference 8682 <b>Advances in Resist Materials and Processing Technology XXX</b></p>	<p>Conference 8683 <b>Optical Microlithography XXVI</b></p>	<p>Conference 8684 <b>Design for Manufacturability through Design-Process Integration VI</b></p>	<p>Conference 8685 <b>Advanced Etch Technology for Nanopatterning II</b></p>
<p>Opening Remarks and Award Presentations · 11:00 to 11:20 am</p> <p>Session 1 · Mon 11:20 am to 12:30 pm Keynote Session</p> <p>Session 2 · Mon 2:00 to 3:40 pm Novel Processing of Patterning Materials</p> <p>Session 3 · Mon 4:00 to 6:00 pm EUV Resists: Joint Session with Conferences 8679 and 8682</p>			<p>Session 1 · Mon 1:30 to 3:10 pm Litho and Plasma Etching Interaction</p> <p>Session 2 · Mon 3:40 to 5:40 pm Plasma/Resist Interaction and LER</p>
<p>Session 4 · Tue 8:00 to 10:00 am Optical Extensions</p> <p>Session 5 · Tue 10:40 am to 12:00 pm Accelerated Development of Materials and Processes: Joint Session with Conference 8681 and 8682</p> <p>Session 6 · Tue 1:20 to 3:10 pm DSA Materials and Processing: Joint Session with Conference 8680 and 8682</p> <p>Session 7 · Tue 3:40 to 5:40 pm Negative Tone Patterning</p>	<p>Opening Remarks · 8:20 to 8:40 am</p> <p>Session 1 · Tue 8:40 to 10:00 am Keynote Session</p> <p>Session 2 · Tue 10:30 am to 12:10 pm 14nm and Beyond</p> <p>Session 3 · Tue 1:40 to 3:20 pm Source and Mask Optimization (SMO) I</p> <p>Session 4 · Tue 3:50 to 5:30 pm RET</p>		<p>Session 3 · Tue 8:30 to 10:10 am Plasma Etching for Advanced Technology Nodes</p> <p>Session 4 · Tue 10:40 am to 12:00 pm Memory Patterning</p> <p>Session 5 · Tue 1:30 to 3:10 pm New Plasma Sources and New Etching Technologies</p> <p>Session 6 · Tue 3:40 to 5:10 pm Emerging Patterning Technology</p>
<p>Session 8 · Wed 8:00 to 10:00 am Novel Patterning Materials</p> <p>Session 9 · Wed 10:30 am to 12:10 pm E-Beam Patterning Materials</p> <p>Session 10 · Wed 1:30 to 2:50 pm EUV Materials, Processing, and Analysis</p> <p>Session 11 · Wed 3:30 to 5:10 pm Fundamental Studies of RLS Behavior</p>	<p>Session 5 · Wed 8:00 to 10:00 am Source and Mask Optimization (SMO) II</p> <p>Session 6 · Wed 10:30 to 11:50 am Process Technology I</p> <p>Session 7 · Wed 1:20 to 3:00 pm Modeling</p> <p>Session 8 · Wed 3:30 to 5:30 pm Process Technology II</p>	<p>Opening Remarks · 8:10 to 8:20 am</p> <p>Session 1 · Wed 8:20 to 10:05 am Keynote Session</p> <p>Session 2 · Wed 10:40 to 11:40 am DFDP: Design for Multipatterning</p> <p>Session 3 · Wed 1:40 to 3:00 pm Design Rules and Routing</p> <p>Session 4 · Wed 3:30 to 5:20 pm Design for Manufacturability for DSA: Joint Session with Conferences 8680 and 8684</p>	
	<p>Session 9 · Thu 8:00 to 10:00 am Optical and DFM I: Joint Session with Conferences 8683 and 8684</p> <p>Session 10 · Thu 10:40 am to 12:00 pm Optical and DFM II: Joint Session with Conferences 8683 and 8684</p> <p>Session 11 · Thu 1:20 to 3:00 pm Simulation</p> <p>Session 12 · Thu 3:30 to 5:30 pm Tooling</p>	<p>Session 5 · Thu 8:00 to 10:00 am Optical and DFM I: Joint Session with Conferences 8683 and 8684</p> <p>Session 6 · Thu 10:40 am to 12:00 pm Optical and DFM II: Joint Session with Conferences 8683 and 8684</p> <p>Session 7 · Thu 1:20 to 3:00 pm Design Implications and Variability</p> <p>Session 8 · Thu 3:30 to 4:30 pm Algorithms for DFM</p>	

## Conference 8679

Mon.–Thur. 25–28 February 2013  
Proceedings of SPIE Vol. 8679

### Extreme Ultraviolet (EUV) Lithography IV

*Conference Chair:* **Patrick P. Naulleau**, Lawrence Berkeley National Lab. (United States)

*Conference Co-Chair:* **Obert R. Wood II**, GLOBALFOUNDRIES Inc. (United States)

*Program Committee:* **Markus Bender**, Advanced Mask Technology Ctr. GmbH Co. KG (Germany); **Jos P. Benschop**, ASML Netherlands B.V. (Netherlands); **Robert L. Brainard**, College of Nanoscale Science & Engineering, Univ. at Albany (United States); **Li-Jui Chen**, Taiwan Semiconductor Manufacturing Co. Ltd. (Taiwan); **Daniel A. Corliss**, IBM Corp. (United States); **Emily E. Gallagher**, IBM Corp. (United States); **Michael Goldstein**, SEMATECH North (United States); **Frank Goodwin**, SEMATECH North (United States); **Naoya Hayashi**, Dai Nippon Printing Co., Ltd. (Japan); **Soichi Inoue**, EUVL Infrastructure Development Ctr., Inc. (Japan); **Bryan S. Kasprovicz**, Photonics, Inc. (United States); **Seong-Sue Kim**, SAMSUNG Electronics Co., Ltd. (Korea, Republic of); **Bruno La Fontaine**, Cymer, Inc. (United States); **Michael J. Lercel**, SEMATECH North (United States); **Ted Liang**, Intel Corp. (United States); **Akira Miyake**, Canon Inc. (Japan); **Hiroaki Morimoto**, Toppan Printing Co., Ltd. (Japan); **Katsuhiko Murakami**, Nikon Corp. (Japan); **Chris Ngai**, Applied Materials, Inc. (United States); **Shinji Okazaki**, Gigaphoton Inc. (Japan); **Uzodinma Okoroanyanwu**, GLOBALFOUNDRIES Inc. (Germany); **Eric M. Panning**, Intel Corp. (United States); **Jan Hendrik Peters**, Carl Zeiss SMS GmbH (Germany); **Jorge J. Rocca**, Colorado State Univ. (United States); **Kurt G. Ronse**, IMEC (Belgium); **Tsutomu Shoki**, HOYA Corp. (Japan); **Stanley E. Stokowski**, KLA-Tencor Corp. (United States); **Anna V. Tchikoulaeva**, Lasertec U.S.A., Inc. Zweigniederlassung Deutschland (Germany); **Thomas I. Wallow**, GLOBALFOUNDRIES Inc. (United States); **Jeong-Ho Yeo**, SAMSUNG Electronics Co., Ltd. (Korea, Republic of); **Masaki Yoshioka**, XTREME technologies GmbH (Germany)

*Conference Sponsor* 

## Conference 8680

Mon.–Thur. 25–28 February 2013  
Proceedings of SPIE Vol. 8680

### Alternative Lithographic Technologies V

*Conference Chair:* **William M. Tong**, KLA-Tencor Corp. (United States)

*Conference Co-Chair:* **Douglas J. Resnick**, Molecular Imprints, Inc. (United States)

*Program Committee:* **Christopher Bencher**, Applied Materials, Inc. (United States); **Joy Y. Cheng**, IBM Almaden Research Ctr. (United States); **Juan J. de Pablo**, Univ. of Wisconsin-Madison (United States); **Elizabeth A. Dobisz**, Hitachi Global Storage Technologies, Inc. (United States); **Timothy R. Groves**, Univ. at Albany (United States); **Cynthia Hanson**, Space and Naval Warfare Systems Ctr. Pacific (United States); **Daniel J. C. Herr**, The Univ. of North Carolina at Greensboro (United States); **Tatsuhiko Higashiki**, Toshiba Corp. (Japan); **James A. Liddle**, National Institute of Standards and Technology (United States); **Shy-Jay Lin**, Taiwan Semiconductor Manufacturing Co. Ltd. (Taiwan); **Lloyd C. Litt**, SEMATECH North (United States), GLOBALFOUNDRIES Inc. (United States); **Hans Loeschner**, IMS Nanofabrication AG (Austria); **John G. Maltabes**, Hewlett-Packard Labs. (United States); **Laurent Pain**, CEA-LETI (France); **Ivo W. Rangelow**, Technische Univ. Ilmenau (Germany); **Benjamin M. Rath sack**, Tokyo Electron America, Inc. (United States); **Ricardo Ruiz**, Hitachi Global Storage Technologies, Inc. (United States); **Frank M. Schellenberg**, Consultant (United States); **Ines A. Stolberg**, Vistec Electron Beam Lithography Group (Germany); **Kevin T. Turner**, Univ. of Pennsylvania (United States); **James J. Watkins**, Univ. of Massachusetts Amherst (United States); **Marco Wieland**, MAPPER Lithography (Netherlands); **Wei Wu**, Univ. of Southern California (United States)

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## Conference 8681

Mon.–Thur. 25–28 February 2013  
Proceedings of SPIE Vol. 8681

### Metrology, Inspection, and Process Control for Microlithography XXVII

*Conference Chair:* **Alexander Starikov**, I&I Consulting (United States)

*Conference Co-Chair:* **Jason P. Cain**, Advanced Micro Devices, Inc. (United States)

*Program Committee:* **Ofer Adan**, Applied Materials (Israel); **John A. Allgair**, GLOBALFOUNDRIES Inc. (United States); **Masafumi Asano**, Toshiba Corp. (Japan); **Benjamin D. Bunday**, SEMATECH North (United States); **Alek C. Chen**, ASML Taiwan Ltd. (Taiwan); **Shaunee Y. Cheng**, IMEC (Belgium); **Timothy F. Crimmins**, Intel Corp. (United States); **Daniel J. C. Herr**, The Univ. of North Carolina at Greensboro (United States); **Chih-Ming Ke**, Taiwan Semiconductor Manufacturing Co. Ltd. (Taiwan); **Shunsuke Koshihara**, Hitachi High-Technologies Corp. (Japan); **Yi-sha Ku**, Industrial Technology Research Institute (Taiwan); **Byoung-Ho Lee**, SAMSUNG Electronics Co., Ltd. (Korea, Republic of); **Christopher J. Raymond**, Nanometrics Inc. (United States); **John C. Robinson**, KLA-Tencor Corp. (United States); **Martha I. Sanchez**, IBM Almaden Research Ctr. (United States); **Matthew J. Sendelbach**, Nova Measuring Instruments, Inc. (United States); **Richard M. Silver**, National Institute of Standards and Technology (United States); **Costas J. Spanos**, Univ. of California, Berkeley (United States); **Vladimir A. Ukraintsev**, Nanometrology International, Inc. (United States); **Alok Vaid**, GLOBALFOUNDRIES Inc. (United States)

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partnering for process control

## Conference 8682

Mon.–Wed. 25–27 February 2013  
Proceedings of SPIE Vol. 8682

### Advances in Resist Materials and Processing Technology XXX

*Conference Chair:* **Mark H. Somervell**, Tokyo Electron America, Inc. (United States)

*Conference Co-Chair:* **Thomas I. Wallow**, GLOBALFOUNDRIES Inc. (United States)

*Program Committee:* **Robert Allen**, IBM Almaden Research Ctr. (United States); **Ramakrishnan Ayothi**, JSR Micro, Inc. (United States); **George G. Barclay**, Dow Advanced Materials (United States); **Luisa D. Bozano**, IBM Almaden Research Ctr. (United States); **Sean D. Burns**, IBM Corp. (United States); **Ralph R. Dammel**, AZ Electronic Materials USA Corp. (United States); **Roel Gronheid**, IMEC (Belgium); **Douglas Guerrero**, Brewer Science, Inc. (United States); **Clifford L. Henderson**, Georgia Institute of Technology (United States); **Christopher K. Hohle**, Fraunhofer-Ctr. Nanoelektronische Technologien (Germany); **Scott W. Jessen**, Texas Instruments Inc. (United States); **Yoshio Kawai**, Shin-Etsu Chemical Co., Ltd. (Japan); **Qinghuang Lin**, IBM Thomas J. Watson Research Ctr. (United States); **Nobuyuki N. Matsuzawa**, Sony Corp. (Japan); **Dah-Chung Owe-Yang**, Shin-Etsu MicroSi, Inc. (United States); **Daniel P. Sanders**, IBM Almaden Research Ctr. (United States); **Plamen Tzviatkov**, FUJIFILM Electronic Materials U.S.A., Inc. (United States); **Todd R. Younk**, Intel Corp. (Belgium)

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## Conference 8683

Tue.–Thur. 26–28 February 2013  
Proceedings of SPIE Vol. 8683

### Optical Microlithography XXVI

*Conference Chair:* **Will Conley**, Cymer, Inc. (United States)

*Conference Co-Chair:* **Kafai Lai**, IBM Corp. (United States)

*Program Committee:* **Pary Baluswamy**, Micron Technology, Inc. (United States); **Peter D. Brooker**, Synopsys, Inc. (United States); **Peter D. Buck**, Toppan Photomasks, Inc. (United States); **Andreas Erdmann**, Fraunhofer-Institut für Integrierte System und Bauelementetechnologie (Germany); **Nigel R. Farrar**, Cymer, Inc. (United States); **Jo Finders**, ASML Netherlands B.V. (Netherlands); **Carlos Fonseca**, Tokyo Electron America, Inc. (United States); **Tsai-Sheng Gau**, Taiwan Semiconductor Manufacturing Co. Ltd. (Taiwan); **Bernd Geh**, Carl Zeiss SMT Inc. (United States); **Yuri Granik**, Mentor Graphics Corp. (United States); **Sachiko Kobayashi**, Toshiba Corp. (Japan); **Jongwook Kye**, GLOBALFOUNDRIES Inc. (United States); **Sukjoo Lee**, SAMSUNG Electronics Co., Ltd. (Korea, Republic of); **Wilhelm Maurer**, Infineon Technologies AG (Germany); **Soichi Owa**, Nikon Corp. (Japan); **Xuelong Shi**, Semiconductor Manufacturing International Corp. (China); **Sam Sivakumar**, Intel Corp. (United States); **Bruce W. Smith**, Rochester Institute of Technology (United States); **Kazuhiro Takahashi**, Canon Inc. (Japan); **Geert Vandenbergh**, imec (Belgium)

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**CYMER**

## Conference 8684

Wed.–Thur. 27–28 February 2013  
Proceedings of SPIE Vol. 8684

### Design for Manufacturability through Design- Process Integration VII

*Conference Chair:* **Mark E. Mason**, Texas Instruments Inc. (United States)

*Conference Co-Chair:* **John L. Sturtevant**, Mentor Graphics Corp. (United States)

*Program Committee:* **Robert Aitken**, ARM Inc. (United States); **Jason P. Cain**, Advanced Micro Devices, Inc. (United States); **Luigi Capodiec**, GLOBALFOUNDRIES Inc. (United States); **Juan-Antonio Carballo**, Broadcom Corp. (United States); **Lars W. Liebmann**, IBM Corp. (United States); **Andrew R. Neureuther**, Univ. of California, Berkeley (United States); **David Z. Pan**, The Univ. of Texas at Austin (United States); **Chul-Hong Park**, SAMSUNG Electronics Co., Ltd. (Korea, Republic of); **Michael L. Rieger**, Synopsys, Inc. (United States); **Vivek K. Singh**, Intel Corp. (United States); **Chi-Min Yuan**, Freescale Semiconductor, Inc. (United States)

## Conference 8685

Mon.–Tue. 25–26 February 2013  
Proceedings of SPIE Vol. 8685

### Advanced Etch Technology for Nanopatterning II

*Conference Chair:* **Ying Zhang**, Taiwan Semiconductor Manufacturing Co. Ltd. (Taiwan)

*Conference Co-Chairs:* **Gottlieb S. Oehrlein**, Univ. of Maryland, College Park (United States); **Qinghuang Lin**, IBM Thomas J. Watson Research Ctr. (United States)

*Program Committee:* **Julie Bannister**, Tokyo Electron America, Inc. (United States); **Maxime Darnon**, LTM CNRS (France); **Sebastian U. Engelmann**, IBM Thomas J. Watson Research Ctr. (United States); **Eric A. Hudson**, Lam Research Corp. (United States); **Catherine B. Labelle**, GLOBALFOUNDRIES Inc. (United States); **Nae-Eung Lee**, Sungkyunkwan Univ. (Korea, Republic of); **Seiji Samukawa**, Tohoku Univ. (Japan); **Denis Shamiryan**, GLOBALFOUNDRIES Dresden Module Two, GmbH & Co. KG (Germany); **Jeff Xu**, Taiwan Semiconductor Manufacturing Co. Ltd. (Taiwan); **Anthony Yen**, Taiwan Semiconductor Manufacturing Co. Ltd. (Taiwan)

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Conference 8681

Metrology, Inspection, and Process Control for Microlithography XXVII

Room: Conv. Ctr. 230 B
11:00 am to 11:20 am

Opening Remarks and Award Presentation

Session Chairs: Alexander Starikov, I&I Consulting (United States); Jason P. Cain, Advanced Micro Devices, Inc. (United States)

Presentation of the Diana Nyssonen Memorial Award for Best Paper in Metrology

Award Sponsored by



Session 1

Room: Conv. Ctr. 230 B
Mon 11:20 am to 12:00 pm

Keynote Session

Session Chairs: Alexander Starikov, I&I Consulting (United States); Jason P. Cain, Advanced Micro Devices, Inc. (United States)

11:20 am: Metrology in times of shrinking budgets (Keynote Presentation), William H. Arnold, ASML US, Inc. (United States) [8681-1]

Lunch Break . . . . . Mon 12:00 pm to 1:30 pm

Conference 8682

Advances in Resist Materials and Processing Technology XXX

Room: Conv. Ctr. Hall 3
11:00 am to 11:20 am

Opening Remarks

Session Chairs: Mark H. Somervell, Tokyo Electron America, Inc. (United States); Thomas I. Wallow, GLOBALFOUNDRIES Inc. (United States)

Conference Business

Award Presentations

Presentation of the 2012 C. Grant Willson Award for Best Paper in Resist

Presentation of the 2012 Hiroshi Ito Memorial Award for the Best Student Paper in Resist

These Two Awards Sponsored by



Presentation of the 2012 Jeffrey Byers Memorial Best Poster Award in Resist

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TOKYO ELECTRON

Session 1

Room: Conv. Ctr. Hall 3
Mon 11:20 am to 12:30 pm

Keynote Session

Session Chairs: Mark H. Somervell, Tokyo Electron America, Inc. (United States); Thomas I. Wallow, GLOBALFOUNDRIES Inc. (United States)

11:20 am: The evolving complexity of patterning materials (Keynote Presentation), Tsutomu Shimokawa, JSR Corp. (Japan); Yoshi Hishiro, JSR Micro, Inc. (United States); Yoshikazu Yamaguchi, Motoyuki Shima, Tooru Kimura, Yoshio Takimoto, Tomoki Nagai, JSR Corp. (Japan) [8682-1]

11:55 am: Optimization of a virtual EUV photoresist for the trade-off between throughput and CDU (Keynote Presentation), Mark D. Smith, John J. Biafore, Trey Graves, Stewart A. Robertson, KLA-Tencor Texas (United States) [8682-2]

Lunch Break . . . . . Mon 12:30 pm to 2:00 pm

Conference 8679

**Extreme Ultraviolet (EUV) Lithography IV**

**Session 1**

**Room: Conv. Ctr. 210 B**  
**Mon 1:30 pm to 3:30 pm**

**Invited I**

Session Chairs: **Jos P. Benschop**, ASML Netherlands B.V. (Netherlands); **Shinji Okazaki**, Gigaphoton Inc. (Japan)

1:30 pm: **EUV in HVM: prospects and challenges** (*Invited Paper*), Sam Sivakumar, Intel Corp. (United States) . . . . . [8679-1]

2:00 pm: **Effect of blank quality on EUVL imaging for 2X node** (*Invited Paper*), Su-Young Lee, Tae-Geun Kim, Sang-Hyun Kim, Hwan-Seok Seo, Seong-Sue Kim, Chan-Uk Jeon, SAMSUNG Electronics Co., Ltd. (Korea, Republic of) . . [8679-2]

2:30 pm: **Investigation of EUV pellicle feasibility** (*Invited Paper*), Luigi Scaccabarozzi, Dan Smith, Pedro Rizo Diago, ASML Netherlands B.V. (Netherlands); Eric Casimiri, ASML Netherlands BV (Netherlands); Nina V. Dziomkina, Henk Meijer, ASML Netherlands B.V. (Netherlands) . . . . [8679-3]

3:00 pm: **EUV resist materials design for 15nm half pitch and below** (*Invited Paper*), Hideaki Tsubaki, Shinji Tarutani, Naoki Inoue, Hiroo Takizawa, Takahiro Goto, FUJIFILM Corp. (Japan) . . . . . [8679-4]

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

Conference 8681

**Metrology, Inspection, and Process Control for Microlithography XXVII**

**Session 2**

**Room: Conv. Ctr. 230 B**  
**Mon 1:30 pm to 3:20 pm**

**Metrology for Process Control**

Session Chairs: **Masafumi Asano**, Toshiba Corp. (Japan); **John C. Robinson**, KLA-Tencor Corp. (United States)

1:30 pm: **Implementation of hybrid metrology at HVM fab for 20nm and beyond** (*Invited Paper*), Alok Vaid, Lokesh Subramany, Liping Cui, Carl Ford, John A. Allgair, Gaurav Agrawal, John Taylor, GLOBALFOUNDRIES Inc. (United States); Carsten Hartig, Peter Ebersbach, GLOBALFOUNDRIES Dresden Module Two, GmbH & Co. KG (Germany); Paul K. Isbester, Charles Kang, Hyang Kyun H. Kim, Cornet Bozdog, Nova Measuring Instruments Inc. (United States) . . . . . [8681-2]

2:00 pm: **On-product overlay enhancement using advanced litho-cluster control based on integrated metrology, ultra-small DBO targets and novel corrections**, Kaustuve Bhattacharyya, ASML Netherlands B.V. (Netherlands); Chih-Ming Ke, Taiwan Semiconductor Manufacturing Co., Ltd. (Taiwan) . . . . . [8681-3]

2:20 pm: **Toward 7nm target on product overlay for 28nm FDSOI technology**, Bertrand LeGratiet, Maxime Gatefait, Pierre-Jerome Goirand, STMicroelectronics (France); Richard J. F. Van Haren, Xing Lan Liu, Maya Doytcheva, ASML Netherlands B.V. (Netherlands); Anne Pastol, ASML Montbonnot (France); Jan Beltman, ASML Netherlands B.V. (Netherlands) . . . . . [8681-4]

2:40 pm: **Introduction of next-generation 3D AFM for advanced process control**, Johann Foucher, Romain Thérèse, CEA-LETI (France); YongHa Paul Lee, Sang-il Park, Sang-Joon Cho, Park Systems Corp. (Korea, Republic of) . . . . . [8681-5]

3:00 pm: **Automated high-volume process monitoring of FEOL 22nm FinFET structures using a TEM**, Roger Alvis, Michael Strauss, David Horspool, Ozan Ugurlu, Pavel Plachinda, Huikai Cheng, Corey Senowitz, Jeff Blackwood, David Foord, FEI Co. (United States) . . . . . [8681-6]

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

Conference 8682

**Advances in Resist Materials and Processing Technology XXX**

**Session 2**

**Room: Marriott San Jose Ballroom Salon III**  
**Mon 2:00 pm to 3:40 pm**

**Novel Processing of Patterning Materials**

Session Chairs: **Dah-Chung Owe-Yang**, Shin-Etsu MicroSi, Inc. (United States); **Nobuyuki N. Matsuzawa**, Sony Corp. (Japan)

2:00 pm: **Sustainable scaling technique on double-patterning process**, Hidetami Yaegashi, Kenichi Oyama, Tokyo Electron Ltd. (Japan); Shohei Yamauchi, Arisa Hara, Sakurako Natori, Tokyo Electron AT Ltd. (Japan); Masatoshi Yamato, Tokyo Electron Ltd. (Japan) . . . . . [8682-3]

2:20 pm: **Dry development rinse process (DDRP) and material (DDRM) for novel pattern collapse free process**, Rikimaru Sakamoto, Yasushi Sakaida, Nissan Chemical Industries, Ltd. (Japan); Bang-Ching Ho, Nissan Chemical Industries, Ltd. (Taiwan) . . . . . [8682-4]

2:40 pm: **Post-litho line-width roughness smoothing by ion implantations**, Tristan Y. Ma, Peng Xie, Ludovic Godet, Patrick M. Martin, Chris Campbell, Jun Xue, Liyan Miao, Yongmei Chen, Huixiong Dai, Christopher Bencher, Chris S. Ngai, Applied Materials, Inc. (United States) . . . . [8682-5]

3:00 pm: **Precuring implant photoresists for shrink and patterning control**, Gustaf Lars Winroth, Erik Rosseel, Christie Delvaux, Efrain Altamirano-Sánchez, Monique Ercken, IMEC (Belgium) . . . . . [8682-6]

3:20 pm: **Application specific ratings for lithography process filters**, Toru Umeda, Shuichi Tsuzuki, Nihon Pall Ltd. (Japan) . . . . . [8682-7]

Coffee Break . . . . . Mon 3:40 pm to 4:00 pm

Conference 8685

**Advanced Etch Technology for Nanopatterning II**

**Session 1**

**Room: Conv. Ctr. 211 B**  
**Mon 1:30 pm to 3:10 pm**

**Litho and Plasma Etching Interaction**

Session Chairs: **Catherine B. Labelle**, GLOBALFOUNDRIES Inc. (United States); **Rich Wise**, IBM Corp. (United States)

1:30 pm: **Why Moore's Law is counting on etch!** (*Keynote Presentation*), Vivek K. Singh, Intel Corp. (United States) . . . . . [8685-1]

2:10 pm: **Extension of patterning technologies down to sub-10nm half pitch** (*Invited Paper*), Shoji Mimotogi, Toshiba Materials Co., Ltd. (Japan) . . . . . [8685-2]

2:40 pm: **Etch correction, and OPC: A look at the current state and future etch correction** (*Invited Paper*), Ian Stobert, Derren Dunn, IBM Corp. (United States) . . . . . [8685-3]

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

Conference 8679

**Extreme Ultraviolet (EUV) Lithography IV**

**Session 2**

**Room: Conv. Ctr. 210 B**

**Mon 4:00 pm to 6:00 pm**

**EUV Resists: Joint Session with Conferences 8679 and 8682**

Session Chairs: **Robert L. Brainard**, College of Nanoscale Science & Engineering, Univ at Albany (United States); **George G. Barclay**, Dow Advanced Materials (United States)

4:00 pm: **Oxide nanoparticle EUV resists: toward understanding the mechanism of positive and negative tone patterning**, Marie E. Krysak, Markos Trikeriotis, Christine Y. Ouyang, Souvik Chakrabarty, Emmanuel P. Giannelis, Christopher K. Ober, Cornell Univ. (United States) . . . [8679-5]

4:20 pm: **Novel EUV resist materials and process for 20nm half-pitch and beyond**, Ken Maruyama, Ramakrishnan Ayothi, Yoshi Hishiro, JSR Micro, Inc. (United States); Motohiro Shiratani, Tooru Kimura, JSR Corp. (Japan) . . . . . [8682-38]

4:40 pm: **Effect of leaving group design on EUV lithography performance**, Owendi Ongayi, Vipul Jain, Suzanne M. Coley, Mike D. Wagner, James F. Cameron, James W. Thackeray, Dow Electronic Materials (United States) . . . . . [8679-6]

5:00 pm: **The novel solution for negative impact of out-of-band and outgassing by top coat materials in EUVL**, Noriaki Fujitani, Rikimaru Sakamoto, Takafumi Endo, Nissan Chemical Industries, Ltd. (Japan); Ryuji Onishi, Nissan Chemical Industries, Ltd. (Japan) and EUVL Infrastructure Development Ctr., Inc. (Japan); Hiroaki Yaguchi, Nissan Chemical Industries, Ltd. (Japan) and IMEC (Belgium); Bang-Ching Ho, Nissan Chemical Industries, Ltd. (Taiwan) . . . . . [8682-9]

5:20 pm: **Secondary electrons in EUV lithography**, Irina Bocharova, Sanjana Das, Ryan Del Rey, Yudhishthir P. Kandel, College of Nanoscale Science & Engineering, Univ. at Albany (United States); Angela Paolucci, College of Nanoscale Science & Engineering, Univ. of Albany (United States); Leonidas E. Ocola, Argonne National Lab. (United States); Carl Ventrice, College of Nanoscale Science & Engineering, Univ. at Albany (United States); Robert A. Bartynski, Rutgers, The State Univ. of New Jersey (United States); Gregory Denbeaux, Robert L. Brainard, College of Nanoscale Science & Engineering, Univ. at Albany (United States) . . . . . [8679-7]

5:40 pm: **Rectification of EUV-patterned contact holes using directed self assembly**, Roel Gronheid, IMEC (Belgium); Todd R. Younkin, Intel Corp. (United States); Arjun Singh, IMEC (Belgium) and Katholieke Univ. Leuven (Belgium); Paulina A. Rincon Delgadillo, IMEC (Belgium) and Katholieke Univ. Leuven (Belgium) and The Univ. of Chicago (United States); Paul F. Nealey, The Univ. of Chicago (United States); Kathleen Nafus, Ainhoa Romo-Negreira, Mark H. Somervell, Tokyo Electron America, Inc. (United States) . . . . . [8682-10]

