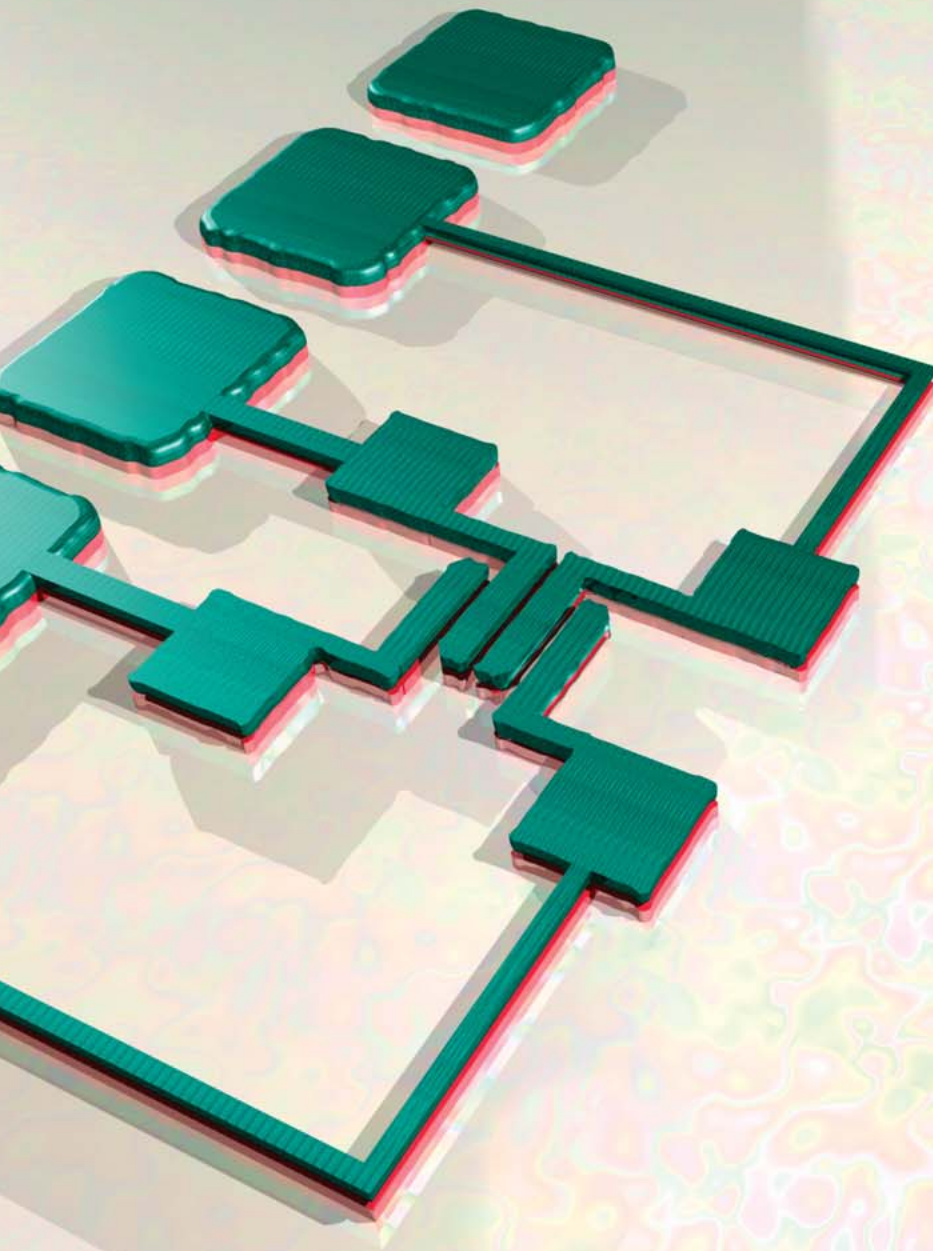# Microlithography

An **SPIE** *Event*

31st International Symposium
19–24 February 2006
San Jose Convention Center and Marriott Hotel
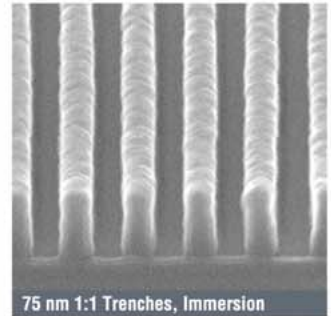*San Jose, California USA*

Conferences • Courses • Exhibition

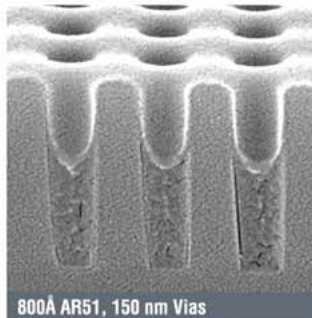**SPIE** The International Society
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Microlithography

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Microlithography

An **SPIE** *Event*

19-24 February 2006 *San Jose Convention Center and Marriott Hotel • San Jose, California USA*

Conferences • Courses • Exhibition

Welcome!

SPIE's Microlithography Symposium is an annual international forum bringing practitioners of micro- and nanolithography together in an exciting, informative, and interactive environment. The Symposium is strongly committed to supporting your interests whether you work in semiconductor production lines, pilot lines, or research laboratories. It succeeds because the programs are tailored to people like you: folks using technologies for today's production or developing it for production in the near future. Moreover, the numerous short courses offered at Microlithography 2006 are taught by people active in the field and recognized for both theoretical knowledge and practical experience.

Hear about the latest state-of-the-art applications and techniques, as well as emerging issues as you are presented with new challenges and alternative technologies. This wide topical reach becomes all the more important as optical lithography, historically the dominant patterning technology, faces new and tough challenges in providing the patterning solutions for leading-edge semiconductor manufacturing.

Sharpen your edge and join us in San Jose for SPIE Microlithography's 31st year!

Symposium Chair
Anthony Yen,
Cymer, Inc.

Symposium Co-Chair
Roxann L. Engelstad,
Univ. of Wisconsin/Madison

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Conferences

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Conf. 6153 **Advances in Resist Materials and Processing Technology XXIII** *(Lin)* p. 33-39				
	Conf. 6154 **Optical Microlithography XIX** *(Flagello)* p. 40-46			
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San Jose Convention Center and Marriott Hotel Floorplans

Second Floor

SAN JOSE CONVENTION CENTER EXHIBIT AND MEETING ROOM LEVEL

Speaker Check-in, Room D

E
D
C3 C4
C2 C1

A4 A5
A3 A6
A2 A7
A1 A8

B3 B4
B2 B1

W M

W M

Down to Rooms K, L, M, N

J3
J2
J1 J4
F2 H
F1 G
M W

Almaden Foyer

Exhibitor Lounge

Exhibition and Registration Area

SPIE Marketplace and Internet Pavilion

Down to San Carlos Street Level

MARKET ST.

CONVENTION CENTER ACCESS

Silicon Valley Board Room

Guadalupe

San Carlos

Almaden

Blossom Hill III

Blossom Hill II

Blossom Hill I

Willow Glen III

Willow Glen II

Willow Glen I

Salon I

Salon II

San Jose Ballroom Salon III

Salon IV

Salon VI

Salon V

THIRD FLOOR

SAN JOSE MARRIOTT SECOND FLOOR

HILTON HOTEL

SOUTH ALMADEN AVE.

WEST SAN CARLOS ST.

Street Level

SAN JOSE CONVENTION CENTER STREET LEVEL

Parking ◄

K L M N

Meeting Rooms

Market Street Entrance

San Jose Visitors Bureau

San Carlos Street Entrance

Up to Exhibits and Meeting Rooms

Almaden Lobby

Almaden Entrance

Main Entrance

MARKET ST.

HYATT SAINT CLAIRE HOTEL

SAN JOSE MARRIOTT Lobby Level

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To the Fairmont Hotel

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General Refreshments

Cyantek Corp.
Micro Lithography Inc.
Mitsui Chemicals America, Inc.

Welcome Announcements

Exhibition Hall 3

Monday . . . . 8:00 to 8:20 am

- **Welcome**
  Symposium Chair: **Anthony Yen,** Cymer, Inc.
- **Introduction of new SPIE Fellows**
  Symposium Chair: **Anthony Yen,** Cymer, Inc.
- **Frits Zernike and the Advances in Optical Microlithography**
  3rd Frits Zernike Award for Microlithography
  Presented by: **Anthony Yen,** Cymer, Inc.

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Plenary Presentations

Exhibition Hall 3

Monday 8:20 to 10:35 am

Sponsored by MICRO

8:20 to 9:05 am

Marching to the Beat of Moore's Law

Yan Borodovsky, Intel Senior Fellow, Technology and Manufacturing Group Director, Advanced Lithography, Intel Corp.

Density scaling in integrated circuits defined as transistor count per unit area doubling every 18-24 month follows the famous observation-come-prediction by Gordon Moore for many generations now. Known as "Moore's law", it has provided all important synchronizing guidance and reference to tools and materials suppliers in addition to IC manufacturers and their customers as to what minimal requirements their products and services need to meet in two, four, six, etc. years from the given moment to satisfy technical and financial expectations in support of the infrastructure required for the development and manufacturing of these technology nodes.

Multiple lithography solutions usually exist for lithographers to choose from at any given node. In general, three broad classes of solutions are usually considered at every node: evolutionary – technology that is extension of existing technology infrastructure at similar or slightly higher cost and risk to schedule; revolutionary – technology that discards significant parts of the existing infrastructure at similar cost, higher risk to schedule but promises higher capability as compared to the evolutionary approach; and last but not least, disruptive – approach that as a rule promises similar or better capabilities, much lower cost and wholly unpredictable risk to schedule and products yield.

In the course of presentation I will compare various lithography approaches and their respective merits against criteria of respective infrastructure availability, affordability and risk to IC manufacturers' schedules, in an attempt to sort out key events that will impact the decision on the choice of lithography technology for large-scale manufacturing for the future technology nodes.

Yan Borodovsky is an Intel Senior Fellow and Director of Advanced Lithography in Intel's Technology and Manufacturing Group, responsible for directing Intel's multi-generational advanced lithography definition and progress. Borodovsky has been involved in the development of lithography tooling and advanced patterning techniques since he joined Intel in 1987 as a staff engineer. He was appointed Intel Fellow in January 1999 and Intel Senior Fellow in November of 2003.

Borodovsky was born in Kharkov, Ukraine, in 1947. He received master's degree in Solid State Devices and Physics from Politechnical Institute in Tula, Russia, in 1971. After graduation, he joined the Nuclear Research Institute of the Ukrainian Academy of Science, Kiev, as an engineer involved in the research and development of solid state spectrometers of nuclear radiation. He left the former Soviet Union in 1979 and started his work at Syncal Corporation developing high-temperature semiconductor materials for deep space thermoelectric conversion devices.

In 1982, Borodovsky joined Advanced Micro Devices as Lithography Staff Engineer. In 1985, Borodovsky moved to Oregon to join ATEQ Corporation, where he designed and developed optical systems and optical testing equipment for the original CORE 2000 Laser Writer.

9:05 to 9:50 am

Optics: There Are No Limits

Prof. Eli Yablonovitch, Department of Electrical Engineering, Univ. of California

Optics is changing! There are exciting new advances in the physics under-pinning the field. In this presentation I will describe three new developments that are re-defining optics:

1. The introduction of "photonic crystals" - artificial nanostructures that are for electromagnetic waves, what semiconductor crystals are for electron waves. These photonic nanostructures are being printed into SOI chips. Full opto-electronic integrated circuits are currently being fabricated in semiconductor foundries.

2. The continued extension of optical lithography far into the sub-wavelength domain, despite repeated premature predictions of its demise. New technologies are enabling lithography at resolutions far beyond expectations based on a naive application of the Rayleigh criteria.

3. The subject of "plasmonics", which studies light waves being guided by metal films and metal wires. The special feature of such metallic guiding structures is that the effective refractive index of the guided light waves can be ($\geq$1000, leading to very short wavelengths. In fact, we may describe these light waves as having "Optical Frequencies, but with X-ray Wavelengths".

Eli Yablonovitch graduated with the Ph.D. degree in Applied Physics from Harvard University in 1972. He worked for two years at Bell Telephone Laboratories, and then became a professor of Applied Physics at Harvard. In 1979 he joined Exxon to do research on photovoltaic solar energy. Then in 1984, he joined Bell Communications Research, where he was a Distinguished Member of Staff, and also Director of Solid-State Physics Research. In 1992 he joined the University of California, Los Angeles, where he is now The Northrop Grumman Opto-Electronics Chair, Professor of Electrical Engineering.

He is a Fellow of the Institute of Electrical and Electronic Engineers, the Optical Society of America, and the American Physical Society. Yablonovitch is a Life Member of Eta Kappa Nu, and a Member of the National Academy of Engineering and the National Academy of Sciences. He has been awarded the Adolf Lomb Medal, the W. Streifer Scientific Achievement Award, the R.W. Wood Prize, and the Julius Springer Prize."

9:50 to 10:35

Continued scaling in integrated circuits—trends in lithography and requirements from device/circuit perspective

Kurt Ronse, Lithography Dept. Director, IMEC (Belgium)

Lithography is one of the key drivers of the device and circuit scaling in integrated circuits. 193-nm immersion lithography has clearly emerged on the company roadmaps as the primary technology for the 65-nm and 45-nm half-pitch nodes. For the 32-nm half-pitch node and beyond, extreme-UV lithography is the prime candidate today.

IMEC, in collaboration with our partners - leading-edge chipmakers, equipment and materials suppliers - has an active program on 193-nm immersion lithography from the very beginning and is now starting a new program on extreme-UV lithography. In this presentation, I will review the progress, challenges and outlook of immersion lithography. We will also take a close look at where EUV can be expected to come in and what the issues are.

IMEC is a premier R&D institute on semiconductor technology and focuses its overall activities on maintaining Moore's law. In this presentation, I will also discuss the scaling challenges and requirements from the device and circuit point of view, drawing on IMEC's current activities and recent results in this area.

Kurt Ronse received an M.S. Degree and PhD in Electrical Engineering from the University of Leuven (Belgium). He joined the lithography group in IMEC in 1990, specializing in the field of phase shifting masks, off-axis illumination techniques and CD control optimization.

He has authored and co-authored numerous publications and conference contributions in the field of optical lithography (I-line, deep-UV, 193nm, 157nm), and is member of SPIE.

Currently he holds the position of lithography department director at IMEC, responsible for the advanced lithography affiliation programs at IMEC (193nm immersion, EUVL).

10:35 to 11:00 am Coffee Break

Special Events

Poster Reception

Exhibition Hall 3

Monday 20 February . . . . 5:30 to 8:00 pm
Conferences 6152, 6153
Thursday 23 February . . . . 5:30 to 8:00 pm
Conferences 6151, 6154, 6155, 6156

Sponsored by **ShinEtsuMicroSi**

Conference attendees are invited to the poster sessions and receptions. Authors of poster papers will be on hand during these sessions to answer questions and provide in-depth discussion concerning their posters. Attendees and authors are required to wear their conference registration badges to the poster sessions.

Authors can set up their posters after 9:00 am on the day of their poster session. Poster supplies (Push-pins) will be available. Other supplies can be obtained from the Presenter Check-in Desk. Poster can be previewed during the day before the formal poster sessions begin at 5:30 pm.

Authors must remove their posters at the conclusion of the poster reception for that day. It is the authors' responsibility to remove their posters. Posters 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.

Conference 6152
2005 Best Paper Announcement and Presentation

Metrology, Inspection, and Process Control for Microlithography

Convention Center A2

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

Conference 6154
Panel Discussion

Lithography for 32-nm Technology

Convention Center A2

Tuesday 21 February . . . . 6:40 to 8:10 pm
Moderators: **Mircea V. Dusa,** ASML MaskTools, Inc.; **Nigel R. Farrar,** Cymer, Inc.

According to ITRS roadmap there are 4 potential solutions to meet lithography requirements for 32nm half pitch: "innovative" 193nm EUV, E-beam or Optical Maskless and Imprint. ITRS suggests narrowing the options in two to three years from now. In parallel, lithography community has to address development and implementation of innovative RET and combine these with Friendly Design Rules.

While we have to address the "narrow down option", we face new challenges from implementation of current complexity related to understanding imaging at hyper-NA with polarized light, combined with challenges coming from unknown implementation of immersion lithography process control where material science questions represent new areas of learning for lithography engineers.

All of the above represent a formidable technical challenge that require revolutionary more than evolutionary changes in the way we approach the future 32nm technology. Our panel will bring together recognized experts from the lithography community and ask them to share with us their thoughts on what and how to address the critical aspects related to lithography technology at 32nm and beyond.

Conference 6152
Panel Discussion

The Future of CD-SEM and Scatterometry

Convention Center A2

Wednesday 22 February . . . . 8:10 to 9:40 pm
Moderators: **Vladimir A. Ukraintsev,** Texas Instruments Inc.; **John L. Sturtevant,** Mentor Graphics Corp.

Panelists: **Bryan J. Rice,** Intel Corp.; **Bhanwar Singh,** Advanced Micro Devices, Inc.; **Masafumi Asano,** Toshiba Corp. (Japan); **David C. Joy,** The Univ. of Tennessee; **Richard M. Silver,** National Institute of Standards and Technology; **Christopher J. Raymond,** Accent Optical Technologies; **Kevin M. Monahan,** KLA-Tencor Corp.; **Alex Danilevsky,** Hitachi High Technologies America, Inc.

The participants include experts from academia, government, and the semiconductor industry.

The roles of several metrology tool technologies are changing due to new challenges and improving alternative solutions. This is especially evident in critical dimension monitoring and control solutions using CDSEM and scatterometry. This panel discussion will focus on current and future applications including roles exploiting the complementary natures of these technologies, the limits of these techniques, and what can be done to improve these technologies by developing strengths and dealing with weaknesses. This discussion should offer insight into future manufacturing and development configurations for these technologies.

Joint Sessions

Conferences 6153 and 6154
on Immersion Lithography Materials

Convention Center A4

Wednesday 22 February . . . . 6:30 to 8:30 pm

The conference chairs of Resist Materials & Processing Technology and Optical Microlithography are sponsoring a special joint session on Materials Challenges in Immersion Lithography. This session will provide an overview of the critical materials issues in immersion lithography. Papers will address high-refractive index fluids for immersion lithography, defect formation and removal, resist topcoats and other important materials issues in this vital area of lithography system integration. This session will serve as an overview of cross-cutting technologies, with many more papers in immersion lithography being presented in additional sessions of each conference.

Conferences 6152 and 6155
on CD Control and CD and Overlay Control

Convention Center A2

Thursday 23 February . . . . 1:30 to 5:00 pm

The conference chairs of Metrology, Inspection, and Process Control and Data Analysis and Modeling for Process Control are sponsoring two back-to-back special joint sessions, CD Control and CD and Overlay Control. These two sessions offer presentations that illustrate and educate on the many issues associated with providing complete solutions for process control from the need for quality metrology to the requirements for interpretation and analysis.

Conference 6156
Panel Discussion

An Open Semiconductor Platform Model: Vision and Practical Issues

Convention Center B1

Thursday 23 February . . . . 7:30 to 9:30 pm

Moderator: **Juan Antonio Carballo,** IBM Corp.

Spiraling design and manufacturing costs, coupled with an ultracompetitive, global electronics market, require unprecedented efficiency and adaptability from all players in the semiconductor value chain. To address this burning need, the integration of Design and Manufacturing increasingly targets common semiconductor platforms with full GDS compatibility across a host of multi-company fabs, with multiple claimed advantages, including sharing resources and increasing flexibility. Design and Process Integration techniques are critical to this approach, including lithography related and variability related capabilities. In this panel, we discuss the vision, pros and cons, and components of an open, collaborative semiconductor platform approach and the role of specific Design and Process Integration techniques in achieving the layout compatibility goal.

Conference 6154
Best Student Paper Award

Sponsored by: CYMER

Convention Center J2

Friday 24 February . . . . 10:20 to 10:30 am

The Cymer Scientific Leadership Award for Best Student Paper, a monetary award to help support students engaged in research activities in optical microlithography, will be awarded this year again at the Optical Lithography conference. Student authors and student co-authors are eligible only. A panel of experts will be invited by the chair of the conference to serve as judges. The paper (oral or poster) demonstrating scientific excellence in presentation, quality and importance to the lithography community will be selected as the winner of this award.

2005 Cymer Best Student Paper Award Winner: High accuracy 65-nm OPC verification: full process window model versus critical failure ORC [5754-128] Amandine Borjon, Philips Semiconductors (France), and Jerome Belledent, Philips Semiconductors (France); Yorick Trouiller, CEA-LETI (France); Corinne Miramond, STMicroelectronics (France); Kyle Patterson, Kevin Lucas , Freescale Semiconductor (France); Christophe Couderc, Philips Semiconductors (France); Frank Sundermann, Jean-Christophe Urbani, Stanislas Baron, STMicroelectronics (France); Yves Rody, Philips Semiconductors (France); Patrick Schiavone, CEA-LETI (France).

SPIE Women in Optics Lunch

SPIE Women in Optics

Tuesday 21 February . . . . Noon to 1:00 pm

Join WiO members and nonmembers for an opportunity to network with other optics professionals, generate new contacts, and expand your resources and referrals. This SPIE hosted luncheon at Microlithography is the perfect way to meet and develop relationships with others in your field. **Advance sign-up is required at the Cashier station by Monday 5:00 pm.**

Student Lunch with the Experts—
A Networking Event

Wednesday 22 February . . . . 12:30 to 1:30 pm

Combine fun, food and networking at this engaging event open to all students. Hosted by SPIE Student Services, this event will feature experts willing to share their accumulated wisdom on career paths within the optics and photonics industry. **Advance sign-up is required at Registration by Monday at 5:00 pm.**

Among the experts in attendance will be:

Michael Lercel, IBM & SEMATECH
Michael Lercel received his PhD in physics from Cornell University in the study of electron beam lithography of self assembled monolayers. After a short, but very practical, experience in wafer process development at IBM Burlington, he moved back to lithography with the IBM Advanced Mask Facility in Burlington Vermont where he served as manager of the facility during the NGL Mask Center of Competency joint development project. After that time with ebeams and x-rays, he went to more practical optical lithography research with IBM East Fishkill and Yorktown Heights. He is currently an IBM assignee to SEMATECH as the associate director of the lithography division.

Harry Levinson, AMD
Harry Levinson currently manages advanced lithography research at AMD. He has been involved with lithography for over two decades, in research, development and manufacturing. He has authored numerous papers and two textbooks on the subject.

Qinghuang Lin, IBM
Dr. Qinghuang Lin is a Research Staff Member at IBM T. J. Watson Research Center. He received his Ph.D. degree from the University of Michigan and was a post-doctoral fellow with Prof. Grant Willson at the University of Texas at Austin. During his more than ten years at IBM, Dr. Lin has worked on lithography, BEOL and technical strategy. He has published more than 55 papers and has more than 20 issued and pending US patents. In addition to his service to SPIE, Dr. Lin currently serves on the Materials Secretariat of the American Chemical Society and the Executive Committee of the Division of the Polymeric Materials: Science and Engineering of the American Chemical Society.

Frank Schellenberg, Mentor Graphics
Frank Schellenberg has a Ph.D. in Applied Physics from Stanford University, and worked for 10 years at IBM Research on data storage applications of photonics and nonlinear optics. He has more recently been involved in sub-wavelength lithography and resolution enhancement technology (RET), and is currently employed at Mentor Graphics, a provider of RET software. He is also a registered patent agent.

Vivek Singh, Intel
Vivek Singh received a Ph.D. in Chemical Engineering from Stanford University in the field of plasma etching and deposition. Since then he has worked on many different aspects of photolithography and OPC/RET. He currently manages the Lithography Modeling Group at Intel.

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BACUS and Photolithography Technical Groups Panel Discussion

Convention Center A2

Monday 20 February . . . . 7:30 to 9:00 pm

193nm Immersion Lithography - Will the mask makers sink or swim!?

Moderators: **Paul Leuhrmann,** ASML; **Brian J. Grenon,** Grenon Consulting, Inc.

Panelists: **Paul W. Ackmann,** Advanced Mask Technology Ctr.; **Donis G. Flagello,** ASML US, Inc.; **Bernd Geh,** Carl Zeiss / ASML-TDC; **Franklin D. Kalk,** Toppan Photomasks, Inc.; **Chris A. Mack,** Gentleman Scientist; **Moshe E. Preil,** Brion Technologies, Inc.; **Christoher J. Progler,** Photronics, Inc

Sponsored by

This panel of leading lithography industry experts will provide a lively discussion with respect to their opinions on both the readiness and challenges facing the mask industry with the introduction of 193nm immersion lithography. The panelists, both lithographers and mask technologists, will provide their potentially dissenting views.

About BACUS
Founded in 1980 by a group of chrome blank users wanting a single voice to interact with suppliers, BACUS has grown to become the largest and most widely known forum for the exchange of technical information of interest to photomask and reticle makers. BACUS joined SPIE in January of 1991 to expand the exchange of information with mask makers around the world.

The group sponsors an informative monthly meeting and newsletter, Photomask. The BACUS annual Photomask Technology and Management Symposium covers photomask technology, photomask processes, lithography, materials and resists, phase shift masks, inspection and repair, metrology, and quality and manufacturing management.

About the Photolithography Technical Group
The primary focus of this group is on photolithography used in the manufacture of devices, tape/disk heads, LCDs, sensors, and other technologies. The group holds joint monthly meetings with the BACUS (Photomask Technical Group) in the San Francisco Bay Area on topics in photolithography technology. Topics that have been discussed at past meetings include half-micron photolithography, a top anti-reflective coating process, and advances in deep UV resist materials, metrology, and overlay. Future meetings will cover process control in semiconductor manufacturing, advanced topics in develop end point detection, depth of focus issues, modeling, dry developable resist systems, and many other fascinating and relevant subjects.

Nanotechnology in Microlithography Technical Group Meeting

Convention Center C1

Tuesday 21 February . . . . 7:00 to 9:00 pm

Chairs: **Michael T. Postek, Richard Silver,** National Institute of Standards and Technology

Sponsored by Molecular Imprints

1) NNI Update
Speaker: **Michael T. Postek**

2) The Potential for CNT in Semiconductor Manufacturing: Presentations and Discussion
Moderators: **Richard Silver** and **Michael T. Postek**

Carbon nanotubes (CNT) present new possibilities for future semiconductor manufacturing both for conventional top-down lithographies as well as botton-up approaches. Carbon nanotubes can be metallic or semiconducting with diameters of around 0.4 nm to 50 nm. The high mobility, current density, thermal conductivity and stability are excellent. Although fundamental science is being done and the potential has been seen, challenges remain for manufacturing. Reproducible manufacturing processes for carbon nanotubes with desired characteristics (i.e., semiconducting vs. metallic, chirality, etc.); precise placement of CNTs, and the integration of millions if not billions of CNT transistors with back-end metallization layers remain daunting challenges. The presentations and discussion will explore the possibilities of CNT integration into semiconductor manufacturing.

About the Nanotechnology in Microlithography Technical Group
Nanotechnology is a strongly multidisciplinary area, and this Technical Group brings together the community of scientists and technologists working at the frontiers of nanoscience and nanotechnology. Basic and applied scientific as well as technological issues are of interest in the context of optics, electrical engineering, and materials science. The Group's scope includes, but is not limited to, the following areas:
- nanoscale function and properties
- nanoparticles, nanotubes, nanofilms and nanodeposits
- nanomolecular and biomolecular materials; nanofabrication, characterization and metrology
- control of nanoscale optical, mechanical, and electronic processes
- transport and interaction in nanostructures
- nanodevices, nanosensors and their applications; quantum wells, wires and dots
- noise, dissipation and information transfer in nanoelectronic devices
- molecular motors and nanomachines
- ion pumps and ion channels
- fluctuation-induced transport
- quantum computing processes and devices photoactive arrays, materials and devices
- nanophotonics; quantum and nonlinear optics in nanostructures
- near-field optics, microscopy and associated technologies
- colloidal systems, smart and self-assembled materials
- environmental nanoparticles and aerosols
- biomaterials and biophotonics.

The Group oversees technology-focused subgroups. Steering Committee members representing different topical areas coordinate and lead meetings at a variety of SPIE symposia.

SPIE Technical Groups provide access to the latest information and publications relevant to your field. Individuals join because they also recognize the value of associating with peers at SPIE conferences and events, which is a great way to keep up on the latest developments.

Course Daily Overview

Sunday	Monday	Tuesday	Wednesday	Thursday
Emerging Lithographic Technologies				
SC100 **Introduction to Electron-Beam Lithography** *(McCord)* 8:30 am to 12:30 pm				
SC101 **Introduction to Microlithography: Theory, Materials, and Processing** *(Willson, Bowden, Thompson)* 8:30 am to 5:30 pm				
SC622 **Nano-Scale Patterning with Imprint Lithography** *(Sreenivasan, Willson, Resnick)* 6:00 to 10:00 pm				
Metrology, Inspection and Process Control				
SC105 **CD Metrology and Image Formation in the Scanning Electron Microscope (SEM)** *(Wells, Postek, Jr.)* 8:30 am to 5:30 pm				
SC618 **Full Wafer Particle and Defect Detection, Review & Characterization** *(Brundle)* 8:30 am to 5:30 pm				
SC705 **Instruments and Methodologies for Accurate Metrology and Fleet Matching** *(Archie, Banke)* 8:30 am to 5:30 pm				
SC778 **Introduction to Advanced Process Control (APC) for Semiconductor Manufacturing** *(Finn, Misra)* 8:30 am to 5:30 pm		*Register for Courses onsite at the Registration Desk!*		
SC101 **Introduction to Microlithography: Theory, Materials, and Processing** *(Willson, Bowden, Thompson)* 8:30 am to 5:30 pm				
SC621 **Lithography Control and Characterization** *(Zavecz)* 8:30 am to 5:30 pm				
SC111 **Lithography Process Control** *(Levinson)* 8:30 am to 5:30 pm				
SC539 **Spectroscopic Ellipsometry Applications in Microlithography** *(Synowicki)* 8:30 am to 5:30 pm				
Resist Technology and Processing				
SC101 **Introduction to Microlithography: Theory, Materials, and Processing** *(Willson, Bowden, Thompson)* 8:30 am to 5:30 pm		SC114 **Plasma Etching and Reactive Ion Etching** *(Coburn)* 8:30 am to 5:30 pm		SC103 **Resists for Deep UV Lithography** *(Willson)* 8:30 am to 5:30 pm
SC111 **Lithography Process Control** *(Levinson)* 8:30 am to 5:30 pm				SC616 **Practical Photoresist Processing** *(Dammel)* 1:30 to 5:30 pm
SC780 **Tracks 101: Microlithography Coat and Develop Basics** *(Daggett)* 8:30 am to 5:30 pm				
SC355 **Fundamentals of Photochemical Contamination Control for Lithographic Tools** *(Kunz)* 6:00 to 10:00 pm				

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Sunday	Monday	Tuesday	Wednesday	Thursday

Optical Microlithography

Sunday	Monday	Tuesday	Wednesday	Thursday
SC120 **193-nm Lithography** (*Dammel, Kunz*) 8:30 am to 5:30 pm	SC579 **Photomask Fabrication and Technology Basics** (*Duff*) 8:30 am to 5:30 pm	SC112 **DfM in the Context of RET-enabled Lithography** (*Liebmann, Wong*) 8:30 am to 12:30 pm		SC118 **Anti-Reflective Coatings: Theory and Practice** (*Dammel*) 8:30 am to 12:30 pm
SC540 **Applying Optical Proximity Correction and Design for Manufacturability to Product Designs** (*Capodieci, Lucas*) 8:30 am to 5:30 pm	SC779 **Polarization for Lithographers** (*Kye, McIntyre*) 8:30 am to 12:30 pm			
SC707 **Basics of Optical Imaging in Microlithography: A Hands-on Approach** (*Milster, Flagello, Brooker*) 8:30 am to 5:30 pm				
SC105 **CD Metrology and Image Formation in the Scanning Electron Microscope (SEM)** (*Wells, Postek, Jr.*) 8:30 am to 5:30 pm				
SC705 **Instruments and Methodologies for Accurate Metrology and Fleet Matching** (*Archie, Banke*) 8:30 am to 5:30 pm				
SC101 **Introduction to Microlithography: Theory, Materials, and Processing** (*Willson, Bowden, Thompson*) 8:30 am to 5:30 pm				
SC116 **Lithographic Optimization: A Theoretical Approach** (*Mack*) 8:30 am to 5:30 pm				
SC117 **The Fundamental Limits of Optical Lithography** (*Smith*) 8:30 am to 12:30 pm				
SC780 **Tracks 101: Microlithography Coat and Develop Basics** (*Daggett*) 8:30 am to 5:30 pm				
SC706 **Imaging and Optics Fundamentals in Microlithography** (*Flagello*) 1:30 to 5:30 pm				
SC124 **Pushing the Limits: Optical Enhancement, Polarization, and Immersion Lithography** (*Smith*) 1:30 to 5:30 pm				
SC355 **Fundamentals of Photochemical Contamination Control for Lithographic Tools** (*Kunz*) 6:00 to 10:00 pm				
SC102 **Optical Lithography Modeling** (*Neureuther, Smith*) 6:00 to 10:00 pm				

Register for Courses onsite at the Registration Desk!

