2010 International Workshop on EUV Lithography

June 21-25, 2010

Makena Beach Golf Resort ▪ Maui, Hawaii

Workshop Agenda

2010 International Workshop on EUV Lithography

Makena Beach Golf Resort, Maui, Hawaii, USA
June 21-25, 2010

Workshop Agenda Outline

Short Courses (Makena Room, June 21-22, 2010)

EUV Lithography
8:00 AM -5:00 PM, Monday, June 21, 2010

Resist Materials for High Resolution Patterning
6:00 PM-10:00 PM, Monday, June 21, 2010

EUV Physics
8:00 AM – 12:00 PM, Tuesday, June 22, 2010

Introduction to Optical Lithography
1:00 PM – 5:00PM, Tuesday, June 22, 2010

EUVL Workshop (June 22-25, 2010)

Tuesday, June 22, 2010

3:00 PM- 5:00 PM	Registration (Kaeo Ballroom Entry Lanai) Speaker Prep (Wailea Room)
5:00 PM- 7:00 PM	Reception (Pacific Lawn)

Wednesday, June 23, 2010

7:00 AM	–	8:00 AM	Breakfast
8:00 AM	–	12:00 PM	Oral Presentations (Wailea Room)
12:00 PM	–	1:00 PM	Lunch (Holokai Pavilion)
1:00 PM	–	5:00 PM	Oral Presentations (Wailea Room)
5:00 PM	–	6:00 PM	Poster Session and Reception (Makena Room)
7:00 PM			Dinner (Pacific Lawn)

Thursday, June 24, 2010

7:00 AM	–	8:00 AM	Breakfast
8:00 AM	–	12:00 PM	Oral Presentations (Wailea Room)
12:00 PM	–	1:00 PM	Lunch (Holokai Pavilion)
1:00 PM	–	3:00 PM	Oral Presentations (Wailea Room)
3:00 PM			Adjourn

Friday, June 25, 2010

8:30 AM	–	10:00 AM	EUVL Workshop Steering Committee Meeting (Kahili Court Private Room)

2010 International Workshop on EUV Lithography

Makena Beach Golf Resort, Maui, Hawaii, USA
June 21-25, 2010

Workshop Agenda

Monday, June 21, 2010

Short Courses

EUV Lithography
by Vivek Bakshi (EUV Litho, Inc.), Patrick Naulleau (LBNL) and Jinho Ahn (Hanyang University)
8:00 AM -5:00 PM, Monday, June 21, 2010

Resist Materials for High Resolution Patterning
by Cliff Henderson (Georgia Tech University)
6:00 PM-10:00 PM, Monday, June 21, 2010

Tuesday, June 22, 2010

Short Courses

EUV Physics
by David Attwood (LBNL)
8:00 AM – 12:00 PM, Tuesday, June 22, 2010

Introduction to Lithography
by Chris Mack (Lithoguru.com)
1:00 PM – 5:00 PM, Tuesday, June 22, 2010

Registration and Reception

3:00 PM- 5:00 PM	Registration & Speaker Prep
5:00 PM- 7:00 PM	Reception

Wednesday, June 23, 2010

8:00 AM Welcome and Introduction

Vivek Bakshi
EUV Litho, Inc., Austin, TX, USA

8:10 AM Session 1: Keynote -1

Session Chair: Sam Sivakumar (Intel)

EUV: Status and Challenges Ahead (Keynote-1)
Jos Benschop
ASML, Eindhoven, Netherlands

EUV Lithography: Approaching Pilot Production (Keynote-2)
Obert Wood
GlobalFoudries, Albany, New York, USA

9: 20 AM Award Ceremony

9:35 AM Break (20 Minutes)

9:55 AM Session 2: High Power EUV Sources

Session Chairs: David Attwood (University of California at Berkeley) and Obert Wood (Global Foundries)

Future of High Power EUV Sources (Source-10, Invited)
Hakaru Mizoguchi
Gigaphoton, Toshigi, Japan

CO_2 Laser-produced Tin Plasmas as EUVL Sources (Source-3)
Thomas Cummins, Gerry O'Sullivan, Emma Sokell, Padraig Dunne, Fergal O'Reilly and Tony Donnelly
University College Dublin, Dublin, Ireland

Improving Efficiency of MOPA Laser System for LPP EUV Source (Source-1, Invited)
Krzysztof M. Nowak, Takashi Suganuma, Toshio Yokotsuka, Koji Fujitaka, Hideo Hoshino, Masato Moriya, Takeshi Ohta, Akira Sumitani, Akira Endo
EUVA (Extreme Ultraviolet Lithography System Development Association), Hiratsuka, Kanagawa, Japan