Conference 8680

**Alternative Lithographic Technologies V**

**Room: Conv. Ctr. Hall 3**

**3:30 pm to 3:35 pm**

**Opening Remarks and Introduction**

Session Chairs: **William M. Tong**, KLA-Tencor Corp. (United States); **Douglas J. Resnick**, Molecular Imprints, Inc. (United States)

**Session 1**

**Room: Conv. Ctr. Hall 3**

**Mon 3:35 pm to 5:35 pm**

**Keynote Session**

3:35 pm: **Directed self-assembly of block copolymers for pattern generation** (*Keynote Presentation*), Caroline A. Ross, Massachusetts Institute of Technology (United States) . . . . [8680-1]

4:15 pm: **NIL Template : progress and challenges** (*Keynote Presentation*), Naoya Hayashi, Dai Nippon Printing Co., Ltd. (Japan) . . . . . [8680-2]

4:55 pm: **Electron multibeam technology for mask and wafer writing** (*Keynote Presentation*), Elmar Platzgummer, IMS Nanofabrication AG (Austria) . . . . . [8680-3]

Conference 8681

**Metrology, Inspection, and Process Control for Microlithography XXVII**

**Session 3**

**Room: Conv. Ctr. 230 B**

**Mon 3:50 pm to 5:40 pm**

**Design-based Metrology and Process Control**

Session Chairs: **Jason P. Cain**, Advanced Micro Devices, Inc. (United States); **Shunsuke Koshihara**, Hitachi High-Technologies Corp. (Japan)

3:50 pm: **Material contrast-based inline metrology: process verification and control using back scattered electron imaging on CD-SEM** (*Invited Paper*), Ofer Adan, Applied Materials (Israel); Carsten Hartig, Daniel Fischer, GLOBALFOUNDRIES Dresden Module Two, GmbH & Co. KG (Germany); Alok Vaid, Abner Bello, GLOBALFOUNDRIES Inc. (United States); Shimon Levi, Applied Materials (Israel); Adam Ge, Jessica Zhou, Applied Materials, Inc. (United States); Maayan Bar-Zvi, Applied Materials (Israel) . . . [8681-7]

4:20 pm: **When things go pear shaped: contour variations of contacts**, Clemens S. Utzny, Advanced Mask Technology Ctr. GmbH Co. KG (Germany) . . . . . [8681-8]

4:40 pm: **Measurement technology to quantify 2D pattern shape in sub-2xnm advanced lithography**, Daisuke Fuchimoto, Hitachi High-Technologies Corp. (Japan); Peter De Bisschop, Jeroen Van de Kerckhove, IMEC (Belgium); Hitoshi Sugahara, Hiroyuki Shindo, Hideo Sakai, Hitachi High-Technologies Corp. (Japan) . . . . . [8681-9]

5:00 pm: **Defect window analysis by using SEM-contour-based shape quantifying method for sub-20nm node production**, J. F. Lin, Jiarui Hu, Chih-Ming Ke, Taiwan Semiconductor Manufacturing Co., Ltd. (Taiwan); Daisuke Hibino, Hitachi High-Technologies Corp (Japan); Ming-yi Hsu, Hitachi High-Technologies Corp. (Taiwan); Hiroyuki Shindo, Yuuji Enomoto, Hitachi High-Technologies Corp. (Japan) . . . [8681-10]

5:20 pm: **A framework for exploring the interaction between design rules and overlay control**, Rani S. Ghaida, Mukul Gupta, Puneet Gupta, Univ. of California, Los Angeles (United States) . . . . [8681-11]



Conference 8682

**Advances in Resist Materials and Processing Technology XXX**

**Session 3**

**Room: Conv. Ctr. 210 B**  
**Mon 4:00 pm to 6:00 pm**

**EUV Resists: Joint Session with Conferences 8679 and 8682**

Session Chairs: **Robert L. Brainard**, College of Nanoscale Science & Engineering, Univ at Albany (United States); **George G. Barclay**, Dow Advanced Materials (United States)

- 4:00 pm: **Oxide nanoparticle EUV resists: toward understanding the mechanism of positive and negative tone patterning**, Marie E. Krysak, Markos Trikeriotis, Christine Y. Ouyang, Souvik Chakrabarty, Emmanuel P. Giannelis, Christopher K. Ober, Cornell Univ. (United States) . . . . . [8679-5]
- 4:20 pm: **Novel EUV resist materials and process for 20nm half-pitch and beyond**, Ken Maruyama, Ramakrishnan Ayothi, Yoshi Hishiro, JSR Micro, Inc. (United States); Motohiro Shiratani, Tooru Kimura, JSR Corp. (Japan) . . . . . [8682-38]
- 4:40 pm: **Effect of leaving group design on EUV lithography performance**, Owendi Ongayi, Vipul Jain, Suzanne M. Coley, Mike D. Wagner, James F. Cameron, James W. Thackeray, Dow Electronic Materials (United States) . . . . . [8679-6]
- 5:00 pm: **The novel solution for negative impact of out-of-band and outgassing by top coat materials in EUVL**, Noriaki Fujitani, Rikimaru Sakamoto, Takafumi Endo, Nissan Chemical Industries, Ltd. (Japan); Ryuji Onishi, Nissan Chemical Industries, Ltd. (Japan) and EUVL Infrastructure Development Ctr., Inc. (Japan); Hiroaki Yaguchi, Nissan Chemical Industries, Ltd. (Japan) and IMEC (Belgium); Bang-Ching Ho, Nissan Chemical Industries, Ltd. (Taiwan) . . . . . [8682-9]
- 5:20 pm: **Secondary electrons in EUV lithography**, Irina Bocharova, Sanjana Das, Ryan Del Rey, Yudhishtir P. Kandel, College of Nanoscale Science & Engineering, Univ. at Albany (United States); Angela Paolucci, College of Nanoscale Science & Engineering, Univ. of Albany (United States); Leonidas E. Ocola, Argonne National Lab. (United States); Carl Ventrice, College of Nanoscale Science & Engineering, Univ. at Albany (United States); Robert A. Bartynski, Rutgers, The State Univ. of New Jersey (United States); Gregory Denbeaux, Robert L. Brainard, College of Nanoscale Science & Engineering, Univ. at Albany (United States) . . . . . [8679-7]
- 5:40 pm: **Rectification of EUV-patterned contact holes using directed self assembly**, Roel Gronheid, IMEC (Belgium); Todd R. Younkin, Intel Corp. (United States); Arjun Singh, IMEC (Belgium) and Katholieke Univ. Leuven (Belgium); Paulina A. Rincon Delgadoillo, IMEC (Belgium) and Katholieke Univ. Leuven (Belgium) and The Univ. of Chicago (United States); Paul F. Nealey, The Univ. of Chicago (United States); Kathleen Nafus, Ainhoa Romo-Negreira, Mark H. Somervell, Tokyo Electron America, Inc. (United States) . . . . . [8682-10]

Conference 8685

**Advanced Etch Technology for Nanopatterning II**

**Session 2**

**Room: Conv. Ctr. 211 B**  
**Mon 3:40 pm to 5:40 pm**

**Plasma/Resist Interaction and LER**

Session Chairs: **Gottlieb S. Oehrlein**, Univ. of Maryland, College Park (United States); **Erwine Pargon**, LTM CNRS (France)

- 3:40 pm: **Toward an integrated line-edge roughness understanding: metrology, characterization, and plasma etching transfer** (*Invited Paper*), Evangelos Gogolides, Vassilios Constantoudis, George Kokkoris, National Ctr. for Scientific Research Demokritos (Greece) . . [8685-4]
- 4:10 pm: **Plasma influence on the attenuation of line-width roughness of EUV photoresist lines ranging from 40 to 22nm half pitch** (*Invited Paper*), Efrain Altamirano-Sánchez, Peter De Schepper, Terje Hansen, Werner Boullart, IMEC (Belgium) . . . . . [8685-5]
- 4:40 pm: **Ar and He plasma pretreatments of model organic masking materials for performance improvement during plasma pattern transfer**, Dominik Metzler, Florian Weilboeck, Nick Fox-Lyon, Gottlieb S. Oehrlein, Univ. of Maryland, College Park (United States); Sebastian U. Engelmann, Robert L. Bruce, IBM Thomas J. Watson Research Ctr. (United States) . . . . . [8685-6]
- 5:00 pm: **Line-edge and width roughness mitigation at 22nm half pitch: the effect of H2/Ar plasma**, Peter De Schepper, Alessandro Vaglio Pret, Terje Hansen, Efrain Altamirano-Sánchez, Werner Boullart, Stefan De Gendt, IMEC (Belgium) . . . . . [8685-7]
- 5:20 pm: **Characterization methodology to support process development of advanced patterning structures**, Shailendra Mishra, Alok Vaid, Chang H. Maeng, Dae-Han Choi, Hyunchul Jung, Liping Cui, Meng Luo, Yongjun Shi, Thaug-Tun Oo, WenPin Peng, Yue Hu, GLOBALFOUNDRIES Inc. (United States); Cornel Bozdog, Paul K. Isbester, Nova Measuring Instruments Inc. (United States); Oded Cohen, Nova Measuring Instruments Ltd. (Israel) . . . . [8685-22]

Conference 8679

**Extreme Ultraviolet (EUV) Lithography IV**

**Session 3**  
**Room: Conv. Ctr. 210 B**  
**Tue 8:00 am to 9:40 am**

**Sources**

Session Chairs: **Li-Jui Chen**, Taiwan Semiconductor Manufacturing Co. Ltd. (Taiwan); **Michael J. Lercel**, SEMATECH North (United States)

8:00 am: **EUVL: A reality in the making**, Masaki Yoshioka, Rolf Apetz, Jeroen Jonkers, Yusuke Teramoto, XTREME technologies GmbH (Germany); Felix Kuepper, Fraunhofer-Institut für Lasertechnik (Germany); Olivier R. Semprez, XTREME technologies GmbH (Germany) . . . . . [8679-8]

8:20 am: **High CE technology EUV source for HVM**, Hakaru Mizoguchi, Gigaphoton Inc. (Japan) . . . . . [8679-9]

8:40 am: **Advances in computer simulations of LPP sources for EUV lithography**, Ahmed Hassanein, Tatyana Sizyuk, Purdue Univ. (United States) . . . . . [8679-10]

9:00 am: **Lifetime and refurbishment of multilayer LPP collector mirrors**, Torsten Feigl, Marco Perske, Hagen Pauer, Tobias Fiedler, Sergiy Yulin, Norbert Kaiser, Andreas Tünnermann, Fraunhofer-Institut für Angewandte Optik und Feinmechanik (Germany); Norbert R. Bowering, Alex I. Ershov, Silvia De Dea, Kay Hoffmann, Bruno La Fontaine, Igor V. Fomenkov, David C. Brandt, Cymer, Inc. (United States) . . . . . [8679-12]

9:20 am: **Contamination concerns at the intermediate focus of an extreme-ultraviolet light source**, David N. Ruzic, John Sporre, Dan Elg, Davide Curreli, Univ. of Illinois at Urbana-Champaign (United States) . . . . . [8679-13]

Coffee Break . . . . . Tue 9:40 am to 10:30 am

Conference 8680

**Alternative Lithographic Technologies V**

**Session 2**  
**Room: Conv. Ctr. Hall 3**  
**Tue 8:20 am to 10:10 am**

**DSA Materials and Applications**

Session Chairs: **Ricardo Ruiz**, HGST (United States); **Christopher Bencher**, Applied Materials, Inc. (United States)

8:20 am: **Sequential infiltration synthesis in lithography** (*Invited Paper*), Jeffrey W. Elam, Seth B. Darling, Yu-Chih Tseng, Qing Peng, Joseph A. Libera, Anil Mane, Leonidas E. Ocola, Argonne National Lab. (United States) . . . . . [8680-4]

8:50 am: **Scaling-down lithographic dimensions with block-copolymer materials: 10nm-sized features with PS-b-PMMA**, Xavier Chevalier, Arkema S.A. (France) and CEA-LETI-Minatec (France); Céilia Nicolet, Arkema S.A. (France) and LCPO (France); Raluca Tiron, Jonathan Pradelles, Ahmed Gharbi, CEA-LETI-Minatec (France); Maxime Argoud, CEA-LETI (France); Michael Delalande, Gilles Cunge, LTM-CNRS (France); Guillaume Fleury, Georges Hadziioannou, LCPO (France); Christophe Navarro, Arkema S.A. (France) . . . . . [8680-5]

9:10 am: **Block copolymer orientation control using a top-coat surface treatment**, Takehiro Seshimo, Tokyo Ohka Kogyo America, Inc. (United States); Carlton Grant Willson, The Univ. of Texas at Austin (United States); Hiroshi Jinnai, Kyushu Univ. (Japan); Christopher J. Ellison, Christopher M. Bates, Michael J. Maher, William J. Durand, Julia D. Cushen, Leon M. Dean, Gregory Blachut, The Univ. of Texas at Austin (United States) . . . . . [8680-6]

9:30 am: **Modeling the rate of morphology evolution during annealing of block copolymer thin films**, Jeffrey D. Weinhold, Phillip D. Hustad, The Dow Chemical Co. (United States); Peter Trefonas III, Dow Electronic Materials (United States) . . . . . [8680-7]

9:50 am: **Healing LER using directed self assembly: treatment of an EUVL resist with aqueous solutions of block copolymers**, Idriss Blakey, Ya-Mi Chuang, Han-Hao Elliot Cheng, Kevin S. Jack, Andrew K. Whittaker, The Univ. of Queensland (Australia) . . . . . [8680-8]

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

Conference 8681

**Metrology, Inspection, and Process Control for Microlithography XXVII**

**Session 4**  
**Room: Conv. Ctr. 230 B**  
**Tue 8:00 am to 10:10 am**

**Inspection**

Session Chairs: **Benjamin D. Bunday**, SEMATECH North (United States); **Timothy F. Crimmins**, Intel Corp. (United States)

8:00 am: **Inline e-beam metrology: the end of an era for image-based critical dimensional metrology? new life for defect metrology** (*Invited Paper*), Eric Solecky, Andrew Stamper, Srinivasan Rangarajan, Arun Srivatsa, Daniel S. Fischer, Oliver D. Patterson, Erin McLellan, IBM Corp. (United States); Alok Vaid, GLOBALFOUNDRIES Inc. (United States); Carsten Hartig, GLOBALFOUNDRIES Dresden Module Two, GmbH & Co. KG (Germany); Benjamin D. Bunday, Abraham Arceo, SEMATECH North (United States); Ralf Buengener, Danica Smith, GLOBALFOUNDRIES Inc. (United States) . . . . . [8681-12]

8:30 am: **Enhancing 9nm node dense patterned defect optical inspection using polarization, angle, and focus**, Bryan M. Barnes, Yeung-Joon Sohn, Hui Zhou, Francois Goasmat, Richard M. Silver, National Institute of Standards and Technology (United States); Abraham Arceo, SEMATECH North (United States) . . . . . [8681-13]

8:50 am: **Capturing buried defects in metal interconnections with electron-beam inspection system**, Hong Xiao, Ximan Jiang, Mike Van Riet, David Trease, Shishir Ramprasad, Pierre Lefebvre, Anadi Bhatia, Chris A. Maher, Olivier Moreau, David Bastard, Paul MacDonald, Cecelia Campochiaro, KLA-Tencor Corp. (United States) . . . . . [8681-14]

9:10 am: **22nm node wafer inspection using diffraction phase microscopy and image post processing**, Renjie Zhou, Lynford Goddard, Gabriel Popescu, Univ. of Illinois at Urbana-Champaign (United States) . . . . . [8681-15]

9:30 am: **Application of DBM tool for detection of EUV mask defect**, Gyun Yoo, SK Hynix, Inc. (Korea, Republic of) . . . . . [8681-16]

9:50 am: **Tabletop coherent diffraction imaging EUV microscope for EUV lithography inspection**, Bosheng Zhang, Matthew D. Seaberg, Daniel E. Adams, Dennis F. Gardener, Margaret M. Mumane, Henry C. Kapteyn, Univ. of Colorado at Boulder (United States) [8681-17]

Coffee Break . . . . . Tue 10:10 am to 10:40 am

Conference 8682

**Advances in Resist Materials and Processing Technology XXX**

**Session 4**

**Room: Marriott San Jose Ballroom Salon III  
Tue 8:00 am to 10:00 am**

**Optical Extensions**

Session Chairs: **Christoph K. Hohle**, Fraunhofer-Ctr. Nanoelektronische Technologien (Germany); **Robert Allen**, IBM Almaden Research Ctr. (United States)

8:00 am: **Process variability of self-aligned multiple patterning**, Kenichi Oyama, Arisa Hara, Sakurako Natori, Shohei Yamauchi, Masatoshi Yamato, Tokyo Electron AT Ltd. (Japan); Hidetami Yaegashi, Tokyo Electron Ltd. (Japan) ..... [8682-11]

8:20 am: **20nm VIA BEOL patterning challenges**, Chien-Hsien S. Lee, Xiang Hu, Wontae Hwang, Hui Husan Tsai, Matthew T. Herrick, Yayi Wei, GLOBALFOUNDRIES Inc. (United States) ..... [8682-13]

8:40 am: **Feasibility study of resist slimming for Mx SIT**, Nicole Saulnier, Chiew-Seng Koay, Matthew Colburn, IBM Corp. (United States); David R. Hetzer, TEL Technology Ctr., America, LLC (United States); Michael J. Cicoria, Tokyo Electron America, Inc. (United States); Jonathan Ludwicki, TEL Technology Ctr., America, LLC (United States); Masayoshi Tagami, Renesas Electronics Corp. (Japan) ..... [8682-14]

9:00 am: **Bottom up/top down high-resolution, high-throughput lithography using vertically assembled block brush polymers**, Karen L. Wooley, Guorong Sun, Sangho Cho, Corrie Clark, Michael Heller, Ang Li, Adriana Pavia-Jiménez, Emile A. Schweikert, Texas A&M Univ. (United States); Peter Trefonas III, James W. Thackeray, Dow Electronic Materials (United States) ..... [8682-37]

9:20 am: **Robust photoresist prepatterns for directed self assembly**, Takehiko Naruoka, Yoshi Hishiro, JSR Micro, Inc. (United States); Yuusuke Anno, JSR Micro N.V. (Belgium); Shinya Minegishi, Yuji Namie, Tomoki Nagai, Yoshikazu Yamaguchi, JSR Engineering Co., Ltd. (Japan); Melia Tijo, Hoa Truong, Joy Y. Cheng, Daniel P. Sanders, IBM Almaden Research Ctr. (United States) ..... [8682-15]

9:40 am: **Combining physical resist modeling and self-consistent field theory for pattern simulation in directed self assembly**, Michael Reilly, Dow Advanced Materials (United States); Valeriy V. Ginzburg, The Dow Chemical Co. (United States); Mark D. Smith, KLA-Tencor Corp. (United States) ..... [8682-16]

Coffee Break ..... Tue 10:00 am to 10:40 am

Conference 8683

**Optical Microlithography XXVI**

**Room: Conv. Ctr. 210 C  
8:20 am to 8:40 am**

**Opening Remarks**

Session Chairs: **Will Conley**, Cymer, Inc. (United States); **Kafai Lai**, IBM Corp. (United States)

**Session 1**

**Room: Conv. Ctr. 210 C  
Tue 8:40 am to 10:00 am**

**Keynote Session**

Session Chairs: **Will Conley**, Cymer, Inc. (United States); **Kafai Lai**, IBM Corp. (United States)

8:40 am: **The increasing pain of scaling with 193i: Where does it hurt? How much more can we endure?** (*Keynote Presentation*), Lars W. Liebmann, IBM Corp. (United States) ..... [8683-1]

9:20 am: **The advent of 3D system-on-chip integration** (*Keynote Presentation*), Eric Beyne, IMEC (Belgium) ..... [8683-2]

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

Conference 8685

**Advanced Etch Technology for Nanopatterning II**

**Session 3**

**Room: Conv. Ctr. 211 B  
Tue 8:30 am to 10:10 am**

**Plasma Etching for Advanced Technology Nodes**

Session Chairs: **Sebastian U. Engelmann**, IBM Thomas J. Watson Research Ctr. (United States); **Maxime Darnon**, LTM CNRS (France)

8:30 am: **Advanced plasma etch for the 10nm node and beyond** (*Invited Paper*), Eric A. Joseph, IBM Thomas J. Watson Research Ctr. (United States) ..... [8685-8]

9:00 am: **A new method based on AFM for the study of photoresist sidewall smoothing and LER transfer during gate patterning for advanced technological nodes** (*Invited Paper*), Marc Fouchier, Erwine Pargon, Laurent M. Azarnouche, Melisa Brihoum, Benjamin Bardet, LTM CNRS (France) ..... [8685-9]

9:30 am: **15nm HP patterning with EUV and SADP: key contributors for improvement of LWR, LER, and CDU**, Kaidong Xu, Laurent Souriau, IMEC (Belgium); David Hellin, Lam Research Corp. (Belgium); Janko Versluijs, Patrick Wong, Diziana Vangoidsenhoven, Nadia Vandembroeck, Harold Dekkers, Xiaoping Shi, Johan Albert, Chi Lim Tan, IMEC (Belgium); Johan Vertommen, Lam Research Corp. (Belgium); Isabelle Orain, Yoshie Kimura, Lam Research Corp. (United States); Vincent Wiaux, Werner Boullart, IMEC (Belgium) ..... [8685-10]

9:50 am: **Tall FIN formation for FINFET devices of 20nm and beyond using multi-cycles of passivation and etch processes**, Dae-Han Choi, Dae Geun Yang, Puneet Khanna, Chang Ho Maeng, Owen Hu, Hongliang Shen, Andy Wei, Sung Kim, GLOBALFOUNDRIES Inc. (United States) [8685-11]

Coffee Break ..... Tue 10:10 am to 10:40 am

Conference 8679

**Extreme Ultraviolet (EUV) Lithography IV**

**Session 4**

**Room: Conv. Ctr. 210 B  
Tue 10:30 am to 12:10 pm**

**Mask I**

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

10:30 am: **Dressed-photon nanopolishing for EUV mask substrate defect mitigation**, Ranganath Teki, Arun J. Kadaksham, Frank Goodwin, SEMATECH North (United States); Takashi Yatsui, Motoichi Ohtsu, The Univ. of Tokyo (Japan) . . . . . [8679-14]

10:50 am: **EUV mask defect analysis from mask to wafer printing**, Yoonsuk Hyun, SK Hynix, Inc. (Korea, Republic of); Jongsu Lee, Hynix Semiconductor Inc. (Korea, Republic of) . [8679-15]

11:10 am: **Investigation of native phase defect printability and comparisons of actinic printing and advanced simulation for 22nm HP EUV Masks**, Il Yong Jang, Jenah Harris-Jones, Ranganath Teki, Vibhu Jindal, Frank Goodwin, SEMATECH North (United States) . . . . . [8679-16]

11:30 am: **EUV actinic blank inspection: from prototype to production**, Anna V. Tchikoulaeva, Lasertec U.S.A., Inc. Zweigniederlassung Deutschland (Germany); Hiroki Miyai, Kiwamu Takehisa, Tomohiro Suzuki, Haruhiko Kusunose, Lasertec Corp. (Japan); Hidehiro Watanabe, Ichiro Mori, Soichi Inoue, EUVL Infrastructure Development Ctr., Inc. (Japan) . . . . . [8679-17]

11:50 am: **E-beam defect inspection of EUV reticles and wafers**, Scott D. Halle, IBM Corp. (United States); Fei Wang, Hermes-Microvision Inc., USA (United States); Ravi Bonam, IBM Corp. (United States); Hung-Yu Tien, Hermes-Microvision Inc., USA (United States); Karen D. Badger, Zhengqing J. Qi, Emily E. Gallagher, Daniel A. Corliss, IBM Corp. (United States); Chiyan Kuan, Wei Fang, Jack Y. Jau, Hermes-Microvision Inc., USA (United States) . . . . . [8679-18]

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

Conference 8680

**Alternative Lithographic Technologies V**

**Session 3**

**Room: Conv. Ctr. Hall 3  
Tue 10:30 am to 12:00 pm**

**UV Imprint Lithography**

Session Chairs: **Douglas J. Resnick**, Molecular Imprints, Inc. (United States); **Tatsuhiko Higashiki**, Toshiba Corp. (Japan)

10:30 am: **Thermally-modulated, multi-site alignment control for nanoimprinting**, Euclid E. Moon, Massachusetts Institute of Technology (United States); Saurabh A. Chandorkar, Intel Corp. (United States); Roger W. Pease, Stanford Univ. (United States) . . . . . [8680-9]

11:00 am: **Single-digit nanofabrication by UV step-and-repeat nanoimprint lithography**, Christophe Peroz, Giuseppe Calafiore, abeam Technologies, Inc. (United States); Scott D. Dhuey, Nerea Alayo, David Gosselin, The Molecular Foundry (United States); Marko Volger, micro resist technology GmbH (Germany); Deidre L. Olynick, Stefano Cabrini, The Molecular Foundry (United States) . . . . . [8680-10]

11:20 am: **Defect reduction for semiconductor memory applications using jet and flash imprint lithography**, Zhengmao Yang, Kang Luo, Xiaoming Lu, Brian Fletcher, Weijun Liu, Frank Y. Xu, Dwayne L. LaBrake, Douglas J. Resnick, S. V. Sreenivasan, Molecular Imprints, Inc. (United States) . . [8680-11]

11:40 am: **Novel fluorinated compounds for releasing material in nanoimprint lithography**, Tsuneo Yamashita, Hisashi Mitsuhashi, Masamichi Morita, Daikin Industries, Ltd. (Japan) . . . [8680-12]

Lunch/Exhibition Break . . Tue 12:00 pm to 1:20 pm

Conference 8681

**Metrology, Inspection, and Process Control for Microlithography XXVII**

**Session 5**

**Room: Conv. Ctr. 230 B  
Tue 10:40 am to 12:00 pm**

**Accelerated Development of Materials and Processes: Joint Session with Conference 8681 and 8682**

Session Chairs: **Clifford L. Henderson**, Georgia Institute of Technology (United States); **Martha I. Sanchez**, IBM Almaden Research Ctr. (United States)

10:40 am: **In situ dissolution analysis of half-pitch line and space patterns at various resist platforms using high-speed atomic force microscopy**, Julius Joseph S. Santillan, Toshiro Itani, EUVL Infrastructure Development Ctr., Inc. (Japan) . . . . . [8682-17]

11:00 am: **Mechanisms of resist pattern size shrinkage caused by electron beam**, Seiichi Tagawa, Osaka Univ. (Japan) and JST-CREST (Japan); Cong Que Dinh, Satoshi Enomoto, Akihiro Oshima, Japan Science and Technology Agency (Japan) . . . . . [8682-18]

11:20 am: **Photoresist shrinkage effects in 16nm node EUV photoresist targets**, Benjamin D. Bunday, Cecilia Montgomery, SEMATECH North (United States) . . . . . [8681-18]

11:40 am: **Precise measurement of photoresist cross-sectional shape change caused by SEM-induced shrinkage**, Takeyoshi Ohashi, Tomoko Sekiguchi, Atsuko Yamaguchi, Junichi Tanaka, Hitachi, Ltd. (Japan); Hiroki Kawada, Hitachi High-Technologies Corp. (Japan) . . . . . [8681-19]

Lunch/Exhibition Break . . Tue 12:00 pm to 1:30 pm

Conference 8682

**Advances in Resist Materials and Processing Technology XXX**

**Session 5**

**Room: Conv. Ctr. 230 B  
Tue 10:40 am to 12:00 pm**

**Accelerated Development of Materials and Processes: Joint Session with Conference 8681 and 8682**

Session Chairs: **Clifford L. Henderson**, Georgia Institute of Technology (United States); **Martha I. Sanchez**, IBM Almaden Research Ctr. (United States)

10:40 am: **In situ dissolution analysis of half-pitch line and space patterns at various resist platforms using high-speed atomic force microscopy**, Julius Joseph S. Santillan, Toshiro Itani, EUVL Infrastructure Development Ctr., Inc. (Japan)..... [8682-17]

11:00 am: **Mechanisms of resist pattern size shrinkage caused by electron beam**, Seiichi Tagawa, Osaka Univ. (Japan) and JST-CREST (Japan); Cong Que Dinh, Satoshi Enomoto, Akihiro Oshima, Japan Science and Technology Agency (Japan)..... [8682-18]

11:20 am: **Photoresist shrinkage effects in 16nm node EUV photoresist targets**, Benjamin D. Bunday, Cecilia Montgomery, SEMATECH North (United States)..... [8681-18]

11:40 am: **Precise measurement of photoresist cross-sectional shape change caused by SEM-induced shrinkage**, Takeyoshi Ohashi, Tomoko Sekiguchi, Atsuko Yamaguchi, Junichi Tanaka, Hitachi, Ltd. (Japan); Hiroki Kawada, Hitachi High-Technologies Corp. (Japan) ..... [8681-19]

Lunch/Exhibition Break . . Tue 12:00 pm to 1:30 pm

Conference 8683

**Optical Microlithography XXVI**

**Session 2**

**Room: Conv. Ctr. 210 C  
Tue 10:30 am to 12:10 pm**

**14nm and Beyond**

Session Chairs: **Jongwook Kye**, GLOBALFOUNDRIES Inc. (United States); **Tsai-Sheng Gau**, Taiwan Semiconductor Manufacturing Co. Ltd. (Taiwan)