Design for Manufacturing

Sunday	Monday	Tuesday	Wednesday	Thursday
SC105 **CD Metrology and Image Formation in the Scanning Electron Microscope (SEM)** (*Wells, Postek, Jr.*) 8:30 am to 5:30 pm		SC112 **DfM in the Context of RET-enabled Lithography** (*Liebmann, Wong*) 8:30 am to 12:30 pm	SC505 **Data to Silicon: Understanding the Fundamentals of MDP, Frame Generation, RET and DFM** (*Morse*) 8:30 to 5:30 pm	
SC705 **Instruments and Methodologies for Accurate Metrology and Fleet Matching** (*Archie, Banke*) 8:30 am to 5:30 pm		SC708 **Impact Of Variability On VLSI Circuits** (*Puri, Heng*) 1:30 to 5:30 pm		
SC778 **Introduction to Advanced Process Control (APC) for Semiconductor Manufacturing** (*Finn, Misra*) 8:30 am to 5:30 pm				
SC116 **Lithographic Optimization: A Theoretical Approach** (*Mack*) 8:30 am to 5:30 pm				
SC111 **Lithography Process Control** (*Levinson*) 8:30 am to 5:30 pm				
SC124 **Pushing the Limits: Optical Enhancement, Polarization, and Immersion Lithography** (*Smith*) 1:30 to 5:30 pm				
SC540 **Applying Optical Proximity Correction and Design for Manufacturability to Product Designs** (*Capodieci, Lucas*) 8:30 am to 5:30 pm				

Don't miss the Exhibition!

Exhibition Halls 1-2

Tuesday - 10:00 am to 5:00 pm
Wednesday - 10:00 am to 4:00 pm

Abeam Technologies
Accent Optical
    Technologies
Aerotech, Inc.
Air Products
Anchor Semiconductor Inc.
Applied Materials
Aprio Technologies
ARO Corp.
ASML
ATMI Packaging
August Technology
AZ Electronic Materials
    USA Corp.
Bachur & Associates
Benchmark Technologies, Inc.
Brewer Science
Brion Technologies, Inc.
Cabot Microeletronics Corp./
    Engineered Surface Finishes
Cadence Design Systems, Inc.
Canon USA, Inc.
Carl Hanser Verlag
Carl Zeiss SMT Inc.
Ciba Specialty Chemicals
Corning Inc.
CUNO Inc.
CVI Laser LLC
Cyantek Corp.
Cymer, Inc.
Digital Optics Corp.
DNS Electronics
Donaldson Co., Inc.
Dongjin Semichem Co., Ltd.
Dynamic Micro Systems
Elionix
Energetiq Technology, Inc.
Entegris, Inc.
EV Group Inc.
Foothill Instruments,LLC
FUJIFILM Electronic Materials
    U.S.A., Inc.
Gestione SiLO srl
Hakuto Co., Ltd.
Heussner Optics, Inc.
Hitachi High Technologies
    America, Inc.
Honeywell Electronic
    Materials
HORIBASTEC
Inko Industrial Corp.

International Radiation Detectors,
    Inc.
Invarium
J.A. Woollam Co.
JSR Micro, Inc.
King Industries, Inc.
KLA-Tencor Corp.
Lasertec USA, Inc.
Leica Microsystems Inc.
Lithotech Japan (LTJ)
Media Lario Technologies
Mentor Graphics
MetroBoost
Metrosol
Micro Lithography Inc.
Micro Magazine
MicroChem Corp.
Microlithography World
Micronic Laser Systems AB
Mitsui Chemicals America, Inc.
Molecular Imprints, Inc.
n&k Technology, Inc.
Nanometrics Inc.
Nanometrology LLC
Nanonex Corp.
National Institute of Standards
    & Technology
National Nanotechnology
    Infrastructure Network
New Way Air Bearings
NexTech Solutions, Inc.
Nikon Precision Inc.
Olympus Industrial America
Omega Optical, Inc. #909
OnWafer Technologies, Inc.
ORC Manufacturing Co., Ltd.
Osram Sylvania
Pall Corp.
Particle Measuring Systems
Photonics Spectra
Photronics, Inc.
PicoQuant GmbH
Pozzetta Products, Inc.
Rainbow Research Optics, Inc.
RAVE LLC,
    Nanotechnology
Renishaw Inc.
Rohm and Haas
    Electronic Materials

RSoft Design Group
Rudolph Technologies
SACHEM, Inc.
SAES Pure Gas, Inc.
Sagantec
SAGEN
Semiconductor International
    Magazine
SensArray Corp.
Shin-Etsu MicroSi, Inc.
Sigma-C
Silicon Canvas Inc.
Solid State Technology
Soluris, Inc.
SPIE Professional Development
Star Tech Instruments
Sumika Electronic Materials, Inc.
Surface Finishes Co. Inc.
Synopsys, Inc.
Technical Manufacturing Corp.
Timbre Technologies

Time-Bandwidth Products AG
Tinsley Labs.
Tokyo Ohka Kogyo America, Inc.
Tokuyama Corp.
Toppan Photomasks, Inc.
Toptica Photonics, Inc.
Veeco Instruments
VLSI Standards, Inc.
Wacom Corp.
Wordingham Technologies
XEI Scientific, Inc.
Yield Engineering Systems, Inc.
Zygo Corp.

Product Spotlights

Join us in the Demo area of the Exhibition Hall, and hear about these new products— in the spotlight!

Tuesday

1:30 pm
Photonic Design Automation (PDA) Software for Optical Lithography and Metrology
Dr. Zhengyu Huang, RSoft Design Group
Advanced simulation features in RSoft's commercial tools based on rigorous electromagnetic waves solvers such as RCWA and FDTD will be introduced for optical lithography and metrology applications.

2:30 pm
Incremental OPC and Real World DFM
Randy Smith, Aprio Technologies, Inc.
Join us for a presentation about how pre-OPC'd component IP can accelerate your time to market.

Microlithography 2006

San Jose McEnery Convention Center
408 Almaden Blvd., San Jose, CA, 95110
San Jose Marriott (Headquarters Hotel)
301 South Market Street, San Jose, CA, 95113

Registration and Information Hours

San Jose McEnery Convention Center, Exhibit Hall 2

Sunday . . . . 7:00 am to 6:00 pm

Monday . . . . 7:00 am to 4:00 pm

Tuesday . . . . 7:00 am to 5:00 pm

Wednesday and Thursday . . . . 7:30 am to 4:00 pm

Friday . . . . 7:30 am to 11:00 am

Exhibition Hours

Exhibition Halls 1-2

Tuesday . . . . 10:00 am to 5:00 pm

Wednesday . . . . 10:00 am to 4:00 pm

Poster Reception

Exhibition Hall 3

Monday . . . . 5:30 to 8:00 pm
(Conf. 6152, 6153)

Thursday . . . . 5:30 to 8:00 pm
(Conf. 6151, 6154, 6155, 6156)

Conference attendees are invited to the poster sessions and receptions. Authors of poster papers will be on hand during these sessions to answer questions and provide in-depth discussion concerning their posters. Attendees and authors are required to wear their conference registration badges to the poster sessions.

Authors can set up their posters after 9:00 am on the day of their poster session. Poster supplies (Push-pins) will be available. Other supplies can be obtained from the Presenter Check-in Desk. Poster can be previewed during the day before the formal poster sessions begin at 5:30 pm.

Authors must remove their posters at the conclusion of the poster reception for that day. It is the authors' responsibility to remove their posters. Posters 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.

Speaker Check-In Room

San Jose Convention Center, "Room D"

Sunday . . . . 1:00 pm to 6:00 pm

Monday through Thursday . . . . 7:30 am to 5:00 pm

Friday . . . . 7:30 am to 12:30 pm

Oral Presentations for Microlitography 2006

SPIE will provide computers in all Microlithography 2006 conference rooms. Authors are required to check in at the Speakers Presentation Room, "Room D" San Jose Convention Center, by 5pm of the day prior to presentation to submit oral presentations and confirm compatibility. Oral presentations are best presented in PowerPoint or Adobe Acrobat PDF formats. Presentations can be accepted on pen drive, CD-Rom, or directly from your laptop.

Audio/Video/Digital Recording Policy

Due to copyright restrictions, strictly no recordings of any kind are permitted without prior written consent of the presenter in any conference session, short course or posters. Consent forms are available at the SPIE Audiovisual Desk and anyone wishing to record must have a written consent form signed and filed for each presenter being recorded. Individuals not complying with this policy will be asked to leave a given session and to surrender their film or disc.

In the Exhibition Hall: For security and courtesy reasons, photographing or videotaping individual booths and displays in the exhibit hall is allowed ONLY with explicit permission from on-site company representatives. Individuals not complying with this policy will be asked to surrender their film and to leave the exhibition hall.

Message Center

San Jose Convention Center, located near registration

Messages will be taken during registration hours Sunday through Thursday by calling: 408-271-6200. Attendees should check the message boards at the message center on a daily basis to receive their messages.

SPIE Marketplace

Open during registration hours, Sunday through Thursday. SPIE publishes a variety of technical books designed to meet diverse research, reference, and educational needs. Proceedings of SPIE technical conferences from this and related meetings may be purchased at the Marketplace. Also available are related books from SPIE Press and professional development courses on CD-ROM and video.

Many of the services of this symposium are made possible by the generous support of sponsors, listed on page 5.

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The on-site Media Center provides press conference facilities, refreshments, and convenient one-stop-shopping for press releases. Credentialed media are invited to communicate news via the provided phone, and modem hook-up. Registration and exhibition fees are waived for media representatives.

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Recruiting Services
Bring copies of your open positions to Microlithography and post them on the boards provided for this purpose. While at the meeting you will also be able to review any resumes posted by meeting attendees; look for the notebook located near the job posting boards. If you're searching for highly skilled candidates for hard-to-fill positions this is a great place to start.

If you don't find the candidates you need, SPIEWorks, the SPIE employment website can help you target a skilled group of optics and photonics professionals after the meeting. Contact Robert Dentel at +1 360 715 3705 or email sales@spieworks.com

Membership in SPIE is not required to post jobs.

Employment Opportunities
Bring a copy of your resume to Microlithography and look for the notebook located near the job posting boards; place your resume inside this book for review by interested employers. Plan to stop by these same job boards throughout the meeting and review current employment opportunities.

In addition to our onsite posting boards, SPIEWorks, the SPIE employment website, offers you an online job database, resume posting, and email notification services year round. Visit www.spieworks.com

Course Materials Desk

Located in the registration area.

Open during registration hours.

If you have registered to attend a short course, please stop by the Course Materials Desk to pick up your course notes and to find out where the class will be located. You may also get a copy of the latest Education Services catalog to see the many courses SPIE has available at symposia, on video and CD-ROM, and to discover the opportunities of customized In-Company courses.

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Coffee Breaks

Coffee will be served during the morning and afternoon break. Please check the individual technical conference listings for exact times.

Monday . . . . 10:30 to 11:00 am; 3:00 to 4:00 pm
Convention Center, East End Main Lobby

Tuesday - Wednesday . . . . 10:00 to 11:00 am; 3:00 to 4:00 pm
Convention Center, Exhibition Halls 1-2

Thursday . . . . 10:00 to 11:00 am; 3:00 to 4:00 pm
Convention Center, East End Main Lobby

Friday . . . . 10:00 to 11:00 am
Convention Center, East End Main Lobby

Breakfast Breads

Breakfast breads and coffee will be served from 7:30 to 8:30 am Monday through Friday for Symposium attendees in the San Jose McEnery Convention Center, Main Lobby.

Desserts

Desserts will be served in the exhibition halls on Tuesday and Wednesday, 3:00 to 4:00 pm.

Quicklunch Coupon

Full conference registrants will receive a lunch coupon redeemable towards a luncheon purchased Tuesday and Wednesday at designated areas in the Exhibition Hall. Coupons will be accepted from 11:30 pm to 1:30 pm both days. Some restrictions apply; please refer to the coupons in your registration packet.

Exhibition Concession Stands

For those whose registration plan does not include the lunch coupons, or for obtaining food and beverage at other than lunch times, concession stands located in the halls will be open during exhibition hours. They will serve hot and cold snacks, beverages, deli-style sandwiches, salads, a few hot entrees, and pastries.

Internet Access

Convention Center - East End Concourse

Sunday - Thursday during registration hours

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

SPIE Copy Center

Sunday through Thursday during registration hours SPIE will provide a copy service during the week for symposium attendees. The rates are 5 cents/copy and $1 per transparency. Located near registration in Exhibit Hall 2.

High Speed Internet at Downtown Hotels

Fairmont Hotel - High speed or wireless - in-room $13.95 per 24 hours; also available in lobby same rate.

San Jose Marriott - High speed In-room $6.95 discount rate per 24 hours, includes access to wireless high speed in public areas of the hotel, excluding meeting and function rooms.

Hilton San Jose & Towers - High Speed Internet in rooms @ $4.95 for 1 hour, $9.95 per day, $21.95 for 3 days, $42.95 for 7 days. WIFI is available in the City Bar & Grill, Business Center and parts of the lobby, but NOT IN ROOMS

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While attending the meeting, stop b the SPIE Marketplace to try out the new SPIE Digital Library. The SPIE Digital Library contains 175.000 full-text papers from SPIE Journals and Proceedings published since 1990. It also includes citations and abstracts for most SPIE papers published since 1995.
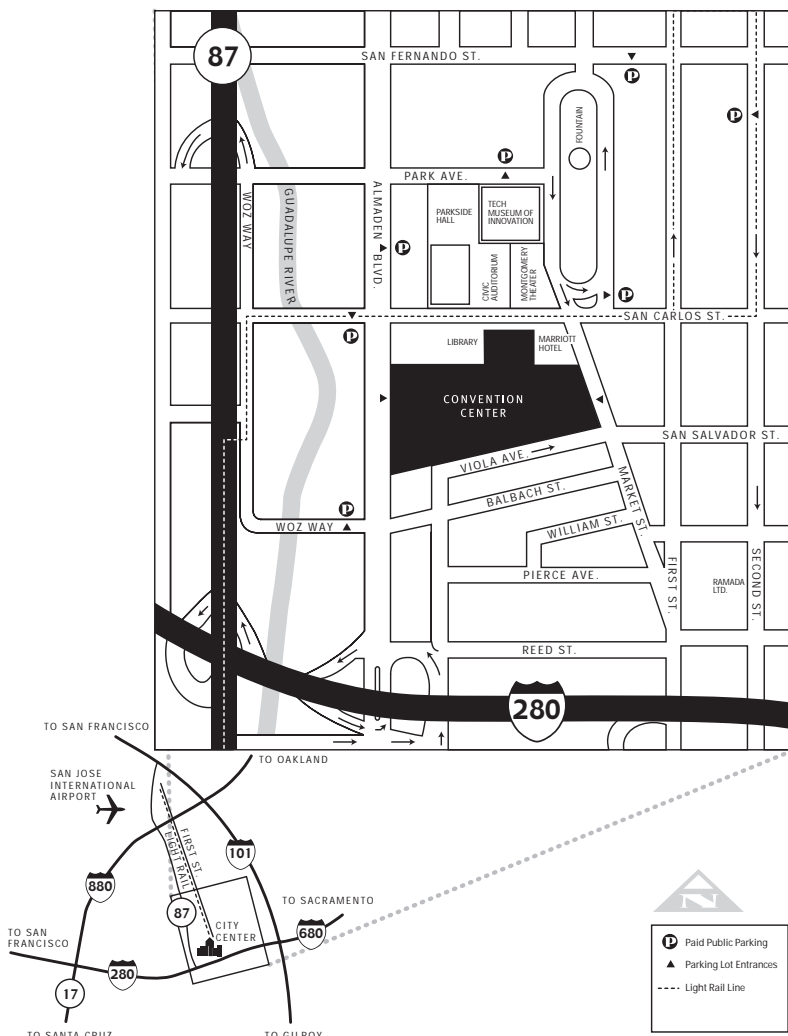
Sightseeing/Restaurants

The San Jose Convention and Visitors Bureau will be operating an Information Desk on the street level of the Convention Center near the main entrance. They will be open during core hours of the convention and will be able to help attendees with lodging, sightseeing, shopping, and restaurant arrangements. Many fine restaurants are located in the downtown business district of San Jose in the vicinity of the Convention Center and adjacent to the light rail system.

Child Care

A few child sitting services available in San Jose are as follows.

1. Bay Area 2nd MOM Inc., Hotel Nanny Service, Toll Free Phone: 1-888-926-3666, or (650) 858-2469, ext. 109. Fax: (650) 493-6598, Email: oncall@2ndmom.com or parentcounselor@2ndmom.com, Website: www.2ndmom.com

2. Sitters Unlimited: Toll Free Phone: (408) 452-0225, E-mail: rfosorio@peoplepc.com or www.sittersunlimited.com

Note: SPIE does not imply an endorsement or recommendation of these services. They are provided on an "information-only" basis for your further analysis and decision. Other services may be available.

Car Rental

Hertz Car Rental has been selected as the official car rental agency for this Symposium. To reserve a car, identify yourself as a Microlithography Conference attendee using the Hertz Meeting Code CV# 029B0009.

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Tuesday-Thursday 21-23 February 2006 • Proceedings of SPIE Vol. 6151

Emerging Lithographic Technologies X

Conference Chair: **Michael J. Lercel**, SEMATECH, Inc. and IBM Corp.

Cochair: **Franklin M. Schellenberg**, Mentor Graphics Corp.

Program Committee: **David T. Attwood, Jr.**, Lawrence Berkeley National Lab. and Univ. of California/Berkeley; **Vivek Bakshi**, SEMATECH, Inc.; **Michael Goldstein**, Intel Corp.; **Timothy Groves**, Leica Microsystems Lithography GmbH (Germany); **Woo-Sung Han**, SAMSUNG Electronics Co., Ltd. (South Korea); **Hiroichi Kawahira**, Sony Corp. (Japan); **Bruno M. La Fontaine**, Advanced Micro Devices, Inc.; **J. A. Liddle**, Lawrence Berkeley National Lab.; **Hans Loeschner**, IMS Nanofabrication GmbH (Austria); **R. Scott Mackay**, Photronics, Inc.; **Pawitter J. Mangat**, Motorola, Inc.; **Christie R. K. Marrian**, IBM Almaden Research Ctr.; **Anthony E. Novembre**, Lucent Technologies; **Laurent Pain**, CEA-LETI (France); **Kazuaki Suzuki**, Nikon Corp. (Japan)

Tuesday 21 February

Opening Remarks

Conv. Ctr. A4 . . . . **Tues. 8:00 to 8:10 am**
Chair: **Michael J. Lercel**, IBM Microelectronics Div.

SESSION 1

Conv. Ctr. A4 . . . . **Tues. 8:10 to 10:10 am**
Keynote Session
Chair: **Franklin M. Schellenberg**, Mentor Graphics Corp.

Keynote Presentations

8:10 am: **A year in the life of immersion lithography at Albany Nanotech** *(Invited Paper)*, M. D. Tittnich, Albany NanoTech . [6151-01]

8:50 am: **Block copolymers: a potential resist platform for the 45-nm node and beyond** *(Invited Paper)*, P. F. Nealey, J. J. de Pablo, Univ. of Wisconsin/Madison . . . . [6151-02]

9:30 am: **To mask or not to mask?** *(Invited Paper)*, R. S. Mackay, Photronics, Inc. . . . . [6151-03]

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

SESSION 2

Conv. Ctr. A4 . . . . **Tues. 10:40 am to 12:20 pm**
EUV Systems I
Chair: **Michael Goldstein**, Intel Corp.

10:40 am: **EUV pellicle development for mask defect control,** Y. A. Shroff, M. Goldstein, B. J. Rice, S. H. Lee, D. L. Williams, Intel Corp. . . . . [6151-04]

11:00 am: **Nikon EUVL development progress summary,** T. Miura, K. Murakami, T. Asami, K. Suzuki, Y. Kohama, K. Hada, Y. Ohkubo, M. Miyazaki, Nikon Corp. (Japan) . . . . [6151-05]

11:20 am: **Schwarzschild-objective-based EUV micro-exposure tool,** U. D. Zeitner, T. Feigl, T. Benkenstein, C. Damm, T. Peschel, N. Kaiser, Fraunhofer-Institut für Angewandte Optik und Feinmechanik (Germany) . . . . [6151-06]

11:40 am: **Evaluation of LER in the patterns replicated by the EUV micro-exposure tool HiNA-3,** Y. Kikuchi, Association of Super-Advanced Electronics Technologies (Japan) . . . . [6151-07]

12:00 pm: **First performance results of the ASML alpha demo tool,** H. Meiling, H. Meijer, ASML Netherlands B.V. (Netherlands); P. Kürz, Carl Zeiss SMT AG (Germany); N. Harned, ASML Wilton . . . . [6151-08]

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

SESSION 3

Conv. Ctr. A4 . . . . **Tues. 1:50 to 3:30 pm**
Advanced Mask I
Chair: **Bruno M. La Fontaine**, Advanced Micro Devices, Inc.

1:50 pm: **EUVL mask blanks: recent results on substrates, multilayers, and the dry-etch process of TaN-absorbers,** H. Seitz, SCHOTT Lithotec AG (Germany) . . . . [6151-09]

2:10 pm: **Demonstration of phase-shift masks for extreme-ultraviolet lithography,** B. M. La Fontaine, A. R. Pawloski, O. R. Wood II, Advanced Micro Devices, Inc.; Y. Deng, KLA-Tencor Corp.; H. J. Levinson, Advanced Micro Devices, Inc.; P. E. Denham, E. M. Gullikson, B. Hoef, Lawrence Berkeley National Lab.; P. P. Naulleau, SUNY/Univ. at Albany; C. Holfeld, C. M. Chovino, Advanced Mask Technology Ctr. (Germany); F. Letzkus, Institut für Mikroelektronik Stuttgart (Germany) . . . . [6151-10]

2:30 pm: **RIM-13: a high-resolution imaging tool for aerial image monitoring of patterned and blank EUV reticles,** M. C. Gower, M. Booth, A. N. Brunton, J. S. Cashmore, P. Elbourn, G. Elliner, J. Greuters, J. Hirsch, L. Kling, N. McEntee, P. Richards, V. Truffert, I. Wallhead, M. D. Whitfield, Exitech Ltd. (United Kingdom) . . . . [6151-11]

2:50 pm: **EUV mask and chuck analysis: simulation and experimentation,** M. Nataraju, J. Sohn, A. R. Mikkelson, R. Engelstad, E. G. Lovell, Univ. of Wisconsin/Madison; C. K. Van Peski, SEMATECH, Inc. . . . . [6151-12]

3:10 pm: **Modeling methodologies and defect printability maps for buried defects in EUV mask blanks,** M. C. Lam, A. R. Neureuther, Univ. of California/Berkeley . . . . [6151-13]

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

Courses of Related Interest

Register for Courses onsite!

SC100 **Introduction to Electron-Beam Lithography** (McCord) - Sunday, 8:30 am to 12:30 pm

SC101 **Introduction to Microlithography: Theory, Materials, and Processing** (Willson, Bowden, Thompson) - Sunday, 8:30 am to 5:30 pm

SC622 **Nano-Scale Patterning with Imprint Lithography** (Sreenivasan, Willson, Resnick) - Sunday, 6:00 pm to 10:00 pm

Sessions 4 and 5 run concurrently.

SESSION 4

Conv. Ctr. A4 . . . . **Tues. 4:00 to 5:40 pm**
EUV Optics
Chair: **Patrick P. Naulleau**, SUNY/Univ. at Albany

4:00 pm: **Visible light point-diffraction interferometer for testing of EUVL optics**, S. Takeuchi, O. Kakuchi, K. Yamazoe, Y. Gomei, Canon Inc. (Japan); T. A. Decker, M. A. Johnson, D. W. Phillion, J. S. Taylor, Lawrence Livermore National Lab. . . . .[6151-14]

4:20 pm: **EUV testing of multilayer mirrors: critical issues**, S. B. Hill, C. Tarrio, S. E. Grantham, T. B. Lucatorto, National Institute of Standards and Technology; T. Madey, Rutgers Univ.; I. Ermanoski, National Institute of Standards and Technology; S. Bajt, Lawrence Livermore National Lab.; M. Chandhok, P. Yan, Intel Corp.; O. R. Wood II, S. Wurm, N. V. Edwards, SEMATECH, Inc. . . . .[6151-15]

4:40 pm: **Model of Ru-surface oxidation for the lifetime scaling of EUVL projection optics mirror**, I. Nishiyama, Association of Super-Advanced Electronics Technologies (Japan) . . . .[6151-16]

5:00 pm: **Improvement in lifetime of projection mirrors used for EUVL tool by irradiation in hydrocarbon atmosphere**, Y. Kakutani, M. Niibe, Univ. of Hyogo (Japan); H. Takase, S. Terashima, Y. Gomei, S. Matsunari, T. Aoki, K. Murakami, Y. Fukuda, Extreme Ultraviolet Lithography System Development Association (Japan) . . . .[6151-17]

5:20 pm: **Characterization of the Carl Zeiss alpha-tool optics with high-accuracy reflectometry at PTB**, F. Scholze, C. Laubis, C. Buchholz, A. Fischer, S. Plöger, F. Scholz, H. Wagner, G. Ulm, Physikalisch-Technische Bundesanstalt (Germany); S. Müllender, H. Enkisch, M. Wedowski, Carl Zeiss SMT AG (Germany) . . . .[6151-18]

SESSION 5

Conv. Ctr. C1 . . . . **Tues. 4:00 to 5:40 pm**
Nano-Imprint Lithography I
Chair: **R. Scott Mackay**, Photronics, Inc.

4:00 pm: **Multi-level step and flash imprint lithography for direct patterning of dielectrics**, F. L. Palmieri, The Univ. of Texas at Austin; M. D. Stewart, Molecular Imprints, Inc.; J. T. Wetzel, ATDF Inc.; J. Hao, Y. Nishimura, K. Jen, The Univ. of Texas at Austin; C. Flannery, National Institute of Standards and Technology; B. Li, H. Chao, S. Young, W. C. Kim, P. S. Ho, C. G. Willson, The Univ. of Texas at Austin . . . . . .[6151-19]

4:20 pm: **Metrology comparison of imprinted raised and recessed features with UV-nanoimprint lithography**, H. Luesebrink, T. Glinsner, EV Group (Austria); J. Beauvais, A. G. Zanzal, D. Drouin, E. LavallÈe, K. M. Lau, M. Cloutier, Quantiscript Inc. (Canada) . . . .[6151-20]

4:40 pm: **Imprintable polymers for photonic crystals**, J. C. Taylor, Hewlett-Packard Co. and The Univ. of Texas at Austin; T. Hostetler, P. Kornilovich, K. M. Kramer, Hewlett-Packard Co. . . . .[6151-21]

5:00 pm: **Defect inspection for imprint lithography using a die-to-database electron-beam verification system**, L. J. Myron, E. Thompson, W. Usry, I. McMackin, D. J. Resnick, Molecular Imprints, Inc.; T. Kitamura, T. Hasebe, S. Nakazawa, T. Tokumoto, NanoGeometry Research Inc. (Japan) . . . .[6151-22]

5:20 pm: **Characterizing nano-imprint pattern cross section and fidelity from x-ray reflectivity**, H. Lee, H. W. Ro, C. L. Soles, National Institute of Standards and Technology; D. Hines, Univ. of Maryland/College Park; R. L. Jones, A. Karim, E. K. Lin, W. Wu, National Institute of Standards and Technology . . . .[6151-23]

Wednesday 22 February

SESSION 6

Conv. Ctr. A4 . . . .**Wed. 8:00 to 10:00 am**
EUV Source I
Chair: **David T. Attwood, Jr.**, Univ. of California/Berkeley

8:00 am: **Development status of EUV sources for use in Beta-tools and high-volume chip manufacturing tools,** U. Stamm, J. Kleinschmidt, C. Ziener, G. Schriever, M. C. Schürmann, G. Hergenhan, XTREME technologies GmbH (Germany) . . . .[6151-24]

8:20 am: **A novel high-brightness electrodeless Z-pinch EUV source,** S. F. Horne, M. M. Besen, D. K. Smith, R. D'Agostino, P. A. Blackborow, Energetiq Technology, Inc. . . . .[6151-28]

8:40 am: **Status of Philips' extreme-UV source,** J. Pankert, G. Derra, P. Zink, Philips GmbH (Germany) . . . .[6151-25]

9:00 am: **LPP EUV source development,** D. Myers, I. V. Fomenkov, B. A. M. Hansson, A. Ershov, N. Bowering, W. Partlo, D. Brandt, Cymer, Inc. . . . .[6151-26]

9:20 am: **Development of CO_2 laser produced Xe plasma EUV light source for microlithography,** H. Mizoguchi, A. Endo, T. Ariga, T. Miura, H. Hoshino, Y. Ueno, M. Nakano, H. Komori, A. Sumitani, T. Abe, T. Suganuma, G. Soumagne, H. Someya, Y. Takabayashi, K. Toyoda, Extreme Ultraviolet Lithography System Development Association (Japan)[6151-27]

9:40 am: **Design and optimization of collectors for extreme-ultraviolet lithography,** F. E. Zocchi, V. Rigato, E. Buratti, Media Lario SRL (Italy) . . . .[6151-29]

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

SESSION 7

Conv. Ctr. A4 . . . . **Wed. 10:30 am to 12:10 pm**
EUV Systems II
Chair: **Woo-Sung Han**, SAMSUNG Electronics Co., Ltd. (South Korea)

10:30 am: **Defect printability study using EUV lithography,** C. Holfeld, K. Bubke, Advanced Mask Technology Ctr. (Germany); B. M. LaFontaine, A. R. Pawlowski, Advanced Micro Devices, Inc.; S. N. Schwarzl, F. Kamm, Infineon Technologies AG (Germany) . . . .[6151-30]

10:50 am: **EUV lithography simulation for the 32-nm node,** E. Kim, Hanyang Univ. (South Korea); S. Kim, SAMSUNG Advanced Institute of Technology (South Korea); J. Park, W. Chang, H. Oh, Hanyang Univ. (South Korea) . . . .[6151-31]

11:10 am: **Simulation analysis of printability of scratch and bump defects in EUV lithography,** M. Sugawara, I. Nishiyama, Association of Super-Advanced Electronics Technologies (Japan) . . . .[6151-32]

11:30 am: **EUV imaging with a 13-nm tabletop laser reaches sub-50-nm spatial resolution,** G. O. Vaschenko, F. Brizuela, C. A. Brewer, M. A. Larotonda, Y. Wang, B. M. Luther, M. C. Marconi, C. S. Menoni, J. J. Rocca, Colorado State Univ.; W. Chao, E. H. Anderson, Y. Liu, D. T. Attwood, Jr., Lawrence Berkeley National Lab. . . . .[6151-33]

11:50 am: **Investigation of the current resolution limits of advanced EUV resists,** P. P. Naulleau, SUNY/Univ. at Albany; J. P. Cain, Advanced Micro Devices, Inc.; K. R. Dean, SEMATECH, Inc.; P. Deanham, K. A. Goldberg, B. Hoef, Lawrence Berkeley National Lab.; B. M. LaFontaine, A. R. Pawloski, Advanced Micro Devices, Inc.; C. E. Larson, G. M. Wallraff, IBM Almaden Research Ctr. . . . .[6151-34]

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

SESSION 8

Conv. Ctr. A4 . . . . **Wed. 1:40 to 3:00 pm**
Maskless
Chairs: **Hans Loeschner**, IMS Nanofabrication GmbH (Austria);
Laurent Pain, CEA-LETI (France)

1:40 pm: **Technology mapping technique for throughput enhancement of character projection equipment,** M. Sugihara, T. Takata, K. Nakamura, Kyushu Univ. (Japan); R. Inanami, e-BEAM Corp. (Japan); H. Hayashi, Tokyo Electron Ltd. (Japan); K. Kishimoto, e-BEAM Corp. (Japan); T. Hasebe, Tokyo Electron Ltd. (Japan); Y. Kawano, e-BEAM Corp. (Japan); Y. Matsunaga, K. Murakami, Kyushu Univ. (Japan); K. Okumura, The Univ. of Tokyo (Japan) . . . .[6151-36]

2:00 pm: **Complementary dose and geometrical solutions for EBDW proximity effects correction: application for sub-45-nm nodes product manufacturing,** S. Manakli, S. Soonekindt, STMicroelectronics (France); J. Todeschini, Philips Semiconductors (France); B. Icard, CEA-LETI (France); S. Leseuil, Philips Semiconductors (France); B. Minghetti, STMicroelectronics (France); L. Pain, CEA-LETI (France) . . . . . .[6151-37]

2:20 pm: **Optical-maskless lithography for flexible high-resolution patterning,** R. Menon, LumArray Inc.; D. Chao, A. Patel, Massachusetts Institute of Technology; M. E. Walsh, H. I. Smith, LumArray Inc. .[6151-38]

2:40 pm: **High-sensitivity interferometric schemes for ML2 micromirror calibrations,** J. Wang, O. Solgaard, Stanford Univ.; A. R. Neureuther, Univ. of California/Berkeley . . . .[6151-39]

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

SESSION 9

Conv. Ctr. A4 . . . . **Wed. 3:30 to 5:30 pm**
Nano-Imprint Lithography II
Chairs: **Pawitter J. Mangat**, Motorola, Inc.; **J. A. A. Liddle**, Lawrence Berkeley National Lab.

