2009 International Workshop On EUV Lithography

July 13-17, 2009

Sheraton Waikiki Beach ▪ Honolulu, Hawaii

Workshop Agenda

EUV LITHO, INC.

2009 International Workshop on EUV Lithography
Sheraton Waikiki Beach, Honolulu, Hawaii, USA
July 13-17, 2009

Workshop Agenda

(A) Lithography Education Series (July 13-14, 2009)

EUV Lithography
Kona Room, 8:00 AM -5:00 PM, Monday, July 13, 2009

Resist Materials for High Resolution Patterning
Kona Room, 6:00 PM-10:00 PM, Monday, July 13, 2009

EUV Physics
Kona Room, 8:00 AM – 12:00 PM, Tuesday, July 14, 2009

Introduction to Lithography
Kona Room, 1:00 PM – 5:00PM, Tuesday, July 14, 2009

(B) EUVL Workshop (July 14-17, 2009)

Tuesday, July 14, 2009

5:00 PM- 7:00 PM	Reception (Helumoa Playground)
4:00 PM- 6:00 PM	Registration & Speaker Prep (Lanai Room)

Wednesday, July 15, 2009

7:00 AM	–	8:00 AM	Continental Breakfast (Lanai Foyer)
8:00 AM	–	12:00 PM	Oral Presentations (Lanai Room)
12:00 PM	–	1:00 PM	Lunch (Honolulu Suite)
1:00 PM	–	4:30 PM	Oral Presentations (Lanai Room)
5:00 PM	–	6:30 PM	Poster Session and Reception (Honolulu Suite)
7:00 PM			Dinner (Rum Fire)

Thursday, July 16, 2009

7:00 AM	–	8:00 AM	Continental Breakfast (Lanai Foyer)
8:00 AM	–	12:00 PM	Oral Presentations and Panel Discussions (Maui Room)
12:00 PM	–	1:00 PM	Lunch (Honolulu Suite)
1:00 PM	–	4:00 PM	Oral Presentations (Maui Room)
4:00 PM			Adjourn

Friday, July 17, 2009

8:30 AM	– 10:30 AM	Breakfast and Steering Committee Meeting (Honolulu Suite)

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Sheraton Waikiki Beach, Honolulu, Hawaii, USA
July 13-17, 2009

Workshop Agenda

Monday, July 13, 2009

Lithography Education Series

EUV Lithography
by Vivek Bakshi (EUV Litho, Inc.), Patrick Naulleau (LBNL) and Jinho Ahn (Hanyang University)
Kona Room, 8:00 AM -5:00 PM, Monday, July 13, 2009

Resist Materials for High Resolution Patterning
by Cliff Henderson (Georgia Tech University)
Kona Room, 6:00 PM-10:00 PM, Monday, July 13, 2009

Tuesday, July 14, 2009

Lithography Education Series

EUV Physics
by David Attwood (LBNL)
Kona Room, 8:00 AM – 12:00 PM, Tuesday, July 14, 2009

Introduction to Lithography
by Chris Mack (Lithoguru.com)
Kona Room, 1:00 PM – 5:00 PM, Tuesday, July 14, 2009

Registration and Reception

5:00 PM- 7:00 PM	Reception (Helumoa Playground)
4:00 PM- 6:00 PM	Registration & Speaker Prep (Lanai Room)

Wednesday, July 15, 2009

8:00 AM Welcome and Introduction

Vivek Bakshi, EUV Litho, Inc.

8:10 AM Session 1: Keynote Presentations

Session Chair: David Attwood (LBNL / UC Berkeley)

R&D Status and Key Technical and Implementation Challenges for HVM Application of EUVL (KEY-1)
Sam Sivakumar
Intel Corporation

Readiness and Challenges in EUV Mask Technology for 32nm-HP Node and Beyond (KEY-2)
Han-Ku Cho and Seong-Sue Kim
Semiconductor R&D Center, Samsung Electronics Co., LTD.