10:30 am: **Computational aspects of optical lithography extension by directed self assembly**, Kafai Lai, Chi-Chun Liu, IBM Corp. (United States); Jed W. Pitera, Joy Y. Cheng, Charles T. Rettner, IBM Almaden Research Ctr. (United States); Daniel Dechene, IBM Corp. (United States); Gregory S. Doerk, Moutaz Fakhry, IBM Almaden Research Ctr. (United States); Jassem Abdallah, Neal V. Lafferty, IBM Corp. (United States); Hsinyu Tsai, IBM Thomas J. Watson Research Ctr. (United States); Michael A. Guillom, IBM Corp. (United States)..... [8683-3]

10:50 am: **Sub-12nm logic optical lithography with 4x pitch division and SMO-lite**, Michael C. Smayling, Tela Innovations, Inc. (United States); Koichiro Tsujita, Canon Inc. (Japan); Hidetami Yaegashi, Tokyo Electron Ltd. (Japan); Valery Axelrad, Sequoia Design Systems, Inc. (United States); Tadashi Arai, Canon Inc. (Japan); Kenichi Oyama, Arisa Hara, Tokyo Electron Ltd. (Japan)..... [8683-4]

11:10 am: **Impact of process decisions on overlay budget for the 14nm node**, David Laidler, Koen D'havé, Philippe J. Leray, Jan V. Hermans, Juergen Boemmels, Shaanee Y. Cheng, IMEC (Belgium); Huixiong Dai, Yongmei Chen, Chris S. Ngai, Applied Materials, Inc. (United States) . . . . [8683-5]

11:30 am: **The impact of 14nm photomask uncertainties on computational lithography solutions**, John L. Sturtevant, Edita Tejnjl, Timothy Lin, Steffen Schultze, Mentor Graphics Corp. (United States); Franklin D. Kalk, Peter D. Buck, Ken Nakamura, Toppan Photomasks, Inc. (United States); GuoXiang Ning, Paul W. Ackmann, GLOBALFOUNDRIES Inc. (United States); Christian Buergel, Fritz Gans, Advanced Mask Technology Ctr. GmbH Co. KG (Germany)..... [8683-6]

11:50 am: **Triple patterning with polygon stitching: scalability and compliance for metal 1 at the 14nm node**, Christopher M. Cork, Synopsys SARL (France); Alexander Miloslavsky, Yong Li, Kevin Lucas, Synopsys, Inc. (United States)..... [8683-7]

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

Conference 8685

**Advanced Etch Technology for Nanopatterning II**

**Session 4**

**Room: Conv. Ctr. 211 B  
Tue 10:40 am to 12:00 pm**

**Memory Patterning**

Session Chairs: **Julie Bannister**, Tokyo Electron America, Inc. (United States); **Nae-Eung Lee**, Sungkyunkwan Univ. (Korea, Republic of)

10:40 am: **Patterning and etch challenges for future DRAM and other high-aspect ratio memory device fabrication (Invited Paper)**, Neal R. Rueger, A. J. Schrinisky, F. Good, A. McGinnis, M. Kiehlbauch, Micron Technology, Inc. (United States)..... [8685-12]

11:10 am: **STTMRAM patterning challenges (Invited Paper)**, Werner Boullart, Dunja Radisic, IMEC (Belgium); Vasile Paraschiv, Etch Tech Solutions (Romania); Koichi Yatsuda, Tokyo Electron Ltd. (Japan); Eiichi Nishimura, Tokyo Electron AT Ltd. (Japan); Tetsuya Ohishi, Tokyo Electron Miyagi Ltd. (Japan); Shigeru Tahara, Tokyo Electron Miyagi (Japan)..... [8685-13]

11:40 am: **An experimental study of VUV plasma damage on porous organo-silicon glass materials**, Jean-Francois G. N. de Marneffe, IMEC (Belgium); Mikolaj Lukaszewicz, IMEC (Belgium) and Wroclaw Univ. (Poland); Liping Zhang, Markus Heyne, IMEC (Belgium) and Katholieke Univ. Leuven (Belgium); Mikhail R. Baklanov, IMEC (Belgium)..... [8685-14]

Lunch/Exhibition Break . . Tue 12:00 pm to 1:30 pm

Conference 8679

**Extreme Ultraviolet (EUV) Lithography IV**

**Session 5**

**Room: Conv. Ctr. 210 B**  
**Tue 1:40 pm to 3:20 pm**

**Resist Outgassing**

Session Chairs: **Soichi Inoue**, EUVL Infrastructure Development Ctr., Inc. (Japan); **Kurt G. Ronse**, IMEC (Belgium)

1:40 pm: **Relationship between resist outgassing and witness sample contamination in the NXE outgas qualification using electrons and EUV**, Ivan Pollentier, Ragava Lokasani, Roel Gronheid, IMEC (Belgium); Shannon B. Hill, Charles Tarrío, Thomas B. Lucatorto, National Institute of Standards and Technology (United States) . . . . . [8679-19]

2:00 pm: **Resist outgassing contamination growth comparison using photon and electron-resist exposure**, Alexander Friz, IBM Almaden Research Ctr. (United States) and SEMATECH Inc. (United States); Karen E. Petrillo, Jaewoong Sohn, SEMATECH North (United States) . . . . . [8679-20]

2:20 pm: **Study of EUV outgassing spatial distribution toward witness plate in the EUV outgas tester**, Yukiko Kikuchi, Hiroyuki Tanaka, Toshiya Takahashi, Kazuhiro Katayama, Isamu Takagi, Norihiko Sugie, Eishi Shiobara, Soichi Inoue, EUVL Infrastructure Development Ctr., Inc. (Japan). . . . . [8679-21]

2:40 pm: **Correlation of electron- and EUV-induced optics contamination from resist outgas species other than C: composition and efficacy of atomic-H cleaning**, Shannon B. Hill, National Institute of Standards and Technology (United States); Nadir S. Faradzhev, Howard Fairbrother, Michael Barclay, Johns Hopkins Univ. (United States); Robert F. Berg, Charles Tarrío, Thomas B. Lucatorto, National Institute of Standards and Technology (United States) . . . . . [8679-22]

3:00 pm: **Balancing lithographic performance and outgassing in EUV photoresists**, Shu-Hao Chang, TSMC Taiwan (Taiwan); Shu-Fang Chen, Ying-Yu Chen, Taiwan Semiconductor Manufacturing Co. Ltd. (Taiwan); Ming-Chin Chien, National Chiao Tung Univ. (Taiwan); Shang-Chieh Chien, TSMC Taiwan (Taiwan); Jui-Ching Wu, Tzu-Lih Lee, Taiwan Semiconductor Manufacturing Co. Ltd. (Taiwan); Jack J. H. Chen, Anthony Yen, TSMC Taiwan (Taiwan). . . . . [8679-23]

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

Conference 8680

**Alternative Lithographic Technologies V**

**Session 4**

**Room: Conv. Ctr. Hall 3**  
**Tue 1:20 pm to 3:10 pm**

**DSA Materials and Processing: Joint Session with Conference 8680 and 8682**

Session Chairs: **Joy Y. Cheng**, IBM Almaden Research Ctr. (United States); **Ralph R. Dammel**, AZ Electronic Materials USA Corp. (United States)

1:20 pm: **Advances in directed self-assembly integration and manufacturability at 300nm** (*Invited Paper*), Benjamin M. Rathsack, Mark H. Somervell, Tokyo Electron America, Inc. (United States); Makato Muramatsu, Keiji Tanouchi, Takahiro Kitano, Tokyo Electron Kyushu Ltd. (Japan); Eiichi Nishimura, Tokyo Electron Miyagi Ltd. (Japan); Koichi Yatsuda, Seiji Nagahara, Hiroyuki Iwaki, Keiji Akai, Mariko Ozawa, Ainhoa Romo-Negreira, Shigeru Tahara, Tokyo Electron Ltd. (Japan); Kathleen Nafus, Tokyo Electron America, Inc. (Japan). . . . . [8682-19]

1:50 pm: **Chemical epitaxy of strongly segregating block copolymers with top-coats for assembling perpendicularly oriented lamella with sub-10nm dimensions**, Hiroshi Yoshida, Hitachi, Ltd. (Japan); Jeong In Lee, Univ. of Wisconsin-Madison (United States); Hyo Seon Suh, Univ. of Chicago (United States); Yoshihito Ishida, Lei Wan, Abelardo R. Hernandez, Univ. of Wisconsin-Madison (United States); Kouhei Aida, Yasuhiko Tada, Hitachi, Ltd. (Japan); Juan J. de Pablo, Paul F. Nealey, Univ. of Chicago (United States) . . . . . [8680-13]

2:10 pm: **New materials in DSA processing with reduced line-edge roughness**, Rahul Sharma, Jessica P. Evans, The Dow Chemical Co. (United States); Shih-Wei Chang, Dow Electronic Materials (United States); John W. Kramer, Phillip D. Hustad, Valeriy V. Ginzburg, Jeffrey D. Weinhold, Daniel J. Murray, The Dow Chemical Co. (United States); Peter Trefonas III, Dow Electronic Materials (United States) . . . . . [8680-14]

2:30 pm: **Progress in directed self-assembly hole shrink applications**, Todd R. Younkin, Intel Corp. (Belgium); Roel Gronheid, Paulina Rincon Delgado, Boon Teik Chan, IMEC (Belgium); Ainhoa Romo-Negreira, Tokyo Electron Europe Ltd. (Netherlands); Kathleen Nafus, Mark H. Somervell, Tokyo Electron America, Inc. (United States) . . . . . [8682-20]

2:50 pm: **Materials and processes enabling block copolymers for lithographic applications**, Guanyang Lin, Yi Cao, Hengpeng Wu, Jian Yin, SungEun Hong, Margareta Paunescu, Jane Wan, Orest Polishchuk, AZ Electronic Materials USA Corp. (United States); Ankit Vora, Melia Tjio, Anindarupa Chunder, Joy Y. Cheng, Daniel P. Sanders, IBM Almaden Research Ctr. (United States) . . . . . [8680-15]

Coffee Break . . . . . Tue 3:10 pm to 3:30 pm

Conference 8681

**Metrology, Inspection, and Process Control for Microlithography XXVII**

**Session 6**

**Room: Conv. Ctr. 230 B**  
**Tue 1:30 pm to 3:10 pm**

**New Horizons**

Session Chairs: **Richard M. Silver**, National Institute of Standards and Technology (United States); **Costas J. Spanos**, Univ. of California, Berkeley (United States)

1:30 pm: **Critical dimension small-angle x-ray scattering measurements of FinFET and 3D memory structures**, Charles Settens, College of Nanoscale Science & Engineering (United States); Benjamin D. Bunday, SEMATECH North (United States); R. Joseph Kliene, Daniel F. Sunday, Chengqing Wang, Wen-li Wu, National Institute of Standards and Technology (United States); Richard Matyi, Univ. at Albany (United States) . . . . . [8681-20]

1:50 pm: **Mueller-based scatterometry measurement of nanoscale structures with anisotropic in-plane optical properties**, Gangadhara Raja Muthinti, Manasa Medikonda, Univ. at Albany (United States); Jody Fronheiser, Vimal K. Kamineni, GLOBALFOUNDRIES Inc. (United States); Brennan L. Peterson, Joseph Race, Nanometrics Inc. (United States); Alain C. Diebold, Univ. at Albany (United States) . . . . . [8681-21]

2:10 pm: **Probing limits of acoustic nanometrology using coherent extreme-ultraviolet light**, Damiano Nardi, Kathleen Hoogboom-Pot, Univ. of Colorado at Boulder (United States); Jorge N. Hernandez-Charpak, Univ. of Colorado (United States); Marie K. Tripp, Sean W. King, Intel Corp. (United States); Erik H. Anderson, Lawrence Berkeley National Lab. (United States); Margaret M. Murnane, Henry C. Kapteyn, Univ. of Colorado at Boulder (United States) . . . . . [8681-22]

2:30 pm: **Nanoscale modulus and surface chemistry characterization for collapse free resists**, Prashant K. Kulshreshtha, Lawrence Berkeley National Lab. (United States); Ken Maruyama, JSR Micro, Inc. (United States); Sara Kiani, Lawrence Berkeley National Lab. (United States); James M. Blackwell, Intel Corp. (United States); Deidre L. Olynick, Paul D. Ashby, Lawrence Berkeley National Lab. (United States) . . . . . [8681-23]

2:50 pm: **Photoluminescence metrology for LED characterization in high-volume manufacturing**, Zhiqiang Li, Christopher J. Raymond, Nanometrics Inc. (United States) . . . . . [8681-24]

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

Conference 8682

Advances in Resist Materials and Processing Technology XXX

Session 6
Room: Conv. Ctr. Hall 3
Tue 1:20 pm to 3:10 pm

DSA Materials and Processing: Joint Session with Conference 8680 and 8682

Session Chairs: Joy Y. Cheng, IBM Almaden Research Ctr. (United States); Ralph R. Dammel, AZ Electronic Materials USA Corp. (United States)

1:20 pm: Advances in directed self-assembly integration and manufacturability at 300mm (Invited Paper), Benjamin M. Rathsack, Mark H. Somervell, Tokyo Electron America, Inc. (United States); Makato Muramatsu, Keiji Tanouchi, Takahiro Kitano, Tokyo Electron Kyushu Ltd. (Japan); Eiichi Nishimura, Tokyo Electron Miyagi Ltd. (Japan); Koichi Yatsuda, Seiji Nagahara, Hiroyuki Iwaki, Keiji Akai, Mariko Ozawa, Ainhoa Romo-Negreira, Shigeru Tahara, Tokyo Electron Ltd. (Japan); Kathleen Nafus, Tokyo Electron America, Inc. (Japan) [8682-19]

1:50 pm: Chemical epitaxy of strongly segregating block copolymers with top-coats for assembling perpendicularly oriented lamella with sub-10nm dimensions, Hiroshi Yoshida, Hitachi, Ltd. (Japan); Jeong In Lee, Univ. of Wisconsin-Madison (United States); Hyo Seon Suh, Univ. of Chicago (United States); Yoshihito Ishida, Lei Wan, Abelardo R. Hernandez, Univ. of Wisconsin-Madison (United States); Kouhei Aida, Yasuhiko Tada, Hitachi, Ltd. (Japan); Juan J. de Pablo, Paul F. Nealey, Univ. of Chicago (United States) [8680-13]

2:10 pm: New materials in DSA processing with reduced line-edge roughness, Rahul Sharma, Jessica P. Evans, The Dow Chemical Co. (United States); Shih-Wei Chang, Dow Electronic Materials (United States); John W. Kramer, Phillip D. Hustad, Valeriy V. Ginzburg, Jeffrey D. Weinhold, Daniel J. Murray, The Dow Chemical Co. (United States); Peter Trefonas III, Dow Electronic Materials (United States) [8680-14]

2:30 pm: Progress in directed self-assembly hole shrink applications, Todd R. Younkin, Intel Corp. (Belgium); Roel Gronheid, Paulina Rincon Delgadillo, Boon Teik Chan, IMEC (Belgium); Ainhoa Romo-Negreira, Tokyo Electron Europe Ltd. (Netherlands); Kathleen Nafus, Mark H. Somervell, Tokyo Electron America, Inc. (United States) [8682-20]

2:50 pm: Materials and processes enabling block copolymers for lithographic applications, Guanyang Lin, Yi Cao, Hengpeng Wu, Jian Yin, SungEun Hong, Margareta Paunescu, Jane Wan, Orest Polishchuk, AZ Electronic Materials USA Corp. (United States); Ankit Vora, Melia Tjio, Anindarupa Chunder, Joy Y. Cheng, Daniel P. Sanders, IBM Almaden Research Ctr. (United States) [8680-15]

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

Conference 8683

Optical Microlithography XXVI

Session 3
Room: Conv. Ctr. 210 C
Tue 1:40 pm to 3:20 pm

Source and Mask Optimization (SMO) I

Session Chairs: Andreas Erdmann, Fraunhofer-Institut für Integrierte Systeme und Bauelementetechnologie IISB (Germany); Bruce W. Smith, Rochester Institute of Technology (United States)

1:40 pm: Robust SMO methodology for exposure tool and mask variations in high-volume production, Takaki Hashimoto, Yasunobu Kai, Kazuyuki Masukawa, Shigeki Nojima, Toshiya Kotani, Toshiba Corp. (Japan) [8683-8]

2:00 pm: Imaging application tools for extremely-low-k1 ArF immersion lithography, Shinichi Mori, Tomoharu Fujiwara, Hajime Aoyama, Junji Ikeda, Taro Ogata, Ryota Matsui, Hisashi Nishinaga, Shintaro Kudo, Tomoyuki Matsuyama, Nikon Corp. (Japan) [8683-9]

2:20 pm: Study of recent CFD-based scheme for analyzing 3D mask effects, Masanori Takahashi, Katsuyoshi Kodera, Masaya Motokubota, Toshiba Corp. (Japan); Yuichi Kawabata, Toshiba Information Systems (Japan) Corp. (Japan); Shimon Maeda, Shigeki Nojima, Satoshi Tanaka, Shoji Mimotogi, Toshiba Corp. (Japan) [8683-10]

2:40 pm: The effect of mask and source complexity on source-mask optimization, Seung-Hune Yang, Seong-Woon Choi, Jungdal Choi, Ho-Kyu Kang, SAMSUNG Electronics Co., Ltd. (Korea, Republic of) [8683-11]

3:00 pm: Illumination pupilgram control using intelligent illuminator, Noriyuki Hirayanagi, Yasushi Mizuno, Masakazu Mori, Naonori Kita, Ryota Matsui, Tomoyuki Matsuyama, Nikon Corp. (Japan) [8683-12]

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

Conference 8685

Advanced Etch Technology for Nanopatterning II

Session 5
Room: Conv. Ctr. 211 B
Tue 1:30 pm to 3:10 pm

New Plasma Sources and New Etching Technologies

Session Chairs: Seiji Samukawa, Tohoku Univ. (Japan); Ying Zhang, Taiwan Semiconductor Manufacturing Co. Ltd. (Taiwan)

1:30 pm: Properties of RLSATM microwave surface wave plasma and its applications to finFET fabrication (Invited Paper), Lee Chen, Tokyo Electron America, Inc. (United States) [8685-15]

2:00 pm: Challenging of 2xnm node MRAM MTJ patterning technology (Invited Paper), Ken Tokashiki, JongChul Park, HyungJoon Kwon, Sangmin Lee, GwangHyun Baek, Jaehun Seo, SangSup Jeong, SAMSUNG Electronics Co., Ltd. (Korea, Republic of) [8685-16]

2:30 pm: Characterization of silicon etching in synchronized pulsed plasma, Maxime Darnon, Moritz Haass, Gilles Cunge, Olivier P. Joubert, LTM CNRS (France); Samer Banna, Applied Materials, Inc. (United States) [8685-17]

2:50 pm: Analysis of cut-mask overlay in self-aligned multiple patterning and a misalignment correction technique based on dry etching, Yijian Chen, Peking Univ. Shenzhen Graduate School (China) [8685-18]

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

Conference 8679

**Extreme Ultraviolet (EUV) Lithography IV**

**Session 6**

**Room: Conv. Ctr. 210 B  
Tue 3:50 pm to 5:30 pm**

**Optics and Metrology**

Session Chairs: **Katsuhiko Murakami**, Nikon Corp. (Japan); **Michael Goldstein**, SEMATECH North (United States)

3:50 pm: **EUVL resist-based aberration metrology**, Germain L. Fenger, Bruce W. Smith, Rochester Institute of Technology (United States); Sudharshanan Raghunathan, Lei Sun, Thomas I. Wallow, Deniz Civay, GLOBALFOUNDRIES Inc. (United States); Kenneth A. Goldberg, Iacopo Mochic, Lawrence Berkeley National Lab. (United States); Obert R. Wood II, GLOBALFOUNDRIES Inc. (United States) . . . [8679-24]

4:10 pm: **In situ optical testing of exposure tools via localized wavefront curvature sensing**, Ryan H. Miyakawa, Christopher N. Anderson, Patrick P. Naulleau, Lawrence Berkeley National Lab. (United States) . . . . . [8679-25]

4:30 pm: **Alignment performance of fiducial mark on EUV blanks**, Hamamoto Kazuhiro, Tsutomu Shoki, Takahiro Onoue, Toshihiko Orihara, Osamu Maruyama, Junichi Horikawa, HOYA Corp. (Japan) . . . . . [8679-26]

4:50 pm: **Three-dimensional nanoscale defect inspection of photomasks using the TSOM method**, Ravikiran Attota, Haesung Park, National Institute of Standards and Technology (United States); Lisa Bendall, Brigham Young Univ. (United States)[8679-27]

5:10 pm: **Application of phase shift focus monitor in EUVL process control**, Lei Sun, Sudharshanan Raghunathan, GLOBALFOUNDRIES Inc. (United States); Vibhu Jindal, SEMATECH North (United States); Eric M. Gullikson, Lawrence Berkeley National Lab. (United States); Pawitter J. Mangat, GLOBALFOUNDRIES Inc. (United States); Iacopo Mochi, Kenneth A. Goldberg, Lawrence Berkeley National Lab. (United States); Oleg Kritsun, Thomas I. Wallow, Deniz Civay, Obert R. Wood II, GLOBALFOUNDRIES Inc. (United States) . . . [8679-28]

**Room: Conv. Ctr. Hall 3  
7:30 pm to 9:00 pm**

**Joint Panel Discussion**

Joint Panel with conferences 8679, 8680, 8682, 8683, 8684

Conference 8680

**Alternative Lithographic Technologies V**

**Session 5**

**Room: Conv. Ctr. Hall 3  
Tue 3:30 pm to 5:00 pm**

**E-Beam Direct-Write for High-Volume Manufacturing I**

Session Chairs: **Cynthia Hanson**, Space and Naval Warfare Systems Ctr. Pacific (United States); **Marco Wieland**, MAPPER Lithography (Netherlands)

3:30 pm: **Reflective electron-beam lithography: lithography results using CMOS controlled digital pattern generator chip**, Thomas Gubiotti, Regina Freed, Jeff F. Sun, Françoise Kidwingira, Jason Yang, Chris F. Bevis, Allen Carroll, Alan D. Brodie, William M. Tong, KLA-Tencor Corp. (United States); Shy-Jay Lin, Wen-Chuan Wang, Taiwan Semiconductor Manufacturing Co. Ltd. (Taiwan) . . . . . [8680-16]

4:00 pm: **Development of maskless electron-beam lithography using nc-Si electron-emitter array**, Akira Kojima, Hideyuki Ohyi, Crestec Corp. (Japan); Naokatsu Ikegami, Nobuyoshi Koshida, Tokyo Univ. of Agriculture and Technology (Japan); Takashi Yoshida, Masayoshi Esashi, Tohoku Univ. (Japan) . . . . . [8680-17]

4:20 pm: **Matching of beams on the MAPPER MATRIX tool: a simulation study**, Jérôme Belledent, CEA-LETI (France); Mari Berglund, MAPPER Lithography (Netherlands); Sebastien Berard-Bergery, Laurent Pain, CEA-LETI (France) . . . . . [8680-18]

4:40 pm: **50 keV electron multibeam mask writing with 0.1nm address grid**, Christof Klein, Hans Loeschner, Elmar Platzgummer, IMS Nanofabrication AG (Austria) . . . . . [8680-19]

**Room: Conv. Ctr. Hall 3  
5:00 pm to 7:00 pm**

**Panel Discussion on Challenges for Directed Self-Assembly**

Session Chairs: **William M. Tong**, KLA-Tencor Corp. (United States); **Joy Y. Cheng**, IBM Almaden Research Ctr. (United States)

Moderators: **Joy Y. Cheng**, IBM Almaden Research Ctr. and **William M. Tong**, KLA-Tencor Corp.

Directed self-assembly (DSA), which combines lithography-defined pre-patterns with self-assembled phase-separated polymers, has become a promising path to continue the scaling of semiconductor devices. As a materials-based resolution enhancement technique, DSA has been demonstrated to augment the patterning capability of 193i, EUV and E-beam lithography, and has begun to transition from research labs to development lines in past two years. While there have been important advances on the materials and process fronts, to enable DSA as a resolution enhancement technology, more efforts are required in areas such as DSA-aware design and low defectivity. The characteristic length and nature of phase-separated polymers impose DSA-specific design restrictions and design-related defectivities. The integration of compact DSA model into design and computational lithography may facilitate the co-optimization of design, materials, and processes. On the defectivity front, more experimental data on inspection, metrology and unit process monitoring are needed to identify the defect sources and intrinsic DSA defects. Please join experts in design, DFM, metrology, and other critical areas in DSA to discuss these critical challenges for DSA.

**Room: Conv. Ctr. Hall 3  
7:30 pm to 9:00 pm**

**Joint Panel Discussion**

Joint Panel with conferences 8679, 8680, 8682, 8683, 8684

Conference 8681

**Metrology, Inspection, and Process Control for Microlithography XXVII**

**Session 7**

**Room: Conv. Ctr. 230 B  
Tue 3:40 pm to 5:40 pm**

**Scatterometry**

Session Chairs: **Richard M. Silver**, National Institute of Standards and Technology (United States); **Alok Vaid**, GLOBALFOUNDRIES Inc. (United States)

3:40 pm: **Inter-comparison between optical and x-ray scatterometry measurements of FinFET structures**, Paul Lemailet, Thomas A. Germer, R. Joseph Kline, Daniel F. Sunday, Chengqing Wang, Wen-li Wu, National Institute of Standards and Technology (United States) . . . . . [8681-25]

4:00 pm: **28nm FDSOI metal gate profile optimization, CD, and undercut monitoring using scatterometry measurement**, Bertrand LeGratiet, Régis Bouyssou, Pascal Gouraud, STMicroelectronics (France); Latifa Desvoivres, CEA-LETI (France); Benjamin Dumont, STMicroelectronics (France); Guillaume Briand, IBM Corp. (France) . . . . . [8681-26]

4:20 pm: **Evaluating scatterometry 3D capabilities for EUV**, Jie Li, Nanometrics Inc. (United States); Oleg Kritsun, GLOBALFOUNDRIES Inc. (United States); Prasad Dasari, Nanometrics Inc. (United States); Catherine R. Volkman, GLOBALFOUNDRIES Inc. (United States); Jiangtao Hu, Nanometrics Inc. (United States) . . . . [8681-27]

4:40 pm: **Scatterometry evaluation of focus dose effects of EUVL structures**, Prasad Dasari, Nanometrics Inc. (United States); Oleg Kritsun, GLOBALFOUNDRIES Inc. (United States); Jie Li, Nanometrics Inc. (United States); Catherine R. Volkman, GLOBALFOUNDRIES Inc. (United States); Jiangtao Hu, Zhuan Liu, Nanometrics Inc. (United States) . . . . . [8681-28]

5:00 pm: **Direct-scatterometry-enabled optical-proximity-correction-model calibration**, Chih-Yu Chen, Yu-Tian Shen, Kuen-Yu Tsai, Jia-Han Li, National Taiwan Univ. (Taiwan); Jason J. Shieh, Alek C. Chen, ASML Taiwan Ltd. (Taiwan) . . . [8681-115]

5:20 pm: **Enhancing scatterometry CD signal-to-noise ratio for 1x logic and memory challenges**, Derrick Shaughnessy, Shankar Krishnan, KLA-Tencor Corp. (United States); Lanhua Wei, KLA-Tencor California (United States); Andrei V. Shchegrov, KLA-Tencor Corp. (United States) . . . . . [8681-122]



Conference 8682

**Advances in Resist Materials and Processing Technology XXX**

**Session 7**

**Room: Marriott San Jose Ballroom Salon III  
Tue 3:40 pm to 5:40 pm**

**Negative Tone Patterning**

Session Chairs: **Plamen Tzviatkov**, FUJIFILM Electronic Materials U.S.A., Inc. (United States); **Douglas Guerrero**, Brewer Science, Inc. (United States)

3:40 pm: **Process development of the EUVL negative-tone imaging at EIDEC**, Toshiya Takahashi, Ryuji Onishi, Toshiro Itani, EUVL Infrastructure Development Ctr., Inc. (Japan) . . . . . [8682-21]

4:00 pm: **Sub-20nm lithography negative-tone chemically-amplified resists using cross-linker additives**, Prashant K. Kulshreshtha, Lawrence Berkeley National Lab. (United States); Ken Maruyama, JSR Micro, Inc. (United States); Sara Kiani, Lawrence Berkeley National Lab. (United States); James M. Blackwell, Intel Corp. (United States); Paul D. Ashby, Deidre L. Olynick, Lawrence Berkeley National Lab. (United States) . . . . . [8682-22]

4:20 pm: **Investigation of trench and contact hole shrink mechanism in the negative-tone develop process**, Sohan S. Mehta, Craig D. Higgins, Shyam Pal, Huipeng Koh, Lokesh Subramany, Salman Iqbal, Bumhwan Jeon, Pedro Morrison, Christos Karanikas, Yayi Wei, GLOBALFOUNDRIES Inc. (United States) . . . . . [8682-23]

4:40 pm: **Negative-tone imaging (NTI) with KrF exposure at the 20nm node: extension of 248nm IIP lithography to under 20nm logic device**, Tae-Hwan Oh, Tae-Sun Kim, Yura Kim, Jahee Kim, Sujeong Heo, Bumjoon Youn, Jaekyung Seo, Kwang-sun Yoon, Byoung Il Choi, SAMSUNG Electronics Co., Ltd. (Korea, Republic of) . . . . . [8682-24]