3:30 pm: **Multi-scale modeling of nano-imprint lithography,** D. A. Mendels, National Physical Lab. (United Kingdom) . . . .[6151-40]

3:50 pm: **Increasing effective resolution through surface conditioners for 1x imprint templates and photomask applications beyond 65 nm,** K. S. Selinidis, J. G. Maltabes, Photronics, Inc.; M. B. Rao, P. Zhang, Air Products and Chemicals, Inc. . . . .[6151-41]

4:10 pm: **NIL template manufacturing using a variable shaped beam e-beam writer and a new pCAR,** M. Irmscher, F. Letzkus, J. Butschke, C. Koepernik, H. Sailer, A. M. Schwersenz, Institut für Mikroelektronik Stuttgart (Germany); G. Hess, M. Renno, SCHOTT Lithotec AG (Germany); E. Thompson, Molecular Imprints, Inc.; H. Schulz, Carl Zeiss SMT AG (Germany) . . . .[6151-42]

4:30 pm: **The role of stresses in nano-imprint lithography,** C. L. Soles, H. W. Ro, H. Lee, R. L. Jones, A. Karim, E. K. Lin, National Institute of Standards and Technology; W. Hu, S. Pang, Univ. of Michigan . .[6151-43]

4:50 pm: **Release layer for nano-imprint lithography,** T. Zhang, Applied MicroStructures Inc. . . . .[6151-44]

5:10 pm: **A new imprint process designed for patterning non-flat substrates,** M. P. Watts, M. L. Miller, N. Stacey, J. Choi, M. Subramanian, S. V. Sreenivasan, Molecular Imprints, Inc. . . . .[6151-45]

Thursday 23 February

SESSION 10

Conv. Ctr. A4 . . . . **Thurs. 8:00 to 10:00 am**
Advanced Mask II
Chairs: **Emily E. Gallagher**, IBM Corp.; **Timothy R. Groves**, Leica Microsystems Lithography GmbH (Germany)

8:00 am: **Phase defect observation using an EUV microscope,** K. Hamamoto, Y. Tanaka, Univ. of Hyogo (Japan); N. Hosokawa, Nitto Thin Film Labs. Co., Ltd. (Japan); N. Sakaya, M. Hosoya, T. Shoki, HOYA Corp. (Japan); T. Watanabe, H. Kinoshita, Univ. of Hyogo (Japan) . . . . .[6151-46]

8:20 am: **Novel low-thermal expansion material for EUV application,** M. Kawata, A. Takada, H. Hayashi, N. Sugimoto, S. Kikugawa, Asahi Glass Co., Ltd. (Japan) . . . .[6151-47]

8:40 am: **Plasma-assisted electrostatic cleaning of nanoparticles from EUV masks,** W. M. Lytle, M. J. Neumann, D. A. Alman, D. N. Ruzic, Univ. of Illinois at Urbana-Champaign . . . .[6151-48]

9:00 am: **Defect inspection of EUV mask blank using confocal microscopy: simulation and experiment,** S. Kim, J. Park, J. Kang, S. Lee, S. Woo, H. Cho, J. Moon, SAMSUNG Electronics Co., Ltd. (South Korea) . . . .[6151-49]

9:20 am: **Evaluation of FIB and e-beam repairs for implementation on step and flash imprint lithography templates,** S. R. Young, W. J. Dauksher, K. J. Nordquist, E. S. Ainley, K. A. Gehoski, Motorola, Inc.; A. A. Graupera, M. H. Moriarty, FEI Co. . . . .[6151-50]

9:40 am: **Building 1x NIL templates: challenges and requirements,** T. DiBiase, KLA-Tencor Corp. . . . .[6151-51]

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

SESSION 11

Conv. Ctr. A4 . . . . **Thurs. 10:30 am to 12:10 pm**
Electron-Projection Lithography
Chair: **Kazuaki Suzuki**, Nikon Corp. (Japan)

10:30 am: **Resolution improvement of EPL stencil mask using thin membrane,** H. Sugimura, M. Norimoto, Y. Negishi, I. Yonekura, H. Eguchi, K. Ito, A. Tamura, Toppan Printing Co., Ltd. (Japan); H. Arimoto, F. Koba, Semiconductor Leading Edge Technologies, Inc. (Japan) . . . . . .[6151-52]

10:50 am: **Advanced image placement performance for the current EPL masks,** H. Eguchi, T. Susa, Toppan Printing Co., Ltd. (Japan); K. Koike, Semiconductor Leading Edge Technologies, Inc. (Japan); S. M. Kunitani, T. Kurosu, T. Yoshii, K. Ogawa, H. Sugimura, K. Ito, A. Tamura, Toppan Printing Co., Ltd. (Japan); H. Sakaue, H. Arimoto, Semiconductor Leading Edge Technologies, Inc. (Japan) . . . .[6151-53]

11:10 am: **Current status of EPL reticle performance,** H. Arimoto, K. Koike, H. Sakaue, N. M. Iriki, Semiconductor Leading Edge Technologies, Inc. (Japan); H. Sugimura, H. Eguchi, T. Susa, M. Norimoto, K. Ito, A. Tamura, Toppan Printing Co., Ltd. (Japan) . . . .[6151-54]

11:30 am: **Mix-and-match overlay performance of EPL exposure tool,** H. Sakaue, K. Koike, H. Arimoto, Semiconductor Leading Edge Technologies, Inc. (Japan) . . . .[6151-55]

11:50 am: **Assessment of EPL mask membrane image placement accuracy due to fabrication processes,** M. Boruszewski, R. L. Engelstad, E. G. Lovell, G. A. Dicks, Univ. of Wisconsin/Madison; H. Sakaue, H. Arimoto, Semiconductor Leading Edge Technologies, Inc. (Japan) . . . .[6151-56]

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

SESSION 12

Conv. Ctr. A4 . . . . **Thurs. 1:40 to 3:00 pm**
Novel Lithography

Chairs: **Franklin M. Schellenberg**, Mentor Graphics Corp.; **Christie R. K. Marrian**, IBM Almaden Research Ctr.

1:40 pm: **Nucleic-acid-based self-assembly of nanostructures,** C. S. Ozkan, X. Wang, Univ. of California/Riverside . . . . [6151-57]

2:00 pm: **Development of potential materials from functionalized carbon nanotubes,** S. A. Gurusamy-Thangavelu, O. F. Yilmaz, K. V. Singh, C. Tsai, Y. Zhang, C. S. Ozkan, M. Ozkan, Univ. of California/ Riverside . . . . [6151-58]

2:20 pm: **The use of PNA for the assembly of SWNTs,** M. Ozkan, Univ. of California/Riverside . . . . [6151-59]

2:40 pm: **Micro/nano lithography realized by chemical printing,** P. Yao, G. J. Schneider, J. A. Murakowski, D. W. Prather, Univ. of Delaware . [6151-60]

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

SESSION 13

Conv. Ctr. A4 . . . . **Thurs. 3:30 to 5:30 pm**
EUV Source II

Chairs: **Vivek Bakshi**, SEMATECH, Inc.; **Akira Endo**, Extreme Ultraviolet Lithography System Development Association (Japan)

3:30 pm: **Cost-effective laser-plasma sources for EUVL,** M. Richardson, C. Koay, S. George, K. Takenoshita, R. Bernath, T. Schmid, M. Al-Rabban, College of Optics and Photonics/Univ. of Central Florida; V. Bakshi, SEMATECH, Inc. . . . . [6151-61]

3:50 pm: **EUV generation using a droplet of a suspension including tin as a target of a high-efficiency LPP source for high-volume prediction,** T. Tomie, H. Yashiro, S. Sarjono, I. Matsushima, National Institute of Advanced Industrial Science and Technology (Japan) . . . . [6151-62]

4:10 pm: **Progress in LPP EUV source development at Osaka University,** N. Miyanaga, Osaka Univ. (Japan) . . . . [6151-63]

4:30 pm: **Modeling and optimization of debris mitigation systems for laser and discharge-produced plasma in EUV lithography devices,** V. A. Sizyuk, A. Hassanein, Z. Insepov, T. S. Sizyuk, Argonne National Lab.; V. Bakshi, SEMATECH, Inc. . . . . [6151-64]

4:50 pm: **Next steps for tin EUV-source optics development,** D. N. Ruzic, M. J. Neumann, H. Qiu, M. A. Jaworski, K. C. Thompson, J. B. Spencer, H. J. Shin, E. L. Antonsen, D. A. Alman, B. E. Jurczyk, Univ. of Illinois at Urbana-Champaign; R. L. Bristol, Intel Corp. . . . . [6151-65]

5:10 pm: **Compact source and beam delivery system for EUV radiation,** K. R. Mann, F. Barkusky, A. Bayer, C. Peth, H. Toettger, Laser-Lab. Göttingen e.V. (Germany) . . . . [6151-66]

✔ Posters-Thursday

The following posters will be displayed all day Thursday. Authors will be present during the formal poster session Thursday evening between 5:30 and 8:00 pm in the Convention Center, Hall 3. Authors may set-up their posters between 9:00 am and 5:00 pm on Thursday.

Advanced Mask

✔ **Characterization of CCD sensor for actinic mask blank inspection,** Y. Tezuka, T. Tanaka, T. Terasawa, Association of Super-Advanced Electronics Technologies (Japan); T. Tomie, National Institute of Advanced Industrial Science and Technology (Japan) . . . . [6151-67]

✔ **Performance and quality analysis of Mo/Si multilayers formed by ion-beam and magnetron sputtering methods,** K. Hiruma, Y. Tanaka, S. Miyagaki, J. Cullins, I. Nishiyama, Association of Super-Advanced Electronics Technologies (Japan) . . . . [6151-68]

✔ **Phase-shift mask for EUV lithography,** C. Constancias, J. Robic, E. Quesnel, CEA-LETI (France) . . . . [6151-69]

✔ **Impact of multi-layer deposition method on defects for EUVL photomask blanks,** J. Cullins, K. Motai, I. Nishiyama, Association of Super-Advanced Electronics Technologies (Japan) . . . . [6151-70]

✔ **Combined absorber stack for optimization of the EUVL mask,** T. Kim, S. Y. Lee, W. S. Kim, C. Kim, I. Kang, Y. Chung, J. Ahn, Hanyang Univ. (South Korea) . . . . [6151-71]

✔ **High-precision (<1ppb/°C) optical heterodyne interferometric dilatometer for determining absolute CTE of EUVL materials,** Y. Takeichi, I. Nishiyama, Association of Super-Advanced Electronics Technologies (Japan); N. Yamada, National Institute of Advanced Industrial Science and Technology (Japan) . . . . [6151-72]

✔ **Actinic EUVL mask blank defect inspection by EUV photoelectron microscopy,** U. Kleineberg, J. Lin, U. Neuhaeusler, J. Slieh, U. Heinzmann, Univ. Bielefeld (Germany); N. Weber, M. Escher, M. Merkel, FOCUS GmbH (Germany); A. Oelsner, D. Valsaitsev, G. Schoenhense, Johannes Gutenberg Univ. Mainz (Germany) . . . . [6151-73]

✔ **Numerical modeling of absorber characteristics for EUVL,** I. Kang, J. Ahn, H. Oh, Y. Chung, Hanyang Univ. (South Korea) . . . . . [6151-74]

✔ **Characterization of striae in ULE® for EUVL optics and masks,** W. R. Rosch, L. Beall, J. E. Maxon, R. Sabia, R. D. Sell, Corning Inc. . . . . [6151-75]

✔ **Striae evaluation of TiO₂-SiO₂ ultra-low expansion glasses using the line-focus-beam ultrasonic material characterization system,** M. Arakawa, J. Kushibiki, Y. Ohashi, Tohoku Univ. (Japan) . . . . . [6151-76]

✔ **Three-dimensional rigorous simulation of EUV defective masks using modal method by Fourier expansion,** R. Smaali, M. Besacier, P. Schiavone, CEA Grenoble (France) . . . . [6151-77]

✔ **Potential materials and formulation for the pellicle of the EUV masks,** J. P. Stehle, SOPRA SA (France) . . . . [6151-78]

Electron-Projection Lithography

✔ **Data conversion system for character projection-type low-energy electron-beam direct writing system,** R. Inanami, K. Kishimoto, e-BEAM Corp. (Japan); K. Nakai, Dainippon Screen Manufacturing Co., Ltd. (Japan); Y. Ichioka, e-BEAM Corp. (Japan); K. Kitamura, R. Yamada, Dainippon Screen Manufacturing Co., Ltd. (Japan); S. Magoshi, Toshiba Corp. (Japan) . . . . [6151-79]

✔ **Tri-layer resists process for fabricating 45-nm L&S patterns by EPL,** F. Koba, K. Matsumaro, E. Soda, T. Watanabe, Y. Matsubara, H. Arimoto, Semiconductor Leading Edge Technologies, Inc. (Japan); T. Matsumiya, D. Kawana, N. Yamashita, Y. Fujii, K. Ohmori, M. Sato, Tokyo Ohka Kogyo Co., Ltd. (Japan); T. Kozawa, S. Tagawa, Osaka Univ. (Japan) . . . . [6151-80]

✔ **New proximity effect correction for under 100-nm patterns,** M. Shoji, N. Horiuchi, T. Chikanaga, T. Niinuma, D. Tzunoda, Nippon Control System Corp. (Japan) . . . . [6151-81]

✔ **Model-based lithography verification system for multilayer structure in electron-beam direct writing,** K. Ogino, H. Hoshino, Y. Machida, Fujitsu Ltd. (Japan) . . . . [6151-82]

Maskless Lithography

✔ **A character projection-type low-energy electron-beam direct writing system for devices of small production lot with a variety of design,** F. Nakamura, K. Watanabe, H. Kinoshita, H. Shinozaki, Y. Kojima, S. Morita, K. Noguchi, N. Yamaguchi, H. Isokawa, K. Kushitani, e-BEAM Corp. (Japan); T. Koshiba, T. Oota, T. Nakasugi, Toshiba Corp. (Japan) . . . . [6151-35]

✔ **C4 compression for maskless lithography: fast segmentation algorithms and hardware realization of the decoder,** V. Dai, H. Liu, A. Zakhor, B. Nikolic, Univ. of California/Berkeley . . . . [6151-84]

✔ **Effects on low-voltage electron-beam lithography,** M. Bolorizadeh, D. C. Joy, The Univ. of Tennessee . . . . [6151-85]

✔ **Wafer scan induced image blur and line-edge roughness in maskless lithography,** Y. Chen, Micron Technology, Inc.; Y. A. Shroff, Intel Corp. . . . . [6151-86]

✔ **Enhancing the performance of rasterization algorithms for optical maskless lithography,** J. D. Hintersteiner, E. Stone, W. Cebuhar, R. Albright, ASML Wilton; N. K. Eib, LSI Logic Corp.; A. M. Latypov, KLA-Tencor Corp.; S. K. Poultney, N. Baba-Ali, Formerly employed by ASML Wilton; E. H. Croffie, Formerly employed by LSI Logic Corp. . [6151-87]

Conference 6151

Nano-Imprint Lithography

✔ **Organic-inorganic hybrid materials for nano-imprint lithography,** J. Katayama, S. Yamaki, M. Hanabata, Kansai Research Institute, Inc. (Japan) . . . .[6151-88]

✔ **Planarization materials for reverse-tone step and flash imprint lithography,** M. W. Lin, W. C. Kim, E. K. Kim, M. D. Dickey, H. Chao, F. L. Palmieri, P. S. Ho, C. G. Willson, The Univ. of Texas at Austin[6151-89]

✔ **Study of nano-imprint for sub-100-nm patterning by using SU-8 resist,** A. Sekiguchi, Y. Kono, Lithotech Japan Corp. (Japan); S. Mori, N. Honda, Nippon Kayaku Co., Ltd. (Japan); Y. Hirai, Osaka Prefecture Univ. (Japan) . . . .[6151-90]

✔ **Nano-imprint lithography using laser irradiation: analysis of changes of the shape of periodical structures,** S. Tamulevicius, V. Grigaliunas, D. Jucius, V. Ostasevicius, A. Palevicius, G. Janusas, Kauno Technologijos Univ. (Lithuania) . . . .[6151-91]

✔ **UV nano-imprint lithography using a diamond-like carbon stamp,** J. Jeong, K. Kim, Y. Sim, D. Choi, E. Lee, Korea Institute of Machinery and Materials (South Korea); S. Park, T. Lim, D. Yang, Korea Advanced Institute of Science and Technology (South Korea) . . . .[6151-92]

✔ **Imprint technology: a potential low-cost solution for sub-45-nm device applications,** N. V. Le, K. A. Gehoski, W. J. Dauksher, K. J. Nordquist, P. J. Mangat, E. S. Ainley, Motorola, Inc. . . . .[6151-93]

✔ **Nano-imprint of sub-100-nm dots and lines feature on 8-inch wafer: influence of layout design,** S. Landis, CEA-LETI (France) . . .[6151-94]

✔ **Full-field overlay in mix-and-match step and flash imprint lithography,** P. Schumaker, T. Rafferty, J. Choi, I. McMackin, Molecular Imprints, Inc.; T. Dibiasi, KLA-Tencor Corp.; S. V. Sreenivasan, Molecular Imprints, Inc. . . . .[6151-153]

✔ **CHARPAN (Charged Particle Nanotech) for sub-50-nm mask and template fabrication,** E. Platzgummer, S. Cernusca, IMS Nanofabrication GmbH (Austria); A. Biedermann, Univ. Wien (Austria); H. Loeschner, IMS Nanofabrication GmbH (Austria) . . . .[6151-154]

EUV Systems

✔ **Ultimate fine-pitch resist patterning using the ASET-HINA,** H. Oizumi, Y. Tanaka, F. Kumasaka, I. Nishiyama, Association of Super-Advanced Electronics Technologies (Japan) . . . .[6151-95]

✔ **Sub-32-nm patterning using the EUV in ASET,** D. Goo, Y. Tanaka, Y. Kikuchi, H. Oizumi, F. Kumasaka, I. Nishiyama, Association of Super-Advanced Electronics Technologies (Japan) . . . .[6151-96]

✔ **Printability of contact-hole patterns in EUVL using 0.3-NA HiNA optics,** Y. Tanaka, H. Oizumi, Y. Kikuchi, D. Goo, F. Kumasaka, I. Nishiyama, Association of Super-Advanced Electronics Technologies (Japan) . . . .[6151-97]

✔ **Direct comparison of printing results and aerial-image modeling for the extreme-ultraviolet microfield exposure tool at SEMATECH North,** P. P. Naulleau, SUNY/Univ. at Albany; K. R. Dean, K. W. Lowack, SEMATECH, Inc. . . . .[6151-98]

✔ **The EUV Resist Test Center at Sematech-North,** K. W. Lowack, K. R. Dean, A. C. Rudack, M. Malloy, SEMATECH, Inc. . . . .[6151-99]

✔ **Process window study with various partial coherences on EUV MET (Micro Exposure Tool) optics,** S. H. Lee, C. Brewer, M. Chandhok, Intel Corp. . . . .[6151-100]

✔ **Accuracy evaluation of the wavefront metrology tool for EUVL projection optics,** K. Otaki, K. Sugisaki, O. Masashi, Y. Zhu, Z. Liu, J. Saito, K. Murakami, C. Ouchi, S. Kato, M. Hasegawa, T. Hasegawa, A. Suzuki, H. Yokota, Extreme Ultraviolet Lithography System Development Association (Japan); M. Niibe, Univ. of Hyogo (Japan) . . . . . .[6151-101]

✔ **Advanced at-wavelength reflectometry with the EUV tube,** A. Egbert, S. Becker, B. N. Chichkov, Phoenix EUV Systems & Services GmbH (Germany) . . . .[6151-102]

✔ **Scaling EUVL litho-roadmap,** M. Chandhok, Intel Corp. . . .[6151-103]

✔ **Lithographic characterization of low-order aberrations in 0.3-NA EUV tools,** P. P. Naulleau, SUNY/Univ. at Albany; J. P. Cain, Advanced Micro Devices, Inc.; K. R. Dean, SEMATECH, Inc.; K. A. Goldberg, Lawrence Berkeley National Lab. . . . .[6151-104]

✔ **Performance characterization of the imaging EUV optical systems for the Reticle Imaging Microscope (RIM),** H. Glatzel, J. Daniel, K. Khajehnouri, W. Mueller, T. Roff, J. Rosenbohm, S. Sporer, N. Wang, Tinsley Labs.; R. Hudyma, Hyperion Development LLC . . . .[6151-157]

EUV Optics

✔ **The effect of charged-particle bombardment on collector mirror reflectivity in lithography devices,** J. P. Allain, A. Hassanein, M. D. Nieto, V. Titov, P. Plotkin, M. Hendricks, Argonne National Lab.; C. Chrobak, Univ. of Wisconsin/Madison; E. Hinson, Argonne National Lab.; M. van der Velden, Technische Univ. Eindhoven (Netherlands); B. J. Rice, Intel Corp. . . . .[6151-105]

✔ **Active cleaning for lithium-coated optics for HVM EUV systems,** M. J. Neumann, E. Ritz, R. DeFreese, H. Qiu, D. A. Alman, B. E. Jurczyk, D. N. Ruzic, Univ. of Illinois at Urbana-Champaign; O. V. Khodykin, A. I. Ershov, Cymer, Inc.; R. L. Bristol, Intel Corp. . . . .[6151-106]

✔ **Halide etching for tin EUV optics cleaning,** H. J. Shin, D. A. Alman, M. R. Hendricks, W. M. Lytle, B. E. Jurczyk, D. N. Ruzic, Univ. of Illinois at Urbana-Champaign; R. L. Bristol, Intel Corp. . . . .[6151-107]

✔ **A new contamination experimental equipment in the NewSUBARU and evaluation of Si-capped multilayer mirrors using it,** M. Niibe, Univ. of Hyogo (Japan) . . . .[6151-108]

✔ **Study of ruthenium-capped multilayer mirror for EUV irradiation durability,** H. Takase, S. Terashima, Y. Gomei, M. Tanabe, Y. Watanabe, T. Aoki, S. Matsunari, K. Murakami, Extreme Ultraviolet Lithography System Development Association (Japan); M. Niibe, Y. Kakutani, Univ. of Hyogo (Japan) . . . .[6151-109]

✔ **Table-top EUV reflectometer,** U. Hinze, B. N. Chichkov, Laser Zentrum Hannover e.V. (Germany) . . . .[6151-110]

✔ **Polarization dependence of multilayer reflectance in the EUV spectral range,** F. Scholze, C. Laubis, C. Buchholz, A. Fischer, S. Plöger, F. D. Scholz, H. Wagner, G. Ulm, Physikalisch-Technische Bundesanstalt (Germany) . . . .[6151-111]

✔ **Interface-engineered multilayer mirrors,** S. A. Yulin, N. Benoit, T. Feigl, N. Kaiser, Fraunhofer-Institut für Angewandte Optik und Feinmechanik (Germany) . . . .[6151-112]

✔ **Multilayer optics with spectral purity layers for the EUV wavelength range,** R. W. van de Kruijs, A. E. Yakshin, FOM-Institute for Plasma Physics Rijnhuizen (Netherlands); M. M. van Herpen, D. J. Klunder, Philips Research Labs. (Netherlands); E. Louis, S. A. van der Westen, FOM-Institute for Plasma Physics Rijnhuizen (Netherlands); H. Enkisch, S. Müllender, Carl Zeiss SMT AG (Germany); B. L. Bakker, Philips Research Labs. (Netherlands); V. Y. Banine, ASML Netherlands B.V. (Netherlands); F. Bijkerk, FOM-Institute for Plasma Physics Rijnhuizen (Netherlands) . . . .[6151-155]

✔ **EUVL wide-range spectrometer for in & out of band spectroscopy,** V. P. Shevelko, P.N. Lebedev Physical Institute (Russia); L. V. Knight, Brigham Young Univ. . . . .[6151-156]

Nanotech

✔ **Sub-100-nm trackwidth development by e-beam lithography for advanced magnetic recording heads,** C. Chen, J. Chang, Headway Technologies, Inc. . . . .[6151-114]

✔ **Fabrication of organic nano-particles by PRINT: master generation using lithographic and RIE techniques,** A. A. Pandya, B. W. Maynor, S. E. Gratton, The Univ. of North Carolina at Chapel Hill; D. G. Yu, C. M. Osburn, North Carolina State Univ.; J. M. DeSimone, The Univ. of North Carolina at Chapel Hill . . . .[6151-115]

✔ **Proximity lithography membrane mask aeroelasticity,** D. R. Huston, D. Burns, Univ. of Vermont; B. E. Boerger, R. A. Selzer, JMAR Technologies, Inc. . . . .[6151-116]

✔ **Electron-beam lithography for high-aspect-ratio trench in thick resist: experimental and simulation,** X. Yang, J. Zhou, S. Xiao, Seagate Technology LLC . . . .[6151-118]

✔ **Soft lithography using perfluorinated polyether molds and PRINT technology for fabrication of electrically active Aarrays and nanowires,** K. B. Wiles, K. Herlihy, B. W. Maynor, N. S. Wiles, The Univ. of North Carolina at Chapel Hill; J. P. Rolland, Liquidia Technologies; J. M. DeSimone, The Univ. of North Carolina at Chapel Hill . . . [6151-119]

✔ **Development of photocurable pillar arrays formed via electrohydrodynamic instabilities,** P. C. Tsiartas, M. D. Dickey, K. E. Allrich, C. G. Willson, The Univ. of Texas at Austin . . . .[6151-120]

✔ **Nano-patterning with high-transmission nano-size metal apertures,** J. W. Hahn, S. Park, E. M. Lee, Yonsei Univ. (South Korea) . . [6151-121]

✔ **Micro-stereo-lithography system,** T. Yoshimoto, H. Yaze, I. Miyaki, Laser Solutions Co., Ltd. (Japan) . . . .[6151-122]

✔ **Integrated simulation of line-edge roughness (LER) effects on sub-65-nm transistor operation: from lithography simulation, to LER metrology, to device operation,** G. P. Patsis, N. Tsikrikas, V. Constantoudis, E. Gogolides, Institute of Microelectronics (Greece) . . . .[6151-123]

✔ **Directed self-assembly and metallization of virus-based hybrid nanostructures,** C. Tsai, C. S. Ozkan, Univ. of California/Riverside . . . .[6151-124]

✔ **Using phase-mask algorithms to direct self assembly,** F. M. Schellenberg, J. A. Torres, Mentor Graphics Corp. . . . .[6151-125]

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✔ **High-power pulsed CO$_2$ laser for EUV lithography,** T. Ariga, H. Hoshino, T. Miura, A. Endo, Extreme Ultraviolet Lithography System Development Association (Japan) . . . .[6151-126]

✔ **Investigation of a novel discharge EUV source for microlithography,** B. S. Bauer III, V. Makhin, S. Fuelling, I. R. Lindemuth, K. Carvalho, Univ. of Nevada/Reno . . . .[6151-127]

✔ **Optical exposure characterization and comparisons for tin EUV systems,** H. Qiu, K. C. Thompson, E. L. Antonsen, D. A. Alman, B. E. Jurczyk, D. N. Ruzic, Univ. of Illinois at Urbana-Champaign; N. V. Edwards, S. Wurm, O. R. Wood II, SEMATECH, Inc.; R. L. Bristol, Intel Corp. . . . .[6151-128]

✔ **Debris characterization and mitigation from tin DPP EUV sources,** K. C. Thompson, M. A. Jaworski, E. L. Antonsen, B. E. Jurczyk, D. N. Ruzic, Univ. of Illinois at Urbana-Champaign; R. L. Bristol, Intel Corp. . . . .[6151-129]

✔ **Three-dimensional integrated simulation and optimization of laser-produced plasma for EUV lithography devices,** A. Hassanein, V. A. Sizyuk, V. A. Morozov, T. S. Sizyuk, Argonne National Lab.; B. J. Rice, Intel Corp. . . . .[6151-130]

✔ **EUV source collector,** N. R. Bowering, A. I. Ershov, W. F. Marx, O. V. Khodykin, D. W. Myers, I. V. Fomenkov, D. C. Brandt, Cymer, Inc. . . . .[6151-131]

✔ **EUV source developments on laser-produced plasmas using cryogenic Xe and Lithium new scheme target,** S. Miyamoto, S. Amano, T. Inoue, P. E. Nica, A. Shimoura, K. Kaku, T. Mochizuki, Univ. of Hyogo (Japan) . . . .[6151-132]