9:10 AM Session 2: EUV Source Technology

Session Co-Chairs: Ndaona Chokani (ETHZ) and Padraig Dunne (UCD)

High Brightness Next Generation EUV Lithography Light Source (SOURCE-1, Invited)
Peter CHOI [1,2], Sergey V. ZAKHAROV [2+], Raul ALIAGA-ROSSEL [1], Aldrice BAKOUBOULA [1], Otman BENALI [1,2], Philippe BOVE [1], Michèle CAU [1], Grainne DUFFY [1], Sebastian FANT [2], Blair LEBERT [2], Ouassima SARROUKH [2], Edmund WYNDHAM [3], Clement ZAEPFFEL [2], Vasily S. ZAKHAROV [2*]
[1] *NANO-UV sas, 16-18 av du Québec, SILIC 705, Villebon/Yvette 91140, France*
[2] *EPPRA sas, 16 av du Québec, SILIC 706, Villebon/Yvette 91140, France*
[3] *Pontificia Universidad Catolica de Chile, Santiago, Chile*
[+] *RRC Kurchatov Institute, Moscow, Russia*
[*] *KIAM RAS, Moscow, Russia*

Angular Distribution of the Ion Emission from a Tin-based Laser Produced Plasma Extreme Ultraviolet Source (SOURCE-2)
Oran Morris, Aodh O'Connor, Emma Sokell and Padraig Dunne
School of Physics, University College Dublin, Belfield, Dublin 4, Ireland

Molecular Dynamics Investigation on Tin (Source-7)
M. Masnavi, M. Nakajima and K. Horioka
Department of Energy Sciences, Tokyo Institute of Technology, Nagatsuta, Midori-ku, Yokohama 226-8502, Japan

Fiber Lasers for EUV Lithography (SOURCE-6, Invited)
Almantas Galvanauskas
University of Michigan, Ann Arbor, MI, USA

LPP EUV Source Development at ETHZ (SOURCE-4)
B. Rollinger, A. Giovannini, D. Bleiner, N. Chokani, and R. S. Abhari
Laboratory for Energy Conversion, ETH Zurich, Sonneggstrasse 3, 8092 Zurich, Switzerland

EUV Source Technology Status (SOURCE-5)
Vivek Bakshi
EUVL Litho, Inc., Austin, TX 78748, USA

10:50 AM Break (15 minutes)

11:05 AM Session 3: EUV Optics

Session Chair: Patrick Naulleau (LBNL)

Multilayer Optics for Next-generation EUVL Systems (OP-1, Invited)
Regina Soufli
Lawrence Livermore National Laboratory, Livermore, CA 94550, USA

Non-rotationally Symmetric Projection Systems for EUVL *(OP-2, Invited)*
R. Hudyma
Hyperion Development LLC, 358 South Overlook Dr., San Ramon, CA 94582, USA

Technology Readiness for HVM Source Collector (OP-3)
Roland Geyl, Renaud Mercier Ythier
Sagem, Avenue de la Tour Maury, 911280 Saint Pierre du Perray FRANCE

12:00 PM Lunch (Honolulu Suite)

1:00 PM Session 4: METROLOGY

Session Co-Chairs: Regina Soufli (LLNL) and Charles Tario (NIST)

High Accuracy EUV Reflectometry and Scattering at the ALS (MET-8, Invited)
Eric M. Gullikson
Center for X-Ray Optics, Lawrence Berkeley National Laboratory, One Cyclotron Road, Berkeley, CA 94720

At-wavelength EUV metrology at NIST (MET-4)
C. Tarrio, S. Grantham, R. E. Vest, P-S. Shaw T. B. Lucatorto
National Institute of Standards and Technology, *100 Bureau Drive, Gaithersburg, MD*

EUV Reflectometry for Determining the Optical Properties of Photoresists and Underlayer Materials upon Irradiation at 13.5 nm (MET-7)
Grace H. Ho,[1] Fu-H. Kang,[1] Yu-H. Shih,[1] Hok-S. Fung,[2] Hwang-W. Fu,[2] Rikimaru Sakamoto,[3] Takafumi Endo,[3] Bang-C. Ho,[3] Yang-T. Huang,[4] and Bor-Y. Shew[2]
[1]*Department of Applied Chemistry, National University of Kaohsiung, Nanzih, Kaohsiung 811, Taiwan*
[2]*National Synchrotron Radiation Research Center, Hsinchu 311, Taiwan.*
[3]*Electronic Materials Research Laboratories, Nissan Chemical Industries, Ltd., Tayama 937-2792, Japan*
[4]*Department of Electronics Engineering, National Chiao Tung University, Hsinchu300, Taiwan*