5:00 pm: **EUV lithography performance of negative-tone chemically amplified fullerene resist**, Alex P. Robinson, Andreas Frommhold, The Univ. of Birmingham (United Kingdom); Alexandra L. McClelland, Irresistible Materials (United Kingdom); Dong Xu Yang, The Univ. of Birmingham (United Kingdom); Xiang Xue, Nano-C, Inc. (United States); Richard E. Palmer, The Univ. of Birmingham (United Kingdom) . . . . . [8682-25]

5:20 pm: **Non-aqueous negative-tone development of inorganic metal oxide nanoparticle photoresists for next-generation lithography**, Christine Y. Ouyang, Yeon Sook Chung, Markos Trikeriotis, Marie E. Krysak, Emmanuel P. Giannelis, Christopher K. Ober, Cornell Univ. (United States) . . . . . [8682-26]

**Room: Conv. Ctr. Hall 3  
7:30 pm to 9:00 pm**

**Joint Panel Discussion**

Joint Panel with conferences 8679, 8680, 8682, 8683, 8684

Conference 8683

**Optical Microlithography XXVI**

**Session 4**

**Room: Conv. Ctr. 210 C  
Tue 3:50 pm to 5:30 pm**

**RET**

Session Chairs: **Carlos Fonseca**, Tokyo Electron America, Inc. (United States); **Sachiko Kobayashi**, Toshiba Materials Co., Ltd. (Japan)

3:50 pm: **Inverse lithography technique (ILT) for advanced CMOS nodes**, Alexandre Villaret, STMicroelectronics (France); Alexander Tritchkov, Mentor Graphics Corp. (United States); Jorge Entradas, Mentor Graphics (Ireland) Ltd. (France); Emek Yesilada, STMicroelectronics (France) . . . . . [8683-14]

4:10 pm: **Mask compensation for process flare in 193nm very low-K1 lithography**, Jeonkyu Lee, Taehyeong Lee, Chunsoo Kang, Jungchan Kim, Jaeseung Choi, Chan-Ha Park, Hyun-Jo Yang, Dong Gyu Yim, SK Hynix, Inc. (Korea, Republic of); Jung-Hoe Choi, Synopsys Korea Inc. (Korea, Republic of); Irene Su, Synopsys Taiwan Ltd. (Taiwan); Hua Song, Synopsys, Inc. (United States); Mun-hoi Do, Synopsys Korea Inc. (Korea, Republic of); Yongfa Fan, Anthony C. Wang, Synopsys, Inc. (United States); Sung-Woo Lee, Synopsys Korea Inc. (Korea, Republic of); Kevin Lucas, Synopsys, Inc. (United States) . . . . . [8683-15]

4:30 pm: **Pupil wavefront manipulation to compensate for mask topography effects in optical nanolithography**, Monica Kempself Sears, Bruce W. Smith, Rochester Institute of Technology (United States) . . . . . [8683-16]

4:50 pm: **Effective model-based SRAF placement for full-chip 2D layouts**, Srividya Jayaram, Pat J. Lacour, Alexander Tritchkov, Mentor Graphics Corp. (United States) . . . . . [8683-17]

5:10 pm: **Wafer topography modeling for ionic implantation mask correction dedicated to 2xnm nodes on FDSOI substrate**, Jean-Christophe Michel, Jean-Christophe Le Denmat, Elodie Sungauer, Frederic Robert, Emek Yesilada, STMicroelectronics (France); Ana Maria Armeanu, Jorge Entradas, Mentor Graphics (France); John L. Sturtevant, Thuy Do, Yuri Granik, Mentor Graphics Corp. (United States) . . . . . [8683-18]

**Room: Conv. Ctr. Hall 3  
7:30 pm to 9:00 pm**

**Joint Panel Discussion**

Joint Panel with conferences 8679, 8680, 8682, 8683, 8684

Conference 8684

**Design for Manufacturability through Design-Process Integration VII**

**Session 6**

**Room: Conv. Ctr. 211 B  
Tue 3:40 pm to 5:10 pm**

**Emerging Patterning Technology**

Session Chairs: **Charles N. Black**, Brookhaven National Lab. (United States); **Ricardo Ruiz**, HGST (United States)

3:40 pm: **Pattern transfer of directed self-assembly patterns for CMOS device applications** (*Invited Paper*), Hsinyu Tsai, Hiroyuki Miyazoe, Sebastian U. Engelmann, Sarunya Bangsaruntip, Isaac Lauer, James J. Buccignano, David P. Klaus, Lynne M. Gignac, Eric A. Joseph, IBM Thomas J. Watson Research Ctr. (United States); Joy Y. Cheng, Daniel P. Sanders, IBM Almaden Research Ctr. (United States); Michael A. Guillorn, IBM Thomas J Watson Research Ctr (United States) . . . . . [8685-19]

4:10 pm: **Novel approaches on double-patterning process toward sub-15nm** (*Invited Paper*), Hidetami Yaegashi, Tokyo Electron Ltd. (Japan); Kenichi Oyama, Shohei Yamauchi, Arisa Hara, Sakurako Natori, Masatoshi Yamato, Tokyo Electron AT Ltd. (Japan) . . . . . [8685-20]

4:40 pm: **Generation and transfer of large-area lithographic patterns in the ~10nm feature size regime** (*Invited Paper*), Thomas R. Albrecht, Christian Bonhôte, Yves-Andre Chapuis, Elizabeth A. Dobisz, He H. Gao, Dan S. Kercher, Jeffrey Lille, Kaniyalal C. Patel, Ricardo Ruiz, Jovita Tjahjadi, Lei Wan, Tsai-Wei Wu, HGST (United States) . . . . . [8685-21]

Conference End.

**Room: Conv. Ctr. Hall 3  
7:30 pm to 9:00 pm**

**Joint Panel Discussion**

Joint Panel with conferences 8679, 8680, 8682, 8683, 8684

Conference 8685

**Advanced Etch Technology for Nanopatterning II**

**Session 6**

**Room: Conv. Ctr. 211 B  
Tue 3:40 pm to 5:10 pm**

**Emerging Patterning Technology**

Session Chairs: **Charles N. Black**, Brookhaven National Lab. (United States); **Ricardo Ruiz**, HGST (United States)

3:40 pm: **Pattern transfer of directed self-assembly patterns for CMOS device applications** (*Invited Paper*), Hsinyu Tsai, Hiroyuki Miyazoe, Sebastian U. Engelmann, Sarunya Bangsaruntip, Isaac Lauer, James J. Buccignano, David P. Klaus, Lynne M. Gignac, Eric A. Joseph, IBM Thomas J. Watson Research Ctr. (United States); Joy Y. Cheng, Daniel P. Sanders, IBM Almaden Research Ctr. (United States); Michael A. Guillorn, IBM Thomas J Watson Research Ctr (United States) . . . . . [8685-19]

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Conference End.

The exhibition will be open during the Poster Session on Tuesday only. Be sure to visit the exhibit booths during this time for insight on what is new and coming soon.

The following posters will be on display after 10:00 am on Tuesday. The interactive poster session with authors in attendance will be Tuesday evening from 6:00 to 8:00 pm.

All symposium attendees are invited to attend the poster sessions. Come view the high-quality papers that are presented in this alternative format, and interact with the poster author who will be available for discussion.

Enjoy light refreshments while networking with colleagues in your field. Attendees are required to wear their conference registration badges to the poster sessions.

**Tuesday Poster Reception Sponsor**



**Conf. 8681 Metrology, Inspection, and Process Control for Microlithography XXVII**

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

**Modeling ion-induced secondary electron emission in scanning ion microscopes**, Kaoru Ohya, Takuya Yamanaka, Univ. of Tokushima (Japan); Jun Kawata, Kagawa National College of Technology (Japan) . . . . . [8681-58]

**The correlation between ArF resist dispense volume and surface tension**, Tung-Chang Kuo, United Microelectronics Corp. (Taiwan) . . [8681-59]

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**Study of overlay in EUV/ArF mix and match lithography**, Chin-Chou K. Huang, Gino Marcuccilli, Kyungbae Hwang, Antonio Mani, KLA-Tencor Corp. (United States); Chua Lin, KLA-Tencor Singapore (Singapore); Dongsu Choi, David C. Tien, KLA-Tencor Corp. (United States); Bill Pierson, KLA-Tencor Texas (United States); Ramkumar Karur-Shanmugam, John C. Robinson, KLA-Tencor Corp. (United States); Byoung-Hoon Lee, Inhwan Lee, Hynix Semiconductor Inc. (Korea, Republic of) . . . . . [8681-92]

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**Process requirements of self-aligned multiple patterning**, Sakurako Natori, Arisa Hara, Shohei Yamauchi, Masatoshi Yamato, Kenichi Oyama, Tokyo Electron AT Ltd. (Japan); Hidetami Yaegashi, Tokyo Electron Ltd. (Japan) . . . . . [8682-51]

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**Analysis of the generating action of the acid from PAG using acid sensitive dyes for EUV resist**, Atsushi Sekiguchi, Litho Tech Japan Co., Ltd. (Japan) . . . . . [8682-54]

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**Calculating development parameters for chemically-amplified resists by the film-reducing method**, Atsushi Sekiguchi, Litho Tech Japan Co., Ltd. (Japan) . . . . . [8682-55]

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**What exactly does 'neutrality' mean for directed self-assembly neutral layers**, Jeffrey T. Smith, Shahid Shaikh, Betty Tang, Applied Materials, Inc. (United States). . . . . [8682-61]

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**EUV lithography using water-developable resist material derived from biomass**, Satoshi Takei, Toyama Prefectural Univ. (Japan); Akihiro Oshima, Osaka Univ. (Japan); Takumi Ichikawa, Atsushi Sekiguchi, Toyama Prefectural Univ. (Japan); Miki Kashiwakura, Osaka Univ. (Japan); Tomoko G. Oyama, Japan Atomic Energy Agency (Japan); Takahiro Kozawa, Seiichi Tagawa, Osaka Univ. (Japan). . . . . [8682-64]

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**Development of new xanthendiol derivatives applied to the negative-tone molecular resists for EB/EUVL**, Masatoshi Echigo, Masako Yamakawa, Yumi Ochiai, Yu Okada, Takashi Makinoshima, Masaaki Takasuka, Mitsubishi Gas Chemical Co., Inc. (Japan) . . . . . [8682-66]

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**Selective laser ablation in resists and block copolymers for high-resolution lithographic patterning**, Deidre L. Olynick, Pradeep N. Perera, Adam M. Schwartzberg, Stefano Cabrini, Lawrence Berkeley National Lab. (United States); Nathan D. Jarnagin, Clifford L. Henderson, Georgia Institute of Technology (United States) . . . . . [8682-69]

**Fabrication of optical film derived from biomass using eco-friendly nanoimprint lithography**, Satoshi Takei, Toyama Prefectural Univ. (Japan); Gaku Murakami, Richell Corp. (Japan); Atsushi Sekiguchi, Toyama Prefectural Univ. (Japan); Tsutomu Obata, Yoshiyuki Yokoyama, Wataru Mizuno, Junji Sumioka, Toyama Industrial Technology Ctr. (Japan); Yuji Horita, Richell Corp. (Japan) . . . . . [8682-70]

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**Method of releasing silicon-based MEMS devices with hard-baked polyimide sacrificial layer**, Javaneh Boroumand Azad, Imen Rezadad, Robert E. Peale, Univ. of Central Florida (United States) . . . . . [8682-80]

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**Point-of-use filter membrane selection, start-up, and conditioning for low-defect photolithography coatings**, Nick L. Brakensiek, Brewer Science, Inc. (United States); Michael F. Cronin, Entegris, Inc. (United States). . . . . [8682-73]

**Strategy for yield improvement with sub-10nm photochemical filtration**, Jennifer Braggin, Entegris, Inc. (United States); Colin J. Brodsky, Michael Linnane, Paul Klymko, IBM Corp. (United States) . . . . . [8682-74]

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**Superselective silicon cryo-etching for nanoscale pattern transfer with block copolymer lithography**, Zuwei Liu, Lawrence Berkeley National Lab. (United States); Xiaodan Gu, Univ. of Massachusetts Amherst (United States); Deidre L. Olynick, Lawrence Berkeley National Lab. (United States). . . . . [8685-23]

**Double patterning with dual hard mask for 28nm node devices and below**, Hubert Hody, Vasile Paraschiv, Vecchio Guglielma, Sabrina Locorotondo, Gustaf Lars Winroth, Raja Athimulam, Werner Boullart, IMEC (Belgium) . . . . . [8685-24]

**Spin-on-carbon hardmask based on fullerene derivatives for high-aspect ratio etching**, Alex P. Robinson, Andreas Frommhold, Richard E. Palmer, The Univ. of Birmingham (United Kingdom). . . . . [8685-25]

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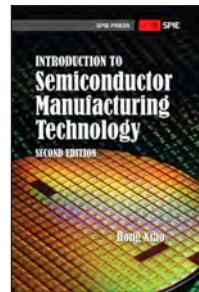
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**Characteristics of selective PMMA etching for forming PS mask**, Makoto Satake, Taku Iwase, Masaru Kurihara, Nobuyuki Negishi, Yasuhiko Tada, Hiroshi Yoshida, Hitachi, Ltd. (Japan) . . . . . [8685-28]

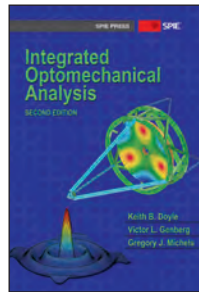
**Yield enhancement of 3D NAND flash devices through broadband bright-field inspection of the channel hole process module**, JungYoul Lee, IlSeok Seo, Seong-Min Ma, HyeonSoo Kim, Jin-Woong Kim, SK Hynix, Inc. (Korea, Republic of); DoOh Kim, KLA-Tencor Corp. (United States); Andrew J. Cross, KLA-Tencor England (United Kingdom); Jorge P. Fernandez, KLA-Tencor Corp. (United States). . . . . [8685-29]

**Introduction of an advanced dual hard mask stack for high resolution pattern transfer**, Jan Paul, Matthias Rudolph, Stefan Riedel, Xaver Thrun, Fraunhofer-Ctr. Nanoelektronische Technologien (Germany); Stephan Wege, Plasway (Germany); Christoph K. Hohle, Fraunhofer-Ctr. Nanoelektronische Technologien (Germany) . . . . . [8685-30]

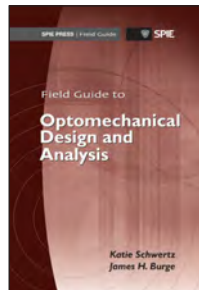
**The importance of lithography and advanced etch techniques for nanofabrication of MOS capacitor with HfO<sub>2</sub>**, Melkamu A. Belete, Royal Institute of Technology (KTH) (Sweden) . . . . . [8685-31]



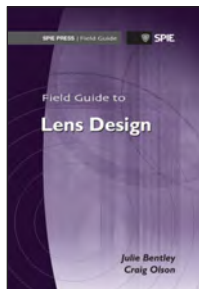
**Introduction to Semiconductor Manufacturing Technology, Second Edition**  
by **Hong Xiao**  
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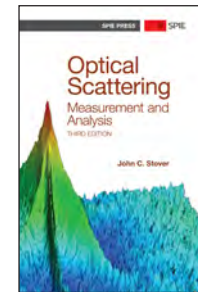
**Integrated Optomechanical Analysis, Second Edition**  
by **Keith B. Doyle, Victor L. Genberg, Gregory J. Michels**  
Vol. PM223



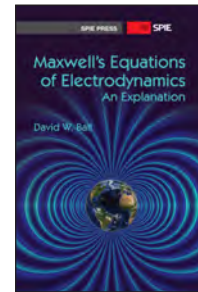
**Field Guide to Optomechanical Design and Analysis**  
by **Katie Schwertz, Jim Burge**  
Vol. FG26



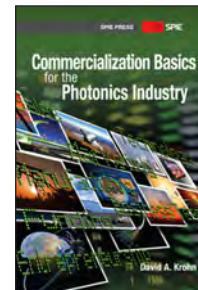
**Field Guide to Lens Design**  
by **Julie Bentley, Craig Olson**  
Vol. FG27



**Optical Scattering: Measurements and Analysis, Third Edition**  
by **John C. Stover**  
Vol. PM224



**Maxwell's Equations of Electrodynamics: An Explanation**  
by **David W. Ball**  
Vol. PM232



**Commercialization Basics for the Photonics Industry**  
by **David Krohn**  
Vol. PM234

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Conference 8679

**Extreme Ultraviolet (EUV) Lithography IV**

**Session 7**  
**Room: Conv. Ctr. 210 B**  
**Wed 8:00 am to 9:40 am**

**OPC and Modeling**

Session Chairs: **Emily E. Gallagher**, IBM Corp. (United States); **Eric M. Panning**, Intel Corp. (United States)

8:00 am: **EUV multilayer defect compensation (MDC) by both absorber pattern modification and a new film deposition technique**, Linyong Pang, Masaki Satake, Ying Li, Danping Peng, Peter Hu, Vikram L. Tolani, Anthony D. Vacca, Bob Gleason, Luminescent Technologies (United States). . . . . [8679-29]

8:20 am: **Evaluation of methods to improve EUV OPC model accuracy**, Tamer H. Coskun, Chris H. Clifford, Germain L. Fenger, GLOBALFOUNDRIES Inc. (United States); Gek Soon Chua, GLOBALFOUNDRIES Singapore (Singapore); Keith P. Standiford, Ralph E. Schlieff, Craig D. Higgins, Yi Zou, GLOBALFOUNDRIES Inc. (United States). . . . . [8679-30]

8:40 am: **Fast 3D thick mask model for full-chip EUVL simulations**, Peng Liu, Xiaobo Xie, Wei Liu, Brion Technologies, Inc. (United States) and ASML US, Inc. (United States); Keith D. Gronlund, Brion Technologies, Inc. (United States) . . . . . [8679-31]

9:00 am: **Position dependent process and proximity correction and verification for extreme-ultraviolet lithography**, Anwei Liu, Cadence Design Systems, Inc. (United States); Huixiong Dai, Applied Materials, Inc. (United States); Hsu-Ting Huang, Ali Mokhberi, Xin Zheng, Cadence Design Systems, Inc. (United States); Chris S. Ngai, Applied Materials, Inc. (United States) . . . . . [8679-32]

9:20 am: **Modeling strategies for EUV mask multilayer defect dispositioning and repair**, Andreas Erdmann, Peter Evanschitzky, Fraunhofer-Institut für Integrierte System und Bauelementetechnologie (Germany); Tristan Bret, Carl Zeiss SMS GmbH (Germany); Rik Jonckheere, IMEC (Belgium). . . . . [8679-33]

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

Conference 8680

**Alternative Lithographic Technologies V**

**Session 6**  
**Room: Conv. Ctr. 230 B**  
**Wed 8:00 am to 9:50 am**

**DSA Metrology and Inspection: Joint Session with Conferences 8680 and 8681**

Session Chairs: **Joy Y. Cheng**, IBM Almaden Research Ctr. (United States); **Martha I. Sanchez**, IBM Almaden Research Ctr. (United States)

8:00 am: **Defect source analysis of directed self-assembly process (DSA of DSA) (Invited Paper)**, Venkat R. Nagaswami, Ryota Harukawa, Mayur Suri, Stephane Durant, Jorge P. Fernandez, Andrew J. Cross, KLA-Tencor Corp. (United States); Paulina A. Rincon Delgadillo, Univ. of Chicago (United States) and IMEC (Belgium); Roel Gronheid, IMEC (Belgium) . . . . . [8680-20]

8:30 am: **Line-edge roughness in directed self assembly**, Ricardo Ruiz, Lei Wan, Elizabeth A. Dobisz, Kanaiyalal C. Patel, Yves-Andre Chapuis, HGST (United States); Taku Iwase, Masaru Kurihara, Hiroshi Yoshida, Hitachi, Ltd. (Japan); Thomas R. Albrecht, HGST (United States). . . . . [8680-21]

8:50 am: **Application of optical CD metrology for alternative lithography**, Masafumi Asano, Akiko Kawamoto, Toshiba Corp. (Japan); Kazuto Matsuki, Toshiba Machine Co., Ltd. (Japan); Stephane Godny, Nova Measuring Instruments Ltd. (Israel); Tingsheng Lin, Koichi Wakamoto, Nova Measuring Instruments K.K. (Japan). . . . . [8681-29]

9:10 am: **Hybrid approach to optical CD metrology of directed self-assembly contacts**, Stephane Godny, Nova Measuring Instruments Ltd. (Israel); Masafumi Asano, Toshiba Corp. (Japan); Koichi Wakamoto, Tim Lin, Nova Measuring Instruments Ltd. (Israel); Akiko Kawamoto, Toshiba Corp. (Japan); Kazuto Matsuki, Toshiba Machine Co., Ltd. (Japan); Cornel Bozdog, Nova Measuring Instruments Inc. (United States); Ronen Urensky, Renan Milo, Nova Measuring Instruments Ltd. (Israel). . . . . [8681-30]

9:30 am: **Three-dimensional characterization of block copolymer lithography patterns using resonant x-ray scattering**, R. Joseph Kline, Daniel F. Sunday, Wen-li Wu, National Institute of Standards and Technology (United States); Gila E. Stein, Univ. of Houston (United States). . . . . [8680-22]

Coffee Break . . . . . Wed 9:50 am to 10:30 am

Conference 8681

**Metrology, Inspection, and Process Control for Microlithography XXVII**

**Session 8**  
**Room: Conv. Ctr. 230 B**  
**Wed 8:00 am to 9:50 am**

**DSA Metrology and Inspection: Joint Session with Conferences 8680 and 8681**

Session Chairs: **Joy Y. Cheng**, IBM Almaden Research Ctr. (United States); **Martha I. Sanchez**, IBM Almaden Research Ctr. (United States)

8:00 am: **Defect source analysis of directed self-assembly process (DSA of DSA) (Invited Paper)**, Venkat R. Nagaswami, Ryota Harukawa, Mayur Suri, Stephane Durant, Jorge P. Fernandez, Andrew J. Cross, KLA-Tencor Corp. (United States); Paulina A. Rincon Delgadillo, Univ. of Chicago (United States) and IMEC (Belgium); Roel Gronheid, IMEC (Belgium) . . . . . [8680-20]

8:30 am: **Line-edge roughness in directed self assembly**, Ricardo Ruiz, Lei Wan, Elizabeth A. Dobisz, Kanaiyalal C. Patel, Yves-Andre Chapuis, HGST (United States); Taku Iwase, Masaru Kurihara, Hiroshi Yoshida, Hitachi, Ltd. (Japan); Thomas R. Albrecht, HGST (United States). . . . . [8680-21]

8:50 am: **Application of optical CD metrology for alternative lithography**, Masafumi Asano, Akiko Kawamoto, Toshiba Corp. (Japan); Kazuto Matsuki, Toshiba Machine Co., Ltd. (Japan); Stephane Godny, Nova Measuring Instruments Ltd. (Israel); Tingsheng Lin, Koichi Wakamoto, Nova Measuring Instruments K.K. (Japan). . . . . [8681-29]

9:10 am: **Hybrid approach to optical CD metrology of directed self-assembly contacts**, Stephane Godny, Nova Measuring Instruments Ltd. (Israel); Masafumi Asano, Toshiba Corp. (Japan); Koichi Wakamoto, Tim Lin, Nova Measuring Instruments Ltd. (Israel); Akiko Kawamoto, Toshiba Corp. (Japan); Kazuto Matsuki, Toshiba Machine Co., Ltd. (Japan); Cornel Bozdog, Nova Measuring Instruments Inc. (United States); Ronen Urensky, Renan Milo, Nova Measuring Instruments Ltd. (Israel). . . . . [8681-30]

9:30 am: **Three-dimensional characterization of block copolymer lithography patterns using resonant x-ray scattering**, R. Joseph Kline, Daniel F. Sunday, Wen-li Wu, National Institute of Standards and Technology (United States); Gila E. Stein, Univ. of Houston (United States). . . . . [8680-22]

Coffee Break . . . . . Wed 9:50 am to 10:40 am

Conference 8682

**Advances in Resist Materials and Processing Technology XXX**

**Session 8**

**Room: Marriott San Jose Ballroom Salon III  
Wed 8:00 am to 10:00 am**

**Novel Patterning Materials**

Session Chairs: **Daniel P. Sanders**, IBM Almaden Research Ctr. (United States); **Ramakrishnan Ayothi**, JSR Micro, Inc. (United States)

8:00 am: **New spin-on metal hardmask materials for lithography processes**, Huirong Yao, Salem Mullen, Elizabeth Wolf, Dalil Rahman, Clement T. Anyadiiegwu, Douglas S. Mckenzie, Joonyeon Cho, Munirathna Padmanaban, AZ Electronic Materials USA Corp. (United States) . . . . . [8682-27]

8:20 am: **Development of KrF hybrid resist for a dual-isolation application**, Steven J. Holmes, Kuang-Jung Chen, Sen Liu, Wu-song Huang, Raneer Kwong, Chungsi J. Wu, Matthew Colburn, Kangguo Cheng, Bruce Doris, IBM Corp. (United States); Qing Liu, STMicroelectronics (United States); Laurent Grenouillet, Maud Vinet, CEA-LETI (France); Gregory Breyta, IBM Almaden Research Ctr. (United States); Scott Luning, GLOBALFOUNDRIES Inc. (United States) . . . . . [8682-28]

8:40 am: **Novel photoresists formed by molecular layer deposition for sub-100nm patterning**, Han Zhou, Stacey F. Bent, Stanford Univ. (United States) . . . . . [8682-29]

9:00 am: **Long wavelength and chemically amplified photobase generators**, William K. Bell, William H. Heath, Carlton Grant Willson, The Univ. of Texas at Austin (United States) . . . . . [8682-30]

9:20 am: **Novel patternable and conducting metal-polymer nanocomposite: a step toward advanced multifunctional materials**, Pedro Javier Rodríguez-Cantó, Mariluz Martínez-Marco, Univ. de València (Spain); Rafael Abargues, Intenanomat S.L. (Spain); Victor Latorre-Garrido, Juan P. Martínez-Pastor, Univ. de València (Spain) . . . . . [8682-31]

9:40 am: **Metal-polymer nanocomposite resists: a step toward in situ nanopatterns metallization**, Rafael Abargues, Intenanomat S.L. (Spain); Mariluz Martínez-Marco, Pedro Javier Rodríguez-Cantó, Jose Marques-Hueso, Juan P. Martínez-Pastor, Univ. de València (Spain) . . . . . [8682-32]

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

Conference 8683

**Optical Microlithography XXVI**

**Session 5**

**Room: Conv. Ctr. 210 C  
Wed 8:00 am to 10:00 am**

**Source and Mask Optimization (SMO) II**

Session Chairs: **Kazuhiro Takahashi**, Canon Inc. (Japan); **Geert Vandenberghe**, IMEC (Belgium)

8:00 am: **Enabling reverse-tone imaging for via levels using attenuated phase-shift mask and source optimization**, Bassem Hamieh, STMicroelectronics (United States); Hyun Chol Choi, SAMSUNG Electronics Co., Ltd. (United States); Burcin Erenturk, GLOBALFOUNDRIES Inc. (United States); Wei Guo, IBM Corp. (United States); Ayman Hamouda, Huikan Liu, GLOBALFOUNDRIES Inc. (United States); Gregory R. McIntyre, Albany NanoTech (United States); Jason Meiring, IBM Corp. (United States); David Moreau, STMicroelectronics (United States); Alan Thomas, Alexander Wei, IBM Corp. (United States) . . . . . [8683-19]

8:20 am: **Introducing a novel flow to estimate challenges encountered while transitioning from RET development to manufacturable Solution**, Aasutosh Dave, Mentor Graphics Corp. (United States); Yong Wah Cheng, GLOBALFOUNDRIES Singapore (Singapore); Omar Elsewefy, Mentor Graphics Corp. (United States); Ying Gong, GLOBALFOUNDRIES Singapore (Singapore); Robin Chia, Pat J. Lacour, Mentor Graphics Corp. (United States); Yee Mei Foong, GLOBALFOUNDRIES Singapore (Singapore) . . . . . [8683-20]

8:40 am: **Manufacturability of computation lithography mask: Current limit and requirements for sub-20nm node**, Jin Choi, Rae Won Lee, In-Yong Kang, Ji-Hyeon Choi, Ji Soong Park, Byung-Gook Kim, Chan-Uk Jeon, SAMSUNG Electronics Co., Ltd. (Korea, Republic of) . . . . . [8683-21]

9:00 am: **The impact of realistic source shape and flexibility on source-mask optimization**, Hajime Aoyama, Yasushi Mizuno, Noriyuki Hirayanagi, Nikon Corp. (Japan); Hiro Izumi, Keiichi Tajima, Nihon Synopsys G.K. (Japan); Joachim Siebert, Wolfgang Demmerle, Synopsys GmbH (Germany); Tomoyuki Matsuyama, Nikon Corp. (Japan) . . . . . [8683-22]

9:20 am: **Source and mask optimization to mitigate hotspots in etch process**, Yuko Kono, Yasunobu Kai, Sayaka Tamaoki, Kazuyuki Masukawa, Takaki Hashimoto, Taiki Kimura, Ryota Aburada, Toshiya Kotani, Toshiba Corp. (Japan) . . . . . [8683-23]

9:40 am: **Global source optimization for MEEF and OPE**, Ryota Matsui, Tomoya Noda, Naonori Kita, Tomoyuki Matsuyama, Nikon Corp. (Japan); Donis G. Flagello, Nikon Research Corp. of America (United States) . . . . . [8683-24]

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

Conference 8684

**Design for Manufacturability through Design-Process**

**Room: Conv. Ctr. 211 B  
8:10 am to 8:20 am**

**Opening Remarks**

Session Chair: **Mark E. Mason**, Texas Instruments Inc. (United States)