✔ **KrF laser-driven Xenon plasma light source of a small-field exposure tool,** G. Soumagne, T. Abe, Extreme Ultraviolet Lithography System Development Association (Japan); Y. Itakura, M. Moriya, Komatsu Ltd. (Japan); H. Someya, T. Suganuma, Extreme Ultraviolet Lithography System Development Association (Japan); T. Watanabe, A. Sumitani, Komatsu Ltd. (Japan); A. Endo, H. Mizoguchi, Extreme Ultraviolet Lithography System Development Association (Japan) . . . .[6151-133]

✔ **Studies on cryogenic Xe capillary jet target for laser-produced plasma EUV-light source,** T. Inoue, P. E. Nica, K. Kaku, A. Shimoura, S. Amano, S. Miyamoto, T. Mochizuki, Univ. of Hyogo (Japan) . [6151-134]

✔ **Energy spectra and charge state of debris emitted from laser-produced minimum mass tin plasmas,** S. Fujioka, H. Nishimura, H. Sakaguchi, Osaka Univ. (Japan); S. Namba, Hiroshima Univ. (Japan); T. Aota, N. Ueda, T. Ando, M. Murakami, K. Nishihara, Y. Kang, A. Sunahara, H. Furukawa, Y. Yasuda, K. Nagai, T. Norimatsu, Y. Izawa, N. Miyanaga, K. Miyanaga, Osaka Univ. (Japan) . . . .[6151-135]

✔ **Analysis of the emission spectrum of Xe and Sn,** A. Sasaki, Japan Atomic Energy Research Institute (Japan); K. Nishihara, Osaka Univ. (Japan); F. Koike, Kitasato Univ. (Japan); T. Kagawa, Nara Women's Univ. (Japan); T. Nishikawa, Okayama Univ. (Japan); A. Sunahara, Osaka Univ. (Japan); H. Tanuma, Tokyo Metropolitan Univ. (Japan) . . . . .[6151-136]

✔ **High-power low-cost drive laser for LPP source,** I. V. Fomenkov, W. N. Partlo, A. Bykanov, C. L. Rettig, J. R. Hoffman, K. Bruzzone, D. W. Myers, D. C. Brandt, Cymer, Inc. . . . .[6151-137]

✔ **Optimization of EUV/SXR plasma radiation source characteristics,** J. J. MacFarlane, P. Wang, I. E. Golovkin, P. R. Woodruff, Prism Computational Sciences, Inc. . . . .[6151-138]

✔ **Preparation of a SnO$_2$ suspension as a target for a high-CE plasma,** H. Yashiro, S. Sarjono, I. Matsushima, T. Tomie, National Institute of Advanced Industrial Science and Technology (Japan) . . . . . .[6151-139]

✔ **Debris mitigation for high-NA laser plasma EUVL sources,** T. Schmid, K. Takenoshita, C. Koay, S. George, S. Teerawattansook, M. Richardson, College of Optics and Photonics/Univ. of Central Florida . . . .[6151-140]

✔ **Out-of-band radiation from tin droplet laser plasma EUV source,** S. George, C. Koay, K. Takenoshita, R. Bernath, G. Shimkaveg, M. Richardson, M. Al-Rabban, College of Optics and Photonics/Univ. of Central Florida; V. Bakshi, SEMATECH, Inc. . . . .[6151-141]

✔ **Ion flux and collector mirror erosion study for microscopic laser-plasma tin-doped droplet EUV sources,** K. Takenoshita, C. Koay, S. George, T. Schmid, S. Teerawattansook, M. Richardson, College of Optics and Photonics/Univ. of Central Florida . . . .[6151-142]

✔ **EUV generation from lithium laser plasma for lithography,** M. Al-Rabban, S. George, G. Shimkaveg, W. Silfvast, C. Koay, K. Takenoshita, R. Bernath, M. Richardson, College of Optics and Photonics/Univ. of Central Florida; H. Scott, Lawrence Livermore National Lab. [6151-143]

✔ **Factors affecting the conversion efficiency of tin laser plasma 13.5-nm source,** C. Koay, S. A. George, K. Takenoshita, M. Richardson, M. M. Al-Rabban, College of Optics and Photonics/Univ. of Central Florida; V. Bakshi, SEMATECH, Inc. . . . .[6151-144]

✔ **Enhancement of conversion efficiency of extreme-ultraviolet radiation from a liquid aqueous solution microjet target by use of dual-laser pulses,** T. Higashiguchi, Univ. of Miyazaki (Japan) [6151-146]

✔ **Study of the dynamic evolution and spectral properties of multi-component plasmas for SXR and EUV production,** J. B. Spencer, D. N. Ruzic, Univ. of Illinois at Urbana-Champaign; J. J. MacFarlane, Prism Computational Sciences, Inc.; D. A. Alman, E. L. Antonsen, Univ. of Illinois at Urbana-Champaign . . . .[6151-147]

✔ **Development of Xe- and Sn-fueled high-power Z-pinch EUV source aiming at HVM,** Y. Teramoto, G. Niimi, D. Yamatani, Y. Joshima, K. Bessho, T. Shirai, T. Takemura, T. Yokota, H. Yabuta, K. C. Paul, K. Kabuki, K. Miyauchi, M. Ikeuchi, K. Hotta, M. Yoshioka, H. Sato, Extreme Ultraviolet Lithography System Development Association (Japan) . . . .[6151-148]

✔ **Development of high-repetition rate and high-power DPP EUV source,** G. Niimi, Y. Teramoto, H. Sato, K. Bessho, T. Shirai, D. Yamatani, Y. Joshima, Extreme Ultraviolet Lithography System Development Association (Japan); T. Takemura, H. Yabuta, T. Yokota, K. C. Paul, K. Kabuki, K. Miyauchi, Ushio Inc. (Japan); K. Hotta, Extreme Ultraviolet Lithography System Development Association (Japan); M. Yoshioka, Ushio Inc. (Japan); K. Toyoda, Extreme Ultraviolet Lithography System Development Association (Japan) . . . .[6151-149]

✔ **Debris mitigation using magnetic field in LPP EUV source,** Y. Kang, Osaka Univ. (Japan) . . . .[6151-151]

✔ **High-temperature LPP collector mirror,** T. Feigl, S. A. Yulin, N. Benoit, N. Kaiser, Fraunhofer-Institut für Angewandte Optik und Feinmechanik (Germany); N. R. Bowering, A. I. Ershov, J. Viatella, K. Bruzzone, I. V. Fomenkov, D. W. Myers, Cymer, Inc. . . . .[6151-152]

Monday-Thursday 20-23 February 2006 • Proceedings of SPIE Vol. 6152

Metrology, Inspection, and Process Control for Microlithography XX

Conference Chair: **Chas N. Archie**, IBM Corp.

Cochair: **John A. Allgair**, SEMATECH, Inc. and Freescale Semiconductors, Inc.

Program Committee: **Michael J. Anderson**, Rohm and Haas Electronic Materials; **Alain G. Deleporte**, STMicroelectronics (France); **Daniel J. Herr**, Semiconductor Research Corp.; **David C. Joy**, The Univ. of Tennessee and Oak Ridge National Lab.; **Brian Martin**, X-FAB UK Ltd. (United Kingdom); **Moitreyee Mukherjee-Roy**, Grace Semiconductor Manufacturing Corp. (China); **Christopher J. Raymond**, Accent Optical Technologies; **Martha I. Sanchez**, IBM Almaden Research Ctr.; **Richard M. Silver**, National Institute of Standards and Technology; **Bhanwar Singh**, Advanced Micro Devices, Inc.; **Michael W. Stan**, Rohm and Haas Electronic Materials; **Alexander Starikov**, Intel Corp.; **Neal T. Sullivan**, Soluris, Inc.; **Brian M. Trafas**, KLA-Tencor Corp.

Monday 20 February

Opening Remarks
Conv. Ctr. A2 . . . . **Mon. 11:00 am to 11:20 pm**
Chair: **Chas N. Archie**, IBM Corp.

Metrology, Inspection, and Process Control for Microlithography
2005 Best Paper Announcement and Presentation

SESSION 1
Conv. Ctr. A2 . . . . **Mon. 11:20 am to 12:00 pm**
Keynote Session
Chair: **Chas N. Archie**, IBM Corp.

Keynote Presentation

11:20 am: **Design-driven metrology: a new paradigm for DFM-enabled process characterization and control; extensibility and limitations** (*Invited Paper*)**,** L. Capodieci, Advanced Micro Devices, Inc. . . . . [6152-01]

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

SESSION 2
Conv. Ctr. A2 . . . .**Mon. 1:30 to 3:10 pm**
Process Development: OPC Model Calibration and Sources of Variation
Chairs: **Richard M. Silver**, National Institute of Standards and Technology; **Daniel J. Herr**, Semiconductor Research Corp.

1:30 pm: **Model-based calculation of weighting in OPC model calibration,** M. Talbi, A. Y. Abdo, J. M. Oberschmidt, R. Viswanathan, D. Fischer, G. Han, S. M. Mansfield, IBM Microelectronics Div. . . . .[6152-02]

1:50 pm: **Exploring CD-SEM charged wafer mapping capabilities to determine root cause,** E. P. Solecky, G. Vakas, C. Archie, IBM Corp.; O. Adan, A. Dajczman, Applied Materials (Israel); R. S. Cornell, Applied Materials; N. Wertsman, Applied Materials (Israel) . . . .[6152-03]

2:10 pm: **Local CD variation and STI remaining topography characterization in 65-nm node with PSM processes,** Y. Gu, S. Chang, G. Zhang, K. Kirmse, D. Rogers, L. Olsen, Texas Instruments Inc.[6152-04]

2:30 pm: **Global pattern density effects on low-k trench CDs for sub-65-nm technology nodes,** J. Hsu, Taiwan Semiconductor Manufacturing Co., Ltd. (Taiwan) . . . .[6152-05]

2:50 pm: **Latent image CD measurements by optic CD metrology to distinguish the contribution of development,** C. Wu, United Microelectronics Corp. (Taiwan) . . . .[6152-06]

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

SESSION 3
Conv. Ctr. A2 . . . .**Mon. 3:30 to 5:20 pm**
Defect I: Yield and Contact Printing
Chairs: **Neal T. Sullivan**, Soluris Inc.; **Brian M. Trafas**, KLA-Tencor Corp.

3:30 pm: **Defect metrology challenges at 45-nm node and beyond** (*Invited Paper*)**,** D. Patel, J. E. Hanrahan, K. Lim, M. Godwin, P. C. Figliozzi, D. Sheu, International SEMATECH Manufacturing Initiative . . . . .[6152-07]

4:00 pm: **Yield enhancement methodologies for 90-nm technology and beyond,** J. A. Allgair, T. Carey, Freescale Semiconductor, Inc.; J. Dougan, Semiconductor 300 (Germany); T. Etnyre, N. Langdon, B. Murray, Freescale Semiconductor, Inc. . . . .[6152-08]

4:20 pm: **Toward full-chip prediction of yield-limiting contact patterning failure: correlation of simulated image parameters to advanced contact metrology metrics,** J. L. Sturtevant, D. Chou, Mentor Graphics Corp. . . . .[6152-09]

4:40 pm: **A systematic study of missing via mechanism and its solutions,** L. Wang, W. Huang, Q. Wu, Shanghai Hua Hong NEC Electronics Co. (China) . . . .[6152-10]

5:00 pm: **Advanced DFM applications using design-based metrology on CD SEM,** G. F. Lorusso, KLA-Tencor Corp.; L. Capodieci, C. E. Tabery, K. B. Shah, B. Singh, S. Roling, B. Schulz, Advanced Micro Devices, Inc.; Z. Kaliblotzky, G. Abbott, D. Stoler, A. R. Azordegan, E. D. Castel, KLA-Tencor Corp. . . . .[6152-194]

✔ Posters-Monday
Chair: **Christopher J. Raymond**, Accent Optical Technologies

The following posters will be displayed all day Monday. Authors will be present during the formal poster session Monday evening between 5:30 and 8:00 pm in the Convention Center, Hall 3 for discussion. Authors may set up their posters between 9:00 am and 5:00 pm on Monday.

✔ **Correlation of scatterometry sensitivities to variation in device parameters,** C. Ko, Y. Ku, Industrial Technology Research Institute (Taiwan); N. P. Smith, Accent Optical Technology, Ltd. (Taiwan) [6152-55]

✔ **Integrated aerial image sensor (AIS): modeling and assembly,** J. Xue, C. J. Spanos, Univ. of California/Berkeley . . . .[6152-61]

✔ **Improvement of alignment and overlay accuracy on amorphous carbon layers,** Y. Hwang, E. Kang, K. Lee, K. Ban, C. Lim, H. Kim, S. Moon, Hynix Semiconductor Inc. (South Korea) . . . .[6152-73]

✔ **nDSE-based overlay alignment: enabling technology for nano metrology and fabrication,** J. Gao, C. E. Picciotto, W. Wu, Hewlett-Packard Co.; I. Park, Hewlett-Packard Co. and Univ. of California/Berkeley; W. M. Tong, Hewlett-Packard Co. . . . .[6152-74]

✔ **Long-range nanopositioning and nanomeasuring machine for application to micro- and nanotechnology,** G. Jäger, T. Hausotte, H. Büchner, E. Manske, I. Schmidt, R. Mastylo, Technische Univ. Ilmenau (Germany) . . . .[6152-75]

✔ **Use in-line AFM to monitor STI profile in 65-nm technology development,** M. Hsieh, J. Yeh, M. Tsai, K. Wang, United Microelectronics Corp. (Taiwan); C. Chen, Veeco Taiwan Inc. (Taiwan) . . . .[6152-124]

✔ **Diffraction signature analysis methods for improving scatterometry precision,** M. E. Littau, C. J. Raymond, D. L. Forman, Accent Optical Technologies . . . .[6152-125]

✔ **Integrated projection optics tester for onboard inspection of immersion ArF scanner,** T. Fujii, K. Suzuki, Y. Mizuno, N. Kita, Nikon Corp. (Japan) . . . .[6152-126]

✔ **Integrated electrostatic micro-sensors for the development of modeling techniques of defects in the actuation of large micro-electromechanical systems,** T. Reissman, E. Garcia, N. Lobontiu, Cornell Univ.; Y. Nam, Kangwon National Univ. (South Korea) [6152-127]

✔ **Macro CD contact ellipticity measurements for lens uniformity qualification,** O. Adan, Applied Materials (Israel); H. A. J. Cramer, G. Janssen, E. van Setten, ASML Netherlands B.V. (Netherlands); N. Wertsman, R. Kris, Applied Materials (Israel) . . . .[6152-128]

✔ **Overlay improvement: local and dynamic shot distortion control by new framework of GCM,** A. Sukegawa, S. Wakamoto, S. Nakajima, M. Kawakubo, N. Magome, Nikon Corp. (Japan) . . . .[6152-129]

✔ **Optimization of an integrated and automated macro inspection system for the utilization of wafer-color variation detection in a photolithography cluster,** S. J. Lickteig, T. Forstner, T. Barnett, D. Dixon, Tokyo Electron America, Inc.; V. C. Menon, M. C. Nicholls, IBM Corp.; R. L. Isaacson, IBM Microelectronics Div. . . . .[6152-130]

✔ **Optical measurements of critical dimensions at several stages of the mask fabrication process,** J. C. Lam, A. S. Gray, P. J. Walsh, n&k Technology, Inc. . . . .[6152-131]

✔ **Aerial image sensor: on-line scanner aberration monitor,** J. K. Tyminski, Nikon Precision Inc.; T. Hagiwara, N. Kondo, Nikon Corp. (Japan) . . . .[6152-132]

✔ **Correlation of wafer backside defects to photolithography hot spots using advanced macro inspection,** A. P. Carlson, August Technology Corp.; F. Phellepes, C. Eskridge, Micron Technology, Inc. . . . .[6152-133]

✔ **High-performance imprint lithography and novel metrology methods using multifunctional pefluoropolyethers,** J. P. Rolland, G. M. Denison, J. A. Brewster, Liquidia Technologies; J. M. DeSimone, The Univ. of North Carolina at Chapel Hill . . . .[6152-136]

✔ **How to evaluate your CD-SEM fleet productivity,** R. Peltinov, Applied Materials, Inc. (Israel) . . . .[6152-138]

✔ **An integrated solution for photomask manufacturing, handling and storage at 65 nm and below,** J. Schwitzgebel, G. Xiao, Photronics, Inc.; S. Nozaki, Hitachi High Technologies America, Inc.; A. Darvish, C. Wu, Fortrend Engineering . . . .[6152-139]

✔ **Defining the role of SEM metrology for advanced process control,** A. V. Nikitin, A. Sicignano, D. Y. Yeremin, E. T. Goldburt, Nanometrology LLC . . . .[6152-140]

✔ **Metrology delay-time reduction in lithography via small-lot wafer transport,** V. K. Shah, E. A. Englhardt, H. R. Armer, Applied Materials, Inc. . . . .[6152-141]

✔ **Increased yield and tool life by reduction of DUV photo contamination using 'Parts per Trillion' pure purge gases,** C. Landoni, SAES Getters S.p.A. (Italy) . . . .[6152-142]

✔ **High-throughput contact critical dimension and gray level value measurement,** H. Xiao, Hermes Microvision, Inc. . . . .[6152-143]

✔ **Real-time on-line monitoring of process water for low-concentrations of bacteria,** J. A. Adams, JMAR Technologies, Inc. . . . .[6152-144]

✔ **Mask inspection method using the electron-beam inspection system based on projection electron microscopy,** A. Onishi, I. Nagahama, Y. Yamazaki, Toshiba Corp. (Japan); N. Noji, T. Kaga, K. Terao, Ebara Corp. (Japan) . . . .[6152-146]

✔ **Three-dimensional isolated and periodic grooves measurement simulations for the semiconductor circuits by scatterometry using the FDTD methods and the time shortening calculation method,** H. Shirasaki, Tamagawa Univ. (Japan) . . . .[6152-148]

✔ **Lens-cementing technology used in optical system of DUV wavelength region: selection of optical cement and degradation evaluation by DUV irradiation,** T. Takahashi, S. Saito, T. Okumura, E. Suzuki, T. Kojima, S. Motomiya, H. Suzuki, Topcon Corp. (Japan); K. Machida, Lasertec Corp. (Japan); T. Tojo, Topcon Corp. (Japan) . . . .[6152-149]

✔ **Swing curve measurement and simulation for high-NA lithography,** J. J. Bauer, U. Haak, K. Schulz, IHP Microelectronics (Germany); G. Old, A. Kraft, Nikon Precision Europe GmbH (Germany) . . . .[6152-150]

✔ **An investigation of the removal of 1-Methyl-2-Pyrrolidinone (NMP),** A. J. Dallas, L. Ding, J. Joriman, B. Hoang, K. Seguin, D. Zastera, Donaldson Co., Inc. . . . .[6152-151]

✔ **Köhler illumination in high-resolution optical metrology,** Y. J. Sohn, R. M. Silver, R. Attota, M. D. Stocker, L. P. Howard, National Institute of Standards and Technology . . . .[6152-152]

✔ **Critical dimension variations of i-line processes due to swing effects,** C. Berger, A. Grandpierre, R. Schiwon, S. Trepte, M. Friedrich, M. Kubis, Infineon Technologies AG (Germany) . . . .[6152-153]

✔ **Detection signal analysis of actinic inspection of EUV mask blanks using dark-field imaging,** T. Tanaka, Y. Tezuka, T. Terasawa, Association of Super-Advanced Electronics Technologies (Japan) . . . .[6152-154]

✔ **Comparison of i-line and DUV high-energy implant litho processes,** C. Berger, A. Grandpierre, Infineon Technologies AG (Germany); P. Schroeder, Infineon Technologies North America; R. Schiwon, M. Kubis, Infineon Technologies AG (Germany) . . . .[6152-155]

✔ **Overlay improvement by nonlinear error correction and nonlinear error control by APC,** D. Choi, A. Jahnke, K. Schumacher, Infineon Technologies AG (Germany); M. J. Hoepfl, Nikon Precision Europe GmbH (Germany) . . . .[6152-156]

✔ **Automated semiconductor circuit pattern evaluation based on tolerance inspection,** T. Mitsui, Y. Yamazaki, Toshiba Corp. (Japan) . . . .[6152-158]

✔ **Superresolving optical microscope by means of two-photon entanglement,** N. Fukutake, Nikon Corp. (Japan) . . . .[6152-159]

✔ **Influence of electron incident angle distribution on CD-SEM linewidth measurements,** M. Tanaka, C. Shishido, Hitachi, Ltd. (Japan); H. Kawada, Hitachi High-Technologies Corp. (Japan)[6152-160]

✔ **Faster root cause analysis with integrated SEM-FIB application in 90-nm fab,** S. K. Wee, Applied Materials South East Asia Pte. Ltd. (Singapore); D. Cheung, Chartered Semiconductor Manufacturing Ltd. (Singapore) . . . .[6152-161]

✔ **Open-loop measurement of data sampling point for SPM,** Y. Wang, X. Zhao, Harbin Institute of Technology (China) . . . .[6152-162]

✔ **Feedback model evaluation of high-mix product manufacturing,** C. Q. Liang, D. King, Grace Semiconductor Manufacturing Corp. (China) . . . .[6152-163]

✔ **Image resolution monitoring technique for CD-SEM tool matching,** M. Oosaki, C. Shishido, Hitachi, Ltd. (Japan); H. Kawada, Hitachi High-Technologies Corp. (Japan) . . . .[6152-164]

✔ **ArF photoresist pattern sample preparation method using FIB without protective coating,** H. Okushima, Y. Kuroda, T. Yaguchi, K. Umemura, R. Tamochi, K. Watanabe, N. Hasegawa, I. Kawata, Hitachi High-Technologies Corp. (Japan); B. Rijpers, ASML Netherlands B.V. (Netherlands) . . . .[6152-165]

✔ **Real-time aerial images based mask inspection, die-to-wafer image inspection,** A. Takada, T. Tojo, Topcon Corp. (Japan) . . . . . .[6152-166]

✔ **Spatial analysis of line-edge roughness through scaling and fractal concepts using AFM techniques,** N. Li, X. Zhao, H. Li, Harbin Institute of Technology (China) . . . .[6152-167]

✔ **Improving scanner productivity and control through innovative connectivity applications,** Y. Ishii, Nikon Corp. (Japan); B. J. Eichelberger, KLA-Tencor Corp. . . . . [6152-168]

✔ **Study of ADI using electron beam,** M. Saito, T. Hayashi, K. Saito, K. Fujihara, Tokyo Electron Ltd. (Japan); J. Lin, Hermes Microvision, Inc. (Taiwan) . . . . [6152-169]

✔ **Leakage monitoring and control with an advanced e-beam inspection system,** K. Wang, J. Yeh, H. Liu, United Microelectronics Corp. (Taiwan); H. Xiao, Hermes Microvision, Inc. . . . . [6152-170]

✔ **High-resistance w-plug monitoring with an advance e-beam system,** K. Wang, J. Yeh, H. Liu, United Microelectronics Corp. (Taiwan); H. Xiao, Hermes Microvision, Inc. . . . . [6152-171]

✔ **The effect of transmission reduction by reticle haze formation,** S. Kim, Y. Kim, J. Park, S. Park, I. An, H. Oh, Hanyang Univ. (South Korea) . . . . [6152-173]

✔ **AIM technology for non-volatile memories microelectronics devices,** P. L. Rigolli, L. Rozzoni, C. Turco, U. Iessi, STMicroelectronics (Italy); Y. Avrahamov, P. Izikson, E. Kassel, KLA-Tencor Corp. (Israel); M. Polli, KLA-Tencor Corp. (Italy) . . . . [6152-175]

✔ **Effect of grating pitch variation on scatterometry measurements,** D. L. Forman, C. J. Raymond, S. G. Hummel, Accent Optical Technologies . . . . [6152-177]

✔ **Satellite spot defect reduction on 193-nm contact hole lithography using photo cell monitor methodology,** C. C. Boulenger, Altis Semiconductor (France) . . . . [6152-180]

✔ **Robust defect detection method using reference image averaging for high-throughput SEM wafer pattern inspection,** H. Okuda, Hitachi Ltd. (Japan) . . . . [6152-181]

✔ **Process-control sensitivity evaluated with precision and CD-variation,** H. Kawada, R. Steffen, Hitachi High-Technologies Corp. (Japan) . . . . [6152-184]

✔ **Error factor of bottom CD measurement of contact-hole using CD-SEM,** H. Abe, Y. Yamazaki, Toshiba Corp. (Japan) . . . . [6152-185]

✔ **A novel approach to characterize trench depth and profile using the 3D tilt capability of a critical dimension-scanning electron microscopy at 65-nm technology mode,** R. Srivastava, P. R. Yelehanka, Chartered Semiconductor Manufacturing Ltd. (Singapore); H. A. Kek, S. L. Ng, Applied Materials South East Asia Pte. Ltd. (Singapore); K. Roman, R. Peltinov, Applied Materials (Israel) [6152-186]

✔ **Landing energy influence on CD-SEM measurement precision and accuracy,** A. Fabre, J. Foucher, Commissariat à l'Energie Atomique (France); M. Poulingue, P. Fabre, G. Sundaram, Soluris Inc. . [6152-187]

✔ **65-nm photolithography process window qualification study with advanced e-beam metrology and inspection systems,** R. H. Hsu, United Microelectronics Corp. (Taiwan) . . . . [6152-188]

✔ **Accurate roughness measurement through SEM noise removal,** R. Kris, D. Chase-Colin, A. Tam, O. Adan, R. Peltinov, R. Katz, Applied Materials (Israel) . . . . [6152-189]

✔ **Low-pressure drop airborne molecular contaminant filtration using open-channel networks,** A. J. Dallas, L. Ding, J. Joriman, D. Zastera, Donaldson Co., Inc. . . . . [6152-190]

✔ **Development of the automated recipe generation system for CD-SEM using CAD design layout,** R. Matsuoka, Hitachi High-Technologies Corp. (Japan); A. Miyamoto, W. Nagatomo, Hitachi, Ltd. (Japan); H. Morokuma, T. Sutani, Hitachi High-Technologies Corp. (Japan) . . . . [6152-191]

✔ **From speculation to specification: a discussion on how to define the tolerance of LER/LWR and its measurement methodology,** A. Yamaguchi, Hitachi, Ltd. (Japan); H. Kawada, T. Iizumi, A. Sugimoto, Hitachi High-Technologies Corp. (Japan) . . . . [6152-192]

✔ **Modeling of linewidth measurement in SEMs using advanced Monte Carlo software,** S. V. Babin, S. Borisov, A. Ivanchikov, I. Ruzavin, Abeam Technologies . . . . [6152-193]

✔ **Application of nano-tips to cold field emission CD-SEM,** A. E. Vladár, R. Zsolt, M. T. Postek, P. P. Kavuri, National Institute of Standards and Technology . . . . [6152-195]

Tuesday 21 February

SESSION 4

Conv. Ctr. A2 . . . . **Tues. 8:00 to 10:10 am**
Process Control I

Chairs: **Alain G. Deleporte**, STMicroelectronics (France); **Christopher J. Raymond**, Accent Optical Technologies

8:00 am: **Litho-metrology challenges for the 45-nm technology node and beyond** *(Invited Paper)*, J. A. Allgair, SEMATECH, Inc. and Freescale Semiconductors, Inc.; M. R. Bishop, B. D. Bunday, P. Lipscomb, International SEMATECH Manufacturing Initiative . . . . [6152-12]

8:30 am: **In-chip optical CD measurements for non-volatile memory devices,** M. Vasconi, STMicroelectronics (Italy); S. Kremer, KLA-Tencor Corp. (France); M. Polli, KLA-Tencor Corp. (Italy); E. Severgnini, S. S. Trovati, STMicroelectronics (Italy) . . . . [6152-13]

8:50 am: **Benchmark comparison of multiple process control strategies for lithographic CD control,** Z. J. Mao, Intel Corp.; W. Kang, Naval Postgraduate School . . . . [6152-14]

9:10 am: **Integrated scatterometry in high-volume manufacturing for polysilicon gate etch control,** M. Sendelbach, A. Munoz, IBM Corp.; K. A. Bandy, IBM Microelectronics Div.; D. J. Prager, Timbre Technologies, Inc.; M. Funk, Tokyo Electron America, Inc. . . . . [6152-15]

9:30 am: **Improved scatterometry method of critical dimension measurements and its application for control of development process,** I. Pundaleva, D. Nam, H. Han, D. Lee, W. Han, SAMSUNG Electronics Co., Ltd. (South Korea) . . . . [6152-16]

9:50 am: **Application of optical CD metrology for recessed Si (Source and Drain) depth measurement,** C. P. Huang, Taiwan Semiconductor Manufacturing Co., Ltd. (Taiwan) . . . . [6152-17]

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

SESSION 5

Conv. Ctr. A2 . . . . **Tues. 10:40 am to 12:20 pm**
Optical Theory, Limits, and Analysis

Chairs: **Christopher J. Raymond**, Accent Optical Technologies; **Michael J. Anderson**, Rohm and Haas Electronic Materials

10:40 am: **Simulations of optical microscope images of line gratings,** T. A. Germer, E. Marx, National Institute of Standards and Technology . . . . [6152-18]

11:00 am: **Scatterfield microscopy using conventional and back focal plane imaging with an engineered illumination field,** H. J. Patrick, R. Attota, T. A. Germer, M. Stocker, R. M. Silver, National Institute of Standards and Technology . . . . [6152-19]

11:20 am: **Optical critical dimension measurement and illumination analysis using through-focus focus metric,** R. Attota, R. M. Silver, National Institute of Standards and Technology; M. R. Bishop, SEMATECH, Inc. . . . . [6152-20]

11:40 am: **Automatic CD-SEM offline recipe creation for OPC qualification and process monitoring in a DRAM pilot-fab environment,** C. Stief, S. Ventola, Applied Materials GmbH (Germany); D. Levitzky, Z. Abraham, O. Menadeva, Applied Materials Israel LTD (Israel); T. Marschner, U. Kramer, D. Kaiser, M. Winking, Infineon Technologies AG (Germany) . . . . [6152-99]

12:00 pm: **Virtual measurements and simulation of interference microscopes,** F. Koerfer, S. Scheermesser, Fraunhofer Institut für Produktionstechnologie (Germany) . . . . [6152-22]

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

Conference 6152

SESSION 6

Conv. Ctr. A2 . . . . **Tues. 1:30 to 3:10 pm**
Standards, Calibration, and Reference Systems

Chairs: **Richard M. Silver**, National Institute of Standards and Technology; **David C. Joy**, The Univ. of Tennessee and Oak Ridge National Lab.

1:30 pm: **CD-SAXS measurements of critical dimension and line-edge roughness of EUVL structures,** R. L. Jones, E. K. Lin, W. Wu, National Institute of Standards and Technology; K. Choi, G. Thompson, B. Rice, Intel Corp. . . . . [6152-23]

1:50 pm: **Progress on implementation of a CD-AFM based reference measurement system,** N. G. Orji, National Institute of Standards and Technology . . . . [6152-24]

2:10 pm: **Traceable AFM dimensional metrology at NIST,** R. G. Dixson, National Institute of Standards and Technology . . . . [6152-25]

2:30 pm: **Accurate in-line CD metrology for semiconductor manufacturing,** B. Perng, J. Shieh, S. Jang, M. Liang, R. Huang, L. Chen, R. Hwang, Taiwan Semiconductor Manufacturing Co., Ltd. (Taiwan); J. Hsu, D. H. Fong, Veeco Instruments Inc. . . . . [6152-26]

2:50 pm: **Carbon-nanotube probes for three-dimensional critical-dimension metrology,** B. C. Park, S. J. Ahn, J. Choi, K. Y. Jung, W. Y. Song, Korea Research Institute of Standards and Science (South Korea) . . . . [6152-84]

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

SESSION 7

Conv. Ctr. A2 . . . . **Tues. 3:40 to 6:00 pm**
CD-SEM I: Improving Capability and LER Metrology

Chairs: **Neal T. Sullivan**, Soluris Inc.; **Bhanwar Singh**, Advanced Micro Devices, Inc.