Modelling of High Intensity EUV Light Sources Based on Laser & Discharge Produced Plasmas (Source-6)
S. V. Zakharov[1,2,3], P. Choi[1,2], V. S. Zakharov[2]
[1] NANO-UV sas, Villebon/Yvette 91140, France
[2] EPPRA sas, Villebon/Yvette 91140, France
[3]also with RRC Kurchatov Institute, Moscow, Russia

Status and Future of High Power EUV Source Technology (Source-11)
Vivek Bakshi
EUVL Litho, Inc., Austin, TX, USA

11:20 Session 3: Next Generation EUV Sources

Session Chair: Jos Benschop (ASML)

Laser-produced terbium & gadolinium Plasmas as EUVL Sources at 6.5 – 6.7 nm (Source-7, Invited)
Padraig Dunne[1], Thomas Cummins[1], John White[1], Deirdre Kilbane[1], Rebekah D'Arcy[1], Emma Sokell[1], Thomas McCormack[1], Imam Kambali[1], Takamitsu Otsuka[2], Colm O'Gorman[1], Enda Scally[1], Fergal O'Reilly[1],Tony Donnelly[1] and Gerry O'Sullivan[1].
[1]University College Dublin, Dublin, Ireland
[2]Utsunomiya University, Tochigi, Japan

Atomic Processes in Plasma EUV Sources at λ=6.5nm (Source-2)
Akira Sasaki
Japan Atomic Energy Agency, Kyoto, Japan

11:55 AM Lunch (Holokai Pavilion)

1:00 PM Session 4: EUV Sources for Metrology

Session Chairs: Padraig Dunne (University College Dublin) and Sergey Zakharov (EPPRA)

EUV Source Development for AIMS and Blank Inspection (Source-4)
Paul A. Blackborow, Matthew J. Partlow, Stephen F. Horne, Matthew M. Besen, Donald K. Smith, Deborah Gustafson
Energetiq Technology, Inc., Woburn, MA, USA

High Brightness EUV Light Source System Development for Actinic Mask Metrology (Source-5)
Sergey V. Zakharov [1,2,5], Peter Choi [1,2], Raul Aliaga-Rossel [1], Adrice Bakouboula [1], Otman Benali [1], Philippe Bove [1], Michele Cau [1], Grainne Duffy [1], Carlo Fanara [2],Wafa Kezzar [1], Blair Lebert [2], Keith Powell [1], Ouassima Sarroukh [2], Luc Tantart [1], Clement Zaepffel [2], Vasily S. Zakharov [2], Alan Michette [3], Edmund Wyndham [4]
[1] NANO-UV sas, Villebon/Yvette 91140, France
[2] EPPRA sas, Villebon/Yvette 91140, France
[3] Dept of Physics, King's College, London WC2R 2LS UK
[4] Pontificia Universidad Catolica de Chile, Santiago, Chile
[5] RRC Kurchatov Institute, Moscow, Russia

High Brightness EUV Source Using a DC High Voltage Generator (Source-8)
John Madey, Luis Elias and Eric Szarmes
University of Hawai'i at Manoa, Manoa, Hawaii, USA

Status of EUV Sources for Mask Metrology (Source-12)
Vivek Bakshi
EUV Litho, Inc, Austin, TX, USA

2:00 PM Session 5: EUV Optics

Session Chair: Yuriy Platonov (Rigaku Innovative Technologies)

Virtual Sputter Chamber - Multiphysics Simulation of Magnetron Sputter & Deposition of EUV/X-ray Thin Films (Optics-1, Invited)
Chris Walton
Lawrence Livermore National Laboratory, Livermore, CA, USA

Growth, Microstructure and Stress Evolution of Sputtered Thin Films for EUV/X-ray Applications (Optics-2, Invited)
Regina Soufli
Lawrence Livermore National Laboratory, Livermore, CA, USA

2:40 PM Break (20 Minutes)

3:00 PM Session 6: Contamination

Session Chairs: Iwao Nishiyama (SELETE) and Greg Denbeaux (University of Albany)

Novel Ozone-based Cleaning Technique for EUV Optics Carbon Contamination (Contamination-2, Invited)
Iwao Nishiyama, Toshihisa Anazawa, Noriaki Takagi, Osamu Suga
MIRAI-Semiconductor Leading Edge Technologies, Inc., Ibaraki, Japan