**Session 1**

**Room: Conv. Ctr. 211 B  
Wed 8:20 am to 10:05 am**

**Keynote Session**

Session Chairs: **Mark E. Mason**, Texas Instruments Inc. (United States); **John L. Sturtevant**, Mentor Graphics Corp. (United States)

8:20 am: **The future of lithography and its impact on design (Keynote Presentation)**, Chris A. Mack, lithoguru.com (United States) . . . . . [8684-1]

8:55 am: **DFM: fabless perspective (Keynote Presentation)**, Jason P. Cain, Advanced Micro Devices, Inc. (United States) . . . . . [8684-2]

9:30 am: **DFM: foundry perspective (Keynote Presentation)**, Luigi Capodiecchi, GLOBALFOUNDRIES Inc. (United States) . . . . . [8684-3]

Coffee Break . . . . . Wed 10:05 am to 10:40 am

Conference 8679

Extreme Ultraviolet (EUV) Lithography IV

Session 8
Room: Conv. Ctr. 210 B
Wed 10:10 am to 12:10 pm

EUV Resists

Session Chairs: Chris S. Ngai, Applied Materials, Inc. (United States); Thomas I. Wallow, GLOBALFOUNDRIES Inc. (United States)

10:10 am: Development status of EUV resist to break the triangle, Takanori Kawakami, JSR Corp. (Japan); Kenji Hoshiko, JSR Micro N.V. (Belgium); Ken Maruyama, JSR Micro, Inc. (United States); Makoto Shimizu, Tooru Kimura, JSR Corp. (Japan)[8679-34]

10:30 am: Evaluation of EUV resist performance with interference lithography in the range of 22nm to 7nm half-pitch, Yasin Ekinci, Michaela Vockenhuber, Mohamad Hojeij, Li Wang, Nassir M. Mojarad, Paul Scherrer Institut (Switzerland) .. [8679-35]

10:50 am: Resist process applications to improve EUV patterning, Karen E. Petrillo, SEMATECH North (USA); Takashi Saito, TEL Technology Ctr., America, LLC (USA); Kyoungyong Cho, Alexander Fritz, Cecilia Montgomery, Dominic Ashworth, Mark Neisser, Stefan Wurm, SEMATECH North (USA); Lior Huki, Akiteru Ko, Metz Andrew, TEL Technology Ctr., America, LLC (USA) .. [8679-36]

11:10 am: Development of molecular resists derivatives for EUV lithography, Patrick Green, Vipul Jain, Brad Bailey, The Dow Chemical Co. (United States) .. [8679-37]

11:30 am: Relationship between stochastic effect and resist pattern defect in extreme-ultraviolet lithography, Takahiro Kozawa, Osaka Univ. (Japan); Julius Joseph S. Santillan, Toshiro Itani, EUVL Infrastructure Development Ctr., Inc. (Japan) [8679-38]

11:50 am: EUV-sensitive Si containing hard mask (Si-HM) for PTD and NTD process in EUVL, Wataru Shibayama, Shuhei Shigaki, Rikimaru Sakamoto, Nissan Chemical Industries, Ltd. (Japan); Ryuji Onishi, Nissan Chemical Industries, Ltd. (Japan) and EUVL Infrastructure Development Ctr., Inc. (Japan); Hiroaki Yaguchi, Nissan Chemical Industries, Ltd. (Japan) and IMEC (Belgium); Bang-Ching Ho, Nissan Chemical Industries, Ltd. (Taiwan) . . . . [8679-39]

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

Conference 8680

Alternative Lithographic Technologies V

Session 7
Room: Conv. Ctr. Hall 3
Wed 10:30 am to 12:00 pm

E-Beam Direct-Write for High-Voluieme Manufacturing II

Session Chairs: Shy-Jay Lin, Taiwan Semiconductor Manufacturing Co. Ltd. (Taiwan); Hans Loeschner, IMS Nanofabrication AG (Austria)

10:30 am: MAPPER: progress toward a high-volume manufacturing system, Marco Wieland, Guido de Boer, Remco J. A. Jager, Jerry J. M. Peijster, Erwin Slot, Stijn W.H. K. Steenbrink, Michel Dansberg, MAPPER Lithography (Netherlands) .. [8680-23]

11:00 am: Quantifying throughput improvements for electron-beam lithography using a suite of benchmark patterns, John G. Hartley, State Univ. of New York at Albany (United States); Nigel C. Crosland, Robert C. Dowling Jr., Vistec Lithography, Inc. (United States); Philip C. Hoyle, Independent Consultant to Vistec Lithography, Inc. (United Kingdom); Andrew McClelland, Cambeam Systems Design Services, Ltd. (United Kingdom); Martin Turnidge, James H. Smith II, Vistec Lithography, Inc. (United States)[8680-24]

11:20 am: Data delivery system for MAPPER using image compression, Jeehong Yang, Qualcomm Inc. (United States); Serap A. Savari, Texas A&M Univ. (United States) .. [8680-25]

11:40 am: Status of chemically amplified resists performances to address line-width roughness and local CD uniformity specifications for the MAPPER MATRIX pre-production platform, Laurent Pain, Béatrice Icard, Claire Sourd, CEA-LETI-Minatec (France); Julien Jussot, Univ. Joseph Fourier (France); Pablo Wiedemann, Abdi Farah, MAPPER Lithography (Netherlands) .. [8680-26]

Lunch/Exhibition Break . . . . . Wed 12:00 pm to 1:20 pm

Conference 8681

Metrology, Inspection, and Process Control for Microlithography XXVII

Session 9
Room: Conv. Ctr. 230 B
Wed 10:40 am to 12:00 pm

Optical Extensions

Session Chairs: Matthew J. Sendelbach, Nova Measuring Instruments, Inc. (United States); Timothy F. Crimmins, Intel Corp. (United States)

10:40 am: Sub-nanometer parametric uncertainties using through-focus and angle-resolved optical metrology, Richard M. Silver, Jing Qin, Bryan M. Barnes, Hui Zhou, Ronald G. Dixon, Francois Goasmat, National Institute of Standards and Technology (United States); Abraham Arceo, SEMATECH North (United States) .. [8681-31]

11:00 am: TSV reveal height and bump dimension metrology by the TSOM method, Victor H. Vartanian, SEMATECH North (United States); Ravikiran Attota, National Institute of Standards and Technology (United States); Steve Olson, Robert Edgeworth, Pete Moschak, Iqbal Ali, Craig Huffman, Harry Lazier, Elizabeth Lorenzini, SEMATECH North (United States) .. [8681-32]

11:20 am: Use of TSOM for sub-11nm node pattern defect detection and HAR features, Abraham Arceo, Benjamin D. Bunday, SEMATECH North (United States); Ravikiran Attota, National Institute of Standards and Technology (United States) .. [8681-33]

11:40 am: Robustness analysis of nonlinear phase retrieval from single-intensity measurement, Alessandro Polo, Silvania F. Pereira, H. Paul Urbach, Technische Univ. Delft (Netherlands) .. [8681-34]

Lunch/Exhibition Break . . . . . Wed 12:00 pm to 1:20 pm



Conference 8682

**Advances in Resist Materials and Processing Technology XXX**

**Session 9**

**Room: Marriott San Jose Ballroom Salon III  
Wed 10:30 am to 12:10 pm**

**E-Beam Patterning Materials**

Session Chairs: **Luisa D. Bozano**, IBM Almaden Research Ctr. (United States); **Roel Gronheid**, IMEC (Belgium)

10:30 am: **Advanced electron-beam resist requirements and challenges**, Andrew T. Jamieson, Bennett W. Olson, Maiying Lu, Nathan E. Wilcox, Intel Corp. (United States) . . . . . [8682-33]

10:50 am: **Effects on electron scattering and resist characteristics using assisting underlayers for e-beam direct-write lithography**, Xaver Thrun, Kang-Hoon Choi, Martin Freitag, Manuela S. Gutsch, Christoph K. Hohle, Katja Steidel, Fraunhofer-Ctr. Nanoelektronische Technologien (Germany); Douglas Guerrero, Brewer Science, Inc. (United States); Thiago R. Figueiro, Aselta Nanographics (France) . . . . . [8682-34]

11:10 am: **Sub-14 nm HSQ line patterning by e-beam dose proximity effect correction assisted with designed line CD/pitch split**, Wei-Su G. Chen, Industrial Technology Research Institute (Taiwan); Chu-Ya Yang, BASF Electronic Materials Taiwan Ltd. (Taiwan); Chiung Yu Lo, Hung-Wen Wei, Frederick T. Chen, Tzu-Kun Ku, Industrial Technology Research Institute (Taiwan)[8682-35]

11:30 am: **The evaluation of photo/e-beam complementary grayscale lithography for high-topography 3D structure**, Liya Yu, Richard Kasica, Lei Chen, Robert Newby, Kerry Siebein, Vincent Luciani, National Institute of Standards and Technology (United States) . . . . . [8682-36]

11:50 am: TBD . . . . . [8682-84]

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

Conference 8683

**Optical Microlithography XXVI**

**Session 6**

**Room: Conv. Ctr. 210 C  
Wed 10:30 am to 11:50 am**

**Process Technology I**

Session Chairs: **Pary Baluswamy**, Micron Technology, Inc. (United States); **Wilhelm Maurer**, Infineon Technologies AG (Germany)

10:30 am: **Integrated scatterometry for tight overlay and CD control to enable 20nm node wafer manufacturing.**, Jos P. Benschop, Andre Engelen, Hugo Cramer, Michael Kubis, Paul C. Hinnen, Hans van der Laan, Kaustuve Bhattacharyya, Jan Mulken, ASML Netherlands B.V. (Netherlands) . . . . . [8683-25]

10:50 am: **Mix-and-match overlay performance of the NSR-S622D immersion scanner**, Katsushi Makino, Takahisa Kikuchi, Shinji Wakamoto, Satoru Sasamoto, Hongki Park, Nikon Corp. (Japan). . . . . [8683-26]

11:10 am: **Interaction of scanner baseline correction, process correction, and wafer alignment on process overlay**, Koen D'havé, David Laidler, Philippe J. Leray, Shaunee Y. Cheng, IMEC (Belgium) . . . . . [8683-27]

11:30 am: **Lithography imaging control by enhanced monitoring of light source performance**, Paolo Alagna, Cymer, Inc. (Belgium); Omar Zurita, Joshua J. Thornes, Cymer, Inc. (United States); Koen D'havé, Lieve Van Look, Joost P. M. Bekaert, IMEC (Belgium); Nakgeun Seong, Gregory Rechsteiner, Ivan Lalovic, Cymer, Inc. (United States). . . . . [8683-28]

Lunch/Exhibition Break . . . . . Wed 11:50 am to 1:20 pm

Conference 8684

**Design for Manufacturability through Design-Process**

**Session 2**

**Room: Conv. Ctr. 211 B  
Wed 10:40 am to 11:40 am**

**DFDP: Design for Multipatterning**

Session Chairs: **Lars W. Liebmann**, IBM Corp. (United States); **Juan-Antonio Carballo**, Broadcom Corp. (United States)

10:40 am: **Diffraction pattern-based optimization of lithographic targets for improved printability**, Shayak Banerjee, IBM Corp. (United States); Kanak B. Agarwal, IBM Austin Research Lab. (United States). . . . . [8684-4]

11:00 am: **Self-aligned double-patterning friendly configuration for standard cell library considering placement impact**, Jhih-Rong Gao, Bei Yu, The Univ. of Texas at Austin (United States); Ru Huang, Peking Univ. (China); David Z. Pan, The Univ. of Texas at Austin (United States) . . . . . [8684-6]

11:20 am: **Evaluation of cost-driven triple-patterning lithography decomposition**, Haitong Tian, Univ. of Illinois at Urbana-Champaign (United States); Hongbo Zhang, Synopsys, Inc. (United States); Martin D. F. Wong, Univ. of Illinois at Urbana-Champaign (United States) . . . . . [8684-7]

Lunch Break . . . . . Wed 11:40 am to 1:40 pm

Conference 8679

**Extreme Ultraviolet (EUV) Lithography IV**

**Session 9**  
**Room: Conv. Ctr. 210 B**  
**Wed 1:40 pm to 3:20 pm**

**High NA and Magnification**

Session Chairs: **Ted Liang**, Intel Corp. (United States); **Jan Hendrik Peters**, Carl Zeiss SMT GmbH (Germany)

1:40 pm: **Mask effects for high-NA EUV: impact of NA, chief-ray-angle, and demagnification** (*Invited Paper*), Jens T. Neumann, Paul Gräupner, Winfried M. Kaiser, Reiner Garreis, Carl Zeiss SMT GmbH (Germany); Bernd Geh, Carl Zeiss SMT Inc. (United States)[8679-40]

2:10 pm: **Considerations for high-numerical aperture EUV** (*Invited Paper*), Harry J. Levinson, GLOBALFOUNDRIES Inc. (United States) . . . . . [8679-41]

2:40 pm: **Projection optics for EUVL micro-field exposure tools with a numerical aperture of 0.5**, Holger K. Glatzel, Zygo Corp. (United States); Dominic Ashworth, SEMATECH North (United States); Mark Bremer, Rodney Chin, Zygo Corp. (United States); Kevin Cummings, SEMATECH North (United States); Luc Girard, Zygo Corp. (United States); Michael Goldstein, SEMATECH North (United States); Eric M. Gullikson, Lawrence Berkeley National Lab. (United States); Russell Hudyma, Hyperion Development LLC (United States); Jame Kennon, Robert Kestner, Louis A. Marchetti, Zygo Corp. (United States); Patrick P. Naulleau, Lawrence Berkeley National Lab. (United States); Regina Souffli, Lawrence Livermore National Lab. (United States); Eberhard A. Spiller, Spiller X-Ray Optics (United States) . . . . . [8679-42]

3:00 pm: **2D EUV mask shadowing requirements for sub-14nm node devices**, Sudharshanan Raghunathan, Obert R. Wood II, GLOBALFOUNDRIES Inc. (United States); Gregory R. McIntyre, IBM Corp. (United States); Germain L. Fenger, GLOBALFOUNDRIES Inc. (United States) . . . . . [8679-43]

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

Conference 8680

**Alternative Lithographic Technologies V**

**Session 8**  
**Room: Conv. Ctr. Hall 3**  
**Wed 1:20 pm to 3:10 pm**

**Nanoimprint Applications**

Session Chairs: **Elizabeth A. Dobisz**, HGST (United States); **John G. Maltabes**, Hewlett-Packard Labs. (United States)

1:20 pm: **30nm nanochannels with plasmonic bowtie nano-antenna: wafer scale device fabrication and applications for biosensing**, Irene Fernandez-Cuesta, Technical Univ. of Denmark (Denmark); Enrica Montinaro, Scott D. Dhuey, P. James Schuck, Stefano Cabrini, Lawrence Berkeley National Lab. (United States) . . . . . [8680-27]

1:50 pm: **Lithography challenges for 2 Tdpsi bit patterned media fabrication and beyond**, Shuaigang Xiao, Xiaomin Yang, Kim Y. Lee, Yautzong E. Hsu, Koichi Wago, Michael R. Feldbaum, Philip Steiner, David S. Kuo, Seagate Technology LLC (United States) . . . . . [8680-28]

2:10 pm: **Meter-long substrate nanopatterning using rolling mask optical lithography**, Ian McMackin, Joseph B. Geddes III, Mukti Aryal, Alfred F. Renaldo, Boris Kobrin, Rolith, Inc. (United States) . . . . . [8680-29]

2:30 pm: **Fabrication of silicon lines with sub-25nm full pitch on 8-mm-wide circular tracks from directed self-assembly of PS-b-PMMA**, Lei Wan, Ricardo Ruiz, He H. Gao, Kanaiyalal C. Patel, Thomas R. Albrecht, HGST (United States); Yi Cao, Jian Yin, SungEun Hong, Guanyang Lin, AZ Electronic Materials USA Corp. (United States) . . . . . [8680-30]

2:50 pm: **High-performance wire grid polarizers using roll-based jet and flash imprint lithography**, Sean Ahn, Mahadevan G. Subramanian, Michael L. Miller, Jack Yang, Byung Jin Choi, Marlon Menezes, Frank Y. Xu, Paul Hellebrekers, Dwayne L. LaBrake, Douglas J. Resnick, S. V. Sreenivasan, Molecular Imprints, Inc. (United States) . . . . . [8680-31]

Coffee Break . . . . . Wed 3:10 pm to 3:30 pm

Conference 8681

**Metrology, Inspection, and Process Control for Microlithography XXVII**

**Session 10**  
**Room: Conv. Ctr. 230 B**  
**Wed 1:20 pm to 3:10 pm**

**LER/LWR**

Session Chairs: **Benjamin D. Bunday**, SEMATECH North (United States); **Byoung-Ho Lee**, SAMSUNG Electronics Co., Ltd. (Korea, Republic of)

1:20 pm: **New methods for understanding and using metrology for line-edge roughness** (*Invited Paper*), Chris A. Mack, Lithoguru.com (United States) . . . . . [8681-35]

1:50 pm: **Development of a calibration standard for sidewall roughness**, Aaron Cordes, Benjamin D. Bunday, SEMATECH North (United States); Hugh Porter, GLOBALFOUNDRIES Inc. (United States); Sean Hand, Jason Osborne, Bruker Nano Inc. (United States) . . . . . [8681-36]

2:10 pm: **Roughness of ArF and EUV resists with different radiation exposure as investigated using three tools: AFM, SEM, and ellipsometry**, Byong Chon Park, Yong Jai Cho, Korea Research Institute of Standards and Science (Korea, Republic of); Insung Kim, Jeongho Yeo, SAMSUNG Electronics Co., Ltd. (Korea, Republic of) . . . . . [8681-37]

2:30 pm: **Data fusion methodology dedicated to CD-SEM LWR measurement calibration**, Nivea G. S. Figueiro, Johann Foucher, CEA-LETI (France) . . . . . [8681-38]

2:50 pm: **Evaluation of methods for noise-free measurement of LER/LWR using synthesized SEM images**, Vassilios Constantoudis, Evangelos Gogolides, National Ctr. for Scientific Research Demokritos (Greece) . . . . . [8681-120]

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

Conference 8682

Advances in Resist Materials and Processing Technology XXX

Session 10

Room: Marriott San Jose Ballroom Salon III
Wed 1:30 pm to 2:50 pm

EUV Materials, Processing, and Analysis

Session Chairs: Todd Ross Younkin, Intel Corp. (Belgium); Yoshio Kawai, Shin-Etsu Chemical Co., Ltd. (Japan)

- 1:30 pm: Progress in resolution, sensitivity, and line-width roughness of EUV chemically-amplified resists, James W. Thackeray, Vipul Jain, James F. Cameron, Paul LaBeaume, Suzanne M. Coley, Owendi Ongayi, Aaron Rachford, Dow Electronic Materials (United States); John J. Biafore, Univ. de Valencia (Spain).[8682-39]
1:50 pm: Negative-tone imaging process and materials for EUV lithography, Shinji Tarutani, Takanobu Takeda, Wataru Nihashi, Shuuji Hirano, Natsumi Yokokawa, Hiroo Takizawa, FUJIFILM Corp. (Japan). [8682-40]
2:10 pm: Underlayer and rinse materials for improving EUV resist performance, Georg Pawlowski, Go Noya, Yuriko Matsuura, Maki Ishii, AZ Electronic Materials (Japan) K.K. (Japan); Huirong Yao, Salem Mullen, Joonyeon Cho, Munirathna Padmanaban, AZ Electronic Materials USA Corp. (United States) [8682-41]
2:30 pm: High-absorbing resists based on trifluoromethacrylate-vinyl ether copolymers for EUV lithography, Matthew D. Christianson, Owendi Ongayi, David Valeri, Matthew M. Meyer, Mike D. Wagner, Dow Chemical Co. (United States). [8682-42]
Coffee Break Wed 2:50 pm to 3:30 pm

Conference 8683

Optical Microlithography XXVI

Session 7

Room: Conv. Ctr. 210 C
Wed 1:20 pm to 3:00 pm

Modeling

Session Chairs: Bernd Geh, Carl Zeiss SMT Inc. (United States); Xuelong Shi, Semiconductor Manufacturing International Corp. (China)

- 1:20 pm: Solutions with precise prediction for thermal aberration error in low-k1 immersion lithography, Kazuya Fukuhara, Toshiba Corp. (Japan); Akiko Mimotogi, Toshiba Materials Co., Ltd. (Japan); Takuya Kono, Toshiba Corp. (Japan); Hajime Aoyama, Taro Ogata, Naonori Kita, Tomoyuki Matsuyama, Nikon Corp. (Japan) .[8683-29]
1:40 pm: Compact OPC model optimization using emulated data, Artak Isoyan, Synopsys, Inc. (United States); Thomas Mülenders, Synopsys GmbH (Germany); Lawrence S. Melvin III, Synopsys, Inc. (United States) . [8683-30]
2:00 pm: A study on the automation of scanner matching, Yuan He, Scott L. Light, Erik R. Byers, Craig Hickman, Micron Technology, Inc. (United States); Alexander Serebryakov, ASML Netherlands B.V. (Netherlands); Vivek Jain, Ronald J. G. Goossens, Zhi-Yuan Nui, Peter Engblom, ASML US, Inc. (United States); Scott Larson, ASML Boise (United States); Bernd Geh, Carl Zeiss SMT Inc. (United States) . [8683-31]
2:20 pm: Adjustment of image decomposition mode and reflection criterion focusing on critical dimension uniformity and exposure dose effectiveness under diffraction effects in optical microlithography using a digital micromirror device, Manseung Seo, Haeryung Kim, Tongmyong Univ. of Information Technology (Korea, Republic of) . [8683-32]
2:40 pm: Simulation of spacer-based SADP (self-aligned double-patterning) for 15nm half pitch, Stewart A. Robertson, KLA-Tencor Texas (United States); Patrick Wong, Vincent Wiaux, IMEC (Belgium) . [8683-33]
Coffee Break Wed 3:00 pm to 3:30 pm

Conference 8684

Design for Manufacturability through Design-Process

Session 3

Room: Conv. Ctr. 211 B
Wed 1:40 pm to 3:00 pm

Design Rules and Routing

Session Chairs: Luigi Capodieci, GLOBALFOUNDRIES Inc. (United States); Chi-Min Yuan, Freescale Semiconductor, Inc. (United States)

- 1:40 pm: Self-aligned double patterning compliant routing with in-design physical verification flow, Jhih-Rong Gao, The Univ. of Texas at Austin (United States); Harshdeep Jawandha, Prasad Atkarc, Atul Walimbe, Bikram Baidya, Intel Corp. (United States); David Z. Pan, The Univ. of Texas at Austin (United States) .[8684-8]
2:00 pm: Pattern matching for identifying and resolving nondecomposition-friendly designs for double-patterning technology (DPT), Lynn T. Wang, Vito Dai, Luigi Capodieci, GLOBALFOUNDRIES Inc. (United States) . [8684-9]
2:20 pm: Detailed routing with advanced flexibility and in compliance with self-aligned double-patterning constraints, Fumiharu Nakajima, Chikaaki Kodama, Toshiba Corp. (Japan); Hiroataka Ichikawa, Toshiba Microelectronics Corp. (Japan); Koichi Nakayama, Toshiba Corp. (Japan); Shigeki Nojima, Toshiba Materials Co., Ltd. (Japan); Toshiya Kotani, Toshiba Corp. (Japan); Shoji Mimotogi, Toshiba Materials Co., Ltd. (Japan); Shinji Miyamoto, Toshiba Corp. (Japan) . [8684-10]
2:40 pm: Pioneering an on-the-fly simulation technique for the detection of layout-dependent effects during IC design phase, Amr M. S. T. Abdelwahed, Mentor Graphics Egypt (Egypt); Rami Fathy, Mentor Graphics Corp. (Canada); Ahmed Ramadan, Mentor Graphics Egypt (Egypt) . [8684-11]
Coffee Break Wed 3:00 pm to 3:30 pm

Conference 8679

**Extreme Ultraviolet (EUV) Lithography IV**

**Session 10**

**Room: Conv. Ctr. 210 B  
Wed 3:50 pm to 5:50 pm**

**Mask II**

Session Chairs: **Stanley E. Stokowski**, KLA-Tencor Corp. (United States); **Tsutomu Shoki**, HOYA Corp. (Japan)

3:50 pm: **Commissioning a new EUV Fresnel zoneplate mask-imaging microscope for lithography generations reaching 8nm**, Kenneth A. Goldberg, Iacopo Mochi, Markus P. Benk, James B. Macdougall, Patrick P. Naulleau, Lawrence Berkeley National Lab. (United States). . . . . [8679-44]

4:10 pm: **The role of defect characterization in the progression toward defect-free EUV mask blanks**, Jenah Harris-Jones, Emilio Stinzianni, C. C. Lin, Tonmoy Chakraborty, SEMATECH North (United States); Shuiqing Hu, Lars Mininni, Chanmin Su, Bruker Nano Inc. (United States). . . . . [8679-45]

4:30 pm: **Experimental phase defect printability evaluation using a programmed phase defect in EUVL mask**, Tsuneo Terasawa, Tsuyoshi Amano, Sunghyun Oh, Takeshi Yamane, Hidehiro Watanabe, EUVL Infrastructure Development Ctr., Inc. (Japan). . . . . [8679-46]

4:50 pm: **EUV defect characterization using quantitative nanomechanical mechanical and nanoelectric mapping**, Shuiqing Hu, Bruker Nano Inc. (United States); Jenah Harris-Jones, SEMATECH North (United States); Lars Mininni, Bruker Nano Inc. (United States); Tonmoy Chakraborty, SEMATECH North (United States); Chanmin Su, Bruker Nano Inc. (United States). . . . . [8679-47]

5:10 pm: **Challenges in EUV mask blank deposition for high-volume manufacturing**, Vibhu Jindal, Patrick A. Kearney, Alin O. Antohe, Milton C. Godwin, Arun J. Kadaksham, Ranganath Teki, Frank Goodwin, SEMATECH North (United States)[8679-48]

5:30 pm: **Extending Ru capping layer durability under physical force cleaning**, SherJang Singh, SUSS MicroTec Inc. (United States). . . . . [8679-49]

Conference 8680

**Alternative Lithographic Technologies V**

**Session 9**

**Room: Conv. Ctr. Hall 3  
Wed 3:30 pm to 5:20 pm**

**Design for Manufacturability for DSA: Joint Session with Conferences 8680 and 8684**

Session Chairs: **Benjamin M. Rathsack**, Tokyo Electron America, Inc. (United States); **Lars W. Liebmann**, IBM Corp. (United States)

3:30 pm: **Directed self-assembly pattern generation of basic FinFET circuit constructs** (*Invited Paper*), Hsinyu Tsai, Hiroyuki Miyazoe, IBM Thomas J. Watson Research Ctr. (United States); Joy Y. Cheng, Jed W. Pitera, IBM Almaden Research Ctr. (United States); Chi-Chun Liu, Steven J. Holmes, IBM Albany Nanotech (United States); Daniel P. Sanders, IBM Almaden Research Ctr. (United States); Eric A. Joseph, IBM Thomas J. Watson Research Ctr. (United States); Lars W. Liebmann, Kafai Lai, IBM Corp. (United States); Michael A. Guillorn, IBM Thomas J. Watson Research Ctr (United States). . . . . [8680-32]

4:00 pm: **Rethinking ASIC design with next-generation lithography and process integration**, Kaushik Vaidyanathan, Carnegie Mellon Univ. (United States); Lars W. Liebmann, Kafai Lai, IBM Corp. (United States); Andrzej J. Strojwas, Larry Pileggi, Carnegie Mellon Univ. (United States). . . . . [8684-12]

4:20 pm: **Fabrication of deterministically isolated gratings through directed self-assembly of block copolymers**, Gregory S. Doerk, Joy Y. Cheng, Charles T. Rettner, Srinivasan Balakrishnan, Noel Arellano, Melia Tjio, Hoa Truong, Daniel P. Sanders, IBM Almaden Research Ctr. (United States). . . . . [8680-33]

4:40 pm: **Computational solution of inverse directed self-assembly problem**, Azat M. Latypov, GLOBALFOUNDRIES Inc. (United States) . . . [8680-34]

5:00 pm: **Design strategy of small topographical guiding templates for sub-15nm integrated circuits contact hole patterns using block copolymer directed self assembly**, He Yi, Stanford Univ. (United States); Xin-Yu Bao, Stanford Univ. (United States) and Applied Materials, Inc., (United States); Richard Tiberio, H. S. Philip Wong, Stanford Univ. (United States). . . . . [8680-35]

Conference 8681

**Metrology, Inspection, and Process Control for Microlithography XXVII**

**Session 11**

**Room: Conv. Ctr. 230 B  
Wed 3:40 pm to 5:40 pm**

**Overlay**

Session Chairs: **Ofer Adan**, Applied Materials (Israel); **Christopher J. Raymond**, Nanometrics Inc. (United States)

3:40 pm: **Mueller polarimetry in the back focal plane: new advances in overlay measurements**, Tatiana Novikova, Bicher Haj Ibrahim, Jacqueline Tran, Ecole Polytechnique (France); Cyril Vannuffel, CEA-LETI (France); Christophe Constancias, CEA-LETI-Minatec (France); Antonello De Martino, Ecole Polytechnique (France). . . . . [8681-39]

4:00 pm: **Diffraction-based overlay and image-based overlay on production flow for advanced technology node**, Yoann Blancquaert, CEA-LETI (France); Christophe Dezauzier, STMicroelectronics (France); Jerome Depre, Jan Beltman, Mohamed Miqyass, ASML Netherlands B.V. (Netherlands). . . . . [8681-40]

4:20 pm: **Reduction of image-based ADI-to-AEI overlay inconsistency with improved algorithm**, Yen-Liang Chen, Taiwan Semiconductor Manufacturing Co., Ltd. (Taiwan). . . . . [8681-41]

4:40 pm: **Fundamentals of overlay measurement and inspection using scanning electron microscope**, Takeshi Kato, Osamu Inoue, Yutaka Okagawa, Satoru Yamaguchi, Koji Arai, Hitachi High-Technologies Corp. (Japan). . . . . [8681-42]

5:00 pm: **DCM: device correlated metrology for overlay measurements**, Charlie Chen, George K. C. Huang, Yuan Chi Pai, Jimmy C. H. Wu, Yu Wei Cheng, Simon C. C. Hsu, Chun Chi Yu, United Microelectronics Corp. (Taiwan); Nuriel Amir, KLA-Tencor Israel (Israel); Dongsu Choi, KLA-Tencor Korea (Korea, Republic of); Tal Itzkovich, KLA-Tencor Israel (Israel); David C. Tien, KLA-Tencor Corp. (United States); Eros Huang, Kelly T. L. Kuo, KLA-Tencor Taiwan (Taiwan); Yutaka Okagawa, Hitachi High-Technologies Corp. (Japan); Takeshi Kato, Hitachi High-Tech Trading Corp. (Japan); Osamu Inoue, Hitachi High-Technologies Corp. (Japan); Luis Huang, Matthew Hsu, Hitachi High-Technologies Corp. (Taiwan). [8681-43]

5:20 pm: **In-die overlay metrology by using CD-SEM**, Osamu Inoue, Takeshi Kato, Yutaka Okagawa, Hiroki Kawada, Hitachi High-Technologies Corp. (Japan). . . . . [8681-70]

**Room: Conv. Ctr. 230 B  
7:30 pm to 9:00 pm**

**Panel Discussion**

**Making a Business Case for Disruptive Metrology Technologies: What Should We Invest In?**

*Panelists:* **John A. Allgair**, GLOBALFOUNDRIES Inc.; **Eric Solecky**, IBM Corp.; **Michael Grumski**, Intel Corp.; **R. Joseph Kline**, National Institute of Standards and Technology; **David K. Lam**, Multibeam Corp.; **Mingwei Li**, KLA-Tencor Corp.