3:40 pm: **Small feature accuracy challenge for CD-SEM metrology: physical model solution,** B. D. Bunday, J. A. Allgair, International SEMATECH Manufacturing Initiative; R. Kris, D. Chase-Colin, A. Y. Karabekov, A. Tam, O. Adan, Applied Materials (Israel); A. Vilenkin, The Hebrew Univ. of Jerusalem (Israel) . . . . [6152-28]

4:00 pm: **Tools to test CD-SEM performance,** D. C. Joy, J. Kim, K. Jaladhi, S. Deo, The Univ. of Tennessee; S. Lee, Auburn Univ. . . [6152-29]

4:20 pm: **Metrology tool fleet management: a comprehensive discussion of requirements and solutions,** E. P. Solecky, IBM Corp. . . . . [6152-30]

4:40 pm: **CD-AFM versus CD-SEM for resist LER and LWR measurements,** J. Foucher, Commissariat à l'Energie Atomique (France) . . . . [6152-31]

5:00 pm: **Impact of line-edge roughness on device performance,** G. F. Lorusso, KLA-Tencor Corp.; L. H. A. Leunissen, M. Jurczak, IMEC (Belgium); H. Marchman, A. R. Azordegan, KLA-Tencor Corp. . . [6152-32]

5:20 pm: **Macro analysis of line-edge and linewidth roughness,** J. Shin, J. Yoon, Y. Jung, S. Lee, S. Woo, H. Cho, J. Moon, SAMSUNG Electronics Co., Ltd. (South Korea) . . . . [6152-33]

5:40 pm: **Characterization of across-device linewidth variation (ADLV) for 65-nm logic SRAM using CDSEM and line-edge roughness algorithms,** W. Chu, IBM Microelectronics Div.; C. J. Radens, IBM Corp.; I. C. Grauer, IBM Microelectronics Div.; D. J. Samuels, IBM Corp.; R. S. Cornell, Applied Materials . . . . [6152-34]

Wednesday 22 February

SESSION 8

Conv. Ctr. A2 . . . . **Wed. 8:00 to 10:10 am**
Overlay

Chairs: **Michael J. Anderson**, Rohm and Haas Electronic Materials; **Alexander Starikov**, Intel Corp.

8:00 am: **The limits of image-based optical overlay metrology** *(Invited Paper)***,** R. M. Silver, M. D. Stocker, R. Attota, J. J. Jun, National Institute of Standards and Technology; W. P. Lipscomb III, International SEMATECH Manufacturing Initiative . . . . [6152-35]

8:30 am: **Multi-layer overlay metrology,** C. P. Ausschnitt, J. L. Morningstar, W. A. Muth, J. Schneider, R. Yerdon, IBM Microelectronics Div.; L. A. Binns, N. P. Smith, Accent Optical Technologies, Ltd. (United Kingdom) . . . . [6152-36]

8:50 am: **Calibrating optical overlay measurements,** W. P. Lipscomb III, J. A. Allgair, B. D. Bunday, M. R. Bishop, International SEMATECH Manufacturing Initiative; R. M. Silver, R. Attota, M. D. Stocker, National Institute of Standards and Technology . . . . [6152-37]

9:10 am: **Metrology tool fleet management: applying FMP tool matching and monitoring concepts to an overlay fleet,** J. L. Morningstar, C. Archie, E. P. Solecky, IBM Corp. . . . . [6152-38]

9:30 am: **In-field overlay uncertainty contributors: a back end study,** M. E. Adel, A. Frommer, E. Kassel, P. Izikson, KLA-Tencor Corp. (Israel); P. J. Leray, IMEC (Belgium); B. Schulz, Advanced Micro Devices, Inc. (Germany) . . . . [6152-39]

9:50 am: **In-chip overlay metrology,** N. P. Smith, Accent Optical Technologies, Ltd. (Taiwan); Y. Ku, C. Tung, Y. Li, H. Pang, Industrial Technology Research Institute (Taiwan); L. A. Binns, T. C. Rigden, G. Reynolds, H. Fink, Accent Optical Technologies, Ltd. (United Kingdom) . . . . [6152-40]

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

SESSION 9

Conv. Ctr. A2 . . . . **Wed. 10:40 am to 12:20 pm**
Hardware and Technique Development

Chairs: **David C. Joy**, The Univ. of Tennessee and Oak Ridge National Lab.; **Moitreyee Mukherjee-Roy**, Grace Semiconductor Manufacturing Corp. (China)

10:40 am: **Self-interferometric electrical image monitors,** J. A. Holwill, A. R. Neureuther, Univ. of California/Berkeley . . . . [6152-41]

11:00 am: **Three-dimensional metrology with side-wall measurement using tilt-scanning operation in digital probing AFM,** K. Murayama, S. Gonda, H. Koyanagi, T. Terasawa, National Institute of Advanced Industrial Science and Technology (Japan) . . . . [6152-42]

11:20 am: **In-line TEM sample preparation and wafer return strategy for rapid yield learning,** N. N. Bicais-Lepinay, STMicroelectronics (France); D. Verkleij, FEI Co. (Netherlands); F. Andre, P. Guyader, STMicroelectronics (France); R. Schampers, FEI Co.; C. Trouiller, S. Decorne, STMicroelectronics (France); L. F. Kwakman, Philips Semiconductors (France); E. Sicurani, CEA-LETI (France) . . . . . . [6152-81]

11:40 am: **Novel techniques for in-line acquisition of microstructure profiles,** H. M. Marchman, Photronics, Inc. . . . . [6152-44]

12:00 pm: **Comprehensive approach to MuGFET metrology,** G. F. Lorusso, KLA-Tencor Corp.; P. J. Leray, T. Vandeweyer, M. Ercken, C. Delvaux, I. K. Pollentier, S. Y. Cheng, N. Collaert, R. Rooyackers, B. Degroote, M. Jurczak, S. Biesemans, O. Richard, H. Bender, IMEC (Belgium); A. R. Azordegan, KLA-Tencor Corp.; S. S. Shirke, J. Prochazka, T. Long, VLSI Standards, Inc. . . . . [6152-45]

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

SESSION 10

Conv. Ctr. A2 . . . . **Wed. 1:30 to 3:30 pm**
CD-SEM II: Metrology DFM Tools
Chairs: **Alexander Starikov**, Intel Corp.; **Brian Martin**, X-FAB UK Ltd. (United Kingdom)

1:30 pm: **Minimizing CD measurement bias through real-time acquisition of 3D feature shapes,** J. Foucher, Commissariat à l'Energie Atomique (France); D. V. Gorelikov, M. Poulingue, P. Fabre, G. Sundaram, Soluris Inc. . . . .[6152-46]

1:50 pm: **Automated CD-SEM recipe creation: a new paradigm in CD-SEM utilization,** B. D. Bunday, J. A. Allgair, International SEMATECH Manufacturing Initiative; L. R. Page, A. Danilevsky, Hitachi High Technologies America, Inc.; K. Yang, S. Koshihara, H. Morokuma, Hitachi High-Technologies Corp. (Japan) . . . .[6152-47]

2:10 pm: **An objective image quality monitor for CD-SEM,** H. Zhang, Univ. of Utah; C. J. Gould, Infineon Technologies AG . . . .[6152-48]

2:30 pm: **Estimation of pattern shape based on CD-SEM image by using MPPC method,** T. Onozuka, Y. Ojima, Hitachi High-Technologies Corp. (Japan); J. Meessen, B. Rijpers, ASML Netherlands B.V. (Netherlands) . . . .[6152-49]

2:50 pm: **Enabling 32-nm DFM and APC strategies with advanced process metrics,** K. M. Monahan, M. Narasimhan, KLA-Tencor Corp. . . . .[6152-50]

3:10 pm: **Evaluation of OPC quality using automated edge placement error measurement with CD-SEM,** C. E. Tabery, Advanced Micro Devices, Inc.; H. Morokuma, Hitachi High-Technologies Corp. (Japan); L. R. Page, Hitachi High Technologies America, Inc. . . . .[6152-51]

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

SESSION 11

Conv. Ctr. A2 . . . . **Wed. 4:00 to 5:30 pm**
Scatterometry
Chairs: **Alain G. Deleporte**, STMicroelectronics (France); **Brian M. Trafas**, KLA-Tencor Corp.

4:00 pm: **A comprehensive test of optical scatterometry readiness for the 65-nm technology production** *(Invited Paper)*, V. A. Ukraintsev, Texas Instruments Inc. . . . .[6152-52]

4:30 pm: **Decorrelation of fitting parameters by Mueller polarimetry in conical diffraction,** A. De Martino, T. A. Novikova, S. Ben Hatit, B. Drevillon, École Polytechnique (France); D. Cattelan, HORIBA Jobin Yvon Ltd. (France) . . . .[6152-53]

4:50 pm: **Dome scatterometry for the measurement of advanced geometry semiconductor devices,** C. J. Raymond, M. Littau, D. L. Forman, S. G. Hummel, Accent Optical Technologies . . . .[6152-54]

5:10 pm: **Influence of semiconductor manufacturing process variation on device parameter measurement for angular scatterometry,** S. Wang, Y. Ku, Industrial Technology Research Institute (Taiwan) . .[6152-56]

Panel Discussion
Conv. Ctr. A2 . . . . **Wed. 8:00 to 9:40 pm**
The Future of CD-SEM and Scatterometry
Chairs: **Vladimir A. Ukraintsev**, Texas Instruments Inc.; **John L. Sturtevant**, Mentor Graphics Corp.; **Bryan J. Rice**, Intel Corp.; **Bhanwar Singh**, Advanced Micro Devices, Inc.; **Masafumi Asano**, Toshiba Corp. (Japan); **David C. Joy**, The Univ. of Tennessee; **Richard M. Silver**, National Institute of Standards and Technology; **Christopher J. Raymond**, Accent Optical Technologies; **Kevin M. Monahan**, KLA-Tencor Corp.; **Alex Danilevsky**, Hitachi High Technologies America, Inc.

The participants include experts from academia, government, and the semiconductor industry.

The roles of several metrology tool technologies are changing due to new challenges and improving alternative solutions. This is especially evident in critical dimension monitoring and control solutions using CDSEM and scatterometry. This panel discussion will focus on current and future applications including roles exploiting the complementary natures of these technologies, the limits of these techniques, and what can be done to improve these technologies by developing strengths and dealing with weaknesses. This discussion should offer insight into future manufacturing and development configurations for these technologies.

Thursday 23 February

SESSION 12

Conv. Ctr. A2 . . . . **Thurs. 8:00 to 10:00 am**
Mask and Lithography System Metrology
Chairs: **Daniel J. Herr**, Semiconductor Research Corp.; **Michael W. Stan**, Rohm and Haas Electronic Materials

8:00 am: **Development of an automated multiple-target mask CD disposition system to enable new sampling strategy,** J. Ma, J. N. Farnsworth, L. Bassist, Y. Cui, B. A. Mammen, R. Padmanaban, V. Nadamuni, M. Kamath, K. Buckmann, J. H. Neff, P. Freiberger, Intel Corp. . . . .[6152-58]

8:20 am: **Phase calibration for attenuating phase-shift masks,** M. S. Hibbs, IBM Corp.; T. A. Brunner, IBM Microelectronics Div. . . . . .[6152-59]

8:40 am: **Investigation on polarization monitoring mask: pattern design and experimental verification,** C. Hwang, D. Park, J. Shin, S. Lee, S. Woo, H. Cho, J. Moon, SAMSUNG Electronics Co., Ltd. (South Korea) . . . .[6152-60]

9:00 am: **Advanced x-ray mask inspection system (AXIS) using scanning electron microscopy for sub-70-nm die-to-database inspections,** B. E. Boerger, JMAR Technologies, Inc.; D. J. Ronning, Lite Enterprises Inc.; B. J. Grenon, Grenon Consulting, Inc.; R. A. Selzer, B. Xing, JMAR Technologies, Inc.; M. J. Trybendis, MJT Consulting [6152-83]

9:20 am: **Line-edge roughness on photolithographic masks,** J. Richter, T. Heins, U. Dersch, R. Liebe, Advanced Mask Technology Ctr. (Germany) . . . .[6152-62]

9:40 am: **CD-etch depth measurement from advanced phase-shift masks and wafers using optical scatterometry,** K. M. Lee, Intel Corp.; S. K. Yedur, Timbre Technologies, Inc.; M. Tavassoli, Intel Corp. .[6152-63]

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

Conference 6152

SESSION 13

Conv. Ctr. A2 . . . . **Thurs. 10:30 am to 12:10 pm**
Defect II

Chairs: **Bhanwar Singh**, Advanced Micro Devices, Inc.; **Michael W. Stan**, Rohm and Haas Electronic Materials

10:30 am: **Polarization control for enhanced defect detection on advanced memory devices,** B. H. Lee, S. B. Chin, SAMSUNG Electronics Co., Ltd. (South Korea); J. Yeo, Y. Gluk, D. Meshulach, Applied Materials (Israel) . . . .[6152-64]

10:50 am: **Product and tool control using integrated auto-macro defect inspection in the photolithography cluster,** V. C. Menon, M. C. Nicholls, R. L. Isaacson, IBM Corp.; S. J. Lickteig, T. Forstner, T. Barnett, J. Mulhall, Tokyo Electron America, Inc. . . . .[6152-65]

11:10 am: **Evaluation of damage induced by electron-beam irradiation to MOS gate pattern and method for damage-free inspection,** M. Matsui, S. Machida, T. Mine, K. Hozawa, K. Watanabe, Y. Goto, Hitachi, Ltd. (Japan); J. Inoue, H. Nagaishi, Renesas Technology Corp. (Japan) . . . .[6152-66]

11:30 am: **In-line semi-electrical process diagnosis methodology for integrated process window optimization of 65-nm and below technology nodes,** M. Lei, Taiwan Semiconductor Manufacturing Company, Ltd. (Taiwan) . . . .[6152-67]

11:50 am: **The use of unpatterned wafer inspection for immersion lithography defectivity studies,** F. Holsteyns, IMEC (Belgium); L. Cheung, KLA-Tencor Corp.; W. Fyen, IMEC (Belgium); G. Simpson, KLA-Tencor Corp.; R. Brun, KLA-Tencor Corp. (France); A. Steinbach, KLA-Tencor Corp.; K. Kenis, D. Van Goidsenhoven, D. Van Den Heuvel, D. Hellin, P. Mertens, M. Maenhoudt, IMEC (Belgium) . . . .[6152-68]

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

SESSION 14

Room: Conv. Ctr. A2 . . . . **Thurs. 1:30 to 3:10 pm**
Joint Session with conference 6155 on CD Control

Chairs: **Chas N. Archie**, IBM Corp.; **Purabi Mazumdar**, National Institute of Standards and Technology

1:30 pm: **CD-SEM image processing-based process window metrology,** C. J. Gould, Infineon Technologies Corp. . . . .[6155-11]

1:50 pm: **In-line CD metrology with combined use of scatterometry and CD-SEM,** M. Asano, T. Ikeda, T. Koike, H. Abe, Toshiba Corp. (Japan) . . . .[6152-69]

2:10 pm: **Full-field exposure control implications of the mask error function,** T. E. Zavecz, TEA Systems Corp. . . . .[6155-12]

2:30 pm: **Scatterometry measurements of line-end shortening structures for focus-exposure monitoring,** W. D. Mieher, KLA-Tencor Corp.; Y. F. Cheng, J. W. Sun, W. K. Hung, B. S. Lin, United Microelectronics Corp. (Taiwan); S. Fu, M. Chiu, KLA-Tencor Corp. (Taiwan); T. G. Dziura, KLA-Tencor Corp. . . . .[6152-70]

2:50 pm: **Back end of line metrology control applications using scatterometry,** L. C. Towidjaja, C. J. Raymond, M. Littau, D. L. Forman, S. G. Hummel, Accent Optical Technologies . . . .[6152-90]

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

SESSION 15

Room: Conv. Ctr. A2 . . . . **Thurs. 3:40 to 5:00 pm**
Joint Session with conference 6155 on CD and Overlay Control

Chairs: **John A. Allgair**, International SEMATECH Manufacturing Initiative; **Andrew Skumanich**, Applied Materials, Inc.

3:40 pm: **Layout optimization for multilayer overlay targets,** L. A. Binns, Accent Optical Technologies, Ltd. (United Kingdom); N. P. Smith, Accent Optical Technologies, Ltd. (Taiwan); C. P. Ausschnitt, J. L. Morningstar, W. Muth, J. Schneider, R. Yerdon, IBM Microelectronics Div. . . . . . .[6155-14]

4:00 pm: **Compensating measured intra-wafer ring oscillator stage delay with intra-wafer exposure dose corrections,** S. Verhaegen, A. Nackaerts, IMEC (Belgium); M. V. Dusa, ASML MaskTools Inc.; R. Carpaij, ASML Netherlands B.V. (Netherlands); G. Vandenberghe, IMEC (Belgium); J. M. Finders, ASML Netherlands B.V. (Netherlands) . . . .[6152-71]

4:20 pm: **Alignment performance monitoring for ASML systems,** W. Chung, V. Temchenko, T. Hauck, S. Schmidt, Infineon Technologies AG (Germany) . . . .[6155-15]

4:40 pm: **Complete characterization of poly-gate critical dimensions through in-situ detection of aerial images in a scanner**, H. Chang, J. Chen, C. Chen, J. Lin, C. Lai, T. Gau, B. Lin, Taiwan Semiconductor Manufacturing Co., Ltd. (Taiwan); M. J. Gassner, Y. Cao, M. E. Preil, Brion Technologies, Inc. . . . .[6152-72]

Courses of Related Interest

Find full Course descriptions on pages 41-64.

SC101 **Introduction to Microlithography: Theory, Materials, and Processing** (Willson, Bowden, Thompson) - Sunday, 8:30 am to 5:30 pm

SC105 **CD Metrology and Image Formation in the Scanning Electron Microscope (SEM)** - (Wells, Postek) - Sunday, 8:30 am to 5:30 pm

SC111 **Lithography Process Control** (Levinson) - Sunday, 8:30 am to 5:30 pm

SC539 **Spectroscopic Ellipsometry Applications in Microlithography** (Synowicki) - Sunday, 8:30 am to 5:30 pm

SC579 **Photomask Fabrication and Technology Basics** (Duff) - Monday, 8:30 am to 5:30 pm

SC618 **Full Wafer Particle and Defect Detection, Review & Characterization** (Brundle) - Sunday, 8:30 am to 5:30 pm

SC621 **Lithography Control and Characterization** (Zavecz) - Sunday, 8:30 am to 5:30 pm

SC705 **Instruments and Methodologies for Accurate Metrology and Fleet Matching** (Archie, Banke) - Sunday, 8:30 am to 5:30 pm

SC778 **Introduction to Advanced Process Control (APC) - for Semiconductor Manufacturing** (Finn, Misra) - Sunday, 8:30 am to 5:30 pm

SC780 **Tracks 101: Microlithography Coat and Develop Basics** (Daggett) - Sunday, 8:30 am to 5:30 pm

Monday-Wednesday 20-22 February 2006 • Proceedings of SPIE Vol. 6153

Advances in Resist Materials and Processing Technology XXIII

Conference Chair: **Qinghuang Lin**, IBM Thomas J. Watson Research Ctr.

Cochair: **Clifford L. Henderson**, Georgia Institute of Technology

Program Committee: **George G. Barclay**, Rohm and Haas Electronic Materials; **Scott J. Bukofsky**, IBM Microelectronics Div.; **Sean D. Burns**, IBM Thomas J. Watson Research Ctr.; **Ralph R. Dammel**, AZ Electronic Materials USA Corp.; **Douglas J. Guerrero**, Brewer Science, Inc.; **Christoph Hohle**, Infineon Technologies AG (Germany); **Dah-Chung Owe-Yang**, Shin-Etsu Chemical Co., Ltd. (Japan); **Kyle Patterson**, Freescale Semiconductor, Inc. (France); **Adam R. Pawloski**, Affymetrix, Inc.; **Vivek M. Prabhu**, National Institute of Standards and Technology; **E. Steve Putna**, Intel Corp.; **Mark H. Somervell**, Texas Instruments Inc.; **Minoru Toriumi**, Osaka Univ. (Japan); **Gregory M. Wallraff**, IBM Almaden Research Ctr.

Monday 20 February

Opening Remarks
Conv. Ctr./ Exhibit Hall 3 . . . Mon. 11:00 to 11:10 am
Chair: **Qinghuang Lin**, IBM Thomas J. Watson Research Ctr.

SESSION 1

Conv. Ctr./ Exhibit Hall 3 Mon. 11:10 am to 12:30 pm
Invited Session
Chair: **Clifford L. Henderson**, Georgia Institute of Technology

11:10 am: **Electronic materials as enablers of microelectronics: yesterday, today and tomorrow** *(Invited Paper, Presentation Only)*, G. S. Calabres, Rohm and Haas Electronic Materials . . . . [6153-01]

11:50 am: **Self-assembly in semiconductor microelectronics** *(Invited Paper)*, C. T. Black, R. Ruiz, Y. Zhang, IBM Thomas J. Watson Research Ctr. . . . . [6153-02]

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

SESSION 2

Conv. Ctr./ Exhibit Hall 3 . . . . . Mon. 1:30 to 3:10 pm
Immersion I
Chairs: **Ralph R. Dammel**, AZ Electronic Materials USA Corp.; **Scott J. Bukofsky**, IBM Microelectronics Div.

1:30 pm: **Numeric analysis of the roles of gas-phase and liquid-phase UV photochemistry in conventional and immersion lithography,** W. D. Hinsberg, F. A. Houle, IBM Almaden Research Ctr. . . . . [6153-03]

1:50 pm: **Topcoat or no topcoat for immersion lithography?,** N. Stepanenko, Infineon Technologies AG (Germany); H. Kim, SAMSUNG Electronics Co., Ltd. (South Korea); S. Kishimura, Matsushita Electric Industrial Co., Ltd. (Japan); M. K. Kocsis, Intel Corp.; M. Maenhoudt, M. Ercken, R. Gronheid, P. Foubert, I. K. Pollentier, D. Van Den Heuvel, N. Vandenbroeck, D. Vangoidsenhoven, C. Delvaux, C. Baerts, W. Fyen, F. Van Roey, G. M. Wells, IMEC (Belgium) . . . . [6153-04]

2:10 pm: **Evaluation of 193-nm immersion resist without topcoat,** Y. Wei, Infineon Technologies North America; N. Stepanenko, A. Laessig, L. Voelkel, Infineon Technologies (Germany); M. Sebald, Infineon Technologies AG (Germany) . . . . [6153-05]

2:30 pm: **Selection and evaluation of developer-soluble topcoat for 193-nm immersion lithography,** Y. Wei, Infineon Technologies North America; K. E. Petrillo, IBM Corp.; P. A. Benson, Micron Technology; U. Okoroanyanwu, Advanced Micro Devices, Inc. . . . . [6153-71]

2:50 pm: **A wet/dry crossover resist for 193-nm lithography,** M. Padmanaban, A. R. Romano, G. Lin, S. Chiu, A. G. Timko, D. Rahman, R. R. Dammel, AZ Electronic Materials USA Corp.; K. L. Turnquest, G. K. Rich, SEMATECH, Inc. . . . . [6153-07]

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

SESSION 3

Conv. Ctr./ Exhibit Hall 3 . . . . . Mon. 3:30 to 5:30 pm
Immersion II
Chairs: **Gregory M. Wallraff**, IBM Almaden Research Ctr.; **Adam R. Pawloski**, Affymetrix, Inc.

3:30 pm: **Materials and process parameters study on ArF immersion defectivity,** S. Kanna, S. Tarutani, H. Inabe, K. Yamamoto, K. Mizutani, H. Kanda, H. Saegusa, Y. Kawabe, Fuji Photo Film Co., Ltd. (Japan); N. Iguchi, K. Shitabatake, FUJIFILM Electronic Materials (Japan) . . [6153-08]

3:50 pm: **Defect studies of resist process for 193-nm immersion lithography,** T. Ando, T. Takayama, H. Tsuji, K. Ishizuka, M. Yoshida, T. Hirano, J. Yokoya, K. Ohmori, Tokyo Ohka Kogyo Co., Ltd. (Japan); K. Nakano, T. Fujiwara, S. Owa, Nikon Corp. (Japan) . . . . [6153-09]

4:10 pm: **High-refractive-index fluids for the next-generation ArF immersion lithography,** Y. Wang, T. Miyamatsu, T. Furukawa, K. Yamada, H. Nakagawa, M. Shima, T. Shimokawa, K. Hieda, JSR Corp. (Japan) . . . . [6153-10]

4:30 pm: **New high-index fluids and resists for immersion lithography,** E. Costner, J. C. Taylor, S. J. Caporale, C. G. Willson, The Univ. of Texas at Austin; W. E. Conley, Freescale Semiconductor, Inc.; D. Dewulf, W. A. Wojtczak, SACHEM Inc . . . . [6153-11]

4:50 pm: **Amplification of the index of refraction of aqueous immersion fluids with homogeneous and heterogeneous media: a progress report,** J. L. Gejo, Columbia Univ.; W. E. Conley, SEMATECH, Inc.; K. Lee, J. Kunjappu, S. Jockusch, N. J. Turro, C. Durning, Columbia Univ. . . . . [6153-12]

5:10 pm: **Immersion topcoat and resist material improvement study by using immersion scanner: lithographic performance and scanning property,** H. Nakagawa, K. Hoshiko, M. Shima, S. Kusumoto, T. Shimokawa, JSR Corp. (Japan); K. Nakano, T. Fujiwara, S. Owa, Nikon Corp. (Japan) . . . . [6153-13]

✔ Posters-Monday

The following posters will be displayed all day Monday. Authors will be present during the formal poster session Monday evening between 5:30 and 8:00 pm in Convention Center Hall 3 for discussion. Authors may set up their posters after 9:00 am on Monday.

Materials and Processes for Immersion Lithography

Resist Materials

ARC/Multilayer Processes

✔ **Design and development of next-generation bottom antireflective coatings for 45-nm process with hyper-NA lithography,** M. Nakajima, T. Sakaguchi, T. Enomoto, Nissan Chemical Industries, Ltd. (Japan) . . . .[6153-96]

✔ **Study of Iso/dense Bias of BARCs and gap-fill materials on via wafer,** R. Huang, Brewer Science, Inc. . . . .[6153-97]

✔ **Implantation blocking characteristics study of organic BARC materials,** M. S. Kim, Hynix Semiconductor Inc. (South Korea)[6153-98]

✔ **New chemical approach for resist poisoning problem in via first dual-Damascene process,** S. Takei, Nissan Chemical Industries, Ltd. (Japan); H. Nakao, CASMAT (Japan) . . . .[6153-99]

✔ **Development of 193-nm wet BARCs for implant,** J. D. Meador, C. Beaman, J. Lowes, C. A. Washburn, R. L. Mercado, U. Senapati, C. Stroud, A. Guerrero, Brewer Science, Inc. . . . .[6153-100]

✔ **New advanced BARC and gap fill materials based on sublimate reduction for 193-nm lithography,** S. Takei, Nissan Chemical Industries, Ltd. (Japan) . . . .[6153-101]

✔ **Use of modified bottom antireflective coatings as a general solution to resist poisoning,** J. V. Beach, SEMATECH, Inc.; K. A. Nowak, W. J. Perez, Brewer Science, Inc.; Y. Solomentsev, R. McGowan, K. Pfeifer, SEMATECH, Inc. . . . .[6153-102]

✔ **Reducing bottom antireflective coating (BARC) defects: optimizing and decoupling the filtration and dispense process,** N. L. Brakensiek, Brewer Science, Inc.; G. Martin, Entegris, Inc.; S. Simmons, Brewer Science, Inc. . . . .[6153-103]

✔ **New developer-soluble gap-fill material with fast plasma etch rate,** A. Qin, R. Huang, Brewer Science, Inc. . . . .[6153-105]

✔ **Fundamental characterization of silicon-containing spin-on hardmask for 193-nm photolithography,** V. Sipani, Y. Hishiro, M. Abatchev, Micron Technology, Inc. . . . .[6153-107]

✔ **Development of MFHM to simplify process step,** K. Lee, S. Park, S. Y. Kim, G. Lee, S. D. Lee, J. Jung, J. Cho, T. Jung, C. K. Bok, Y. Cho, D. Lee, H. S. Kim, S. Moon, J. Kim, Hynix Semiconductor Inc. (South Korea) . . . .[6153-108]

✔ **Thin-bilayer resists approach for 193 nm and future photolithography,** Y. Hishiro, M. Hyatt, Micron Technology, Inc. . . . .[6153-109]

Resist Processing

✔ **Gas-phase fluorination of resist for improving line-end pullback during etch,** R. D. Peters, P. K. Montgomery, P. Stout, Freescale Semiconductor, Inc. . . . .[6153-26]

✔ **Improved ion implantation masking through photoresist fluorination,** P. K. Montgomery, R. D. Peters, T. A. Breeden, M. Azrak, J. E. Moore, J. Jiang, Freescale Semiconductor, Inc. . . . .[6153-110]

✔ **Trim etch development methodology to fabricate sub-90-nm node transistor with ArF lithography,** J. Y. Kim, DongbuAnam Semiconductor Inc. (South Korea) . . . .[6153-112]

✔ **Research on new node separation process without exposure,** K. R. Kang, S. Y. Ahn, J. H. Lee, Y. H. Kim, T. S. Kim, SAMSUNG Electronics Co., Ltd. (South Korea) . . . .[6153-113]

✔ **Formulated surface conditioners to enhance the non-collapse and defect-free process windows: a bi-functional approach for sub-100-nm lithography,** M. Sanada, M. Sugiyama, Dainippon Screen Manufacturing Co., Ltd. (Japan); M. Jaramillo, Jr., P. Zhang, T. J. Bzik, Air Products and Chemicals, Inc. . . . .[6153-114]

✔ **Molecular contamination control technologies for high-NA 193-nm lithography,** A. Imai, T. Tanahashi, T. Nakano, NICHIAS Corp. (Japan); N. Takahashi, Tokyo Electron Ltd.; J. Kitano, M. Shioguchi, Tokyo Electron Kyushu Ltd. (Japan) . . . .[6153-115]

✔ **ArF processing of 90-nm design rule lithography achieved through enhanced thermal processing,** M. Kagerer, D. Miller, FSI International Inc.; W. Chang, The Univ. of Western Ontario (Canada); D. J. Williams, Sumika Electronic Materials, Inc. . . . .[6153-116]

✔ **Process development and resist modification for metal trench layers from 65-nm to 45-nm nodes,** S. Wu, S. Lee, C. Yu, B. S. Lin, United Microelectronics Corp. (Taiwan); Y. Suzuki, S. A. Robertson, C. Xu, T. Tanaka, I. Wan, Rohm and Haas Electronic Materials .[6153-117]

✔ **Parameter investigation of PEB sensitivity,** S. K. Oh, E. K. Son, C. S. Park, J. Y. Lee, J. W. Kim, D. Kim, J. Kim, Dongjin Semichem. Co. Ltd. (South Korea); G. Lee, S. C. Moon, Hynix Semiconductor Inc. (South Korea) . . . .[6153-118]

✔ **Extending i-line capabilities through variance,** D. Miller, P. D. Vickers, FSI International Inc.; D. J. Williams, Sumika Electronic Materials, Inc.; A. Salinas, J. Peterson, Texas Instruments Inc. . . . .[6153-119]

✔ **Thickness dependence of the lithographic performance in positive type photoresists,** J. H. Kim, N. Choi, Y. Kim, T. Kim, SAMSUNG Electronics Co., Ltd. (South Korea) . . . .[6153-120]