ZnO Scintillator for Single-shot EUV Laser Focal Spot Imaging with sub-100 Picosecond Response Time (MET-1, Invited)
T. Shimizu[a,d], K. Yamamoi[a], E. Estacio[a], T. Nakazato[a,d], N. Sarukura[a,d],Y. Kagamitani[b], D. Ehrentraut[b], T. Fukuda[b,c],
[a] *Institute of Laser Engineering, Osaka Univ., 2-6 Yamadaoka, Suita, Osaka 565-0871, Japan*
[b] *Institute of Multidisciplinary Research for Advanced Materials, Tohoku Univ.*
[c] *WPI Advanced Institute for Materials Research Tohoku University*

Development of X-ray Tool for Critical-Dimension Metrology (MET-2)
Boris Yokhin[1 *], Alexander Krokhmal[1], Alexander Dikopoltsev[1], David Berman[1], Isaac Mazor[1], Byoung-Ho Lee[2], Dong-Chul Ihm[2] and Kwang Hoon Kim[2]
[1]*Jordan Valley Semiconductors Ltd., Ramat Gabriel Ind. Zone, Migdal Haemek,*

Israel, 23100
[2]Samsung Electronics, San#16 Banwol-dong, Hwasung-City, Gyeonggi-Do, Korea 445-701

Development of ultra-fine structure metrology system using coherent EUV source (MET-5)
Hiroo Kinoshita[1,3], Nagata Yutaka[2,3], Tetsuo Harada[1,3], and Takeo Watanabe[1,3]
[1]LASTI, University of Hyogo, 3-1-2, Koto, Kamigori, Ako, Hyogo, Japan 678-1205
[2]RIKEN Wakou
[3] JST CREST

2:40 PM Break (20 Minutes)

3:00 PM Session 4: Contamination

Session Co-chairs: David Ruzic (UIUC) and Grace Ho (NUK)

An Investigation of Debris Production by Various EUV Sources (CONT-1, Invited)
D.N. Ruzic, J. Sporre, V. Surla, M.J. Neumann
Center for Plasma Material Interactions, Department of Nuclear Plasma and Radiological Engineering, University of Illinois at Urbana-Champaign, IL, USA

Modification of Ru Surfaces during Simultaneous Irradiation of Thermalized and Energetic Sn particles at Grazing Incidence (CONT-2, Invited)
V. Rigato
INFN Laboratori Nazionali di Legnaro, Italy

Predicting Optics Damage Potential from Resist Outgassing Components (CONT-3)
C. Tarrio,[1] S. B. Hill,[1] N. Faradzhev,[2] R. E. Vest,[1] R. Garg,[3] T. B. Lucatorto[1]
[1]National Institute of Standards and Technology
[2]Rutgers University
[3]University at Albany

Absolute Total Ion Yield and the Relative Extent of Ionic Outgassing of Photoresists and Underlayer Materials upon Irradiation at 13.5 nm (CONT-4)
Grace H. Ho, Yu-H. Shih, and Fu-H. Kang
Department of Applied Chemistry, National University of Kaohsiung, Nanzih, Kaohsiung 811, Taiwan

Mask and Optics Contamination from outgassing, in-band, and out-of-band exposures (CONT-5)
G. Denbeaux, Leonid Yankulin,Yu-Jen Fan, R. Garg, Chimaobi Mbanaso, Petros Thomas, Alin Antohe
College of Nanoscale Science and Engineering, University at Albany, NY, USA

4:30 PM BREAK (30 Minutes)

5:00 PM – 6:30 PM Poster Session and Reception

5:00 PM Session 5: Poster Session

Session Chair: Ken Goldberg (LBNL)

1-D Plasma Modeling with Radiation Transport (Source-3)
J. White, A. Cummings, P. Dunne, and G. O'Sullivan,
School of Physics, University College Dublin, Ireland

Resist Transmission Measurement using EUV Light (MET-3)
Takeo Watanabe, Yasuyuki Fukushima, Tetsuo Harada, and Hiroo Kinoshita
Laboratory of advanced Science and Technology for Industry, University of Hyogo, Hyogo 678-1205, Japan.