*Moderators:* **Alok Vaid**, GLOBALFOUNDRIES, Inc.; **Benjamin D. Bunday**, SEMATECH North; **Matthew J. Sendelbach**, Nova Measuring Instruments, Inc.

Continuing decrease in the device dimensions, combined with complex disruptive materials and 3D architectures have placed increasing demands on metrology tools. Over the years, the industry has implemented several innovative solutions to alleviate these challenges, but most of them have been incremental improvements rather than revolutionary. There seems to be inertia preventing the adoption of revolutionary and disruptive measurement techniques, some of which have been in the limelight for about a decade. The panel will focus on three key disruptive solutions which have been identified as potential next-generation metrology and inspection technologies for some time – CD-SAXS, Multi-ebeam-based inspection, and He-ion imaging. Our panel of experts will come from a mix of IC manufacturers, suppliers, academia, and research consortia. Panelists will review the technical, business and financial aspects of these technologies and also try to form a consensus on whether they are really needed to meet current industry requirements. The panel will recommend whether the industry should continue to invest in these technologies, and if so, then what it will “actually” take to get them implemented in HVM.

Conference 8682

**Advances in Resist Materials and Processing Technology XXX**

**Session 11**

**Room: Marriott San Jose Ballroom Salon III  
Wed 3:30 pm to 5:10 pm**

**Fundamental Studies of RLS Behavior**

Session Chairs: **Sean D. Burns**, IBM Corp. (United States); **Scott W. Jessen**, Texas Instruments Inc. (United States)

3:30 pm: **The impact on LWR of resist formulation parameters**, Kyoungyoung Cho, Mark Neisser, SEMATECH North (United States); Shinji Tarutani, Naoki Inoue, Hideaki Tsubaki, FUJIFILM Corp. (Japan) . . . . . [8682-43]

3:50 pm: **Monitoring the evolution of line-edge roughness (LER) during development using an analog of quenched flow kinetics**, Martha I. Sanchez, Linda K. Sundberg, Gregory M. Wallraff, IBM Almaden Research Ctr. (United States); William D. Hinsberg, Columbia Hill Technical Consulting (United States); Ramakrishnan Ayothi, Yoshi Hishiro, JSR Micro, Inc. (United States); Luisa D. Bozano, Hoa Truong, IBM Almaden Research Ctr. (United States); Karen E. Petrillo, IBM Corp. (United States) . . . . . [8682-44]

4:10 pm: **Breakthrough of RLS trade-off relation in EUV resists studied by picosecond and femtosecond pulse radiolysis**, Seiichi Tagawa, Osaka Univ. (Japan) and Japan Science and Technology Agency (Japan); Takafumi Kondoh, Osaka Univ. (Japan); Satoshi Enomoto, Ravi Joshi, Akihiro Oshima, Osaka Univ. (Japan) and Japan Science and Technology Agency (Japan); Jinfeng Yang, Yoichi Yoshida, Osaka Univ. (Japan) . . . . . [8682-45]

4:30 pm: **Evaluation of sensitivity for positive-tone nonchemically and chemically amplified resists using ionized radiation: EUV, x-ray, electron, and ion-induced reactions**, Akihiro Oshima, Osaka Univ. (Japan) and JST-CREST (Japan); Tomoko G. Oyama, Japan Atomic Energy Agency (Japan) and Japan Society for the Promotion of Science (Japan); Masakazu Washio, Waseda Univ. (Japan); Seiichi Tagawa, Osaka Univ. (Japan) and JST-CREST (Japan) . . . . . [8682-46]

4:50 pm: **Study on dissolution behavior of polymer-bound and polymer-blended photo-acid generator (PAG) resists**, Hiroki Yamamoto, Takahiro Kozawa, Seiichi Tagawa, Osaka Univ. (Japan) . . . . . [8682-47]

Conference End.

Conference 8683

**Optical Microlithography XXVI**

**Session 8**

**Room: Conv. Ctr. 210 C  
Wed 3:30 pm to 5:30 pm**

**Process Technology II**

Session Chairs: **Sukjoo Lee**, SAMSUNG Electronics Co., Ltd. (Korea, Republic of); **Nigel R. Farrar**, Cymer, Inc. (United States)

3:30 pm: **A comparative study of self-aligned quadruple and sextuple patterning techniques for sub-15nm IC scaling**, Yijian Chen, Weiling Kang, Qi Cheng, Peking Univ. Shenzhen Graduate School (China) . . . . . [8683-34]

3:50 pm: **Grayscale lithography: 3D structuring and thickness control**, Marcel Heller, Dieter Kaiser, Maik Stegemann, Jens Schneider, Nicolo Morgana, Georg Holfeld, Daniel Sarlette, Infineon Technologies Dresden (Germany) . . . . . [8683-35]

4:10 pm: **Modification of an attenuated phase-shift mask for single-exposure double and multiple patterning**, Frederick T. Chen, Wei-Su G. Chen, Ming-Jinn Tsai, Tzu-Kun Ku, Industrial Technology Research Institute (Taiwan) . . . . . [8683-36]

4:30 pm: **Avoiding wafer-print artifacts in spacer is dielectric (SID) patterning**, Gerard Luk-Pat, Benjamin D. Painter, Alexander Miloslavsky, Synopsys, Inc. (United States); Peter De Bisschop, IMEC (Belgium); Adam Beacham, Synopsys, Inc. (Canada); Kevin Lucas, Synopsys, Inc. (United States) . . . . . [8683-37]

4:50 pm: **Best focus shift mitigation for extending the depth of focus**, Anna Szucs, Jonathan Planchot Jr., Vincent Farys, Emek Yesilada, Clovis Alleaume, STMicroelectronics (France); Laurent Depre, Russel J. Dover, Brion Technologies, Inc. (United States); Cecile Gourgon, Maxime Besacier, CEA-LETI (France); Angélique Nachtwein, Paul Rusu, ASML Netherlands B.V. (Netherlands) . . . . . [8683-38]

5:10 pm: **Wafer sublayer impact in OPC/ORC models for 2xnm node implant layers**, Elodie Sungauer, Jean-Christophe Michel, Jean-Christophe Le Denmat, Emek Yesilada, Frederic Robert, STMicroelectronics (France); Song Lan, Mu Feng, Xiaobo Xie, Laurent Depre, Russel J. Dover, ASML US, Inc. (United States) . . . . . [8683-39]

Conference 8684

**Design for Manufacturability through Design-Process**

**Session 4**

**Room: Conv. Ctr. Hall 3  
Wed 3:30 pm to 5:20 pm**

**Design for Manufacturability for DSA: Joint Session with Conferences 8680 and 8684**

Session Chairs: **Benjamin M. Rathsack**, Tokyo Electron America, Inc. (United States); **Lars W. Liebmann**, IBM Corp. (United States)

3:30 pm: **Directed self-assembly pattern generation of basic FinFET circuit constructs** (*Invited Paper*), Hsinyu Tsai, Hiroyuki Miyazoe, IBM Thomas J. Watson Research Ctr. (United States); Joy Y. Cheng, Jed W. Pitera, IBM Almaden Research Ctr. (United States); Chi-Chun Liu, Steven J. Holmes, IBM Albany Nanotech (United States); Daniel P. Sanders, IBM Almaden Research Ctr. (United States); Eric A. Joseph, IBM Thomas J. Watson Research Ctr. (United States); Lars W. Liebmann, Kafai Lai, IBM Corp. (United States); Michael A. Guillorn, IBM Thomas J. Watson Research Ctr (United States) . . . . . [8680-32]

4:00 pm: **Rethinking ASIC design with next-generation lithography and process integration**, Kaushik Vaidyanathan, Carnegie Mellon Univ. (United States); Lars W. Liebmann, Kafai Lai, IBM Corp. (United States); Andrzej J. Strojwas, Larry Pileggi, Carnegie Mellon Univ. (United States) . . . . . [8680-12]

4:20 pm: **Fabrication of deterministically isolated gratings through directed self-assembly of block copolymers**, Gregory S. Doerk, Joy Y. Cheng, Charles T. Rettner, Srinivasan Balakrishnan, Noel Arellano, Melia Tjio, Hoa Truong, Daniel P. Sanders, IBM Almaden Research Ctr. (United States) . . . . . [8680-33]

4:40 pm: **Computational solution of inverse directed self-assembly problem**, Azat M. Latypov, GLOBALFOUNDRIES Inc. (United States) . . . . . [8680-34]

5:00 pm: **Design strategy of small topographical guiding templates for sub-15nm integrated circuits contact hole patterns using block copolymer directed self assembly**, He Yi, Stanford Univ. (United States); Xin-Yu Bao, Stanford Univ. (United States) and Applied Materials, Inc., (United States); Richard Tiberio, H. S. Philip Wong, Stanford Univ. (United States) . . . . . [8680-35]

The following posters will be on display after 10:00 am on Wednesday. The interactive poster session with authors in attendance will be Wednesday evening from 6:00 to 8:00 pm. All symposium attendees are invited to attend the poster sessions. Come view the high-quality papers that are presented in this alternative format, and interact with the poster author who will be available for discussion. Enjoy light refreshments while networking with colleagues in your field. Attendees are required to wear their conference registration badges to the poster sessions.

Wednesday Poster Reception Sponsors



Conf. 8679 Extreme Ultraviolet (EUV) Lithography IV

Session Chairs: **Patrick P. Naulleau**, Lawrence Berkeley National Lab. (United States); **Obert R. Wood II**, GLOBALFOUNDRIES Inc. (United States)

**The limit of OAI and AttPSM in EUVL**, Shinn-Sheng Yu, Yen-Cheng Lu, Chih-Tsung Shih, Taiwan Semiconductor Manufacturing Co. Ltd. (Taiwan); Jack J. H. Chen, Anthony Yen, TSMC Taiwan (Taiwan); Burn J. Lin, Taiwan Semiconductor Manufacturing Co. Ltd. (Taiwan) . . . . . [8679-56]

**Experimental verification of EUV mask limitations at high-numerical apertures**, Rikon Chao, Univ. of California, Berkeley (United States); Paul Gräupner, Carl Zeiss SMT GmbH (Germany); Eric M. Gullikson, Lawrence Berkeley National Lab. (United States); Seong-Sue Kim, SAMSUNG Electronics Co., Ltd. (Korea, Republic of); Jens T. Neumann, Carl Zeiss SMT GmbH (Germany); Ryan H. Miyakawa, Lawrence Berkeley National Lab. (United States); Hwan-Seok Seo, SAMSUNG Electronics Co., Ltd. (Korea, Republic of); Andrew R. Neureuther, Univ. of California, Berkeley (United States); Patrick P. Naulleau, Lawrence Berkeley National Lab. (United States) . . . . . [8679-57]

**Homogeneity improvement of TiO<sub>2</sub>-SiO<sub>2</sub> glass synthesized by the soot method and its evaluation using the ultrasonic measurement system**, Masahiro Kawagishi, Junko Konishi, Masaaki Takata, AGC Electronics Co., Ltd. (Japan); Jun-ichi Kushibiki, Mototaka Arakawa, Yuji Ohashi, Tohoku Univ. (Japan) . . . . . [8679-58]

**Inspection and compositional analysis of sub-20 nm EUV mask blank defects by a thin film decoration technique**, Vibhu Jindal, Patrick A. Kearney, Alin O. Antohe, Arun J. Kadaksham, Emilio Stinziani, Jenah Harris-Jones, Frank Goodwin, SEMATECH North (United States); Takahiro Onoue, HOYA Corp. (Japan) . . . . . [8679-59]

**Impact of the phase defect structure on wafer printability and an actinic dark-field blank inspection signal**, Tsuyoshi Amano, Tsuneo Terasawa, EUVL Infrastructure Development Ctr., Inc. (Japan) . . . . . [8679-60]

**Modeling studies on alternative EUV mask concepts for higher NA**, Andreas Erdmann, Tim Fühner, Peter Evanschitzky, Fraunhofer-Institut für Integrierte System und Bauelementechnologie (Germany); Jens T. Neumann, Johannes Ruoff, Paul Gräupner, Carl Zeiss SMT GmbH (Germany) . . . . . [8679-61]

**Low-thermal expansion material cleaning and optimization for EUV blank deposition at SEMATECH**, Arun J. Kadaksham, Teki Ranganatha, Matthew House, Milton C. Godwin, Patrick A. Kearney, Vibhu Jindal, Alin O. Antohe, Jenah Harris-Jones, Andy Ma, Frank Goodwin, SEMATECH North (United States) . . . . . [8679-62]

**Local area EUV mask patterning for native defect analysis**, Adam Lyons, Univ. at Albany (United States); Ranganath Teki, SEMATECH North (United States); John G. Hartley, Univ. at Albany (United States) . . . . . [8679-63]

**Evaluation of novel projection electron microscopy (PEM) optics for EUV mask inspection**, Ryoichi Hirano, Hidehiro Watanabe, Susumu Iida, Tsuyoshi Amano, Tsuneo Terasawa, EUVL Infrastructure Development Ctr., Inc. (Japan); Masahiro Hatakeyama, Takeshi Murakami, EBARA Corp. (Japan) . . . . . [8679-64]

**Registration error improvement of fiducial mark on EUV mask with MIRAI EUV ABI prototype**, Tetsunori Murachi, EUVL Infrastructure Development Ctr., Inc. (Japan) . . . . . [8679-65]

**Study of simulated projection electron microscope images of defects on EUV mask**, Susumu Iida, Tsuyoshi Amano, Ryoichi Hirano, Tsuneo Terasawa, Hidehiro Watanabe, EUVL Infrastructure Development Ctr., Inc. (Japan) . . . . . [8679-66]

**Development of 3D Monte Carlo simulations for predicting multilayer geometry of pit-type EUV defects**, Robert F. Spivey III, Rensselaer Polytechnic Institute (United States); Ranganath Teki, SEMATECH North (United States); Toh-Ming Lu, Rensselaer Polytechnic Institute (United States) . . . . . [8679-67]

**Effect of phase defect shape for ABI signal intensity and printed CD on wafer with simulation**, Noriaki Takagi, Yukiyasu Arisawa, Tsuneo Terasawa, EUVL Infrastructure Development Ctr., Inc. (Japan) . . . . . [8679-68]

**Mathematical model for calculating speckle contrast through focus**, Rene A. Claus, Univ. of California, Berkeley (United States) and Lawrence Berkeley National Lab. (United States); Andrew R. Neureuther, Univ. of California, Berkeley (United States); Patrick P. Naulleau, Lawrence Berkeley National Lab. (United States) . . . . . [8679-69]

**Evaluating the effect of EUV multilayer buried defects on feature printability using a stochastic resist model**, Trey Graves, KLA-Tencor Texas (United States) . . . . . [8679-70]

**Factors affecting resist-outgas qualification: dependence of contamination on dose, exposure time, and wafer area**, Charles Tarrio, Shannon B. Hill, Robert F. Berg, Steven Grantham, National Institute of Standards and Technology (United States); Nadir S. Faradzhev, Johns Hopkins Univ. (United States); Thomas B. Lucatoro, National Institute of Standards and Technology (United States) . . . . . [8679-71]

**Status of EUV radiometry at PTB**, Christian Laubis, Annett Barboutis, Martin Biel, Christian Buchholz, Benjamin Dubrau, Andreas Fischer, Anne Hesse, Jana Puls, Christian Stadelhoff, Victor Soltwisch, Frank Scholze, Physikalisch-Technische Bundesanstalt (Germany) . . . . . [8679-72]

**Hartmann wavefront sensor for EUV radiation**, Klaus Mann, Bernhard Flöter, Tobias Mey, Bernd Schäfer, Laser-Lab. Göttingen e.V. (Germany); Barbara Keitel, Elke Plönjes, Kai Tiedtke, Deutsches Elektronen-Synchrotron (Germany) . . . . . [8679-73]

**A reverse design method for EUV lithography illumination system**, Yanqiu Li, Qiuli Mei, Fei Liu, Beijing Institute of Technology (China) . . . [8679-74]

**Patterning at 6.5nm wavelength using interference lithography**, Nassir M. Mojarad, Michaela Vockenhuber, Li Wang, Paul Scherrer Institut (Switzerland); Bernd Terhalle, Tesa Scribos GmbH (Germany); Yasin Ekinici, Paul Scherrer Institut (Switzerland) . . . . . [8679-75]

**Simulation of the relationship between sensitivity and LWR in an EUV resist with photo-decomposable quencher**, Suchit Bhattarai, Andrew R. Neureuther, Univ. of California, Berkeley (United States); Patrick P. Naulleau, Lawrence Berkeley National Lab. (United States) . . . [8679-76]

**Relation between sensitivity and resolution in polymer bound PAG and polymer blend PAG**, Satoshi Enomoto, Tuan N. Dang, Seiichi Tagawa, Osaka Univ. (Japan) . . . . . [8679-77]

**Assessment of out-of-band radiation from EUV AD1 and investigation of spectral sensitivity resists in the DUV region**, Kyoungyoung Cho, Alexander Friz, Mark Neisser, SEMATECH North (United States); Sang-In Han, ASML US, Inc. (United States) . . . . . [8679-78]

**Stochastic resist patterning simulation using PSM for EUV lithography**, Seongchul Hong, Jinho Ahn, Seejun Jeong, Jae Uk Lee, Hanyang Univ. (Korea, Republic of); Jonggul Doh, Hanyang Univ. (Korea, Republic of) and SAMSUNG Electronics Co., Ltd. (Korea, Republic of); Seung Min Lee, Jongseok Kim, Hanyang Univ. (Korea, Republic of) . . . . . [8679-79]

**Quencher distribution engineering of out-of-band insensitive EUV resists: experiments and stochastic simulation**, Shang-Chieh Chien, Shu-Hao Chang, TSMC Taiwan (Taiwan); Jui-Ching Wu, Taiwan Semiconductor Manufacturing Co. Ltd. (Taiwan); Jack J. H. Chen, Anthony Yen, TSMC Taiwan (Taiwan) . . . . . [8679-80]

**Evaluation and prediction of resist sensitivity: chemically amplified resists for EB, 13.5nm EUV, and 6x-m EUV extension**, Tomoko G. Oyama, Japan Atomic Energy Agency (Japan) and Japan Society for the Promotion of Science (Japan); Akihiro Oshima, Tuan N. Dang, Osaka Univ. (Japan) and JST-CREST (Japan); Satoshi Enomoto, Osaka Univ. (Japan); Masakazu Washio, Waseda Univ. (Japan); Seiichi Tagawa, Osaka Univ. (Japan) and JST-CREST (Japan) . . . . . [8679-81]

**Study of LWR reduction and pattern collapse suppression for 16nm node EUV resists**, Eishi Shiobara, Yukiko Kikuchi, Toshiro Itani, EUVL Infrastructure Development Ctr., Inc. (Japan) . . . . . [8679-82]

**Reaction mechanisms of various chemically-amplified EUV and EB resist**, Satoshi Enomoto, Tuan N. Dang, Akihiro Oshima, Seiichi Tagawa, Osaka Univ. (Japan) . . . . . [8679-83]

**Development of an atomic hydrogen system for treatment of EUV mask blanks**, Tyler Mowll, College of Nanoscale Science & Engineering (United States); Arun J. Kadaksham, Zachary R. Robinson, SEMATECH North (United States); Sarah Mead, Carl Ventrice, College of Nanoscale Science & Engineering (United States) . . . . . [8679-84]

The following posters will be on display after 10:00 am on Wednesday. The interactive poster session with authors in attendance will be Wednesday evening from 6:00 to 8:00 pm. All symposium attendees are invited to attend the poster sessions. Come view the high-quality papers that are presented in this alternative format, and interact with the poster author who will be available for discussion. Enjoy light refreshments while networking with colleagues in your field. Attendees are required to wear their conference registration badges to the poster sessions.

**Resist outgassing characterization based on the resist compositions and process**, Norihiko Sugie, Toshiya Takahashi, Kazuhiro Katayama, Isamu Takagi, Yukiko Kikuchi, Hiroyuki Tanaka, Eishi Shiobara, Soichi Inoue, EUVL Infrastructure Development Ctr., Inc. (Japan) . . . . . [8679-85]

**Zero-CTE controlled TiO<sub>2</sub>-SiO<sub>2</sub> glasses for EUVL**, Jun-ichi Kushibiki, Mototaka Arakawa, Yuji Ohashi, Yuko Maruyama, Tohoku Univ. (Japan); Naofumi Yamada, National Institute of Advanced Industrial Science and Technology (Japan) . . . . . [8679-86]

**Enhancements to the electrodeless Z-pinch EUV source to support first and second-generation actinic mask inspection tools**, Matthew J. Partlow, Stephen F. Horne, Deborah S. Gustafson, Matthew M. Besen, Donald K. Smith, Paul Blackborow, Energetiq Technology, Inc. (United States)[8679-87]

**Collector optic in-situ Sn removal using hydrogen plasma**, John Sporre, Dan Elg, Jason Peck, Tae S. Cho, David N. Ruzic, Univ. of Illinois at Urbana-Champaign (United States); Shalendra N. Srivastava, David C. Brandt, Cymer, Inc. (United States) . . . . . [8679-88]

**Laser-produced plasma EUV light sources for EUVL patterning at 20nm node and beyond**, David C. Brandt, Igor V. Fomenkov, David W. Myers, Daniel J. Brown, Bruno La Fontaine, Nigel R. Farrar, Cymer, Inc. (United States) . . . . . [8679-89]

**High-brightness LPP source for EUVL applications**, Samir S. Ellwi, Adlyte (Switzerland) . . . . . [8679-90]

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**Long-term behavior of fuel delivery system for EUV sources using tin droplets**, Luna Bozinova, Nadia Gambino, Reza S. Abhari, ETH Zurich (Switzerland) . . . . . [8679-92]

**Magnetic mitigation of debris for EUV sources**, Dan Elg, John Sporre, Davide Curreli, David N. Ruzic, Univ. of Illinois at Urbana-Champaign (United States) . . . . . [8679-93]

**Enhancing resolution with pupil filtering for projection printing systems with fixed or restricted illumination angular distribution**, Gregory R. McIntyre, IBM Corp. (United States); Obert R. Wood II, GLOBALFOUNDRIES Inc. (United States); Leon Teeuwen, ASML US, Inc.

(United States); Daniel A. Corliss, IBM Corp. (United States); Theo van den Akker, ASML Netherlands B.V. (Netherlands); Erik M. Sohmen, Carl Zeiss AG (Germany); Martin Burkhardt, Karen E. Petrillo, IBM Corp. (United States). . . . . [8679-94]

**Roughness and variability in EUV lithography: who is to blame?, part I**, Alessandro Vaglio Pret, Roel Gronheid, IMEC (Belgium); Todd R. Younkin, Intel Corp. (United States); Gustaf Lars Winroth, IMEC (Belgium); John J. Biafore, KLA-Tencor Corp. (United Kingdom); Yusuke Anno, Kenji Hoshiko, JSR Micro N.V. (Belgium); Vassilios Constantoudis, National Ctr. for Scientific Research Demokritos (Greece)[8679-95]

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**7nm node EUV predictive study of mask LER transference to CD variance**, Deniz Civay, Thomas I. Wallow, Harry J. Levinson, GLOBALFOUNDRIES Inc. (United States); Joachim Siebert, Eva Nash, Ulrich K. Klostermann, Synopsys GmbH (Germany) . . . . . [8679-97]

**Silica aerogel can capture flying particles in EUV tools**, Kazuya Ota, Jiro Inoue, Nikon Corp. (Japan) . . . . . [8679-98]

**Impact of EUV mask roughness on lithography performance**, Yukiyasu Arisawa, Tsuneo Terasawa, Hidehiro Watanabe, EUVL Infrastructure Development Ctr., Inc. (Japan) . . . . . [8679-99]

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**Simulation-assisted layout biasing in EUV lithography and prediction of an optimum resist parameter space**, Chandra Sarma, SEMATECH North (United States); John J. Biafore, KLA-Tencor Texas (United States); Karen E. Petrillo, Mark Neisser, SEMATECH North (United States)[8679-101]

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**Investigation of coat-develop track system for EUV resist processing**, Masahiko Harumoto, Osamu Tamada, Tadashi Miyagi, Koji Kaneyama, Akihiko Morita, Charles N. Pieczulewski, Masaya Asai, SOKUDO Co., Ltd. (Japan). . . . . [8679-104]

**Heat behavior of extreme-ultraviolet pellicle including mesh support**, Inseon Kim, Hye-keun Oh, Ji-won Kim, Eun-jin Kim, Hanyang Univ. (Korea, Republic of) . . . . . [8679-105]

**The need for EUV lithography at advanced technology for sustainable wafer cost**, Arindam Mallik, Wim Vansumere, IMEC (Belgium); Abdelkarim Mercha, Naoto Horiguchi, Steven Demuyncck, Juergen Boemmels, Zsolt Tokei, Geert Vandenbergh, Kurt G. Ronse, Aaron Thean, Diederik Verkest, Hans Lebon, An Steegen, IMEC (Belgium) . . . . . [8679-107]

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**Synthesis of molecular glass photoresists based on bisphenol A backbone and their application in EUV photolithography**, Guoqiang Yang, Jian Xu, Li Chen, Shuangqing Wang, Shayu Li, Rui Hu, Institute of Chemistry (China) . . . . . [8679-109]

**High-power EUV discharge-produced plasma source based on liquid tin jet electrodes**, Konstantin Koshelev, Vladimir M. Krivtsun, Oleg F. Yakushev, Alexander A. Lash, Institute of Spectroscopy (Russian Federation); Aleksander Yu. Vinokhodov, Vladimir Mikhailovich Borisov, Alexander V. Prokofiev, Troitsk Institute for Innovation and Fusion Research (Russian Federation) . . . . . [8679-110]

**Measuring local critical dimension uniformity of contact holes: variability and correlation issues**, Vijaya-Kumar Murugesan Kupuswamy, National Ctr. for Scientific Research Demokritos (Greece) and National Technology Univ. of Athens (Greece); Vassilios Constantoudis, Evangelos Gogolides, National Ctr. for Scientific Research Demokritos (Greece); Alessandro Vaglio Pret, Roel Gronheid, IMEC (Belgium) . . . . . [8679-111]

**Molecular glass photoresists based on 9,9'-spirobifluorene derivatives: Synthesis and application in EUV photolithography**, Yi Li, Qingshan Hao, Jinping Chen, Tianjun Yu, Technical Institute of Physics and Chemistry (China) . . . . . [8679-112]

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**Particle detection of sub-20nm particles in low pressure conditions for applications in the semiconductor industry**, Yashdeep Khopkar, College of NanoScale Science & Engineering, Univ. at Albany (United States); Spencer Natman, College of NanoScale Science & Engineering, Univ. of Albany (United States); Vibhu Jindal, SEMATECH North (United States); Gregory Denbeaux, College of Nanoscale Science & Engineering, Univ. of Albany (United States). . . . . [8679-114]

**Comparison of O<sub>2</sub>-N<sub>2</sub> and H<sub>2</sub> plasma cleaning for EUV applications**, E. Kosmowska, David F. Varley, Ronald Vane, Cameron Moor, XEI Scientific, Inc. (USA). . . . . [8679-115]

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**Dissipative particle dynamics study on directed self-assembly in holes**, Takeo Nakano, Masaaki Matsukuma, Kazuyoshi Matsuzaki, Tokyo Electron AT Ltd. (Japan); Makoto Muramatsu, Tadatashi Tomita, Takahiro Kitano, Tokyo Electron Kyushu Ltd. (Japan) . . . . . [8680-38]