✔ **New development application method to improve critical dimension control,** C. Hong, Dongbu Anam Semiconductor Inc. (South Korea) . . . .[6153-121]

✔ **Stability of photoresist coating performance of small dispense nozzle size in photolithographic spin coating process,** X. Li, W. T. Greene, T. Lehmann, LSI Logic Corp. . . . .[6153-124]

✔ **Improved resist quality and performance via advanced filtration,** E. L. Alemy, A. Carmona, W. C. Nelson, AZ Electronic Materials USA Corp.; M. H. Tseng, W. P. Wolfrum, CUNO Inc. . . . .[6153-125]

Resist Defects

✔ **A universal process develop methodology for complete removal of residues from 300-mm wafer-edge bevel,** M. Randall, IBM Microelectronics Div.; C. Longstaff, K. Ueda, T. Winter, Tokyo Electron U.S. Holdings, Inc. . . . .[6153-126]

✔ **Use of direct washing of chemical dispense nozzles for defect control,** M. Linnane, G. L. Mack, IBM Microelectronics Div.; C. Longstaff, K. Ueda, N. Yokomori, T. Winter, Tokyo Electron U.S. Holdings, Inc. . . . .[6153-128]

✔ **The suppression method of powder formation in ArF photoresist,** G. Lee, H. Kim, E. Lee, M. Kim, S. Y. Kim, C. K. Bok, H. S. Kim, S. Moon, J. Kim, Hynix Semiconductor Inc. (South Korea) . . . .[6153-130]

✔ **The correlation between polymer platform of ArF photoresist and defect in the track nozzle of manufacturing process line,** J. Y. Song, Korea Kumho Petrochemical Co., Ltd. (South Korea) . . . . . .[6153-131]

✔ **TARC process and productivity improvements on KrF lithography,** T. Couteau, Spansion LLC; M. A. Carcasi, Tokyo Electron America, Inc . . . .[6153-132]

✔ **Studies of the mechanism for immersion specific defects,** T. Ishibashi, T. Hanawa, T. Suganaga, K. Narimatsu, K. Suko, Renesas Technology Corp. (Japan); M. Terai, T. Kumada, Mitsubishi Electric Corp. (Japan); T. Ando, Tokyo Ohka Kogyo Co.,Ltd. (Japan) . . . . . .[6153-133]

✔ **Defectivity reduction by optimization of 193-nm immersion lithography using an interfaced exposure-track system,** K. R. Nafus, S. Hatakeyama, Tokyo Electron Kyushu Ltd. (Japan); H. Kosugi, Tokyo Electron America, Inc.; T. Tomita, Tokyo Electron Kyushu Ltd. (Japan); R. Moerman, Y. van Dommelen, P. Huisman, ASML Netherlands B.V. (Netherlands) . . . .[6153-134]

✔ **Defect reduction by using a new rinse solution for 193-nm conventional and immersion lithography,** O. Miyahara, T. Shimoaoki, K. Yoshihara, J. Kitano, Tokyo Electron Kyushu Ltd. (Japan) .[6153-135]

✔ **193-nm immersion process defect generation and reduction mechanism investigation using analytical methods,** S. Hatakeyama, M. Enomoto, T. Niwa, T. Tomita, T. Shimoaoki, H. Kyoda, J. Kitano, Tokyo Electron Kyushu Ltd. (Japan); S. Shimura, T. Kawasaki, Tokyo Electron Ltd. (Japan) . . . .[6153-136]

✔ **An investigation on defect-generation conditions in immersion lithography,** M. Enomoto, T. Shimoaoki, H. Kyoda, J. Kitano, Tokyo Electron Kyushu Ltd. (Japan); T. Suganaga, Renesas Technology Corp. (Japan) . . . .[6153-137]

Conference 6153

Resist Fundamentals and Simulation

✔ **Deprotection kinetics in 193-nm photoresist thin films: influence of copolymer content,** S. Kang, V. M. Prabhu, B. D. Vogt, E. K. Lin, W. Wu, National Institute of Standards and Technology; K. L. Turnquest, SEMATECH, Inc. . . . .[6153-138]

✔ **The reaction mechanism of poly[4-hydroxystyrene-co-4-(1,1,1,3,3,3-hexafluoro-2-hydroxypropyl)-styrene],** H. Yamamoto, T. Kozawa, K. Okamoto, S. Tagawa, Osaka Univ. (Japan); T. Ando, M. Sato, H. Komano, Tokyo Ohka Kogyo Co., Ltd. (Japan) . . . .[6153-139]

✔ **Analysis of the effect of mechanical strength of the resist film on pattern collapse behavior using atomic force microscope,** O. Tamada, T. Goto, M. Sanada, Dainippon Screen Manufacturing Co., Ltd. (Japan); T. Moriuchi, T. Niiyama, A. Kawai, Nagaoka Univ. of Technology (Japan) . . . .[6153-140]

✔ **Resist dissolution behavior according to protecting group in polymer,** K. Im, J. Jegal, J. Park, D. Kim, J. Kim, Dongjin Semichem. Co. Ltd. (South Korea) . . . .[6153-141]

✔ **Thermal effects study of chemically amplified resist,** S. Kim, The Catholic Univ. of Korea (South Korea) . . . .[6153-142]

✔ **Profile simulation parameter model of negative-type thick-film resist,** Y. Sensu, A. Sekiguchi, Y. Kono, Litho Tech Japan Corp. (Japan) . . . .[6153-143]

✔ **Reflow modeling for elongated contact-hole shape,** J. E. Lee, D. Kim, H. Kang, J. Kim, H. Oh, Hanyang Univ. (South Korea); J. Park, Hynix Semiconductor Inc. (South Korea) . . . .[6153-144]

Line-Edge Roughness

✔ **Contributions to innate material roughness in resist,** J. M. Roberts, R. P. Meagley, Intel Corp.; T. H. Fedynyshyn, R. F. Sinta, D. K. Astolfi, R. B. Goodman, A. Cabral, MIT Lincoln Lab. . . . .[6153-145]

✔ **LWR reduction at the 55-nm node through combination of classical process optimization and application of surface conditioner solutions,** P. Wong, W. Gehoel, S. Sinkwitz, ASML Netherlands B.V. (Netherlands); P. Zhang, M. Jaramillo, Jr., M. B. Rao, B. Horvath, B. F. Ross, D. M. King, Air Products and Chemicals, Inc. . . . .[6153-146]

✔ **Line-width roughness analysis of EUV resists after development in homogenous CO_2 solutions using CO_2 compatible salts (CCS) by using a three-parameter model,** V. Constantoudis, E. Gogolides, G. P. Patsis, Institute of Microelectronics (Greece); M. I. Wagner, J. P. DeYoung, Micell Technologies, Inc. . . . .[6153-147]

✔ **LWR reduction in 193-nm resist by resist smoothing,** Y. Inatomi, T. Kawasaki, M. Iwashita, Tokyo Electron Ltd. (Japan) . . . .[6153-148]

✔ **Post-etch LWR performance of novel surface conditioner solutions,** P. Zhang, M. Jaramillo, Jr., M. B. Rao, Air Products and Chemicals, Inc.; A. R. Pawloski, K. L. Turnquest, Advanced Micro Devices, Inc. . . . .[6153-149]

✔ **Pattern noise in electron-beam exposed sub-35-nm contacts,** W. J. Poppe, Univ. of California/Berkeley; J. A. Liddle, E. H. Anderson, Lawrence Berkeley National Lab.; A. R. Neureuther, Univ. of California/ Berkeley . . . .[6153-150]

NGL

✔ **Effect of the number distribution of protecting group on low-molecular weight polyphenols for electron-beam lithography,** T. Hirayama, D. Shiono, H. Hada, J. Onodera, Tokyo Ohka Kogyo Co., Ltd. (Japan); H. Fukuda, A. Yamaguchi, Hitachi, Ltd. (Japan); M. Ueda, Tokyo Institute of Technology (Japan) . . . .[6153-17]

✔ **Molecular glass and segmented photoresist design for EUV lithography,** A. De Silva, D. Forman, C. K. Ober, Cornell Univ.[6153-151]

✔ **The material design to reduce outgassing in acetal-based chemically amplified resist for EUV lithography,** S. Masuda, Y. Kawanishi, S. Hirano, S. Kamimura, K. Mizutani, S. Yasunami, Y. Kawabe, Fuji Photo Film Co., Ltd. (Japan) . . . .[6153-152]

✔ **Optimization of photo-acid generator in CA resist for EUVL,** T. Watanabe, Univ. of Hyogo (Japan) and CREST, JST (Japan); H. Hada, Tokyo Ohka Kogyo, Co., Ltd. (Japan); H. Kinoshita, Y. Tanaka, H. Shiotani, Y. Fukushima, Univ. of Hyogo (Japan) and CREST, JST (Japan); H. Komano, Tokyo Ohka Kogyo Co., Ltd. (Japan) . . . .[6153-153]

✔ **Performance comparison of chemically amplified resists under EUV, EB, and KrF exposure,** D. Shimizu, M. Nobuji, T. Kai, Y. Yamaguchi, T. Shimokawa, JSR Corp. (Japan); K. Fujiwara, JSR Micro, Inc. . . . .[6153-154]

✔ **Development of EUV resists in CO_2 solutions using CO_2 compatible salts (CCS): a kinetic view of dissolution of conventional resists in supercritical CO_2,** J. P. DeYoung, M. I. Wagner, C. Harbinson, M. Miles, Micell Technologies, Inc.; A. E. Zweber, R. G. Carbonell, North Carolina State Univ. . . . .[6153-55]

✔ **Development of EUV resists in supercritical CO_2 solutions using CO_2 compatible salts (CCS): results from a two-level full factorial design of experiments (DOE),** M. I. Wagner, J. P. DeYoung, C. Harbinson, Micell Technologies, Inc. . . . .[6153-157]

✔ **Evaluation of most recent chemically amplified resists for high-resolution direct write using a Leica SB350 variable-shaped beam writer,** A. M. Schwersenz, H. Sailer, M. Irmscher, Institut für Mikroelektronik Stuttgart (Germany); C. Hohle, J. Kretz, F. Kamm, K. Choi, F. Thrum, Infineon Technologies AG (Germany); D. Beyer, U. Denker, K. Kliem, M. Boettcher, Leica Microsystems Lithography GmbH (Germany) . . . .[6153-158]

Novel Processes and Applications

✔ **Self-aligned direct write of a double-sided transistor gate on membrane using an evaporated e-beam resist,** J. Beauvais, Quantiscript Inc. (Canada); P. S. Kelkar, Univ. de Sherbrooke (Canada); E. Lavallee, D. Drouin, K. M. Lau, Quantiscript Inc. (Canada) [6153-159]

✔ **40-100-nm contact hole processes of ZEP520A e-beam resist on PCM prototyping applications,** W. G. Chen, Y. Chuo, H. Hsu, Y. Chen, C. Lee, M. Kao, M. Tsai, Industrial Technology Research Institute (Taiwan) . . . .[6153-160]

✔ **Monodisperse nanocarriers: novel fabrication of polymeric nanoparticles for bio-nanotechnology,** L. E. Euliss, C. M. Welch, B. W. Maynor, K. Hahn, J. M. DeSimone, The Univ. of North Carolina at Chapel Hill . . . .[6153-161]

✔ **Supercritical CO_2 for high-resolution photoresist development,** N. M. Felix, Cornell Univ.; K. Tsuchiya, Tokyo Institute of Technology (Japan); C. M. Y. Luk, C. K. Ober, Cornell Univ. . . . .[6153-162]

✔ **Monitoring photoresist dissolution in supercritical carbon dioxide using a quartz crystal microbalance,** A. E. Zweber, R. G. Carbonell, North Carolina State Univ. . . . .[6153-163]

✔ **Study of dynamical formation and shape of microlenses formed by the reflow method,** S. Audran, STMicroelectronics (France) and Univ. Louis Pasteur (France); B. Faure, B. P. Mortini, STMicroelectronics (France); G. Schlatter, G. Hadziioannou, Univ. Louis Pasteur (France) . . . .[6153-164]

✔ **Thick-photosensitive polymers for enhanced wafer-level packaging in MEMS, compound semiconductor, packaging, and optical applications,** M. J. Shaw, MicroChem Corp. . . . .[6153-165]

✔ **High-sensitivity and non-antimonite permanent photoresist for MEMS,** K. Misumi, K. Saito, H. Obiya, Tokyo Ohka Kogyo Co., Ltd. (Japan) . . . .[6153-168]

✔ **Laser-induced oxidation of metallic thin films as a method for creating grayscale photomasks,** G. H. Chapman, D. K. Poon, C. Choo, J. Wang, M. Chang, Y. R. Tu, Simon Fraser Univ. (Canada) . . . .[6153-169]

✔ **Chemically amplified, thick film, i-line resist for electroplating and redistribution applications,** M. A. Toukhy, S. K. Mullen, M. Paunescu, C. Chen, G. Pawlowski, Y. Murakami, AZ Electronic Materials USA Corp. . . . .[6153-170]

✔ **Highly re-entrant profiles in a thick photosensitive material for nanotechnology applications,** W. W. Flack, H. T. Nguyen, Ultratech, Inc.; M. Shaw, MicroChem Corp. . . . .[6153-171]

✔ **Acidolysis small molecule phenolic ether used as accelerator in photosensitive diazonaphthaquinone systems,** Y. Zou, Beijing Normal Univ. (China) . . . .[6153-172]

✔ **A novel photosensitive material for redistribution and stress buffer reduction on 300-mm wafers,** W. W. Flack, H. T. Nguyen, Ultratech, Inc.; E. S. Capsuto, Shin-EtsuMicroSi, Inc. . . . .[6153-173]

✔ **A lamp thermoelectricity based integrated bake/chill system for advanced photoresist processing,** A. E. Tay, National Univ. of Singapore (Singapore); H. T. Chua, The Univ. of Western Australia (Australia); X. Wu, National Univ. of Singapore (Singapore) . . [6153-175]

✔ **The new bake plate optimized for a PEB process,** S. Goto, K. Matsuchika, A. Hisai, Dainippon Screen Manufacturing Co., Ltd. (Japan) . . . . [6153-176]

✔ **Advanced photoresist dispense valve control technology,** G. Standley, Freescale Semiconductor, Inc.; B. Kidd, K. Hartman, Integrated Designs, L.P. . . . . [6153-177]

✔ **Resists for sub-100 nm patterning at 193-nm exposure,** N. D. Jarnagin, K. E. Gonsalves, The Univ. of North Carolina at Charlotte; J. M. Roberts, Y. Wang, Intel Corp. . . . . [6153-178]

Tuesday 21 February

SESSION 4

**Marriott San Jose Ballroom
Salon III** . . . . **Tues. 8:00 to 10:00 am**
Resist Materials

Chairs: **George G. Barclay**, Rohm and Haas Electronic Materials; **Vivek M. Prabhu**, National Institute of Standards and Technology

8:00 am: **Development of new resist materials for 193-nm dry and immersion lithography,** T. Sasaki, N. Shirota, Y. Takebe, O. Yokokoji, Asahi Glass Co., Ltd. (Japan) . . . . [6153-15]

8:20 am: **Non-ionic photoacid generators for chemically amplified resists: structure effect on resist performance,** H. Yamato, T. Asakura, M. Ohwa, Ciba Specialty Chemicals K.K. (Japan) . . . . [6153-29]

8:40 am: **Negative-tone polyphenol resist based on chemically amplified polarity change reaction with sub-50-nm resolution capability,** K. Kojima, Hitachi, Ltd. (Japan) . . . . [6153-16]

9:00 am: **Synthesis of high-refractive index sulfur containing polymers for 193-nm immersion lithography: a progress report,** I. Blakey, The Univ. of Queensland (Australia); W. E. Conley, Freescale Semiconductor, Inc.; G. George, Queensland Univ. of Technology (Australia); D. J. T. Hill, H. Liu, F. Rasoul, A. K. Whittaker, The Univ. of Queensland (Australia)[6153-69]

9:20 am: **Reactivity of model compounds of ArF immersion, ArF, and KrF resists with diphenylsulfinyl radical cation: a cage-escape product of photochemistry of triphenylsulfonium salts,** Y. Matsui, H. Sugawara, The Institute of Scientific and Industrial Research, Osaka Univ. (Japan); S. Tsuji, T. Itani, Semiconductor Leading Edge Technolgies, Inc.; S. Seki, T. Kozawa, S. Tagawa, The Institute of Scientific and Industrial Research, Osaka Univ. (Japan) . . . . [6153-18]

9:40 am: **All-organic nonionic photoacid generating compounds with functionalized fluoroorganic sulfonate motif for chemically amplified resists,** R. Ayothi, Y. Yi, C. K. Ober, Cornell Univ.; E. S. Putna, W. Yueh, H. B. Cao, Intel Corp. . . . . [6153-19]

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

SESSION 5

**Marriott San Jose Ballroom
Salon III** . . . . **Tues. 10:20 am to 12:00 pm**
ARC/Multilayer Processes

Chairs: **Sean D. Burns**, IBM Thomas J. Watson Research Ctr.; **Douglas J. Guerrero**, Brewer Science, Inc.

10:20 am: **Silicon containing polymer in applications for 193-nm high-NA lithography processes,** D. Pfeiffer, S. D. Burns, K. E. Petrillo, A. P. Mahorowala, K. Babich, D. R. Medeiros, IBM Thomas J. Watson Research Ctr.; V. Pham, A. H. Gabor, S. D. Allen, IBM Microelectronics Div.; P. J. Brock, C. Larson, IBM Almaden Research Ctr.; Y. Lin, IBM Microelectronics Div. . . . . [6153-20]

10:40 am: **Spin-on hard mask with dual-BARC property for 50-nm devices,** J. Hah, Y. S. Chae, Y. Jang, M. Ryoo, S. Choi, S. Woo, H. Cho, J. Moon, SAMSUNG Electronics Co., Ltd. (South Korea) . . . . [6153-21]

11:00 am: **Contact angle switchable BARCs (SBARCs) for improved pattern collapse and defect control,** C. Chang, D. C. Yu, J. C. Lin, B. J. Lin, Taiwan Semiconductor Manufacturing Co., Ltd. (Taiwan); J. W. Thackeray, V. Vohra, G. Wayton, T. Kurihara, Rohm and Haas Electronic Materials . . . . [6153-22]

11:20 am: **The effects of etch chemistry on the etch rates of ArF BARC products,** H. Zhuang, AZ Electronic Materials USA Corp.; B. Ji, Air Products and Chemicals, Inc.; Z. Xiang, AZ Electronic Materials USA Corp.; P. Badowski, Air Products and Chemicals, Inc.; P. Lu, M. Neisser, AZ Electronic Materials USA Corp. . . . . [6153-23]

11:40 am: **Two-layer antireflection strategies for implant applications,** D. J. Guerrero, T. R. Smith, Brewer Science, Inc.; M. Kato, S. Kimura, M. Umezaki, T. Enomoto, Nissan Chemical Industries, Ltd. (Japan) . [6153-24]

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

SESSION 6

**Marriott San Jose Ballroom
Salon III** . . . . **Tues. 1:30 to 3:10 pm**
Resist Processing

Chairs: **E. Steve Putna**, Intel Corp.; **Mark H. Somervell**, Texas Instruments Inc.

1:30 pm: **Investigating 248-nm and 193-nm resist degradation during reactive ion oxide etching,** M. May, STMicroelectronics (France) and CEA-LETI (France); C. Sourd, CEA-LETI (France); B. P. Mortini, STMicroelectronics (France); D. Perret, Rohm and Haas Electronic Materials (France); D. W. Chung, G. Barclay, Rohm and Haas Electronic Materials; C. Brochon, G. Hadziioannou, Univ. Louis Pasteur (France) . . . . [6153-25]

1:50 pm: **Reactive ion etching of fluorine-containing photoresists,** K. S. Patel, V. Pham, W. Li, M. Khojasteh, P. R. Varanasi, IBM Microelectronics Div. . . . . [6153-111]

2:10 pm: **Resist process window characterization for the 45-nm node using an interferometric immersion microstepper,** A. Bourov, B. W. Smith, M. Slocum, E. C. Piscani, Amphibian Systems . . . . [6153-27]

2:30 pm: **New 193-nm top antireflective coatings for superior swing reduction,** W. Huang, W. H. Heath, R. W. Kwong, W. Li, K. S. Patel, P. R. Varanasi, IBM Microelectronics Div. . . . . [6153-28]

2:50 pm: **A high-throughput, low-defectivity puddle-less develop process for 193-nm lithography,** T. Winter, K. Ueda, Tokyo Electron U.S. Holdings, Inc.; G. L. Mack, J. J. Bright, IBM Microelectronics Div. . . . . [6153-127]

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

Conference 6153

SESSION 7

Marriott San Jose Ballroom
Salon III . . . . **Tues. 3:30 to 5:10 pm**
Resist Processes and Simulation

Chairs: **Christoph K. Hohle**, Infineon Technologies AG (Germany);
Dah-Chung Owe-Yang, Taiwan Semiconductor Manufacturing Co.,
Ltd. (Taiwan)

3:30 pm: **Defect marginality screen for resists patterned in random
bright-field layout,** D. S. Fryer, V. K. Singh, S. Dhoot, A. J. Muray, S.
Sivakumar, Intel Corp. . . . .[6153-30]

3:50 pm: **Minimizing wafer defectivity during high-temperature baking
of organic films in 193-nm lithography,** M. Randall, M. Linnane, IBM
Microelectronics Div.; C. Longstaff, K. Ueda, J. Nicholson, T. Winter, Tokyo
Electron U.S. Holdings, Inc. . . . .[6153-31]

4:10 pm: **Effect of topcoat and resist thickness on line-edge
roughness,** L. Singh, I. Matthew, A. R. Pawloski, A. M. Minvielle,
Advanced Micro Devices, Inc. . . . .[6153-32]

4:30 pm: **A mechanistic model for line-edge roughness,** M. D. Smith,
KLA-Tencor Corp. . . . .[6153-33]

4:50 pm: **OPC of resist reflow process,** S. Kim, The Catholic Univ. of
Korea (South Korea) . . . .[6153-35]

Wednesday 22 February

SESSION 8

Marriott San Jose Ballroom
Salon III . . . .**Wed. 8:00 to 10:00 am**
Resist Fundamental

Chairs: **Vivek M. Prabhu**, National Institute of Standards and
Technology; **Minoru Toriumi**, Osaka Univ. (Japan)

8:00 am: **Direct determination of photoresist composition changes
during UV exposure,** F. A. Houle, V. Deline, H. D. Truong, R.
Sooriyakumaran, IBM Almaden Research Ctr. . . . .[6153-36]

8:20 am: **Dissolution fundamentals of 193-nm methacrylate-based
photoresists,** A. B. Rao, S. Kang, B. D. Vogt, V. M. Prabhu, E. K. Lin, W.
Wu, National Institute of Standards and Technology; K. L. Turnquest,
SEMATECH, Inc.; W. D. Hinsberg, IBM Almaden Research Ctr. . .[6153-37]

8:40 am: **Diffusion mechanism of water for immersion lithography,** M.
Toriumi, Osaka Univ. (Japan) . . . .[6153-38]

9:00 am: **Resist modeling parameter extraction for a dry/immersion
hybrid photoresist for contact-hole applications,** S. A. Robertson, S.
Yamada, J. M. Leonard, Rohm and Haas Electronic Materials . .[6153-39]

9:20 am: **Fundamentals of the reaction-diffusion process in model EUV
photoresists,** K. Lavery, National Institute of Standards and Technology;
K. Choi, Intel Corp.; B. D. Vogt, V. M. Prabhu, E. K. Lin, W. Wu, S. K. Satija,
National Institute of Standards and Technology; M. J. Leeson, H. B. Cao,
G. Thompson, H. Deng, D. S. Fryer, Intel Corp. . . . .[6153-40]

9:40 am: **Difference between initial distributions of proton and counter
anion in chemically amplified electron-beam resist,** T. Kozawa, H.
Yamamoto, A. Saeki, S. Tagawa, Osaka Univ. (Japan) . . . .[6153-41]

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

SESSION 9

Marriott San Jose Ballroom
Salon III . . . . **Wed. 10:20 am to 12:00 pm**
LER

Chairs: **Kyle Patterson**, Freescale Semiconductor, Inc. (France);
Adam R. Pawloski, Affymetrix, Inc.

10:20 am: **Deconstructing the resist to probe innate material
roughness,** T. H. Fedynyshyn, R. F. Sinta, D. K. Astolfi, A. Cabral, MIT
Lincoln Lab.; J. M. Roberts, Intel Corp. . . . .[6153-42]

10:40 am: **The shape of the reaction-diffusion front in 193-nm
chemically amplified photoresists,** B. D. Vogt, S. Kang, V. M. Prabhu, A.
B. Rao, E. K. Lin, S. K. Satija, National Institute of Standards and
Technology; K. L. Turnquest, SEMATECH, Inc.; W. Wu, National Institute of
Standards and Technology . . . .[6153-43]

11:00 am: **Study of the effect of amine additives on LWR and LER,** F. M.
Houlihan, AZ Electronic Materials USA Corp. . . . .[6153-44]

11:20 am: **The transfer of photoresist LER through etch,** A. R. Pawloski,
A. Acheta, S. Bell, H. J. Levinson, Advanced Micro Devices, Inc. [6153-45]

11:40 am: **Changes of chemical nature of photoresists induced by
various plasma treatments and their impact on LWR,** H. Kawahira, N.
N. Matsuzawa, Sony Atsugi Technology Ctr. (Japan); E. Matsui, Sony Corp.
(Japan); A. Ando, K. M. A. Salam, M. Yoshida, Y. Yamaguchi, K. Kugimiya,
T. Tatsumi, H. Nakano, Sony Atsugi Technology Ctr. (Japan); T. Iwai, M. Irie,
Tokyo Ohka Kogyo Co., Ltd. (Japan) . . . .[6153-46]

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

SESSION 10

Marriott San Jose Ballroom
Salon III . . . . **Wed. 1:30 to 3:10 pm**
NGL

Chairs: **Gregory M. Wallraff**, IBM Almaden Research Ctr.; **Ralph R.
Dammel**, AZ Electronic Materials USA Corp.

1:30 pm: **A vinyl ether-resist system for UV-cured nanoimprint
lithography,** H. Ito, F. A. Houle, M. W. Hart, R. A. DiPietro, IBM Almaden
Research Ctr. . . . .[6153-47]

1:50 pm: **Adhesion between template materials and UV-cured
nanoimprint resists,** F. A. Houle, IBM Almaden Research Ctr.; E. Guyer, E.
Rice, R. Dauskardt, Stanford Univ.; D. C. Miller, IBM Almaden Research
Ctr. . . . .[6153-48]

2:10 pm: **Overcoming pattern collapse on e-beam and EUV
lithography,** A. Jouve, CEA-LETI (France); A. Pikon, Rohm and Haas
Electronic Materials; H. H. Solak, Paul Scherrer Institut (Switzerland); J.
Tortai, CEA-LETI (France) . . . .[6153-155]

2:30 pm: **Molecular glass resists for next-generation lithography,** D.
Bratton, R. Ayothi, N. M. Felix, Cornell Univ.; H. B. Cao, H. Deng, Intel
Corp.; C. K. Ober, Cornell Univ. . . . .[6153-50]

2:50 pm: **Effects of material design on EUV resist outgassing,** K. R.
Dean, SEMATECH, Inc.; K. E. Gonsalves, The Univ. of North Carolina at
Charlotte . . . .[6153-51]

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

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SESSION 11

Marriott San Jose Ballroom
Salon III . . . . **Wed. 3:30 to 5:30 pm**
Novel Processes and Applications

Chairs: **Clifford L. Henderson**, Georgia Institute of Technology;
George G. Barclay, Rohm and Haas Electronic Materials

3:30 pm: **Fabrication of biologically relevant nanostructures using particle replication in non-wetting templates (PRINT),** J. M. DeSimone, The Univ. of North Carolina at Chapel Hill; G. M. Denison, Liquidia Technologies; E. Enlow, L. E. Euliss, S. E. Gratton, K. Herlihy, B. W. Maynor, A. A. Pandya, J. Park, The Univ. of North Carolina at Chapel Hill; J. P. Rolland, Liquidia Technologies; C. M. Welch, The Univ. of North Carolina at Chapel Hill . . . . [6153-52]

3:50 pm: **Nanolithography in thermally sacrificial polymers using nanoscale thermal probes,** Y. Hua, S. R. Saxena, W. P. King, C. L. Henderson, Georgia Institute of Technology . . . . [6153-53]

4:10 pm: **Novel low-dielectric constant photodefinable polyimides for low-temperature polymer processing,** K. Yamanaka, Georgia Institute of Technology and Central Glass Co. Ltd. (Japan); M. Romeo, C. L. Henderson, Georgia Institute of Technology; K. Maeda, Central Glass Co. Ltd. (Japan) . . . . [6153-54]

4:30 pm: **Development of EUV resists in supercritical CO_2 solutions using CO_2 compatible salts (CCS),** M. I. Wagner, J. P. DeYoung, C. Harbinson, Micell Technologies, Inc. . . . . [6153-156]

4:50 pm: **Optimization of dual-BARC structures for hyper-NA immersion lithography,** N. N. Matsuzawa, B. Thuunakart, K. Ozawa, Y. Yamaguchi, H. Nakano, H. Kawahira, Sony Atsugi Technology Ctr. (Japan) . . . . [6153-56]

5:10 pm: **Double-exposure technology using silicon containing materials,** S. Lee, J. Jung, C. K. Bok, H. S. Kim, S. Moon, Hynix Semiconductor Inc. (South Korea) . . . . [6153-57]

SESSION 12

Room: Conv. Ctr. A4 . . . . **Wed. 6:30 to 8:30 pm**
Joint Session with conference 6154 on Immersion Lithography Materials

Chairs: **Qinghuang Lin**, IBM Thomas J. Watson Research Ctr.; **Donis G. Flagello**, ASML US, Inc.

6:30 pm: **Everything you ever wanted to know about why the semiconductor industry needs a high-refractive index photoresist, but were afraid to ask**, W. E. Conley, Freescale Semiconductor, Inc. [6153-58]

6:50 pm: **Second-generation fluids for 193-nm immersion lithography**, R. H. French, W. Qiu, R. C. Wheland, M. K. Yang, M. F. Lemon, M. K. Crawford, H. V. Tran, S. Peng, DuPont Co. . . . . [6154-42]

7:10 pm: **The effect of photoresist/topcoat properties on defect formation in immersion lithography**, G. M. Wallraff, IBM Almaden Research Ctr.; D. Gill, IBM Thomas J. Watson Research Ctr.; C. E. Larson, L. K. Sundberg, IBM Almaden Research Ctr.; D. L. Goldfarb, IBM Thomas J. Watson Research Ctr.; C. Robinson, IBM Corp. . . . . [6153-59]

7:30 pm: **Controlled contamination studies with photoacid generators in 193-nm immersion lithography**, V. Liberman, S. T. Palmacci, M. Rothschile, MIT Lincoln Lab.; A. Grenville, SEMATECH, Inc. . . . . [6154-43]

7:50 pm: **Watermark defect formation and removal for immersion lithography**, C. Chang, D. Yu, J. C. Lin, B. J. Lin, Taiwan Semiconductor Manufacturing Co., Ltd. (Taiwan) . . . . [6154-44]

8:10 pm: **New hydrophilic topcoat material for immersion lithography**, P. Zhang, S. J. Weigel, T. Braymer, T. J. Markley, B. F. Ross, M. B. Rao, M. Jaramillo, Jr., Air Products and Chemicals, Inc.; U. Okoroanyanwu, Advanced Micro Devices, Inc. . . . . [6153-60]

Courses of Related Interest

Register for Courses onsite!