A Compact and Ultrahigh-vacuum Reflectometer for EUV Applications (MET-6)
Hwang-W. Fu,[1] Grace H. Ho,[2] Liang-J. Huang,[1] Chia-F. Chang,[1] Shang-W. Lin,[1] Shiang-W. Luo,[1] Fu-H. Kang,[2] Yuh-H. Shih,[2] Hok-S. Fung,[1] and Bor-Y. Shew[1]
[1]*National Synchrotron Radiation Research Center, Hsinchu 311, Taiwan.*
[2]*Department of Applied Chemistry, National University of Kaohsiung, Nanzih, Kaohsiung 811, Taiwan*

An Investigation of the Impact of Mask Shadowing Effect on Flare in Extreme Ultraviolet Lithography (MASK-1)
Jun-Hwan Lee, O-Hyun Kim
Department of Electronic and Electrical Engineering,
Pohang University of Science and Technology, South Korea

Development of Mask Contamination / Inspection System for EUV Lithography (MASK-2)
Sangsul Lee[1 2], Chang Young Jeong[1], Dong Geun Lee[3], Seong-Sue Kim[3], Han-Ku Cho[3], Seung-yu Rah[4], Ohyun Kim[5], Moonsuk Yi[6] and Jinho Ahn[1]
[1] Department of Materials Science and Engineering, Hanyang University
[2]Information Display Research Institute, Hanyang University
[3] Photomask Team, Memory Division, Semiconductor Business, Samsung Electronics Co., LTD
[4] Pohang Accelerator Laboratory
[5] Department of Electrical Engineering, Pohang University of Science and Technology
[6] School of Electrical and Computer Engineering, Pusan National University

Optimizing Structure of Attenuated Phase Shift Mask for Minimizing Shadowing Effect (MASK-7)
Hyun-Duck Shin[1], Chang Young Jeong[2], Sangsul Lee[2], Tae Geun Kim[2], and Jinho Ahn[2]
[1]Department of Nanoscale Semiconductor Engineering, Hanyang University, Korea
[2]Department of Material Science and Engineering, Hanyang University, Korea

Dependence of Acid Yield on Polymer Structure in EUV Chemically Amplified Resist (RESIST-5)
Hiroki Yamamoto[1], Takahiro Kozawa[1], Seiichi Tagawa[1],Takeshi Iwai[2], and Junichi Onodera[2]
[1]The Institute of Scientific and Industrial Research, Osaka University (ISIR), Japan
[2]Tokyo Ohka Kogyo Co., Ltd. (TOK), Japan

Line Width Roughness Investigation through Resist Molecular Structure in Extreme Ultra-violet Lithography (Resist-3)
Hyunsu Kim
Lithography Laboratory, Department of Applied Physics, Hanyang University, Ansan, 426-791, S. Korea

7:00 PM Dinner (Rum Fire)

Thursday, July 16, 2009

8:00 AM Session 7: Panel Discussion

Panel Discussion Moderator: David Attwood (LBNL)

Topic: EUVL R&D Status

Panelists:

David Attwood – USA (University of California at Berkley)

Hiroo Kinoshita –Japan (Hyogo University)

Padraig Dunne – Europe (University College, Dublin)

Grace Ho – Taiwan (National University of Kaohsiung)

Jinho Ahn – Korea (Hanyang University)

9:00 AM Session 8: EUV Mask

Session Co-Chairs: Hiroo Kinoshita (Hyogo University) and Jinho Ahn (Hanyang University)

Optimizing the Mask Structure for Extreme Ultraviolet Lithography (MASK-6, Invited)
Chang Young Jeong, Sangsul Lee, Hyun-Duck Shin, Tae Geun Kim, and Jinho Ahn
Department of Materials Science and Engineering, Hanyang University, 17 Haengdang-Dong, Seoul, 133-791, Korea

Wavelength-Specific Reflections: A Decade of EUV Mask Inspection Research (MASK-4, Invited)
Kenneth A. Goldberg[1], Iacopo Mochi[1], Sungmin Huh[2]
[1]Lawrence Berkeley National Laboratory
[2]SEMATECH

Study of Critical Dimensions of Printable Phase Defects Using an Extreme Ultraviolet microscope (MASK-3, Invited)
Hiroo Kinoshita[1, 3] Yoshito Kamaji[1, 3], Kei Takase[1, 3], Takashi Sugiyama[2], Toshiyuki Uno[2] Tetsuo Harada[1] and Takeo Watanabe[1, 3]
[1]*Laboratory of Advanced Science and Technology for Industry, University of Hyogokamigori, Ako-gun, Hyogo 678-1205, Japan*
[2]*Asahi Glass Co., Ltd., R&D Center, Yokohama 221-8755, Japan*
[3]*JST, CREST, Yonban, Chiyoda, Tokyo 102-0081, Japan*

Zoneplate lenses for EUV microscopy (MASK-5)
Iacopo Mochi[1], Kenneth A. Goldberg[1], Erik H. Anderson[1], Sungmin Huh[2]
[1] Lawrence Berkeley National Laboratory
[2] SEMATECH

10: 15 AM Break (15 Minutes)

10:30 AM Session 9: Panel Discussion

Panel Discussion Moderator: Vivek Bakshi (EUV Litho, Inc.)