**Dissipative particle dynamics simulations to optimize contact hole shrink process using graphoeptaxial directed self assembly**, Hironobu Sato, Hiroki Yonemitsu, Yuriko Seino, Toshiba Corp. (Japan); Hirokazu Kato, Toshiba America Electronic Components, Inc. (Japan); Masahiro Kanno, Toshiba Corp. (Japan); Katsutoshi Kobayashi, Toshiba Materials Co., Ltd. (Japan); Ayako Kawanishi, Toshiba Corp. (Japan); Katsuyoshi Kodera, Toshiba Materials Co., Ltd. (Japan); Tsukasa Azuma, Toshiba Corp. (Japan) . . [8680-55]

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**Computational simulation of block copolymer directed self-assembly in small topographical guiding templates**, He Yi, Stanford Univ. (United States); Azat M. Latypov, GLOBALFOUNDRIES Inc. (United States); H. S. Philip Wong, Stanford Univ. (United States) . . . . . [8680-57]

**High-X block co-polymer for directed self assembly**, Yuji Namie, Shin-ya Minegishi, Tomoki Nagai, Yoshikazu Yamaguchi, JSR Engineering Co., Ltd. (Japan); Yuusuke Anno, JSR Micro, N.V. (Belgium); Takehiko Naruoka, Yoshi Hishiro, JSR Micro, Inc. (United States) . . . . . [8680-58]

**Self-assembled lithography and potential applications to electronic devices**, Koji Asakawa, Atsushi Hieno, Shigeki Hattori, Hiroko Nakamura, Tsutomu Nakanishi, Ryota Kitagawa, Akira Fujimoto, Toshiba Corp. (Japan) . . . . . [8680-59]

**Graphoepitaxial directed self-assembly of PS-b-PDMS block copolymers on nanopatterned silicon nitride substrates**, Dipu Borah, Barbara Kosmala, Sozaraj Rasappa, Ramsankar Senthamarakannan, Univ. College Cork (Ireland); Matthew T. Shaw, Intel Ireland Ltd. (Ireland); Justin D. Holmes, Michael A. Morris, Univ. College Cork (Ireland) . . . . . [8680-60]

**How do modulations in surface energy of hard mask enabling materials correlate with direct self-assembly (DSA) effectiveness?**, Mary Ann J. Hockey, Yubao Wang, Brewer Science, Inc. (United States); Douglas Guerrero, Brewer Science, Inc. (Belgium) . . . . . [8680-61]

**DSA patterning for the resolution of 1x nm**, Daiju Shiono, Tsuyoshi Kurosawa, Kenichiro Miyashita, Tasuku Matsumiya, Ken Miyagi, Katsumi Ohmori, Tokyo Ohka Kogyo Co., Ltd. (Japan) . . . . . [8680-62]

**Variations in chemoepitaxial templates and their effects on equilibrium block copolymer microdomain shapes**, Paul N. Patrone, Univ. of Maryland, College Park (United States) and National Institute of Standards and Technology (United States); Gregg M. Gallatin, National Institute of Standards and Technology (United States) [8680-63]

**Using process monitor wafers to understand directed self-assembly defects**, YoungJun Her, AZ Electronic Materials USA Corp. (United States); Yukio Hashimoto, Nihon Entegris K. K. (Japan); Yi Cao, AZ Electronic Materials USA Corp. (United States); Paulina A. Rincon Delgadillo, Univ. of Chicago (United States); Roel Gronheid, IMEC (Belgium); Ainhoa Romo-Negreira, Mark H. Somervell, Kathleen Nafus, Tokyo Electron America, Inc. (United States) . . . . . [8680-64]

**Partial patterning of periodic nanostructures using block copolymer lithography**, Hiroyuki Suzuki, Reo Kometani, Sunao Ishihara, Shin'ichi Warisawa, The Univ. of Tokyo (Japan) . . . [8680-65]

**Orientation and position-controlled block copolymer nanolithography for bit-patterned media**, Ryousuke Yamamoto, Masahiro Kanamaru, Katsuya Sugawara, Yasuaki Ootera, Takeshi Okino, Hiroyuki Hieda, Norikatsu Sasao, Naoko Kihara, Yoshiyuki Kamata, Akira Kikitsu, Toshiba Corp. (Japan) . . . . . [8680-66]

**PS-b-PAA as a high  $\chi$  polymer for directed self-assembly: A study of solvent and thermal annealing processes for PS-b-PAA**, Richard A. Lawson, Jing Cheng, Wei-Ming Yeh, Nathan D. Jarnagin, Laren M. Tolbert, Clifford L. Henderson, Georgia Institute of Technology (United States) . . . . . [8680-93]

**PS-b-PHEMA: synthesis, characterization, and processing of a potential new high  $\chi$  polymer for directed self-assembly lithography**, Jing Cheng, Richard A. Lawson, Wei-Ming Yeh, Nathan D. Jarnagin, Laren M. Tolbert, Clifford L. Henderson, Georgia Institute of Technology (United States) . . . . . [8680-94]

**PS-b-PHOST as a high  $\chi$  block copolymer for directed self-assembly: Properties, DSA, and novel methods for selective block removal**, Nathan D. Jarnagin, Wei-Ming Yeh, Jing Cheng, Andrew Peters, Richard A. Lawson, Laren M. Tolbert, Clifford L. Henderson, Georgia Institute of Technology (United States) . . . . . [8680-95]

**Coarse grained molecular dynamics model of block copolymer directed self-assembly**, Richard A. Lawson, Andrew Peters, Peter Ludovice, Clifford L. Henderson, Georgia Institute of Technology (United States) . . . . . [8680-96]

**Tuning the domain size of block copolymers for directed self-assembly using polymer blending: molecular dynamics simulation studies**, Richard A. Lawson, Andrew Peters, Peter Ludovice, Clifford L. Henderson, Georgia Institute of Technology (United States) . . . . . [8680-97]

**Effects of block copolymer polydispersity and  $\chi$ N on pattern line edge roughness and line width roughness from directed self-assembly of diblock copolymers**, Andrew Peters, Richard A. Lawson, Peter Ludovice, Clifford L. Henderson, Georgia Institute of Technology (United States) . . [8680-98]

**Direct-Write/Maskless Lithography Alignment strategy for mixed e-beam and optical lithography**, Paul J. Duval, Kamal Tabatabaie-Alavi, Dale M. Shaw, Alan R. St. Germain, Raytheon Co. (United States) . . . . . [8680-67]

**Block co-polymer multiple patterning directed self-assembly on PS-OH brush layer and AFM based nanolithography**, Francesc X. Perez-Murano, Ctr. Nacional de Microelectrónica (Spain) . . . . . [8680-69]

**Image contrast of line-cut/contact features in complementary e-beam lithography**, Enden D. Liu, David K. Lam, Multibeam Corp. (United States) . . . . . [8680-70]

**Direct-write maskless lithography using patterned oxidation of Si-substrate induced by femtosecond laser pulses**, Amirkianoosh Kiani, Krishnan Venkatakrishnan, Bo Tan, Ryerson Univ. (Canada) . . . . . [8680-71]

**A slim column cell of 12nm resolution for wider application of e-beam lithography**, Akio Yamada, Hitoshi Tanaka, Yoshihisa Oae, Tomohiko Abe, Youichi Shimizu, Advantest Corp. (Japan) [8680-72]

**Practical study on the electron-beam-only alignment strategy for the electron-beam direct-writing technology**, Yoshinori Kojima, Yasushi Takahashi, Shuzo Ohshio, Shinji Sugatani, e-Shuttle Inc. (Japan); Jun-ichi Kon, Fujitsu Labs., Ltd. (Japan) . . . . . [8680-73]

**Practical proof of CP element-based design for 14nm node and beyond**, Takashi Maruyama, e-Shuttle, Inc. (Japan); Hiroshi Takita, Hiromi Hoshino, Morimi Osawa, Fujitsu Semiconductor Ltd. (Japan); Shinji Sugatani, e-Shuttle, Inc. (Japan); Yoshinori Kojima, e-Shuttle Inc. (Japan); Masaru Ito, Toshio Hino, Fujitsu Semiconductor Ltd. (Japan); Rimon Ikeno, Univ. of Tokyo (Japan); Tetsuya Iizuka, Satoshi Komatsu, Makoto Ikeda, Kunihiro Asada, The Univ. of Tokyo (Japan) . . . . . [8680-75]

**Reticle level compensation for long-range process effect**, Thiago R. Figueiro, Aselta Nanographics (France) and CNRS CEA LTM (France); Clyde H. Browning, Patrick Schiavone, Aselta Nanographics (France) . . . . . [8680-76]

**Investigation of shot noise, dose, and focus latitude for e-beam direct write**, Regina Freed, Thomas Gubiotti, Shinichi Kojima, Chris F. Bevis, Alan D. Brodie, KLA-Tencor Corp. (United States) . . . . . [8680-77]

**Contrast enhanced exposure strategy in multibeam mask writing**, Nikola Belic, Uli Hofmann, GenlSys GmbH (Germany); Jan Kliikovits, IMS Nanofabrication AG (Austria) . . . . . [8680-78]

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**Sub-22nm silicon template nanofabrication by advanced spacer patterning technique for NIL applications**, Jong-Moon Park, Kun-Sik Park, Seong-Ook Yoo, Jin-Ho Lee, Electronics and Telecommunications Research Institute (Korea, Republic of) . . . . . [8680-79]

**Low-angle deposition as a low-cost nanofabrication process for wire grid polarizers**, Mike P. Watts, Impattern Solutions (United States) . . . . . [8680-80]

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**Effective process enhancements for negative-tone development (NTD) method**, Go Noya, AZ Electronic Materials (Japan) K.K. (Japan) . . [8680-82]

**Direct electron-beam patterning of sub-10nm graphene interconnects**, Zhengqing J. Qi, Julio Rodriguez-Manzo, Univ. of Pennsylvania (United States); Sung Ju Hong, Seoul National Univ. (Korea, Republic of); Eric A. Stach, Brookhaven National Lab. (United States); Mirija Drndi?, A.T. Charlie Johnson, Univ. of Pennsylvania (United States) . . . . . [8680-83]

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**Compatibility of optimized source over design changes in foundry environment**, Aasutosh Dave, Mentor Graphics Corp. (United States); Jojo Pei, Semiconductor Manufacturing International Corp. (China); Cynthia Zhu, Feng Shao, Mentor Graphics Corp. (United States); Verne Xu, Semiconductor Manufacturing International Corp. (China); Omar Elsewefy, Mentor Graphics Corp. (United States) . . . . . [8683-56]



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**3D resist-loss full-chip verification and hot-spots disposition**, Elynn Yang, Shyue-Fong Quek, Yee Mei Foong, Dong Qing Zhang, GLOBALFOUNDRIES Singapore (Singapore); Jens Hassmann, Andre Leschok, GLOBALFOUNDRIES Dresden Module Two, GmbH & Co. KG (Germany); Yun Tang, GLOBALFOUNDRIES Singapore . . . . . [8683-57]

**Development of a 75W XLR solution for increased depth of focus**, Brian King, Rui Jiang, Cymer, Inc. (United States) and DUV Products (United States); Rostislav I. Rokitski, Cymer, Inc. (United States); Dan Wilson, Cymer, Inc. (United States) and DUV Products (United States); Gunasira G. Padmabndu, Marcus Osibov, Will Conley, Cymer, Inc. (United States) . . . . . [8683-58]

**3D lithography for implant applications**, Jens Schneider, Henning Feick, Dieter Kaiser, Marcel Heller, Matthias Schmeide, Daniel Sarlette, Infineon Technologies Dresden (Germany) . . . . . [8683-59]

**Lens heating impact analysis and controls for critical device layers by computational method**, Du Hyun Beak, Jin-Phil Choi, Tony Park, Young Sun Nam, Youngseog Kang, Chan Hoon Park, SAMSUNG Electronics Co., Ltd. (Korea, Republic of); Ki-Yeop Park, Chang-Hoon Ryu, Wenjin Huwang, Ki-Ho Baik, ASML Korea Co., Ltd. (Korea, Republic of) . . . . . [8683-60]

**Effects of nested and isolated features focus difference for scanner proximity matching**, GuoXiang Ning, GLOBALFOUNDRIES Dresden Module Two, GmbH & Co. KG (United States); Paul W. Ackmann, Huipeng Koh, GLOBALFOUNDRIES Inc. (United States); Frank Richter, Matthias Ruhm, GLOBALFOUNDRIES Dresden Module Two, GmbH & Co. KG (Germany); Weilong Wong, GLOBALFOUNDRIES Inc. (United States); Jens Busch, GLOBALFOUNDRIES Dresden Module Two, GmbH & Co. KG (Germany); Norman Chen, GLOBALFOUNDRIES Inc. (United States); Karin Kurth, Andre Leschok, Chin-Teong Lim, GLOBALFOUNDRIES Dresden Module Two, GmbH & Co. KG (Germany) . . . . . [8683-61]

**Implementation of focus drilling on a 60W XLR system**, Will Conley, Brian King, Rui Jiang, Slava Rokitski, Dan Wilson, Gunasiri G. Padmabandu, Marcus Osibov, Ronnie P. Flores, Robert Rosal, Theodore Cacouris, Eric R. Gross, Cymer, Inc. (United States); Gerald Litchenberg, Cymer B.V. (Netherlands); Emile Merkus, Cymer B.V. (Netherlands) and Cymer Inc. (United States); Marijn van Berkel, Martine De Haan, Cymer B.V. (Netherlands); Carol Jackson, Cymer, Inc. (United States) and Cymer Inc. (United States) . . . [8683-62]

**Source mask optimization using real-coded genetic algorithms**, Chaoxing Yang, Xiangzhao Wang, Sikun Li, Shanghai Institute of Optics and Fine Mechanics (China); Andreas Erdmann, Fraunhofer-Institut für Integrierte System und Bauelementetechnologie (Germany) . . . . . [8683-63]

**Effective method of source mask optimization flow incorporating mask 3D model**, Hak-Yong Sim, SK Hynix, Inc. (Korea, Republic of) . [8683-64]

**Mask 3D effects on contact layouts of 1Xnm NAND flash devices**, Jongwon Jang, Hynix Semiconductor Inc. (Korea, Republic of) . [8683-65]

**High-speed and flexible PEB 3D diffusion simulation based on Sylvester equation**, Pei-Chun Lin, Chung-Ping Chen, National Taiwan Univ. (Taiwan) . . . . . [8683-66]

**Application for resist profile-enhanced model and reOPC**, Oseo Park, Jian Liu, Chidam Kallingal, GLOBALFOUNDRIES Inc. (United States) [8683-67]

**Line-edge roughness (LER) mitigation studies specific to interference-like lithography**, Burak Baylav, Rochester Institute of Technology (United States) . . . . . [8683-68]

**The studies of SMO process on contact layer of 20nm node**, Wei-Cyuan Lo, Yung-Feng Cheng, Ming-Jui Chen, United Microelectronics Corp. (Taiwan) . . . . . [8683-69]

**Lens heating effect and its compensation for 20nm logic product**, Bumhwan Jeon, GLOBALFOUNDRIES Inc. (United States) [8683-70]

**High-power XLR system for enhanced process capability**, Gunasiri G. Padmabandu, Will Conley, Rui Jiang, Brian King, Marcus Osibov, Ronnie P. Flores, Robert Rosal, Theodore Cacouris, Eric R. Gross, Cymer, Inc. (United States) . . . . . [8683-71]

**SMO and NTD for robust single-exposure solution on contact patterning for 40nm node flash memory devices**, Chih-Chieh Yu, Chin-Cheng Yang, Elvis Yang, Ta-Hung Yang, Kuang-Chao Chen, Chih-Yuan Lu, Macronix International Co., Ltd. (Taiwan) . . . . . [8683-72]

**Multiple-step process window aware OPC for hyper-NA lithography**, Chung-Te Hsuan, Cheming Hu, Fred Lo, Elvis Yang, Ta-Hung Yang, Kuang-Chao Chen, Chih-Yuan Lu, Macronix International Co., Ltd. (Taiwan) . . . . . [8683-73]

**Studies of suitable mask enhanced error factor for 2D patterns**, Chih-I Wei, Yung-Feng Cheng, Ming-Jui Chen, United Microelectronics Corp. (Taiwan) . . . . . [8683-74]

**Pixel-based inverse lithography using a mask filtering technique**, Wen Lv, Qi Xia, Shiyuan Liu, Huazhong Univ. of Science and Technology (China) . . . . . [8683-75]

**Intensity quality full-chip verification for yield improvement**, Elynn Yang, Shyue-Fong Quek, Mark Lu, Yee Mei Foong, CongShu Zhou, GLOBALFOUNDRIES Singapore . . . . . [8683-76]

**Hybrid OPC technique using rule-based and model-based flows**, Mohammed Harb, Hesham M. Abdelghany, Mentor Graphics Egypt (Egypt) . . . . . [8683-77]

**High-precision beam shaping in lithography and semiconductor applications**, Ansgar Teipel, LIMO Lissotschenko Mikrooptik GmbH (Germany) . . . . . [8683-79]

**Model of freeform illumination mode and polarization mode for 193nm immersion lithography**, Yunbo Zhang, Aijun Zeng, Qiao Yuan, Ying Wang, Huijie Huang, Shanghai Institute of Optics and Fine Mechanics (China). . . . . [8683-80]

**Analytical equation of image intensity that predicts the forbidden patten pitch**, Masato Shibuya, Tokyo Polytechnic Univ. (Japan); Junichi Tamaki, Tokyo Polytechnic Univ. (Japan) and Orc Manufacturing Co., Ltd. (Japan) . . . . . [8683-81]

**Integrated analysis of optical system with non-uniform supporting loads in assembly**, Yiping Shen, Huazhong Univ. of Science and Technology (China) . . . . . [8683-82]

**Optomechanical characterization of large wafer stepper-optics with respect to centering errors, lens distances, and center thicknesses**, Daniel Stickler, TRIOPTICS GmbH (Germany) . . . [8683-83]

**A customized Exicor system for measuring residual birefringence in lithographic lenses**, Andy Breninger, Baoliang Wang, Hinds Instruments, Inc. (United States) . . . . . [8683-84]

**Flare management for 40nm logic devices**, Yuusuke Tanaka, Takao Tamura, Masashi Fujimoto, Kyoichi Tsubata, Naka Onoda, Renesas Electronics Corp. (Japan); Kiyoshi Fujii, Semiconductor Leading Edge Technologies Inc (Japan) . . . . . [8683-85]

**Wavefront testing of pinhole based on point diffraction interferometer**, Xin Jia, Tingwen Xing, Jiajun Xu, Wumei Lin, Zhijie Liao, Institute of Optics and Electronics (China) . . . . . [8683-86]

**Design and simulation of illuminator with microscanning slit array for NA 0.75 lithography system**, Linglin Zhu, Aijun Zeng, Shanhua Zhang, Ruifang Fang, Huijie Huang, Shanghai Institute of Optics and Fine Mechanics (China). . . . . [8683-87]

**Zero expansion glass ceramic ZERODUR® roadmap for advanced lithography**, Thomas Westerhoff, Tanja Bizjak, Peter Hartmann, Ralf Jedamzik, SCHOTT AG (Germany) . . . . . [8683-88]

**Mask sidewall clamping**, Geert-Jan Naaijkens, Nick Rosielle, Maarten Steinbuch, Technische Univ. Eindhoven (Netherlands) . . . . . [8683-89]

**Conf. 8684 Design for Manufacturability through Design-Process**

**A novel methodology for building robust design rules by using design-based metrology (DBM)**, Myeongdong Lee, Sungkyunkwan Univ. (Korea, Republic of) and SAMSUNG Electronics Co., Ltd. (Korea, Republic of); Seiryung Choi, Jinwoo Choi, Jaehyun Kim, Hyunju Sung, Hyunyoung Yeo, Myoungseob Shim, Gyoyoung Jin, Chilhee Chung, SAMSUNG Electronics Co., Ltd. (Korea, Republic of); Yonghan Roh, Sungkyunkwan Univ. (Korea, Republic of) . . . . . [8684-5]

Conference 8679

**Extreme Ultraviolet (EUV) Lithography IV**

**Session 11**  
**Room: Conv. Ctr. 210 B**  
**Thu 8:30 am to 12:00 pm**

**Invited II**

Session Chairs: **Daniel A. Corliss**, IBM Corp. (United States); **Seong-Sue Kim**, SAMSUNG Electronics Co., Ltd. (Korea, Republic of)

8:30 am: **ASML's NXE platform performance and volume introduction** (*Invited Paper*), Rudy Peeters, Sjoerd Lok, Erwin V. Alphen, Noreen Harned, Henk Meijer, David Ockwell, Eelco van Setten, Judon Stoeldraijer, Robert Kazinczi, Richard Droste, Hans Meiling, Ron Kool, ASML Netherlands B.V. (Netherlands); Peter Kuerz, Martin Lowisch, Carl Zeiss SMT GmbH (Germany); Jan-Willem van der Horst, ASML Netherlands B.V. (Netherlands) . . . . . [8679-50]

9:00 am: **CO<sub>2</sub>/Sn LPP EUV sources for device development and HVM** (*Invited Paper*), David C. Brandt, Igor V. Fomenkov, David W. Myers, Daniel J. Brown, Bruno La Fontaine, Nigel R. Farrar, Cymer, Inc. (United States) . . . . . [8679-51]

9:30 am: **Optics for ASML's NXE:3300 platform** (*Invited Paper*), Martin Lowisch, Peter Kuerz, Olaf Conradi, Winfried M. Kaiser, Wolfgang Seitz, Gero Wittich, Carl Zeiss SMT GmbH (Germany) . . . . . [8679-52]

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

10:30 am: **Through-focus EUV multilayer defect repair with nanomachining** (*Invited Paper*), Gregory R. McIntyre, IBM Microelectronics (United States); Emily E. Gallagher, Mark Lawliss, IBM Corp. (United States); Tod E. Robinson, Jeff LeClaire, Ron R. Bozak, Roy L. White, RAVE LLC (United States) . . . . . [8679-53]

11:00 am: **Patterning challenges of EUV lithography for 1x-nm node DRAM and beyond** (*Invited Paper*), Tae-Seung Eom, Hong-Ik Kim, Choon-Ky Kang, Yoon-Jung Ryu, Seung-Hyun Hwang, Ho-Hyuk Lee, Hee-Youl Lim, Jeong-Su Park, Noh-Jung Kwak, Hyosang Kang, SK Hynix, Inc. (Korea, Republic of) . . . . . [8679-54]

11:30 am: **Toward manufacturing a 14nm node device with complementary EUV lithography** (*Invited Paper*), Jan V. Hermans, David Laidler, Philippe J. Leray, IMEC (Belgium); Huixiong Dai, Applied Materials, Inc. (United States); Shaunee Y. Cheng, IMEC (Belgium) . . . . . [8679-55]

Conference End.

Conference 8680

**Alternative Lithographic Technologies V**

**Session 10**  
**Room: Conv. Ctr. Hall 3**  
**Thu 8:00 am to 10:10 am**

**DSA Vias**

Session Chairs: **James Watkins**, Univ. of Massachusetts Amherst (United States); **Benjamin M. Rathsack**, Tokyo Electron America, Inc. (United States)

8:00 am: **Patterning process for semiconductor using directed self assembly** (*Invited Paper*), Jaewoo Nam, Eun Sung Kim, Daekeun Kang, Hangeun Yu, Kyoungseon Kim, Shiyong Yi, Chul-Ho Shin, Ho-Kyu Kang, SAMSUNG Electronics Co., Ltd. (Korea, Republic of) . . . . . [8680-36]

8:30 am: **Potential of block copolymer's directed self-assembly for contact hole shrink and contact multiplication**, Raluca Tiron, Ahmed Gharbi, CEA-LETI-Minatec (France); Maxime Argoud, CEA-LETI (France); Xavier Chevalier, CEA-LETI-Minatec (France); Jérôme Belledent, CEA-LETI (France); Jonathan Pradelles, CEA-LETI-Minatec (France); Patricia Pimenta Barros, CEA-LETI (France); Christophe Navarro, Arkema S.A. (France); Michael Delalande, Lab. des Technologies de la Microélectronique (France); Gilles Cunge, LTM CNRS (France); Johann Foucher, CEA-LETI-Minatec (France); Guillaume Fleury, Georges Hadziioannou, Univ. Bordeaux 1 (France); Sebastien Barnola, Laurent Pain, CEA-LETI (France) . . . . . [8680-37]

8:50 am: **Exploration of the directed self-assembly-based nanofabrication design space using computational simulations**, Azat M. Latypov, Gerard M. Schmid, Ji Xu, He Yi, GLOBALFOUNDRIES Inc. (United States); Kenji Yoshimoto, GLOBALFOUNDRIES Inc. (United States) and Kyoto Univ. (Japan) . . . . . [8680-56]

9:10 am: **The hole shrink problem: theoretical studies of directed self-assembly in cylindrical confinement**, Nabil Laachi, Kris T. Delaney, Bongkeun Kim, Univ. of California, Santa Barbara (United States); Robert Bristol, Corey J Weinheimer, David Shykind, Intel Corp. (United States); Glenn H. Fredrickson, Univ. of California, Santa Barbara (United States) . . . . . [8680-39]

9:30 am: **Novel process variation model for graphoepitaxial directed self-assembly lithography based on the dissipative particle dynamics method**, Katsuyoshi Kodera, Toshiba Corp. (Japan); Shimon Maeda, Satoshi Tanaka, Shoji Mimotogi, Toshiba Materials Co., Ltd. (Japan); Hironobu Sato, Tsukasa Azuma, Toshiba Corp. (Japan) . . . . . [8680-40]

9:50 am: **Defectivity study of directed self-assembly of cylindrical diblock copolymers in laterally confined thin channels**, Bongkeun Kim, Nabil Laachi, Materials Research Lab. (United States); Glenn H. Fredrickson, Mitsubishi Chemical Ctr. for Advanced Materials (United States) . . . . . [8680-41]

Coffee Break . . . . . Thu 10:10 am to 10:40 am

Conference 8681

**Metrology, Inspection, and Process Control for Microlithography XXVII**

**Session 12**  
**Room: Conv. Ctr. 230 B**  
**Thu 8:00 am to 9:50 am**

**SEM, AFM, SPM**

Session Chairs: **Matthew J. Sendelbach**, Nova Measuring Instruments Inc. (United States); **Vladimir A. Ukrantsev**, Nanometrology International, Inc. (United States)

8:00 am: **CD-SAXS for 3D dimensional metrology on 32nm-pitch line patterns** (*Invited Paper*), R. Joseph Kline, Daniel F. Sunday, Wen-li Wu, National Institute of Standards and Technology (United States) . . . . . [8681-44]

8:30 am: **Precise morphology imaging of the photoresist in water**, Hiroshi Itoh, Tadahiro Odaka, Chunmei Wang, National Institute of Advanced Industrial Science and Technology (Japan) . . . . . [8681-45]

8:50 am: **3D AFM method for characterization of resist-multilayer roughness and side-wall morphology of lithographic patterns: effect of aerial image contrast and processes**, YongHa Paul Lee, Park Systems Corp. (Korea, Republic of) . . . . . [8681-46]

9:10 am: **Three-dimensional profile extraction and top/bottom CD monitoring with CD-SEM by line-edge roughness analysis**, Atsuko Yamaguchi, Takeyoshi Ohashi, Hitachi, Ltd. (Japan); Takahiro Kawasaki, Osamu Inoue, Hiroki Kawada, Hitachi High-Technologies Corp. (Japan) . . . . . [8681-47]

9:30 am: **Buckling characterization of gate all around silicon nanowires**, Shimon Levi, Applied Materials (Israel) . . . . . [8681-48]

9:50 am: **Characterization of a first measurement effect in CD-SEM repeating measurements**, Boxiu S. Cai, Siyuan F. Yang, Yi Shih A. Lin, Yi Huang, Wendy Li, Semiconductor Manufacturing International Corp. (China) . . . . . [8681-68]

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

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## Conference 8683

### Optical Microlithography XXVI

Session 9  
Room: Conv. Ctr. 210 C  
Thu 8:00 am to 10:00 am

#### Optical and DFM I: Joint Session with Conferences 8683 and 8684

Session Chairs: **Mark E. Mason**, Texas Instruments Inc. (United States); **Will Conley**, Cymer, Inc. (United States)

8:00 am: **Interference harmonics and rigorous EM spectrum analysis method for low-k1 CD Bossung tilt correction**, Shuo-Yen Chou, Hoi-Tou Ng, Yi-Yin Chen, Chien-Fu Lee, Ru-Gun Liu, Tsai-Sheng Gau, Burn J. Lin, Taiwan Semiconductor Manufacturing Co. Ltd. (Taiwan) ..... [8683-40]

8:20 am: **Improved SADP decomposition for SID process with model-based verification**, Yuelin Du, Univ. of Illinois at Urbana-Champaign (United States) and Synopsys, Inc. (United States); Hua Song, James P. Shiely, Synopsys, Inc. (United States); Martin D. F. Wong, Univ. of Illinois at Urbana-Champaign (United States) ..... [8684-13]

8:40 am: **Model-based stitching and inter-mask bridge prevention for double-patterning lithography (DPL)**, Guillaume Landie, STMicroelectronics (France) ..... [8683-41]

9:00 am: **Mask strategy and layout decomposition for self-aligned quadruple patterning**, Weiling Kang, Peking Univ. Shenzhen Graduate School (China); Chen Feng, Univ. of Michigan (United States); Yijian Chen, Peking Univ. Shenzhen Graduate School (China) ..... [8684-14]

9:20 am: **Application of artificial neural networks to compact mask models in optical lithography simulation**, Viviana Agudelo, Tim Fühner, Andreas Erdmann, Peter Evanschitzky, Fraunhofer-Institut für Integrierte System und Bauelementetechnologie (Germany) ..... [8683-42]