SC101 **Introduction to Microlithography: Theory, Materials, and Processing** (Willson, Bowden, Thompson) - Sunday, 8:30 am to 5:30 pm

SC103 **Resists for Deep UV Lithography** (Willson) - Thursday, 8:30 am to 5:30 pm

SC111 **Lithography Process Control** (Levinson) - Sunday, 8:30 am to 5:30 pm

SC114 **Plasma Etching and Reactive Ion Etching** (Coburn) - Tuesday, 8:30 am to 5:30 pm

SC355 **Fundamentals of Photochemical Contamination Control for Lithographic Tools** (Kunz) - Sunday, 6:00 pm to 10:00 pm

SC579 **Photomask Fabrication and Technology Basics** (Duff) - Monday, 8:30 am to 5:30 pm

SC616 **Practical Photoresist Processing** (Dammel) - Thursday, 1:30 to 5:30 pm

SC778 **Introduction to Advanced Process Control (APC) - for Semiconductor Manufacturing** (Finn, Misra) - Sunday, 8:30 am to 5:30 pm

SC780 **Tracks 101: Microlithography Coat and Develop Basics** (Daggett) - Sunday, 8:30 am to 5:30 pm

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Optical Microlithography XIX

Conference Chair: **Donis G. Flagello**, ASML US, Inc.

Cochair: **Harry J. Levinson**, Advanced Micro Devices, Inc.

Program Committee: **Pary Baluswamy**, Micron Technology, Inc.; **Han-Ku Cho**, SAMSUNG Electronics Co., Ltd. (South Korea); **Peter Dirksen**, Philips Research Labs. (Netherlands); **Andrew Grenville**, SEMATECH, Inc.; **Scott D. Hector**, Freescale Semiconductors, Inc.; **Tatsuhiko Higashiki**, Toshiba Corp. (Japan); **Yao Ching Ku**, Taiwan Semiconductor Manufacturing Co., Ltd. (Taiwan); **Kafai Lai**, IBM Microelectronics Div.; **Koichi Matsumoto**, Nikon Corp. (Japan); **Wilhelm Maurer**, Infineon Technologies AG (Germany); **Bruce W. Smith**, Rochester Institute of Technology; **Akiyoshi Suzuki**, Extreme Ultraviolet Lithography System Development Association and Canon (Japan); **Geert Vandenberghe**, IMEC (Belgium); **Gary Zhang**, Texas Instruments Inc.

Tuesday 21 February

Introduction
Conv. Ctr. J2 . . . . **Tues. 8:00 to 8:10 am**
Chair: **Donis G. Flagello**, ASML US, Inc.

SESSION 1

Conv. Ctr. J2 . . . . **Tues. 8:10 to 10:10 am**
Invited Session
Chairs: **Donis G. Flagello**, ASML US, Inc.; **Harry J. Levinson**, Advanced Micro Devices, Inc.

8:10 am: **From optical proximity correction to lithography-driven physical design (1996-2006): 10 years of resolution enhancement technology and the roadmap enablers for the next decade** *(Invited Paper)*, L. Capodieci, Advanced Micro Devices, Inc. . . . . [6154-01]

8:40 am: **The optics of photomasks: from shadowy past to scattered future** *(Invited Paper)*, C. J. Progler, Photronics, Inc. . . . . [6154-02]

9:10 am: **Lithographic lens: its history and evolution** *(Invited Paper)*, T. Matsuyama, Y. Ohmura, Nikon Corp. (Japan); D. M. Williamson, Nikon Research Corp. of America . . . .[6154-03]

9:40 am: **The realization of EUV lithography** *(Invited Paper)*, H. Meiling, H. Meijer, P. Kürz, ASML Netherlands B.V. (Netherlands); N. Harned, ASML Wilton . . . .[6154-04]

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

SESSION 2

Conv. Ctr. J2 . . . . **Tues. 10:30 am to 12:10 pm**
Immersion Lithography I
Chairs: **Bruce W. Smith**, Rochester Institute of Technology; **Koichi Matsumoto**, Nikon Corp. (Japan)

10:30 am: **Characterization of imaging performance of immersion lithography at NA=0.93,** D. Gil, T. A. Brunner, IBM Thomas J. Watson Research Ctr.; D. A. Corliss, C. A. Fonseca, J. Tirapu, IBM Microelectronics Div.; K. E. Petrillo, IBM Thomas J. Watson Research Ctr.; P. Vanoppen, ASML Netherlands B.V. (Netherlands) . . . .[6154-05]

10:50 am: **The next phase for immersion lithography,** H. Sewell, ASML US, Inc.; J. Mulkens, ASML Netherlands B.V. (Netherlands); D. C. McCafferty, L. Markoya, ASML US, Inc.; B. Streefkerk, ASML Netherlands B.V. (Netherlands); P. Gräupner, Carl Zeiss SMT AG (Germany) . .[6154-06]

11:10 am: **Immersion lithography robustness for the C065-nm node,** S. P. Warrick, Freescale Semiconductor, Inc. (France); R. Morton, Philips Semiconductors (France); A. Mauri, J. Chapon, STMicroelectronics (France); J. Belledent, Philips Semiconductors (France); W. E. Conley, Freescale Semiconductor, Inc.; K. D. Lucas, J. Gomez, Freescale Semiconductor, Inc. (France); C. Monget, STMicroelectronics (France); J. Gemmink, Philips Semiconductors (France) . . . .[6154-07]

11:30 am: **Current status and future prospect of immersion lithography,** S. Owa, H. Nagasaka, K. Nakano, Y. Ohmura, Nikon Corp. (Japan) . . . .[6154-08]

11:50 am: **Immersion specific defect mechanisms: findings and recommendations for their control,** M. K. Kocsis, Intel Corp. and IMEC (Belgium); D. Van Den Heuvel, M. Maenhoudt, D. Vangoidsenhoven, IMEC (Belgium); G. M. Wells, S. C. O'Brien, IMEC (Belgium) and Texas Instruments Inc.; N. Stepanenko, IMEC (Belgium) and Infineon Technologies (Germany); M. Benndorf, IMEC (Belgium) and Philips Research Labs. (Belgium); R. Gronheid, IMEC (Belgium); H. W. Kim, IMEC (Belgium) and Samsung Electronics Co. Ltd. (South Korea); S. Kishimura, IMEC (Belgium) and Matsushita Electric Industrial Co. (Japan); M. Ercken, F. Van Roey, W. Fyen, P. Foubert, IMEC (Belgium); R. Moerman, B. Streefkerk, ASML Netherlands B.V. (Netherlands) . . . .[6154-180]

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

SESSION 3

Conv. Ctr. J2 . . . . **Tues. 1:30 to 3:30 pm**
Hyper-NA and Polarization
Chairs: **Andrew Grenville**, SEMATECH, Inc.; **Akiyoshi Suzuki**, Canon Inc. (Japan)

1:30 pm: **Optical lithography at 1.85 NA through evanescent immersion imaging,** B. W. Smith, Y. Fan, Rochester Institute of Technology . . . .[6154-10]

1:50 pm: **Enabling the 45-nm node by hyper-NA polarized lithography,** W. P. de Boeij, H. van Greevenbrök, M. Klaassen, G. Swinkels, M. A. van de Kerkhof, K. van Ingen Schenau, L. de Winter, M. Wehrens, ASML Netherlands B.V. (Netherlands) . . . .[6154-11]

2:10 pm: **Effect of azimuthally polarized illumination imaging on device pattern beyond 45-nm node,** K. Ozawa, Sony Atsugi Technology Ctr. (Japan) and Nikon Corp. (Japan); B. Thunnakart, T. Kaneguchi, Sony Atsugi Technology Ctr. (Japan); I. Mita, Sony Corp. (Japan); A. Someya, Sony Atsugi Technology Ctr. (Japan); T. Nakashima, H. Nishinaga, Y. Mizuno, T. Matsuyama, M. Hamatani, Nikon Corp. (Japan) . . . . .[6154-12]

2:30 pm: **Experimental verification of PSM polarimetry: monitoring polarization at 193-nm high-NA with phase-shift masks,** G. R. McIntyre, A. R. Neureuther, Univ. of California/Berkeley; V. Vellanki, P. Reynolds, Benchmark Technologies . . . .[6154-13]

2:50 pm: **Polarization aberration analysis in optical lithography systems,** J. Kye, Advanced Micro Devices, Inc.; N. Yamamoto, Spansion LLC; G. R. McIntyre, Univ. of California/Berkeley; H. J. Levinson, Advanced Micro Devices, Inc. . . . .[6154-14]

3:10 pm: **High-NA polarized light lithography for 0.29-k1 process,** C. Park, H. Yang, D. Yim, Hynix Semiconductor Inc. (South Korea); S. Tseng, Y. Min, A. C. Chen, ASML Taiwan Ltd. (Taiwan) . . . .[6154-15]

Coffee Break . . . . 3:30 to 3:50 pm

Conference 6154

SESSION 12

Conv. Ctr. J2 . . . . **Thurs. 1:30 to 3:30 pm**
Developments in RET II
Chairs: **Geert Vandenberghe**, IMEC (Belgium); **HanKu Cho**,
SAMSUNG Electronics Co., Ltd. (South Korea)

1:30 pm: **Fast inverse lithography technology,** D. S. Abrams, L. Pang, A. Moore, Luminescent Technologies, Inc. . . . .[6154-55]

1:50 pm: **The improvement of DOF for sub-100-nm process by focus scan,** J. Kim, H. Yang, C. Park, D. Yim, Hynix Semiconductor Inc. (South Korea); Y. Min, A. C. Chen, S. Tseng, ASML Taiwan Ltd. (Taiwan) [6154-56]

2:10 pm: **Finding the right way: DFM versus area efficiency for 65-nm gate layer lithography,** C. S. Sarma, Infineon Technologies North America; S. Scheer, IBM Microelectronics Div.; K. Herold, Infineon Technologies North America; A. C. Thomas, IBM Microelectronics Div.; U. P. Schroeder, Infineon Technologies North America . . . .[6154-57]

2:30 pm: **Pushing the lithography limit: applying inverse lithography technology (ILT) at the 65-nm generation,** C. Hung, B. Zhang, E. G. Guo, Semiconductor Manufacturing International Corp. (China); L. Pang, Y. Liu, K. Wang, Luminescent Technologies, Inc. . . . .[6154-58]

2:50 pm: **Improvement of shot uniformity on a wafer by controlling transmittance distribution of a photomask using laser,** M. Lee, S. Choi, C. Jeon, D. Kim, W. Han, Samsung Electronics Semiconductor (South Korea); S. V. Oshemkov, V. J. Dmitriev, E. Zait, G. Ben-Zvi, UC Laser Technologies Ltd. (Israel) . . . .[6154-59]

3:10 pm: **Patterning 45-nm node flash/DRAM contact hole mask with hyper-NA immersion lithography and optimized illumination,** T. Chen, D. J. Van Den Broeke, S. D. Hsu, ASML MaskTools Inc.; S. Park, G. Berger, T. H. Coskun, ASML MaskTools; J. F. Chen, ASML MaskTools Inc.; J. De Vocht, ASML MaskTools; J. C. Park, K. Gronlund, R. J. Socha, ASML MaskTools Inc.; J. Finder, A. Engelen, ASML Netherlands B.V. (Netherlands) . . . .[6154-60]

Coffee Break . . . . 3:30 to 3:50 pm

SESSION 13

Conv. Ctr. J2 . . . . **Thurs. 3:50 to 5:30 pm**
Image and Process Modeling II
Chairs: **Yao-Ching Ku**, Taiwan Semiconductor Manufacturing Co., Ltd. (Taiwan); **Peter Dirksen**, Philips Research Labs. (Netherlands)

3:50 pm: **Calibrating OPC models using asymmetric structures,** L. Depre, C. Cork, Synopsys, Inc. (France); Q. Yan, Synopsys, Inc.; S. Baron, STMicroelectronics (France) . . . .[6154-61]

4:10 pm: **Lithography process optimization using linear superposition of commonly available illumination modes,** Y. Yudhistira, Chartered Semiconductor Manufacturing Ltd.; M. M. Crouse, S. Siddiqui, H. Matis, IBM Microelectronics Div. . . . .[6154-63]

4:30 pm: **Mask topography effect on OPC at hyper-NA lithography,** S. Lee, I. Kim, S. Lee, SAMSUNG Electronics Co., Ltd. (South Korea) . . . .[6154-64]

4:50 pm: **In quest of predictive lithography simulation,** C. K. Kalus, SIGMA-C GmbH (Germany) . . . .[6154-65]

5:10 pm: **Predictive focus exposure matrix modeling for full-chip lithography applications,** L. Chen, Y. Cao, M. Preil, H. Liu, W. Shao, M. Feng, J. Ye, Brion Technologies, Inc. . . . .[6154-66]

✔ Posters- Thursday
The following posters will be displayed all day Thursday. Authors will be present during the formal poster session Thursday evening between 5:30 and 8:00 pm in the Convention Center, Hall 3. Authors may set-up their posters between 9:00 am and 5:00 pm on Thursday.

Developments in RET

✔ **Resolution enhancement technology using an apodization theory application,** S. Park, Hanyang Univ. (South Korea); S. Shim, N. Choi, J. Kim, Seoul National Univ. (South Korea); H. K. Oh, Hanyang Univ. (South Korea) . . . .[6154-80]

✔ **Performance study of chromeless phase lithography mask for the 65-nm node and beyond,** Y. Kojima, T. Ohshima, K. Chiba, T. Konishi, Toppan Printing Co., Ltd. (Japan) . . . .[6154-81]

✔ **Optimization of chromeless phase mask by comparing scattering bars with zebra patterns,** H. Kang, D. Shin, H. Jeong, Hanyang Univ. (South Korea); S. Kim, Samsung Electronics Semiconductor (South Korea); C. Lee, Samsung Electronics Co., Ltd. (South Korea); H. Oh, Hanyang Univ. (South Korea) . . . .[6154-82]

✔ **Application of super-diffraction lithography (SDL) for an actual device fabrication,** S. Nakao, I. Kanai, A. Nakae, J. Sakai, K. Narimatsu, K. Suko, Renesas Technology Corp. (Japan) . . . . .[6154-84]

✔ **DOF enhancement for contact holes by using Nikon's CDP option and its introduction into production,** L. Armellin, V. E. Dureuil, L. Nuel, Altis Semiconductor (France); V. Salvetat, Nikon Precision Europe GmbH (France); W. W. Meier, Nikon Precison Europe GmbH (Germany) . . . .[6154-85]

✔ **Model-based placement and optimization of subresolution assist features,** L. S. Melvin III, B. D. Painter, L. D. Barnes, Synopsys, Inc. . . . .[6154-86]

✔ **The investigation of 193-nm CPL 3D topology mask effect on wafer process performance,** Y. F. Cheng, Y. L. Chou, C. H. Yang, United Microelectronics Corp. (Taiwan) . . . .[6154-87]

✔ **Robust double-exposure flow for memory,** J. W. Park, Mentor Graphics Corp.; Y. Kang, I. Kim, S. Suh, SAMSUNG Electronics Co., Ltd. (South Korea) . . . .[6154-88]

✔ **Multiple focus plane exposure in 248-nm lithography to improve the focus latitude and CD controllability of 110-nm contact**, S. Jung, E. T. C. Yang, T. H. Yang, K. Chen, J. Ku, C. Lu, Macronix International Co., Ltd. (Taiwan) . . . . [6154 89]

✔ **Contact-hole process window improved by assistant features with FLEX function on KrF,** C. Chiang, C. Shih, W. B. Wu, Nanya Technology Corp. (Taiwan) . . . .[6154-90]

Exposure Tools, Subsystems, and Materials

✔ **One method to monitor Nikon scanner PPD function and some reticle surface particle detect machine,** W. Yang, Y. Lin, C. Huang, United Microelectronics Corp. (Taiwan) . . . .[6154-91]

✔ **LIS design approach for optimum efficiency,** L. Ryzhikov, Y. Vladimirsky, ASML Netherlands B.V. . . . .[6154-92]

✔ **Active spectral control of DUV-light sources for OPE minimization,** W. J. Dunstan, R. N. Jacques, R. J. Rafac, R. Rao, F. Trintchouk, Cymer, Inc. . . . .[6154-94]

✔ **Imaging interferometric lithography 244-nm testbed,** S. Smolev, A. Frauenglass, A. Biswas, S. R. J. Brueck, The Univ. of New Mexico . . . .[6154-95]

✔ **Effects of beam pointing instability on two-beam interferometric lithography,** Y. Fan, A. Bourov, B. W. Smith, Rochester Institute of Technology . . . .[6154-96]

✔ **Beam shaping elements with polarizing functionality for 193 nm,** P. Triebel, M. Cumme, D. Mademann, M. Schrenk, P. W. Weissbrodt, JENOPTIK Laser, Optik, Systeme GmbH (Germany) . . . .[6154-97]

✔ **High-throughput homogenizers for hyper-NA illumination systems,** L. Aschke, H. Ganser, M. Darscht, Y. Miklyaev, D. Hauschild, LIMO Lissotschenko Mikrooptik GmbH (Germany) . . . .[6154-98]

✔ **GT40A: durable 45-W ArF injection-lock laser light source for dry/ immersion lithography,** T. Yamazaki, Gigaphoton Inc. (Japan)[6154-99]

✔ **Structure and optical property of large-size CaF2 single crystals grown by the CZ method,** I. Masada, T. Nawata, T. Date, T. Mabuchi, E. Nishijima, Tokuyama Corp. (Japan); T. Fukuda, Tohoku Univ. (Japan); Y. Inui, Tokuyama Corp. (Japan) . . . . [6154-100]

Image and Process Modeling

✔ **Benchmark of numerical versus analytical proximity curve calculations,** R. Köhle, C. Bodendorf, W. Hoppe, Infineon Technologies AG (Germany) . . . . [6154-102]

✔ **Evaluation of partial coherent imaging using the transfer function in immersion lithography,** M. Jung, E. Kwak, H. Oh, Hanyang Univ. (South Korea); S. Shin, N. Choi, J. Kim, Seoul National Univ. (South Korea) . . . . [6154-103]

✔ **Heterogeneous diffusion model for simulation of resist process,** C. Lim, J. Park, S. Kim, H. Kim, S. Moon, Hynix Semiconductor Inc. (South Korea) . . . .[6154-104]

✔ **Three-dimensional simulation of mask-induced polarization effect on imaging in immersion lithography,** E. Kwak, K. D. Kim, M. R. Jung, H. K. Oh, Hanyang Univ. (South Korea) . . . .[6154-105]

✔ **Simulation of dense contact hole (k1=0.35) arrays with 193-nm immersion lithography,** A. M. Biswas, A. K. Raub, S. R. J. Brueck, The Univ. of New Mexico; Y. A. Borodovsky, G. A. Allen, Intel Corp. . . . .[6154-106]

✔ **How to obtain accurate resist simulations in very low-k1 era,** T. Chiou, ASML Taiwan Ltd. (Taiwan); C. Park, J. Choi, Hynix Semiconductor Inc. (South Korea); Y. Min, ASML Taiwan Ltd. (South Korea); S. G. Hansen, ASML US, Inc.; S. Tseng, A. C. Chen, ASML Taiwan Ltd. (Taiwan); D. Yim, Hynix Semiconductor Inc. (South Korea) . . . .[6154-107]

✔ **Intensive 2D SEM model calibration for 45 nm and beyond,** G. E. Bailey, T. Do, Y. Granik, I. Kusnadi, Mentor Graphics Corp.; A. Estroff, IMEC . . . .[6154-109]

✔ **Methods for benchmarking photolithography simulators: part IV,** T. Graves, M. D. Smith, KLA-Tencor Corp. . . . .[6154-110]

✔ **The capability of a 1.3-NA microstepper using 3D EMF mask simulations,** W. Conley, Freescale Semiconductor, Inc.; J. J. Meute, G. K. Rich, SEMATECH, Inc.; J. E. Webb, D. S. Goodman, R. L. Maier, Corning Tropel Corp. . . . .[6154-111]

Image Quality and Characterization

✔ **PSF-based flare model and procedures for simulation,** W. B. Howard, M. Smith, KLA-Tencor Corp. . . . .[6154-112]

✔ **Experimental measurement of photoresist modulation curves,** A. Bourov, B. W. Smith, M. Slocum, E. C. Piscani, Amphibian Systems . . . .[6154-113]

✔ **Phase-shift focus monitoring techniques,** W. R. Roberts, M. M. McQuillan, Infineon Technologies . . . .[6154-114]

✔ **Study of polarized aberration measurement using SPIN method,** Y. Shiode, T. Ebihara, Canon Inc. (Japan) . . . .[6154-115]

✔ **Effect of lens aberrations on OPC model accuracy for low-k1 lithography process,** J. Ahn, C. Jeong, J. Park, J. Choi, J. Lee, MagnaChip Semiconductor, Ltd. (South Korea) . . . .[6154-116]

✔ **Fractal model applied wavefront aberration for the expression of local flare,** T. Nakashima, T. Ogata, Nikon Corp. (Japan) . . .[6154-117]

✔ **Analysis of the combined impact of the laser spectrum, illuminator miscalibrations, and lens aberrations on the 90-nm technology node imaging with off-axis illuminations,** S. Loi, U. Iessi, STMicroelectronics (Italy) . . . .[6154-118]

✔ **Flare effect of different shape of illumination apertures in 193-nm optical lithography system,** Y. Yun, J. Moon, H. Jeon, J. Kim, K. Kim, DongbuAnam Semiconductor Inc. (South Korea) . . . .[6154-119]

OPC and Implementation

✔ **Intelligent model-based OPC,** W. Huang, Taiwan Semiconductor Manufacturing Co., Ltd. (Taiwan) . . . .[6154-121]

✔ **Maximizing test pattern coverage for OPC model build,** A. Khoh, S. Quek, Y. Foong, J. Cheng, B. Choi, Chartered Semiconductor Manufacturing Ltd. (Singapore) . . . .[6154-123]

✔ **A novel approach for full-chip SRAF printability check modeling performance,** C. Hung, Q. Liu, Semiconductor Manufacturing International Corp. (China); L. Zhang, Mentor Graphics Corp. [6154-124]

✔ **A methodology to take LER effect into OPC modeling algorithm,** C. Hung, Q. Liu, Z. Deng, Semiconductor Manufacturing International Corp. (China); L. Zhang, Mentor Graphics Corp. (China) . . . .[6154-125]

✔ **Line end optimization through optical proximity correction: a case study,** D. Chou, Mentor Graphics Corp.; K. McAllister, Integrated Device Technology, Inc. . . . . [6154-126]

✔ **Efficient OPC model generation and verification for focus variation,** Y. H. Park, SAMSUNG Electronics Co., Ltd. (South Korea) . .[6154-128]

✔ **Model-based OPC for 65-nm node random size contact hole with SRAF,** C. Huang, L. Yeh, C. Shih, Nanya Technology Corp. (Taiwan); H. Liao, Mentor Graphics Taiwan, Ltd. (Taiwan); C. Yeh, Nanya Technology Corp. (Taiwan) . . . .[6154-129]

✔ **Using reconfigurable OPC to improve quality and throughput of sub-100-nm IC manufacturing,** P. LoPresti, R. D. Morse, Aprio Technologies, Inc. . . . .[6154-131]

✔ **Application of CM0 resist model to OPC and verification,** Y. Granik, N. B. Cobb, D. Medvedev, Mentor Graphics Corp. . . . .[6154-132]

✔ **Verifying high-NA polarization OPC treatment on wafer,** R. E. Schlief, Infineon Technologies North America; R. Pforr, M. Hennig, J. Thiele, C. T. Bodendorf, Infineon Technologies AG (Germany); M. Hoepfl, Nikon Precision Europe GmbH (Germany) . . . .[6154-133]

✔ **Improvements in post-OPC data constraints for enhanced process corrections,** R. L. Burns, Y. Cui, Z. Zhao, I. Stobert, IBM Microelectronics Div.; P. J. LaCour, K. Madkour, A. Yehia, M. Gheith, Mentor Graphics Corp. . . . .[6154-134]

✔ **Fast and low-complexity model-based optical proximity correction and phase-shift mask design,** A. A. Poonawala, P. Milanfar, Univ. of California/Santa Cruz . . . .[6154-135]

✔ **Integration the retical systematic CD errors into an OPC modeling and correction,** G. Han, S. M. Mansfield, A. A. Krasnoperova, IBM Microelectronics Div. . . . .[6154-136]

✔ **Simulation-based post-OPC verification to enhance process window, citical failure analysis, and yield,** J. Kang, J. Choi, S. Park, K. Yun, Y. Lee, K. Kim, DongbuAnam Semiconductor Inc. (South Korea) . . . .[6154-137]

✔ **Mask process variation induced OPC accuracy in sub-90-nm technology node,** S. Park, Y. Shim, J. Kang, J. Choi, K. Yoon, Y. Lee, K. Kim, DongbuAnam Semiconductor Inc. (South Korea) . . . . .[6154-138]

✔ **Process window OPC for reduced process variability and enhanced yield,** A. A. Krasnoperova, J. A. Culp, I. Graur, S. M. Mansfield, IBM Microelectronics Div.; P. J. LaCour, H. A. M. Maaty Omar, Mentor Graphics Corp. . . . .[6154-139]

✔ **Layout 'hot spots' for advancing optical technologies,** J. A. Holwill, G. R. McIntyre, W. J. Poppe, A. R. Neureuther, Univ. of California/ Berkeley . . . .[6154-140]

✔ **Building a computational model for process proximity correction,** G. Perçin, H. Huang, F. X. Zach, A. Sezginer, Invarium Inc. . .[6154-141]

Optimization, Control, and Performance

✔ **Enhancing DRAM process window with inverse lithography technology (ILT),** C. Chu, B. Tsao, K. Chiou, S. Lee, J. Huang, ProMOS Technologies (Taiwan); Y. Liu, L. Pang, Luminescent Technologies, Inc. . . . .[6154-142]

✔ **A systematic study of the "dip" in the CD through-pitch curve for low-k1 processes,** J. Zhu, Q. Wu, Shanghai Hua Hong NEC Electronics Co. Ltd. (China) . . . .[6154-143]

✔ **High-NA illumination affects the hard mask and antireflection layer optimization,** V. Huang, Macronix International Co., Ltd. (Taiwan) . . . .[6154-144]

✔ **Application of aberration optimization for specific pattern using Nikon's TAO method,** W. W. Meier, Nikon Precision Europe GmbH (Germany); G. Weirauch, Infineon Technologies (Germany); M. J. Hoepfl, Nikon Precision Europe GmbH (Germany); A. Jahnke, Infineon Technologies (Germany) . . . .[6154-145]

✔ **Novel high-refractive index fluids for 193-nm immersion lithography,** J. J. S. Santillan, A. Otoguro, T. Itani, K. Fujii, Semiconductor Leading Edge Technologies, Inc. (Japan); A. Kagayama, T. Nakano, N. Nakayama, H. Tamatani, S. Fukuda, Mitsui Chemicals, Inc. (Japan) . . . . [6154-183]

✔ **Development of cleaning process for immersion lithography,** C. Chang, D. Yu, J. C. H. Lin, B. J. Lin, Taiwan Semiconductor Manufacturing Co., Ltd. (Taiwan) . . . . [6154-184]

Friday 24 February

SESSION 14

Conv. Ctr. J2 . . . . **Fri. 8:00 to 10:00 am**
Advanced Exposure Systems and Components I
Chairs: **Bruce W. Smith**, Rochester Institute of Technology; **Koichi Matsumoto**, Nikon Corp. (Japan)

8:00 am: **Mass production level ArF immersion exposure tool,** M. Okumura, J. Ishikawa, M. Hamatani, M. Nei, Nikon Corp. (Japan) [6154-67]

8:20 am: **Development status of a 193-nm immersion exposure tool,** T. Chibana, H. Nakano, H. Hata, N. Kodachi, N. Sano, Y. Matsuoka, Y. Kawasaki, S. Mori, K. Chiba, Canon Inc. (Japan) . . . . [6154-68]

8:40 am: **Immersion lithography with an ultrahigh-NA in-line catadioptric lens and a high-transmission flexible polarization illumination system,** H. C. Jasper, T. M. Modderman, M. A. van de Kerkhof, C. Wagner, W. P. de Boeij, P. Vanoppen, ASML Netherlands B.V. (Netherlands); B. Kneer, Carl Zeiss AG (Germany) [6154-69]

9:00 am: **Early learning on hyper-NA imaging using two-beam immersion interference,** E. Hendrickx, M. Op de Beeck, R. Gronheid, J. Versluijs, L. Van Look, M. Ercken, IMEC (Belgium) . . . . [6154-70]

9:20 am: **SLM lithography: printing to below k1=0.30 without previous OPC processing,** T. Sandstrom, I. Ivonin, H. Martinsson, Micronic Laser Systems AB (Sweden) . . . . [6154-71]

9:40 am: **Liquid immersion lithography at 193 nm using a high-NA achromatic interferometer,** A. Charley, STMicroelectronics (France); A. Lagrange, O. Lartigue, P. Bandelier, CEA-LETI (France); M. Derouard, STMicroelectronics (France); P. Schiavone, CEA Grenoble (France) . . . . [6154-72]

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

Best Student Paper Award
Conv. Ctr. J2 . . . . **Fri. 10:20 to 10:30 am**
Sponsored by CYMER

SESSION 15

Conv. Ctr. J2 . . . . **Fri. 10:30 am to 12:30 pm**
Advanced Exposure Systems and Components II
Chairs: **Akiyoshi Suzuki**, Canon Inc. (Japan); **Kafai Lai**, IBM Microelectronics Div.

10:30 am: **Catadioptric lens design: the breakthrough to hyper-NA optics,** B. Kneer, Carl Zeiss AG (Germany); H. Feldmann, R. B. Garreis, P. Gräupner, R. Kläsges, Carl Zeiss SMT AG (Germany) . . . . [6154-75]

10:50 am: **A hyper-NA projection lens for ArF immersion exposure tool,** H. Ikezawa, Nikon Corp. (Japan) . . . . [6154-73]

11:10 am: **What determines the ultimate resolution? The critical relationship between exposure tools and photoresists,** T. Honda, Y. Kishikawa, Y. Iwasaki, A. Ohkubo, M. Kawashima, M. Yoshii, Canon Inc. (Japan) . . . . [6154-74]

11:30 am: **XLA-300: the fourth-generation ArF MOPA light source for immersion lithography,** F. Trintchouk, T. Ishihara, W. D. Gillespie, R. M. Ness, R. Bergstedt, C. J. Wittak, R. R. Perkins, Cymer, Inc. . . . . [6154-76]

11:50 am: **A new on-machine measurement system to measure wavefront aberrations of projection optics with hyper NA,** Y. Ohsaki, T. Mori, S. Koga, M. Ando, K. Yamamoto, T. Tezuka, Canon Inc. (Japan) . . . . [6154-77]

12:10 pm: **High-power injection-lock 6-kHz 60-W laser for ArF dry/wet lithography,** H. Mizoguchi, Gigaphoton Inc. (Japan) . . . . [6154-78]

Courses of Related Interest

Find full Course descriptions on pages 41-64.

Thursday 23 February 2006 • Proceedings of SPIE Vol. 6155

Data Analysis and Modeling for Patterning Control III

Conference Chair: **Iraj Emami**, Advanced Micro Devices, Inc.

Cochairs: **Christopher P. Ausschnitt**, IBM Corp.; **Kenneth W. Tobin, Jr.**, Oak Ridge National Lab.