Carbon Contamination of EUV Masks and its Effect on Imaging (Contamination- 4)
Greg Denbeaux[1], Yu-Jen Fan[1], Leonid Yankulin[1], Petros Thomas[1], Chimaobi Mbanaso[1], Alin Antohe[1], Rashi Garg[1], Andrea Wüest[2], Patrick Naulleau[3], Kenneth Goldberg[3], Iacopo Mochi[3]
[1]College of Nanoscale Science and Engineering, University at Albany, NY
[2]SEMATECH, Albany, NY
[3]CXRO, Lawrence Berkeley National Lab, Berkeley, CA

Analysis of Carbon Contamination on EUV Mask using CSM / ICS (Mask-1)
Jae Uk Lee[1] , Chang Young Jeong[1] , Sangsul Lee[1], Jong Gul Doh[1], ' Dong Geun Lee[2], Seong-Sue Kim[2], Han-Ku Cho[2], Seung-yu Rah[3] and Jinho Ahn[1]
[1] Department of Materials Science and Engineering, Hanyang University, Korea
[2] Photomask Team, Memory Division, Semiconductor Business, Samsung Electronics Co., LTD, Korea
[3] Pohang Accelerator Laboratory, Korea

Outgassing and Extreme-ultraviolet Photochemistry of Photoresist and Underlayer Materials (Contaminaion-1)
Grace H. Ho, Fu-H. Kang, Chih-H. Shao, Wei-L. Hung, Chih-B Kao, and Yu-L. Chou
Department of Applied Chemistry, National University of Kaohsiung, Kaohsiung, Taiwan

Nanoparticle Contamination Control and Metrology for the Extreme Ultraviolet Lithography (EUVL) Systems (Contamination-3)
David Y.H. Pui
University of Minnesota, Minneapolis, MN, USA

4:20 PM Break (40 Minutes)

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

5:00 PM Session 7: Poster Session

Session Chair: Ken Goldberg (LBNL)

Chemical Vapor Composite Silicon Carbide (CVC SiC™) Mirror Substrates (Optics-3)
Clifford T. Tanaka
Trex Enterprises Corporation, Kauai, HI, USA

Production of High Purity Functional Water at Point-of-Use for Advanced Mask Cleaning Processes (Mask-3)
Annie Xia
Entegris, Inc., Billerica, MA, USA

EUV Laser for Applications in EUVL Mask Metrology (Source-9)
Davide Bleiner[1], Christoph Imesch[1], Felix Staub[1], Yasin Ekinci[2], Vivek Bakshi[3], and Juerg Balmer[1]
[1]Institute for Applied Physics, University of Berne, Berne, Switzerland
[2]Paul Scherrer Institute, Laboratory for Micro & Nanotechnology, Villigen PSI, Switzerland
[3]EUV Litho, Inc., Austin TX, USA

An Investigation of Flare Value at Pattern Edge Region in EUVL (Resist -5)
Kangyoo Song, Junhwan Lee, Changreol Kim[1], Yongdae Kim[1], Ohyun Kim
Pohang University of Science and Technology, Pohang, Republic of Korea
[1]Hynix Semiconductor Inc, Republic of Korea

Counting outgassing molecules (Contamination-5)
Chih-H. Shao, Chih-B. Kao, Yu-L. Chou, Wei-L. Hung and Grace H. Ho*
Department of Applied Chemistry, National University of Kaohsiung, Nanzih, Kaohsiung 811, Taiwan

Contamination Removal using the Evactron® De-Contaminator (Contamination-6)
Christopher G. Morgan, Ronald Vane, Senajith B. Rekawa[1], Paul E. Denham[1], Brian H. Hoef[1], Michael S. Jones[1], and Patrick P. Naulleau[1]
XEI Scientific, Inc.
1755 E. Bayshore Blvd., Redwood City, CA 94063
[1]Center for X-Ray Optics (CXRO), Lawrence Berkeley National Laboratory, 1 Cyclotron Rd., Berkeley, CA 94720

A New Resist Evaluation System developed at NewSUBARU (Resist-7)

Hiroo Kinoshita and Takeo Watanabe
Laboratory of Advanced Science and Technology for Industry
University of Hyogo, 1-1-2 Kouto kamigoro Ako-gun Hyogo Pref., Japan 678-1205

7:00 PM Dinner (Pacific Lawn)

Thursday, June 24, 2010

8:00 AM Welcome and Announcements

Vivek Bakshi
EUV Litho, Inc, Austin, TX USA

8:10 AM Session 8: Keynote – 2

EUVL Development in Japan (Keynote-3)
Iwao Nishiyama
SELETE, Japan

8:45 AM Session 9: EUVL R&D Status

Session Chairs: Hiroo Kinoshita (Hyogo University) and David Attwood (University of California at Berkeley)