9:40 am: **Process characteristics and layout decomposition of self-aligned sextuple patterning: the end of spatial frequency multiplication?**, Weiling Kang, Yijian Chen, Peking Univ. Shenzhen Graduate School (China) ..... [8684-15]

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

## Conference 8684

### Design for Manufacturability through Design-Process

Session 5  
Room: Conv. Ctr. 210 C  
Thu 8:00 am to 10:00 am

#### Optical and DFM I: Joint Session with Conferences 8683 and 8684

Session Chairs: **Mark E. Mason**, Texas Instruments Inc. (United States); **Will Conley**, Cymer, Inc. (United States)

8:00 am: **Interference harmonics and rigorous EM spectrum analysis method for low-k1 CD Bossung tilt correction**, Shuo-Yen Chou, Hoi-Tou Ng, Yi-Yin Chen, Chien-Fu Lee, Ru-Gun Liu, Tsai-Sheng Gau, Burn J. Lin, Taiwan Semiconductor Manufacturing Co. Ltd. (Taiwan) ..... [8683-40]

8:20 am: **Improved SADP decomposition for SID process with model-based verification**, Yuelin Du, Univ. of Illinois at Urbana-Champaign (United States) and Synopsys, Inc. (United States); Hua Song, James P. Shiely, Synopsys, Inc. (United States); Martin D. F. Wong, Univ. of Illinois at Urbana-Champaign (United States) ..... [8684-13]

8:40 am: **Model-based stitching and inter-mask bridge prevention for double-patterning lithography (DPL)**, Guillaume Landie, STMicroelectronics (France) ..... [8683-41]

9:00 am: **Mask strategy and layout decomposition for self-aligned quadruple patterning**, Weiling Kang, Peking Univ. Shenzhen Graduate School (China); Chen Feng, Univ. of Michigan (United States); Yijian Chen, Peking Univ. Shenzhen Graduate School (China) ..... [8684-14]

9:20 am: **Application of artificial neural networks to compact mask models in optical lithography simulation**, Viviana Agudelo, Tim Fühner, Andreas Erdmann, Peter Evanschitzky, Fraunhofer-Institut für Integrierte System und Bauelementetechnologie (Germany) ..... [8683-42]

9:40 am: **Process characteristics and layout decomposition of self-aligned sextuple patterning: the end of spatial frequency multiplication?**, Weiling Kang, Yijian Chen, Peking Univ. Shenzhen Graduate School (China) ..... [8684-15]

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

Conference 8680

Alternative Lithographic Technologies V

Session 11

Room: Conv. Ctr. Hall 3  
Thu 10:40 am to 11:50 am

Nanoprobe Array Direct-Write Technologies

Session Chairs: **Ivo W. Rangelow**, Technische Univ. Ilmenau (Germany); **Frank M. Schellenberg**, Consultant (United States)

10:40 am: **Scanning probe lithography approach for beyond CMOS devices** (*Invited Paper*), Zahid Durrani, Imperial College London (United Kingdom); Marcus Kaestner, Manuel Hofer, Elshad Guliyev, Ahmad Ahmad, Tzvetan Ivanov, Ivo W. Rangelow, Technische Univ. Ilmenau (Germany) . . . . . [8680-42]

11:10 am: **0.1-nanometer resolution positioning stage for sub-10nm scanning probe lithography**, Eberhard Manske, Ivo W. Rangelow, Nataliya Vorbringer-Dorozhovets, Felix G. Balzer, Marcus Kaestner, Manuel Hofer, Elshad Guliyev, Ahmad Ahmad, Tzvetan Ivanov, Technische Univ. Ilmenau (Germany) . . . . . [8680-44]

11:30 am: **Mix and match electron-beam and scanning probe lithography for high-throughput sub-10nm lithography**, Marcus Kaestner, Manuel Hofer, Ivo W. Rangelow, Technische Univ. Ilmenau (Germany) . . . . . [8680-45]

Lunch Break . . . . . Thu 11:50 am to 1:20 pm

Session 12

Room: Conv. Ctr. Hall 3  
Thu 1:20 pm to 3:10 pm

E-Beam Direct-Write for High-Volume Manufacturing III

Session Chairs: **Ines A. Stolberg**, Electron Beam Lithography Group (Germany); **Marco Wieland**, MAPPER Lithography (Netherlands)

1:20 pm: **Influence of high-energy electron irradiation on ultra-low-k characteristics and transistor performance** (*Invited Paper*), Katja Steidel, Fraunhofer-Ctr. Nanoelektronische Technologien (Germany); Thomas Werner, GLOBALFOUNDRIES Inc. (Germany); Martin Freitag, Manuela S. Gutsch, Kang-Hoon Choi, Christoph K. Hohle, Fraunhofer-Ctr. Nanoelektronische Technologien (Germany); Robert Seidel, GLOBALFOUNDRIES Dresden Module Two, GmbH & Co. KG (Germany) . . . . . [8680-46]

1:50 pm: **A dose modification strategy of electron-beam direct-writing considering TDDB reliability in LSI interconnects**, Yoshihiro Midoh, Atsushi Osaki, Koji Nakamae, Osaka Univ. (Japan) . [8680-47]

2:10 pm: **Influence of data volume and e-beam proximity correction on process window in multiple e-beam direct-write lithography**, Shy-Jay Lin, Pei-Yi Liu, Jen-Hom Chen, Wen-Chuan Wang, Jaw-Jung Shin, Bum J. Lin, Taiwan Semiconductor Manufacturing Co. Ltd. (Taiwan); Mark A. McCord, Sameet K. Shriyan, KLA-Tencor Corp. (United States) . . . . . [8680-48]

2:30 pm: **A study of total blur for ultimate resolution of electron-beam lithography toward 11nm half-pitch technology and beyond**, Kozo Ogino, Fujitsu Semiconductor Ltd. (Japan) . [8680-49]

2:50 pm: **MAPPER alignment sensor evaluation on process wafers**, Niels Vergeer, MAPPER Lithography (Netherlands); Ludovic Lattard, CEA-LETI (France); Guido de Boer, Fred C. M. Couweleers, Dhara Dave, MAPPER Lithography (Netherlands); Jonathan Pradelles, CEA-LETI-Minatec (France); Jessy Bustos, CEA-LETI (France) . . . . . [8680-50]

Coffee Break . . . . . Thu 3:10 pm to 3:30 pm

Conference 8681

Metrology, Inspection, and Process Control for Microlithography XXVII

Room: Conv. Ctr. 230 B  
10:30 am to 10:40 am

Presentation of the Best Student Paper Award

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Session 13

Room: Conv. Ctr. 230 B  
Thu 10:40 am to 12:10 pm

Cross-technology Comparisons, Hybrids, and Accuracy

Session Chairs: **Vladimir A. Ukraintsev**, Nanometrology International, Inc. (United States); **Chih-Ming Ke**, Taiwan Semiconductor Manufacturing Co. Ltd. (Taiwan)

10:40 am: **Edge determination methodology for cross-section STEM image of photoresist feature used for reference metrology** (*Invited Paper*), Kiyoshi Takamasu, Haruki Okitou, Satoru Takahashi, The Univ. of Tokyo (Japan); Mitsuru Konno, Osamu Inoue, Hiroki Kawada, Hitachi High-Technologies Corp. (Japan) . . . . . [8681-49]

11:10 am: **Characterizing edge profiles of photomask structures with complementary information from SEM and AFM**, Dorothee Hüser, Wolfgang Hässler-Grohne, Physikalisch-Technische Bundesanstalt (Germany) . . . . . [8681-50]

11:30 am: **Mosaicing of critical dimensions data to enable 1X node production**, Johann Foucher, Nivea G. S. Figueiro, Romain Thérèse, CEA-LETI (France); Yong-Ha Paul Lee, Ahjin Jo, Sang-Joon Cho, Park Systems Corp. (Korea, Republic of) . . . . . [8681-51]

11:50 am: **High-accuracy CD matching monitor for CD-SEM beyond 20nm process**, Kazuhiro Ueda, Takeshi Mizuno, Katsumi Setoguchi, Hitachi High-Technologies Corp. (Japan) . . . . . [8681-82]

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

Session 14

Room: Conv. Ctr. 230 B  
Thu 1:40 pm to 3:20 pm

Process Control

Session Chairs: **Masafumi Asano**, Toshiba Corp. (Japan); **Alek C. Chen**, ASML Taiwan Ltd. (Taiwan)

1:40 pm: **In-field in design metrology target integration for advanced CD and overlay process control via DoseMapper and high-order overlay correction for 28nm and beyond logic node**, Bertrand LeGratiet, Julien Ducote, Fabrice Bernard-Granger, STMicroelectronics (France) . . . . [8681-52]

2:00 pm: **CD optimization methodology for extending optical lithography**, Timothy J. Wiltshire, Cheuk Wong, Gitanjali K. Seevaratnam, Nelson Felix, Timothy A. Brunner, Pawan Rawat, IBM Corp. (United States); Maryana Escalante-Marun, ASML Netherlands B.V. (Netherlands); Won D. Kim, Erica Rottenkolber, ASML US, Inc. (United States); Abdalmohezen Elmalk, Vivian Wang, Christian Leewis, Paul C. Hinnen, ASML Netherlands B.V. (Netherlands) . . . . . [8681-53]

2:20 pm: **Improvement of focus accuracy on processed wafer exposure**, Satomi Higashibata, Toshiba Corp. (Japan); Nobuhiro Komine, Toshiba Materials Co., Ltd. (Japan); Kazuya Fukuhara, Koike Takashi, Yoshimitsu Kato, Koji Hashimoto, Toshiba Corp. (Japan) . . . . . [8681-54]

2:40 pm: **Overlay analysis considered individual factor: scanner, wafer process**, Boo Hyun Ham, Soon Mok Ha, Seong-Ho Moon, Byeongsoo Kim, Joon-Soo Park, Seok-Woo Nam, SAMSUNG Electronics Co., Ltd. (Korea, Republic of) . [8681-55]

3:00 pm: **An investigation of high-order process correction models and techniques to improve data filtering by using a multipass cascading approach in an advanced technology node**, Md Zakir Ullah, Mohamed Fazly Mohamed Jazim, Stephen Tran, Andy Qiu, Dawn Goh, TECH Semiconductor Singapore Pte, Ltd. (Singapore); Jesline Ang, Desmond Goh, KLA-Tencor Singapore (Singapore); David C. Tien, Chin-Chou K. Huang, KLA-Tencor Corp. (United States); Dongsub Choi, KLA-Tencor Korea (Korea, Republic of) . . . . . [8681-56]

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

Conference 8683

Optical Microlithography XXVI

**Room: Conv. Ctr. 210 C**  
**10:30 am to 10:40 am**

**2013 Best Student Paper Award**  
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**Session 10**  
**Room: Conv. Ctr. 210 C**  
**Thu 10:40 am to 12:00 pm**

**Optical and DFM II: Joint Session with Conferences 8683 and 8684**

Session Chairs: **Kafai Lai**, IBM Corp. (United States); **John L. Sturtevant**, Mentor Graphics Corp. (United States)

10:40 am: **3D resist profile modeling for OPC applications**, Yongfa Fan, Synopsys, Inc. (United States); Koh Kar Kit, Globalfoundries (China); Wolfgang Hoppe, Bernd Kuechler, Synopsys GmbH (Germany); Makoto Miyagi, Synopsys, Inc. (United States); Thomas Schmöller, Synopsys GmbH (Germany) . . . . . [8683-43]

11:00 am: **Triple-patterning lithography (TPL) layout decomposition using end cutting**, Bei Yu, Jih-Rong Gao, David Z. Pan, The Univ. of Texas at Austin (United States) . . . . . [8684-16]

11:20 am: **On the accuracy of different Fourier transforms of VLSI designs**, Rajai Nasser, Paul Hurley, IBM Zürich Research Lab. (Switzerland) . . . . . [8683-44]

11:40 am: **Process window analysis of algorithmic assist feature placement options at the 2xnm node DRAM**, Jinhyuck Jeon, Shinyoung Kim, Chan-Ha Park, Hyun-Jo Yang, Dong Gyu Yim, SK Hynix, Inc. (Korea, Republic of) [8684-17]

Lunch Break . . . . .Thu 12:00 pm to 1:20 pm

**Session 11**  
**Room: Conv. Ctr. 210 C**  
**Thu 1:20 pm to 3:00 pm**

**Simulation**

Session Chairs: **Peter D. Brooker**, Synopsys, Inc. (United States); **Yuri Granik**, Mentor Graphics Corp. (United States)

1:20 pm: **Benchmarking study of 3D mask modeling for 2X and 1X nodes**, ChangAn Wang, GLOBALFOUNDRIES Inc. (United States)[8683-45]

1:40 pm: **Validation of OPC resist-model tuning after source modification with SMO**, Werner Gillijns, Jeroen Van de Kerckhove, Peter De Bisschop, IMEC (Belgium); David Rio, ASM Belgium N.V. (United States); Stephen D. Hsu, Mu Feng, Jiong Jiang, Brion Technologies, Inc. (United States) . . . . . [8683-46]

2:00 pm: **Topographic mask modeling with reduced-basis finite element method**, Jacek K. Tyminski, Nikon Research Corp. of America (United States); Jan Pomplun, Lin Zschiedrich, JCMwave GmbH (Germany); Donis G. Flagello, Nikon Research Corp. of America (United States); Tomoyuki Matsuyama, Nikon Corp. (Japan) . . . . . [8683-47]

2:20 pm: **Accurate 3D EMF mask model for full-chip simulation**, Michael Lam, Kostas Adam, David Fryer, Christian D. Zuniga, David Wei, Mentor Graphics Corp. (United States). [8683-48]

2:40 pm: **Role of 3D photoresist simulation for advanced technology nodes**, Aravind Narayana Samy, Rolf Seltmann, Frank Kahlenberg, Jessy Schramm, GLOBALFOUNDRIES Dresden Module Two, GmbH & Co. KG (Germany); Bernd Kuechler, Ulrich K. Klostermann, Synopsys GmbH (Germany) . . . . . [8683-49]

Coffee Break . . . . .Thu 3:00 pm to 3:30 pm

Conference 8684

Design for Manufacturability through Design-Process

**Session 6**  
**Room: Conv. Ctr. 210 C**  
**Thu 10:40 am to 12:00 pm**

**Optical and DFM II: Joint Session with Conferences 8683 and 8684**

Session Chairs: **Kafai Lai**, IBM Corp. (United States); **John L. Sturtevant**, Mentor Graphics Corp. (United States)

10:40 am: **3D resist profile modeling for OPC applications**, Yongfa Fan, Synopsys, Inc. (United States); Koh Kar Kit, Globalfoundries (China); Wolfgang Hoppe, Bernd Kuechler, Synopsys GmbH (Germany); Makoto Miyagi, Synopsys, Inc. (United States); Thomas Schmöller, Synopsys GmbH (Germany) . . . . . [8683-43]

11:00 am: **Triple-patterning lithography (TPL) layout decomposition using end cutting**, Bei Yu, Jih-Rong Gao, David Z. Pan, The Univ. of Texas at Austin (United States) . . . . . [8684-16]

11:20 am: **On the accuracy of different Fourier transforms of VLSI designs**, Rajai Nasser, Paul Hurley, IBM Zürich Research Lab. (Switzerland) . . . . . [8683-44]

11:40 am: **Process window analysis of algorithmic assist feature placement options at the 2xnm node DRAM**, Jinhyuck Jeon, Shinyoung Kim, Chan-Ha Park, Hyun-Jo Yang, Dong Gyu Yim, SK Hynix, Inc. (Korea, Republic of) [8684-17]

Lunch Break . . . . .Thu 12:00 pm to 1:20 pm

**Session 7**  
**Room: Conv. Ctr. 211 B**  
**Thu 1:20 pm to 3:00 pm**

**Design Implications and Variability**

Session Chairs: **Robert Aitken**, ARM Inc. (United States); **Michael L. Rieger**, Synopsys, Inc. (United States)

1:20 pm: **Compact modeling of fin-width roughness induced FinFET device variability using the perturbation method**, Qi Cheng, Weiling Kang, Yijian Chen, Peking Univ. Shenzhen Graduate School (China) . . . . . [8684-18]

1:40 pm: **Understanding device impact of line-edge/width roughness in frequency domain**, Peng Xie, He Ren, Aneesh Nainani, Huixiong Dai, Christopher Bencher, Chris S. Ngai, Applied Materials, Inc. (United States) . . . . . [8684-19]

2:00 pm: **SRAM circuit performance in the presence of process variability of self-aligned multiple patterning**, Yijian Chen, Peking Univ. Shenzhen Graduate School (China) . . . . [8684-20]

2:20 pm: **Post-routing back-end-of-the-line layout optimization for improved time-dependent dielectric breakdown reliability**, Tuck Boon Chan, Andrew B. Kahng, Univ. of California, San Diego (United States) . . . . . [8684-21]

2:40 pm: **Double patterning: solutions in parasitics extraction**, Dusan Petranovic, James K. Falbo, Nur Kurt-Karsilayan, Mentor Graphics Corp. (United States) . . . . . [8684-22]

Coffee Break . . . . .Thu 3:00 pm to 3:30 pm



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## Conference 8680

### Alternative Lithographic Technologies V

**Session 13**  
**Room: Conv. Ctr. Hall 3**  
**Thu 3:30 pm to 5:00 pm**

#### DSA Lines-Spaces

Session Chairs: **Frank M. Schellenberg**, Consultant (United States); **Christopher Bencher**, Applied Materials, Inc. (United States)

3:30 pm: **Fabrication of 28nm pitch Si fins with DSA lithography (Invited Paper)**, Gerard M. Schmid, Richard A. Farrell, Ji Xu, Moshe E. Preil, GLOBALFOUNDRIES Inc. (United States); Michael J. Cicoria, Vidhya Chakrapani, Tokyo Electron America, Inc. (United States); David R. Hetzer, TEL Technology Ctr., America, LLC (United States); Mark H. Somervell, Benjamin M. Rathsack, Tokyo Electron America, Inc. (United States). . . . . [8680-51]

4:00 pm: **Directed self-assembly process integration in a 300mm pilot line environment**, Chi-Chun Liu, Jassem Abdallah, Steven J. Holmes, Cristina Estrada-Raygoza, Yunpeng Yin, IBM Albany NanoTech (United States); David R. Hetzer, TEL Technology Ctr., America, LLC (United States); Michael J. Cicoria, Mark H. Somervell, Tokyo Electron America, Inc. (United States); Matthew Colburn, IBM Albany NanoTech (United States). . . . . [8680-52]

4:20 pm: **Process sensitivities in exemplary chemo-epitaxy directed self-assembly integration**, Paulina A. Rincon Delgadillo, Univ. of Chicago (United States) and IMEC (Belgium); Roel Gronheid, IMEC (Belgium); Guanyang Lin, Yi Cao, AZ Electronic Materials USA Corp. (United States); Ainhoa Romo-Negreira, Tokyo Electron Europe Ltd. (Netherlands); Mark H. Somervell, Kathleen Nafus, Tokyo Electron America, Inc. (United States); Paul F. Nealey, Univ. of Chicago (United States). . . . . [8680-53]

4:40 pm: **Large-scale dynamics of directed self-assembly block copolymers on chemically pre-patterned surface**, Kenji Yoshimoto, Takashi Taniguchi, Kyoto Univ. (Japan). . . . . [8680-54]

Conference End.

## Conference 8681

### Metrology, Inspection, and Process Control for Microlithography XXVII

**Session 15**  
**Room: Conv. Ctr. 230 B**  
**Thu 3:50 pm to 5:20 pm**

#### Late Breaking News

Session Chairs: **Ofer Adan**, Applied Materials (Israel); **Alexander Starikov**, I&I Consulting (United States)

3:50 pm: **Gaps analysis for CD metrology beyond the 22nm node (Invited Paper)**, Benjamin D. Bunday, SEMATECH North (United States). . . . . [8681-57]

4:20 pm: **High-speed atomic force microscope for patterned defect review**, Chanmin Su, Haiming Wang, Yan Hu, Shuiqing Hu, Jason Osborne, Sean Hand, Jian Shi, Bruker Nano Inc. (United States). . . . . [8681-100]

4:40 pm: **Metrology solutions for high-performance Germanium multigate field-effect transistors using optical scatterometry**, Hock-Chun Chin, Moh-Lung Ling, Nanometrics Inc. (United States); Bin Liu, Xingui Zhang, National Univ. of Singapore (Singapore); Jie Li, Yongdong Liu, Jiangtao Hu, Nanometrics Inc. (United States); Yee-Chia Yeo, National Univ. of Singapore (Singapore). [8681-107]

5:00 pm: **Enhancing metrology by combining spacial variability and global inference**, Costas J. Spanos, Jae Yeon (Claire) Baek, Univ. of California, Berkeley (USA). . . . . [8681-123]

Conference End.

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**Conference 8683**

**Optical Microlithography  
 XXVI**

**Session 12**  
**Room: Conv. Ctr. 210 C**  
**Thu 3:30 pm to 5:30 pm**

**Tooling**

Session Chairs: **Soichi Owa**, Nikon Corp. (Japan); **Jo Finders**, ASML Netherlands B.V. (Netherlands)

3:30 pm: **A study of vertical lithography for high-density 3D structures**, Masaki Mizutani, Shin-Ichiro Hirai, Ichiro Koizumi, Ken-Ichiro Mori, Seiya Miura, Canon Inc. (Japan) . . . . . [8683-50]

3:50 pm: **Power up: 120 Watt injection-locked ArF excimer laser required for both multipatterning and 450mm wafer lithography**, Takeshi Asayama, Youichi Sasaki, Gigaphoton Inc. (Japan); Akihiko Kurosu, Hiroaki Tsushima, Takahito Kumazaki, Gigaphoton Inc. (Japan); Kouji Kakizaki, Komatsu Ltd. (Japan); Takashi Matsunaga, Hakaru Mizoguchi, Gigaphoton Inc. (Japan) . . . . . [8683-51]

4:10 pm: **High-power 120W ArF immersion laser for high-dose applications**, Rostislav I. Rokitski, Robert J. Rafac, Ricardo Dubi, Joshua J. Thomes, John T. Melchior, Theodore Cacouris, Mary Haviland, Daniel J. Brown, Cymer, Inc. (United States) . . [8683-52]

4:30 pm: **Comprehensive thermal aberration and distortion control of lithographic lenses for accurate overlay**, Yohei Fujishima, Satoshi Ishiyama, Susumu Isago, Akihiro Fukui, Hajime Yamamoto, Toru Hirayama, Tomoyuki Matsuyama, Yasuhiro Ohmura, Nikon Corp. (Japan) . . . . . [8683-53]

4:50 pm: **High-order field-to-field corrections for imaging and overlay for achieving sub-20nm lithography requirements**, Jan Mulkens, Michael Kubis, Paul C. Hinnen, Hans van der Laan, Wim Tel, ASML Netherlands B.V. (Netherlands) . . . . . [8683-54]

5:10 pm: **High-accuracy and high-productivity immersion scanner enabling 1xnm hp manufacturing**, Yosuke Shirata, Yuichi Shibazaki, Junichi Kosugi, Kikuchi Takahisa, Yasuhiro Ohmura, Nikon Corp. (Japan) . . . . . [8683-55]

5:30 pm: **Extending ArFi immersion down to 1xnm production nodes by new TWINSCAN 'NXT' scanner generations**, Remi Pieternella, Wim P. de Boeij, Igor Bouchoms, Martijn Leenders, Robert Kazinczi, Pieter Gunter, Martin Verhoeven, Siebe Landheer, Marjin Hoofman, Joost Smits, Janneke van Heteren, ASML Netherlands B.V. (Netherlands) . . . . . [8683-91]

**Room: Conv. Ctr. 210 C...5:50 pm to 6:00 pm**

**Closing Remarks**

Session Chairs: **Will Conley**, Cymer, Inc. (United States); **Kafai Lai**, IBM Corp. (United States)

Conference End.

**Conference 8684**

**Design for Manufacturability  
 through Design-Process**

**Session 8**  
**Room: Conv. Ctr. 211 B**  
**hu 3:30 pm to 4:30 pm**

**Algorithms for DFM**

Session Chairs: **Chul-Hong Park**, SAMSUNG Electronics Co., Ltd. (Korea, Republic of); **Jason P. Cain**, Advanced Micro Devices, Inc. (United States)

3:30 pm: **Model-based hint for litho-hotspot fixing beyond 20nm node**, Jae-Hyun Kang, SAMSUNG Electronics Co., Ltd. (Korea, Republic of); Sarah Mohamed, Mentor Graphics Egypt (Egypt); Wael ElManhawey, Mentor Graphics Corp. (United States); Byung-Moo Kim, Naya Ha, SAMSUNG Electronics Co., Ltd. (Korea, Republic of); Hung Bok Choi, Kee Sup Kim, SAMSUNG Electronics Co., Ltd. (Korea, Republic of); Jean-Marie Brunet, Joe Kwan, Mentor Graphics Corp. (United States); Kareem Madkour, Mentor Graphics Egypt (Egypt); Evan Lee, Mentor Graphics Korea (Korea, Republic of) . . . . . [8684-23]

3:50 pm: **A novel algorithm for automatic arrays detection in a layout**, Marwah Shafee, Mentor Graphics Egypt (Egypt); Jea-Woo Park, Ara Aslyan, Juan Andres Torres, Mentor Graphics Corp. (United States); Kareem Madkour, Mentor Graphics Egypt (Egypt); Wael ElManhawey, Mentor Graphics Corp. (United States) [8684-24]

4:10 pm: **An automated resource management system to improve production tapeout turn-around time**, Junwei Lu, Mentor Graphics Corp. (China); Eric G. Guo, Qigwei Liu, Sherry Zhu, Semiconductor Manufacturing International Corp. (China); Jenny Tsai, Mark C. Simmons, Mentor Graphics Corp. (United States); Jason Wu, Semiconductor Manufacturing International Corp. (China) . . . . . [8684-25]

Conference End.

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# 2014 Advanced Lithography

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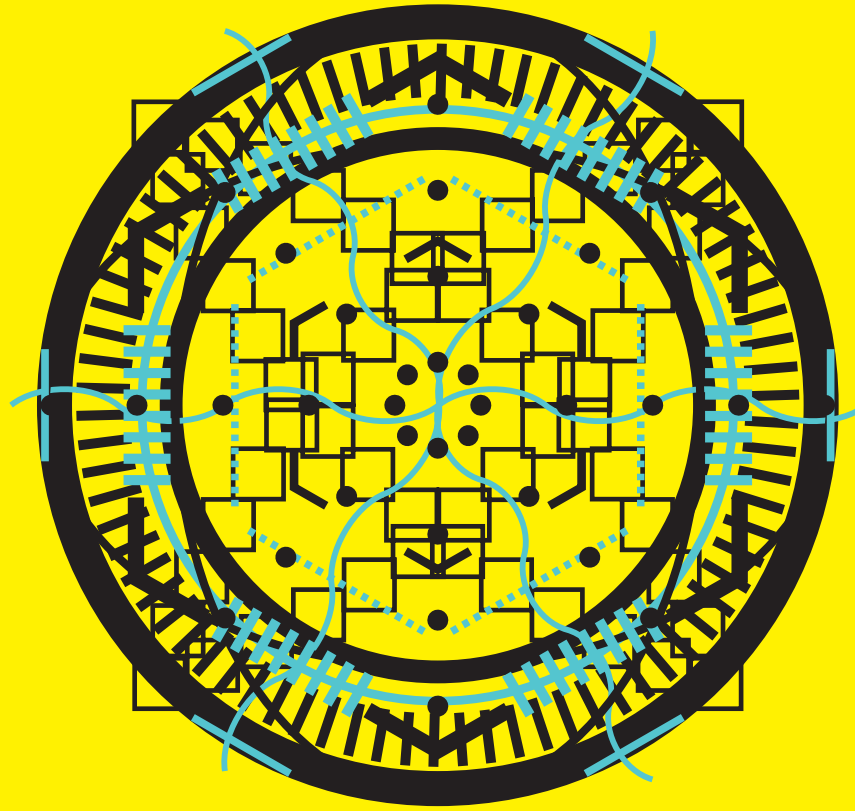
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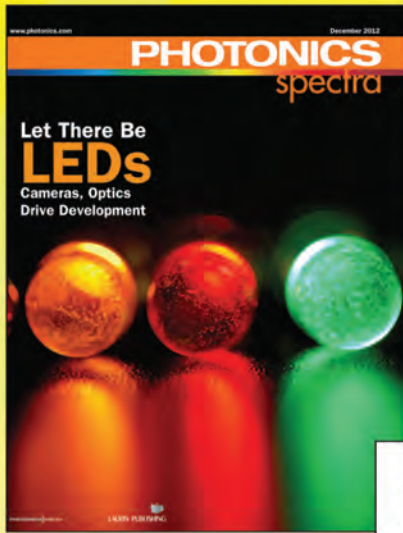
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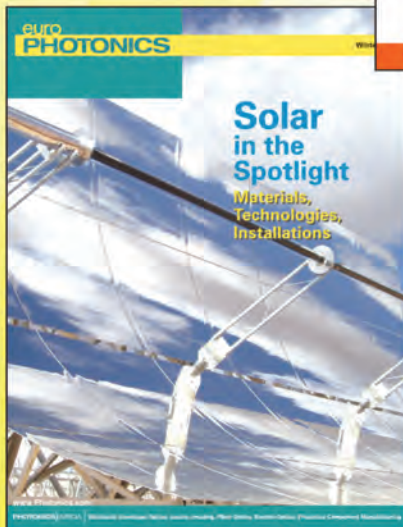


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