Program Committee: **Ariel Ben-Porath**, Applied Materials (Israel); **Carol A. Boye**, IBM Corp.; **Stephen J. Buffat**, Nantero, Inc.; **David A. Crow**, INFICON; **Merritt Funk**, Tokyo Electron America, Inc.; **Matthew Hankinson**, KLA-Tencor Corp.; **Martin A. Hunt**, nLine Corp.; **Charles E. May**, LSI Logic Corp.; **Purabi Mazumdar**, National Institute of Standards and Technology; **James R. Moyne**, Brooks Automation; **Sukesh Patel**, Blue Control Technologies; **Bhanwar Singh**, Advanced Micro Devices, Inc.; **Andrew Skumanich**, Applied Materials, Inc.; **Costas J. Spanos**, Univ. of California/Berkeley; **Anthony J. Toprac**, A. Toprac Consultancy Inc.

Thursday 23 February

Opening Remarks
Conv. Ctr. C1 . . . . **Thurs. 8:10 to 8:20 am**
Chair: **Iraj Emami**, Advanced Micro Devices, Inc.

SESSION 1

Conv. Ctr. C1 . . . . **Thurs. 8:20 to 10:00 am**
Modeling
Chair: **Martin A. Hunt**, nLine Corp.

8:20 am: **Criteria for selecting reliable statistically calibrated lithographic process models,** Q. Yan, J. Shiely, Synopsys, Inc. [6155-01]

8:40 am: **Process influence study on optical model generation during model-based OPC development,** C. Lim, Infineon Technology AG (Germany); V. Temchenko, R. Wildfeuer, U. Mierau, S. Schmidt, Infineon Technologies AG (Germany); M. Niehoff, Mentor Graphics Corp. (Germany) . . . . [6155-02]

9:00 am: **Dry-etch proximity function for model-based OPC beyond 65-nm node,** S. Sato, K. Ozawa, F. Uesawa, Sony Corp. (Japan) . . [6155-03]

9:20 am: **Hyper-NA model validation for the 45-nm node,** P. J. M. Van Adrichem, Synopsys, Inc.; S. Palmer, SEMATECH, Inc.; M. Bai, Synopsys, Inc. . . . . [6155-04]

9:40 am: **Multivariate visualization techniques in statistical process monitoring and their applications to semiconductor manufacturing,** P. He, Spansion LLC . . . . [6155-05]

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

SESSION 2

Conv. Ctr. C1 . . . . **Thurs. 10:30 am to 12:10 pm**
APC
Chair: **Charles E. May**, LSI Logic Corp.

10:30 am: **Design and use of multi-dependent error analysis APC system,** J. de Caunes, J. van Herk, Philips Semiconductors (France); S. P. Warrick, Freescale Semiconductor, Inc. (France); B. Le Gratiet, Philips Semiconductors (France); J. Chapon, C. Monget, STMicroelectronics (France); J. Gemmink, Philips Semiconductors (France) . . . . [6155-06]

10:50 am: **Dynamic generation of controller groups to cascade lithography process control parameters in a semiconductor manufacturing facility,** C. Gould, A. Singhal, Infineon Technologies AG . . . . [6155-07]

11:10 am: **Real-time spatial control of steady-state wafer temperature during thermal processing in microlithography,** A. E. B. Tay, W. K. Ho, N. Hu, National Univ. of Singapore (Singapore); K. Tsai, Intel Corp.; Y. Zhou, Institute of Chemical and Engineering Sciences (Singapore) . . . . [6155-08]

11:30 am: **Advanced process control of poly-silicon gate critical dimensions,** P. J. Rudolph, LSI Logic Corp. . . . . [6155-09]

11:50 am: **Test structures for measuring micron-scale gate length spatial correlation,** P. D. Friedberg, W. Cheung, C. J. Spanos, Univ. of California/Berkeley . . . . [6155-10]

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

SESSION 3

Room: Conv. Ctr. A2 . . . . **Thurs. 1:30 to 3:10 pm**
Joint Session with conference 6152 on CD Control
Chairs: **Purabi Mazumdar**, National Institute of Standards and Technology; **Chas N. Archie**, IBM Corp.

1:30 pm: **CD-SEM image processing-based process window metrology**, C. J. Gould, Infineon Technologies Corp. . . . . [6155-11]

1:50 pm: **In-line CD metrology with combined use of scatterometry and CD-SEM**, M. Asano, T. Ikeda, T. Koike, H. Abe, Toshiba Corp. (Japan) . . . . [6152-69]

2:10 pm: **Full-field exposure control implications of the mask error function**, T. E. Zavecz, TEA Systems Corp. . . . . [6155-12]

2:30 pm: **Scatterometry measurements of line-end shortening structures for focus-exposure monitoring**, W. D. Mieher, KLA-Tencor Corp.; Y. F. Cheng, J. W. Sun, W. K. Hung, B. S. Lin, United Microelectronics Corp. (Taiwan); S. Fu, M. Chiu, KLA-Tencor Corp. (Taiwan); T. G. Dziura, KLA-Tencor Corp. . . . . [6152-70]

2:50 pm: **Back end of line metrology control applications using scatterometry**, L. C. Towidjaja, C. J. Raymond, M. Littau, D. L. Forman, S. G. Hummel, Accent Optical Technologies . . . . [6152-90]

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

SESSION 4

Room: Conv. Ctr. A2 . . . . **Thurs. 3:40 to 5:00 pm**
Joint Session with conference 6152 on CD and Overlay Control
Chairs: **Andrew Skumanich**, Applied Materials, Inc.; **John A. Allgair**, International SEMATECH Manufacturing Initiative

3:40 pm: **Layout optimization for multilayer overlay targets**, L. A. Binns, Accent Optical Technologies, Ltd. (United Kingdom); N. P. Smith, Accent Optical Technologies, Ltd. (Taiwan); C. P. Ausschnitt, J. L. Morningstar, W. Muth, J. Schneider, R. Yerdon, IBM Microelectronics Div. . . . . . . [6155-14]

4:00 pm: **Compensating measured intra-wafer ring oscillator stage delay with intra-wafer exposure dose corrections**, S. Verhaegen, A. Nackaerts, IMEC (Belgium); M. V. Dusa, ASML MaskTools Inc.; R. Carpaij, ASML Netherlands B.V. (Netherlands); G. Vandenberghe, IMEC (Belgium); J. M. Finders, ASML Netherlands B.V. (Netherlands) . . . . [6152-71]

4:20 pm: **Alignment performance monitoring for ASML systems**, W. Chung, V. Temchenko, T. Hauck, S. Schmidt, Infineon Technologies AG (Germany) . . . . [6155-15]

4:40 pm: **Complete characterization of poly-gate critical dimensions through in-situ detection of aerial images in a scanner**, H. Chang, J. Chen, C. Chen, J. Lin, C. Lai, T. Gau, B. Lin, Taiwan Semiconductor Manufacturing Co., Ltd. (Taiwan); M. J. Gassner, Y. Cao, M. E. Preil, Brion Technologies, Inc. . . . . [6152-72]

✔ Posters-Thursday

The following posters will be displayed all day Thursday. Authors will be present during the formal poster session Thursday evening between 5:30 and 8:00 pm in the Convention Center, Hall 3. Authors may set-up their posters between 9:00 am and 5:00 pm on Thursday.

✔ **Advanced exposure and focus control by proximity profile signature matching,** W. Zhou, A. See, J. Yu, United Microelectronics Corp. (Singapore) . . . . [6155-16]

✔ **Matching poly-layer ADI and AEI process window by using ADI index,** W. Zhou, Z. Zou, A. See, United Microelectronics Corp. (Singapore) . . . . [6155-17]

✔ **Statistical shape analysis applied to microlithography,** A. Micheletti, Univ. degli Studi di Milano (Italy); E. Severgnini, STMicroelectronics (Italy); F. Terragni, Univ. degli Studi di Milano (Italy) and STMicroelectronics (Italy); S. S. Trovati, M. Vasconi, STMicroelectronics (Italy) . . . . [6155-18]

✔ **Evaluation of an advanced process control solution to detect wafer positioning issues within the hot and cold modules of a lithography track,** O. Guillaume, M. Bouchardy, Altis Semiconductor (France) . . . . [6155-19]

✔ **Optical anisotropy approach in spectroscopic ellipsometry to determine the CD of contact-hole patterns,** J. Kyoung, H. Cheon, S. Noh, Hanyang Univ. (South Korea) . . . . [6155-21]

✔ **Improvement of OPC accuracy for 65-nm node contact using KIF,** T. H. Wu, United Microelectronics Corp. (Taiwan) . . . . [6155-22]

✔ **Predictive modeling for the control of consumable optics in a lithographic system,** C. T. Conley, Nikon Precision Inc. . . . . . [6155-23]

✔ **Consideration of components impacting polarization, including their measurement and qualification,** S. D. Slonaker, Nikon Precision Inc.; J. Kye, Advanced Micro Devices, Inc.; G. R. McIntyre, Univ. of California/Berkeley . . . . [6155-24]

✔ **Combined use of X-ray reflectometry and spectroscopic ellipsometry for characterization of the optical properties of very thin films,** J. P. Cain, Advanced Micro Devices, Inc.; S. Robie, Spansion LLC; H. K. Bolla, Q. Zhang, B. Singh, I. Emami, Advanced Micro Devices, Inc. . . . . [6155-25]

Courses of Related Interest

Find full Course descriptions on pages 41-64.

SC105 **CD Metrology and Image Formation in the Scanning Electron Microscope (SEM)** - (Wells, Postek) - Sunday, 8:30 am to 5:30 pm

SC111 **Lithography Process Control** (Levinson) - Sunday, 8:30 am to 5:30 pm

SC116 **Lithographic Optimization: A Theoretical Approach** (Mack) - Sunday, 8:30 am to 5:30 pm

SC705 **Instruments and Methodologies for Accurate Metrology and Fleet Matching** (Archie, Banke) - Sunday, 8:30 am to 5:30 pm

SC778 **Introduction to Advanced Process Control (APC) - for Semiconductor Manufacturing** (Finn, Misra) - Sunday, 8:30 am to 5:30 pm

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Design and Process Integration for Microelectronic Manufacturing IV

Conference Chair: **Alfred K. K. Wong**, Magma Design Automation, Inc.

Cochair: **Vivek K. Singh**, Intel Corp.

Program Committee: **Victor V. Boksha**, HPL Technologies Inc.; **Juan Antonio Carballo**, IBM Corp.; **Hiroichi Kawahira**, Sony Corp. (Japan); **Lars W. Liebmann**, IBM Corp.; **Mark E. Mason**, Texas Instruments Inc.; **Kevin M. Monahan**, KLA-Tencor Corp.; **Christopher J. Progler**, Photronics, Inc.; **Michael L. Rieger**, Synopsys, Inc.; **John L. Sturtevant**, Mentor Graphics Corp.; **Dennis M. C. Sylvester**, Univ. of Michigan; **Jörg Thiele**, Infineon Technologies AG (Germany)

Thursday 23 February

Opening Remarks
Conv. Ctr. B1 . . . . **Thurs. 8:30 to 8:40 am**
Chair: **Alfred K. K. Wong**, Magma Design Automation

SESSION 1

Conv. Ctr. B1 . . . . **Thurs. 8:40 to 10:00 am**
Invited Session
Chair: **Alfred K. K. Wong**, Magma Design Automation

8:40 am: **Synergistic optimization of design and process for 65 nm and beyond** *(Invited Paper)***,** K. Warren, IBM Corp. . . . . [6156-01]

9:20 am: **Layout rule trend and impact upon CPU design** *(Invited Paper)***,** C. Webb, Intel Corp. . . . . [6156-02]

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

SESSION 2

Conv. Ctr. B1 . . . . **Thurs. 10:30 am to 12:10 pm**
Design-Manufacturing Interface
Chairs: **Lars W. Liebmann**, IBM Microelectronics Div.; **Michael L. Rieger**, Synopsys, Inc.

10:30 am: **Through-process modeling in a DfM environment,** S. M. Mansfield, G. Han, IBM Microelectronics Div.; A. Nouh, Mentor Graphics . . . . [6156-03]

10:50 am: **A genuine design manufacturability check for designers,** P. Hurat, M. L. Cote, C. Tsai, Clear Shape Technologies, Inc. . . . . . [6156-04]

11:10 am: **Annotated layout optimization,** J. Thiele, R. Koehle, B. Kuechler, Infineon Technologies AG (Germany) . . . . [6156-05]

11:30 am: **Silicon IP reuse standards for design for manufacturability,** J. A. Carballo, IBM Corp.; S. Sundareswaran, Freescale Semiconductor, Inc. . . . . [6156-06]

11:50 am: **Call for an industry standard for pattern transfer models for usage in OPC and design for manufacturability,** T. C. Roessler, W. Grimm, J. Thiele, Infineon Technologies AG (Germany) . . . . [6156-07]

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

SESSION 3

Conv. Ctr. B1 . . . . **Thurs. 1:30 to 4:40 pm**
Model-Based Layout Synthesis
Chairs: **John L. Sturtevant**, Mentor Graphics Corp.; **Jörg Thiele**, Infineon Technologies AG (Germany)

1:30 pm: **A heuristic method for statistical digital circuit sizing** *(Invited Paper)***,** S. P. Boyd, S. Kim, D. Patil, M. A. Horowitz, Stanford Univ. . . . . [6156-08]

2:10 pm: **Layout verification and optimization based on flexible design rules,** J. Yang, Univ. of Michigan; L. Capodieci, Advanced Micro Devices, Inc; D. M. Sylvester, Univ. of Michigan . . . . [6156-09]

2:30 pm: **Self-compensating design for reduction of timing and leakage sensitivity to systematic pattern dependent variation,** Y. Kim, Univ. of Michigan; P. Gupta, A. B. Kahng, Blaze-DFM Inc.; D. M. Sylvester, Univ. of Michigan . . . . [6156-10]

2:50 pm: **DFM: a practical layout optimization procedure for the improved process window for an existing 90-nm product,** J. Ho, Y. Wang, Xilinx, Inc.; Y. Hou, B. S. Lin, C. Yu, United Microelectronics Corp. (Taiwan); C. L. Ma, K. Wu, Anchor Semiconductor Inc. . . . . [6156-11]

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

3:40 pm: **CD analysis of advanced photolithography and its impact on critical design structures,** R. Seltmann, K. A. Romero, R. Stephan, G. Burbach, J. Paufler, D. Greenlaw, AMD Saxony Manufacturing GmbH (Germany) . . . . [6156-12]

4:00 pm: **Platform for collaborative DFM,** W. J. Poppe, A. R. Neureuther, Univ. of California/Berkeley; L. Capodieci, Advanced Micro Devices, Inc. . . . . [6156-13]

4:20 pm: **Lithography oriented DfM for 65 nm and beyond,** S. Kyoh, T. Kotani, A. Ikeuchi, S. Inoue, Toshiba Corp. (Japan) . . . . [6156-14]

SESSION 4

Conv. Ctr. B1 . . . . **Thurs. 4:40 to 5:40 pm**
Special Session on DFM Roadmap and Future Trends
Chairs: **Juan Antonio Carballo**, IBM Corp.; **Victor V. Boksha**, HPL Technologies Inc.

4:40 pm: **DFM requirements and solution roadmaps: the multi-layer approach,** J. A. Carballo, S. Nassif, IBM Corp. . . . . [6156-15]

5:00 pm: **ITRS evolution: from nodes to cycles,** P. A. Gargini, Intel Corp. . . . . [6156-16]

5:20 pm: **The nanotech impact on IC processing: near and long term,** J. N. Randall, R. Stallcup, T. Cavanaugh, Zyvex Corp. . . . . [6156-17]

Panel Discussion
Conv. Ctr. B1 . . . .**Thurs. 7:30 to 9:30 pm**
An Open Semiconductor Platform Model: Vision and Practical Issues
Chair: **Juan Antonio Carballo**, IBM Corp.

Spiraling design and manufacturing costs, coupled with an ultracompetitive, global electronics market, require unprecedented efficiency and adaptability from all players in the semiconductor value chain. To address this burning need, the integration of Design And Manufacturing increasingly targets common semiconductor platforms with full GDS compatibility across a host of multi-company fabs, with multiple claimed advantages, including sharing resources and increasing flexibility. Design and Process Integration techniques are critical to this approach, including lithography related and variability related capabilities. In this panel, we discuss the vision, pros and cons, and components of an open, collaborative semiconductor platform approach and the role of specific Design and Process Integration techniques in achieving the layout compatibility goal.

✔ Posters-Thursday

Chairs: **Kevin M. Monahan**, KLA-Tencor Corp.; **Christopher J. Progler**, Photronics, Inc.

The following posters will be displayed all day Thursday. Authors will be present during the formal poster session Thursday evening between 5:30 and 8:00 pm in the Convention Center, Hall 3. Author may set-up their posters between 9:00 am and 5:00 pm on Thursday.

✔ **Patterning with spacer for expanding the resolution limit of current lithography tool,** W. Jung, Hynix Semiconductor Inc. (South Korea) . . . .[6156-27]

✔ **OPC to improve lithographic process window,** J. C. Word V, K. Sakajiri, Mentor Graphics Corp. . . . .[6156-29]

✔ **Lithography window check before mask tape-out in sub-0.18-um technology,** M. Lu, D. King, F. Li, C. Q. Liang, Grace Semiconductor Manufacturing Corp. (China); L. S. Melvin III, Synopsys, Inc. .[6156-31]

✔ **Improving model-based OPC performance for sub-60-nm devices using real-source optical model,** S. Jung, I. Kim, Y. Kang, G. Yeo, S. Woo, H. Cho, J. Moon, SAMSUNG Electronics Co., Ltd. (South Korea) . . . .[6156-32]

✔ **Full-chip lithography manufacturability check for yield improvement,** Y. Huang, H. T. Tseng, S. Lin, C. C. Yu, United Microelectronics Corp. (Taiwan); C. Wang, H. Y. Liu, Brion Technologies, Inc. . . . .[6156-33]

✔ **Qualifying process models for OPC simulations,** M. Al-Imam, Mentor Graphics Corp.; S. M. Mansfield, IBM Microelectronics Div.; G. Han, IBM Corp.; R. S. Fathy, Mentor Graphics Corp. . . . .[6156-35]

✔ **Optimal segmentation of polygon edges,** A. Sezginer, B. Yenikaya, H. Huang, Invarium Inc. . . . .[6156-36]

✔ **The use of optical proximity correction to compensate for differences in N-type and P-type polysilicon,** L. S. Melvin III, J. H. Huang, Synopsys, Inc. . . . .[6156-37]

✔ **RET for the wire layer of a 3D memory,** Y. Chen, Matrix Semiconductor, Inc.; V. G. Kamat, A. Sezginer, Invarium Inc. .[6156-38]

✔ **Considerations of model-based OPC verification for sub-70-nm memory device,** C. Kim, J. Choi, B. M. Nam, D. Yim, Hynix Semiconductor Inc. (South Korea) . . . .[6156-39]

✔ **Simple method to verify OPC data based on exposure condition,** J. Moon, Y. Ahn, S. Oh, B. M. Nam, D. Yim, Hynix Semiconductor Inc. (South Korea) . . . .[6156-40]

✔ **Using design intent to qualify and control lithography manufacturing,** J. E. Vasek, B. Wilkinson, D. Smith, A. J. Reich, C. M. Garza, Sr., Freescale Semiconductor, Inc.; J. N. Wiley, J. Zhao, Brion Technologies, Inc.; Y. Nehmadi, Applied Materials, Inc.; Z. Abraham, Applied Materials (Israel) . . . .[6156-41]

✔ **High-accurate hybrid-OPC method for sub-60-nm memory device,** H. Yune, Hynix Semiconductor Inc. (South Korea) . . . .[6156-42]

✔ **The use of process models to enhance device performance through semiconductor design,** L. S. Melvin III, D. N. Zhang, M. Tran, Synopsys, Inc. . . . .[6156-44]

✔ **Across-field CD control improvement for critical level imaging: new applications for layout correction and optimization,** F. X. Zach, G. Percin, A. Sezginer, Invarium Inc.; J. K. Tyminski, S. D. Slonacker, S. P. Renwick, Nikon Precision Inc. . . . .[6156-48]

✔ **The influence of calibration pattern coverage for lumped parameter resist models on OPC convergence and accuracy,** M. Niehoff, Mentor Graphics (Germany); C. Bodendorf, Infineon Technologies AG (Germany); S. D. Shang, Mentor Graphics Corp. . . . .[6156-50]

✔ **Development of hot-spot fixer,** T. Kotani, S. Kyoh, S. Kobayashi, Toshiba Corp. (Japan); E. Morita, S. J. Klaver, T. Horiuchi, J. Peeters, S. Kuramoto, Takumi Technology Corp.; T. Inazu, A. Ikeuchi, Y. Urakawa, S. Inoue, Toshiba Corp. (Japan) . . . .[6156-51]

✔ **Method of propagation of variance for DFM,** J. Lei, Synopsys, Inc. . . . .[6156-53]

✔ **Modeling of non-uniform device geometries for post-lithography circuit analysis,** S. S. Shah, Univ. of Michigan; P. Gupta, Blaze DFM Inc.; Y. Kim, Univ. of Michigan; A. B. Kahng, Blaze DFM Inc.; D. M. Sylvester, Univ. of Michigan . . . .[6156-54]

✔ **Fast lithography simulation under focus variations for OPC and layout optimizations,** P. Yu, D. Z. Pan, The Univ. of Texas at Austin; C. A. Mack, KLA-Tencor Corp. . . . .[6156-55]

✔ **Lithography simulation-based full-chip design analyses,** P. Gupta, Blaze DFM Inc.; P. Sharma, Univ. of California/San Diego; A. B. Kahng, O. S. Nakagawa, S. Shah, Blaze DFM Inc. . . . .[6156-56]

✔ **Modeling edge placement error distribution in standard cell library,** P. Gupta, A. B. Kahng, Blaze DFM Inc.; S. V. Muddu, Univ. of California/San Diego; O. S. Nakagawa, Blaze DFM Inc. . . . .[6156-57]

✔ **Reticle enhancement verification for the 65-nm and 45-nm nodes,** K. D. Lucas, K. Patterson, Freescale Semiconductor, Inc. (France); A. Borjon, Philips Semiconductors (France); Y. Trouiller, CEA-LETI (France); O. R. Toublan, Mentor Graphics Corp. (France) . . . .[6156-58]

✔ **Challenges and solutions for trench lithography beyond 65-nm node,** Z. G. Lu, C. Ho, M. E. Mason, A. Anderson, R. Mckee, R. A. Jackson, C. Zhu, R. M. Terry, Texas Instruments Inc. . . . .[6156-60]

✔ **An ultra-thin Si-fin (8.6~11.4nm) FinFET fabricated with 193-nm scanner photolithography and thermal oxide hard mask etching techniques,** W. Liao, C. Tsai, United Microelectronics Corp. (Taiwan) . . . .[6156-61]

✔ **Improving asymmetric printing and low-margin using custom illumination for contact-hole lithography,** S. W. Jessen, R. M. Terry, M. E. Mason, S. C. O'Brien, R. A. Soper, W. J. Yarbrough, T. M. Wolf, Texas Instruments Inc. . . . .[6156-62]

✔ **Implementation of adaptive site optimization in model-based OPC for minimizing ripples,** M. S. Bahnas, M. Al-Imam, Mentor Graphics Corp. (Egypt); P. J. LaCour, A. Seoud, Mentor Graphics Corp.; H. Ragai, Ain Shams Univ. (Egypt) . . . .[6156-63]

✔ **Impact of process variation on 65-nm across-chip linewidth variation,** L. Hong, T. E. Brist, J. L. Sturtevant, P. J. LaCour, M. Niehoff, Mentor Graphics Corp. . . . .[6156-64]

✔ **Accurate OPC-model generation through use of a streamlined data flow incorporating automated test-structure layout and CD-SEM recipe generation,** M. E. Coles, L. W. Flanagin, B. M. Rathsack, S. Prins, J. W. Blatchford, Texas Instruments Inc. . . . .[6156-65]

✔ **Diblock copolymer directed self-assembly for CMOS device fabrication,** L. Chang, Stanford Univ. . . . .[6156-66]

Friday 24 February

SESSION 5

Conv. Ctr. B1 . . . . **Fri. 8:00 to 10:00 am**
Restricted Design Rules

Chairs: **Dennis M. Sylvester**, Univ. of Michigan; **Mark E. Mason**, Texas Instruments Inc.

8:00 am: **Maximization of layout printability/manufacturability by extreme layout regularity** *(Invited Paper)*, L. Pileggi, T. K. Jhaveri, S. Rovner, A. J. Strojwas, Carnegie Mellon Univ. . . . .[6156-18]

8:40 am: **Reducing DfM to practice: the lithography manufacturability assessor,** L. W. Liebmann, S. Mansfield, G. Han, J. Culp, J. Hibbeler, R. Y. Tsai, IBM Microelectronics Div. . . . .[6156-19]

9:00 am: **Design-friendly DFM rule,** M. Osawa, T. Minami, H. Futatsuya, S. Asai, Fujitsu Ltd. (Japan) . . . .[6156-20]

9:20 am: **Toward DFM: process worthy design and OPC through verification method using MEEF, TF-MEEF, and MTT,** I. Kim, Y. Kang, S. Jung, S. Suh, E. Lee, S. Woo, H. Cho, SAMSUNG Electronics Co., Ltd. (South Korea) . . . .[6156-21]

9:40 am: **Process-window-aware RET and OPC,** A. Sezginer, F. X. Zach, B. Yenikaya, H. Huang, Invarium Inc. . . . .[6156-22]

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

SESSION 6

Conv. Ctr. B1 . . . . **Fri. 10:30 to 11:50 am**
Analysis Techniques
Chairs: **Hiroichi Kawahira**, Sony Atsugi Technology Ctr. (Japan);
Vivek K. Singh, Intel Corp.

10:30 am: **Meeting critical gate linewidth control needs at the 65-nm node,** A. P. Mahorowala, IBM Thomas J. Watson Research Ctr.; S. D. Halle, IBM Corp.; A. H. Gabor, W. Chu, A. C. Barberet, D. J. Samuels, A. Y. Abdo, L. Y. Tsou, W. Yan, IBM Microelectronics Div.; S. Iseda, Sony Electronics Inc.; B. Dirahoui, IBM Microelectronics Div.; A. Nomura, Advanced Micro Devices, Inc.; K. S. Patel, I. Ahsan, F. Azam, G. D. .. Berg, IBM Microelectronics Div.; T. B. Faure, IBM Corp. . . . . [6156-23]

10:50 am: **Hot-spot management in ultra-low-k1 lithography,** K. Hashimoto, S. Usui, S. Nojima, S. Tanaka, E. Yamanaka, S. Inoue, Toshiba Corp. (Japan) . . . . [6156-24]

11:10 am: **Experimental verification of improved printability for litho-driven designs,** J. van Wingerden, L. Le Cam, Philips Research Labs. (Belgium); R. Wientjes, Philips Semiconductors (Netherlands); M. Benndorf, Philips Research Labs. (Belgium); Y. Trouiller, CEA-LETI (France); J. Belledent, R. D. Morton, Philips Semiconductors (France); Y. Aksenov, Philips Research Labs. (Belgium) . . . . [6156-25]

11:30 am: **From poly line to transistor: building BSIM models for non-rectangular transistors,** W. J. Poppe, Univ. of California/Berkeley; L. Capodieci, J. J. Wu, Advanced Micro Devices, Inc. . . . . [6156-26]

Closing Remarks
Conv. Ctr. B1 . . . . **Fri. 11:50 am to 12:00 pm**
Chair: **Vivek K. Singh**, Intel Corp.

Courses of Related Interest
Find full Course descriptions on pages 41-64.

SC112 **DfM in the Context of RET-enabled Lithography** (Liebmann, Wong) - Tuesday, 8:30 am to 12:30 pm

SC124 **Pushing the Limits: Optical Enhancement, Polarization, and Immersion Lithography** (Smith) - Sunday, 1:30 to 5:30 pm

SC505 **Data to Silicon: Understanding the Fundamentals of MDP, Frame Generation, RET and DFM** (Morse) - Wednesday 8:30 pm 5:30 pm

SC540 **Applying Optical Proximity Correction and Design for Manufacturability to Product Designs** (Capodieci, Lucas) - Sunday, 8:30 am to 5:30 pm

SC708 **Impact Of Variability On VLSI Circuits** (Puri, Heng) - Tuesday, 1:30 to 5:30 pm

SC778 **Introduction to Advanced Process Control (APC) - for Semiconductor Manufacturing** (Finn, Misra) - Sunday, 8:30 am to 5:30 pm

SC780 **Tracks 101: Microlithography Coat and Develop Basics** (Daggett) - Sunday, 8:30 am to 5:30 pm

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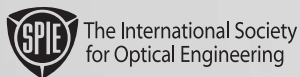[6154-13]S3,
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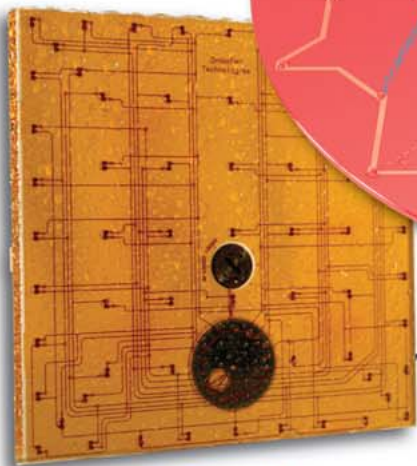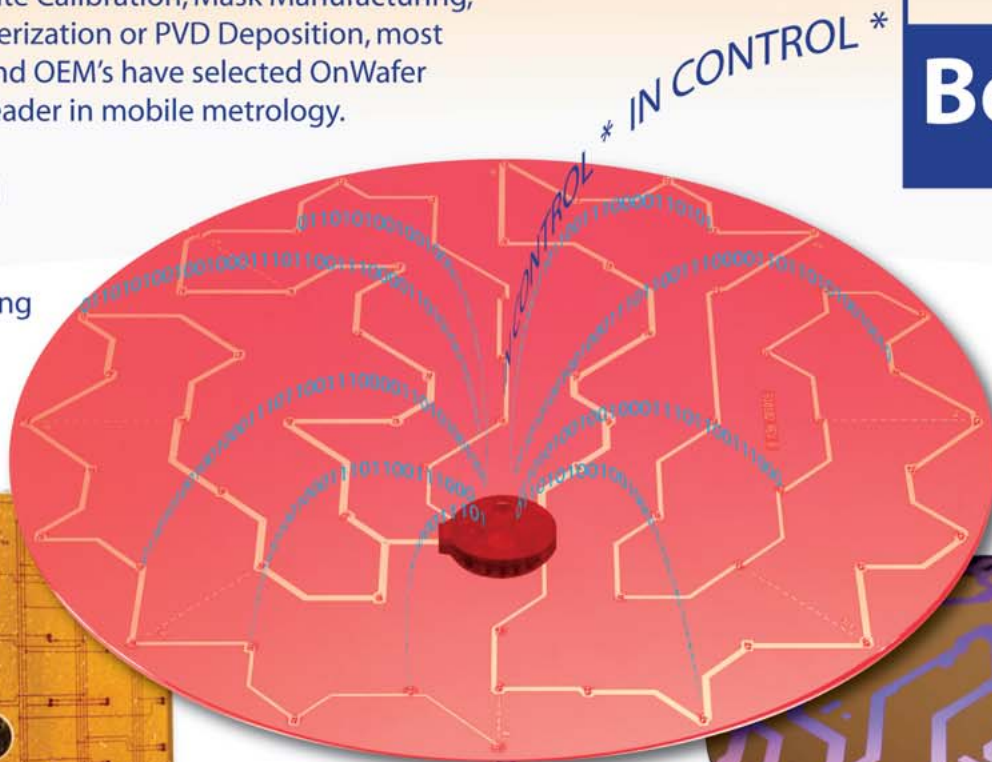Nonattendee member price: $600
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