Topic: Actinic Defect Inspection Technology for EUVL Masks

Panelists:

Hiroo Kinoshita (Hyogo University)

Debbie Gustafson (Energetiq)

Sergey Zakharov (Nano UV)

John Madey (University of Hawaii)

Hironari Yamada (Ritsumeikan University)

Vivek Bakshi (EUV Litho, Inc.)

12:00 PM – 1:00 PM Lunch

1:00 PM Session 10: EUV Resist

Session Co-Chairs: Takahiro Kozawa (Osaka University) and Chris Mack (Lithoguru.com)

Development Status and Future Prospect of Extreme Ultraviolet Resists (Resist -9, Invited)
Takahiro Kozawa
The Institute of Scientific and Industrial Research, Osaka University (ISIR), Japan

Improvement of EUV Resist Materials (RESIST-1, Invited)
Jeongsik KIM, Jungyoul LEE, Jae-Woo LEE, Deog- Bae KIM, Jaehyun KIM
Dongjin Semichem CO., Ltd, 625-3 Yodang-Ri, Yanggam-Myun, Hwasung-Si, Gyeonggi-Do, 445-931 KOREA

Molecular Resist Materials for EUVL Lithography: What Might Be Possible and How Do We Get There? (RESIST-11, Invited)
Clifford L. Henderson[1], Richard A. Lawson[1], Laren M. Tolbert[2]
[1] *School of Chemical & Biomolecular Engineering, Georgia Institute of Technology, Atlanta, GA 30332-0100, USA*
[2] *School of Chemistry and Biochemistry, Georgia Institute of Technology, Atlanta, GA 30332, USA*

EUV Interference Lithography (RESIST-10, Invited)
Harun H. Solak[1,2], V. Auzelyte[1], A. Langner[1], S. S. Sarkar[1], A. Weber[1], H. Pruchova[1], M. Kropf[1], C. David[1], J. Gobrecht[1]
[1] *Paul Scherrer Institut, Lab for Micro and Nanotechnology, Villigen 5232, Switzerland*
[2] *EULITHA AG, 5232 Villigen PSI, Switzerland*

EUV Interference Lithography in New SUBARU (RESIST-6)
Takeo Watanabe[1], Tae Geun Kim[1, 2], Tetsuo Harada[1], Yasuyuki Fukushima[1], and Hiroo Kinoshita[1]
[1] *Laboratory of advanced Science and Technology for Industry, University of Hyogo, Hyogo 678-1205, Japan*
[2] *Division of Advanced Materials Science and Engineering, Hanyang University, Seoul 133-791, Korea*

Monte Carlo Simulation of Chemical Intermediates in CARs (RESIST-4)
A. Saeki, T. Kozawa, and S. Tagawa
The Institute of Scientific and Industrial Research, Osaka University, 8-1 Mihogaoka, Ibaraki, Osaka 567-0047, Japan

2:50 PM Break (15 minutes)

3:05 PM Session 11: LER

Session Chair: Cliff Henderson (Georgia Tech)

Stochastic Approach to Modeling Line Edge Roughness in Photolithography (Resist-8, Invited)
Chris Mack
Lithoguru.com, 1605 Watchhill Rd., Austin, TX 78703

How Will Wafer Plane Line-edge Roughness Requirements Impact Mask Specifications? (RESIST-7, Invited)
Patrick P. Naulleau and Simi A. George
Center for X-Ray Optics, Lawrence Berkeley National Laboratory, Berkeley, CA 94720

Sub-22 nm Line and Space patterning using Resist Reflow Process for Extreme Ultra-Violet Lithography (RESIST-2)
In Wook Cho, Hyunsu Kim, Jee-Hye You, Hye-Keun Oh
Lithography Laboratory, Department of Applied Physics, Hanyang University, Ansan, 426-791, S. Korea

4:00 PM WORKSHOP SUMMARY

Vivek Bakshi, EUV Litho Inc.

4:10 PM Adjourn

Friday, July 17, 2009

8:30 AM - 10:30 AM (Honolulu Suite)

8:30 AM	**Breakfast**
9:00 AM	**EUVL Workshop Steering Committee Meeting**


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LITHO, INC.