Panelists:

Greg Denbeaux – USA (University of Albany)

Hiroo Kinoshita –Japan (Hyogo University)

Padraig Dunne – Europe (University College, Dublin)

Chun-Hung Lin – Taiwan (National Cheng Kung University)

Jinho Ahn – Korea (Hanyang University)

10:00 AM Break (15 Minutes)

10:15 AM Session 10: EUVL Mask

Session Chair: Jinho Ahn (Hanyang University)

Development Status of EUVL Blank and Substrate (Mask-6, Invited)
Yoshiaki Ikuta and Toshiyuki Uno
Central Research Center, Asahi Glass Co. Ltd., JAPAN

Defect Detection and Inspection Unmasked: The current state of EUV mask defects (Mask-2, Invited)
Kenneth A. Goldberg, Iacopo Mochi, Sungmin Huh[1], David Chan[1]
Lawrence Berkeley National Laboratory, Berkeley, CA, USA
[1]SEMATECH, Albany, NY, USA

Study of the Minimum Phase Defect Affecting the Exposure Result (Mask-5, Invited)
Hiroo Kinoshita,[1, 3], Kei Takase[1, 3], Toshiyuki Uno[2], Takeo Watanabe[1, 3], and Tetuo Harada[1, 3]
[1]Laboratory of Advanced Science and Technology for Industry, University of Hyogo
1-1-2 Kouto Kamigori, 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

11:15 AM Session 11: LER

Session Chair: Patrick Naulleau (LBNL)

Mask Metrology and Pattern Profile Analysis Using the AIT: Down to 64 nm (Mask-4)
Iacopo Mochi, Kenneth A. Goldberg, Tom Wallow[1]
Lawrence Berkeley National Laboratory, Berkeley, CA, USA
[1]Global Foundries, Albany, NY, USA

Stochastic Resist Simulation at EUV (LER-2, Invited)
John J. Biafore, Mark D. Smith
KLA-Tencor, Austin, TX, USA

The Influence of Photoresist Development on Line Edge Roughness (LER-1, Invited)
Chris Mack
Lithoguru.com, Austin, TX, USA

12:10 PM – 1:10 PM Lunch (Holokai Pavilion)

1:10 PM Session 12: EUV Resist

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

Contact Size Variations: Dissecting the Sources (Resist-8, Invited)
Patrick Naulleau
Center for X-ray Optics, Lawrence Berkeley National Laboratory
MS 2-4001 Cyclotron Rd, Berkeley, CA 94720

Flare Mapping and Correction results for EUV Alpha Demo Tool (Resist -4, Invited)
James Moon, Cheol-Kyun Kim, Byoung-Sub Nam, Chang-Moon Lim, Donggyu Yim, and Sung-Ki Park
Hynix Semiconductor Inc., Kyungki-do, Korea

Nanoscale Chemical Reaction Induced in Chemically Amplified Resists upon Exposure to Extreme Ultraviolet Radiation (Resist-1, Invited)
Takahiro Kozawa
Osaka University, Osaka, Japan

Novel molecular Materials based on Noria and Double Calixarene for EB and EUV Resist Systems (Resist -2, Invited)
Tadatomi Nishikubo and Hiroto Kudo
Kanagawa University, Japan

Effects of Acid Amplifiers and Polymer Bound Photoacid Generators on EUV Resist Performance: Fundamental Studies and Lithographic Results (Resist-3, Invited)
Gregory M Wallraff, Phillip J. Brock, Young-Hye Na, Mark Sherwood, Hoa D. Truong, William S. A. Swanson, H. C. Kim, W.D. Hinsberg, Masaki Fujiwara* and Kazuhiko Maeda*, Ramakrishnan Ayothi #, Yoshi Hishiro#
IBM Almaden Research Center, San Jose, CA, USA,
** Central Glass Corporation, Ltd., Tokyo, Japan*
 # JSR Micro, Sunnyvale, CA USA

Radiation Chemistry of EUV and EB Resists (Resist-6)
Seiichi Tagawa[1,2]
[1] *The Institute of Scientific and Industrial Research, Osaka University,*
[2] *Japan Science and Technology Agency, CREST, c/o Osaka University, Japan*

2:45 PM WORKSHOP SUMMARY

EUVL Workshop Summary and Announcements

Vivek Bakshi
EUV Litho Inc, Austin, TX, USA

3:00 PM Adjourn

Friday, June 25, 2010

EUVL Workshop Steering Committee Meeting

8:30 AM	**Breakfast**
9:00 -10: 00 AM	**EUVL Workshop Steering Committee Meeting**

EUV
Litho, Inc.