2013 International Workshop on EUV Lithography

June 10-14, 2013

Makena Beach & Golf Resort ▪ Maui, Hawaii

Workshop Proceedings

2013 International Workshop on EUV Lithography
Makena Beach & Golf Resort, Maui, Hawaii
June 10-14, 2013

2013 EUVL Workshop Sponsors

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Makena Beach & Golf Resort, Maui, Hawaii, USA

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Workshop Agenda Outline

Monday, June 10, 2013

8:30 AM -5:00 PM

EUV Lithography Short Course (Kaeo Ballroom)

Tuesday, June 11, 2013

3:00 PM - 5:00 PM

Registration (Kaeo Ballroom Foyer)
Speaker Prep (Wailea Salon)

6:00 PM - 7:30 PM

Reception (Pacific Lawn)

Wednesday, June 12, 2013

7:30 AM – 8:30 AM	Breakfast (Café Kiowai)
8:30 AM – 11:35 AM	Oral Presentations (Wailea Salon)
11:35 AM – 12:25 PM	Lunch (Molokini Room)
12:25 PM – 3:45 PM	Oral Presentations (Wailea Salon)
3:45 PM	Afternoon off for Networking

Thursday, June 13, 2013

7:30 AM – 8:30 AM Breakfast (Café Kiowai)

8:30 AM – 12:00 PM Oral Presentations (Wailea Salon)

12:00 PM – 1:00 PM Lunch (Molokini Room)

1:00 PM – 5:00 PM Oral Presentations (Wailea Salon)

5:00 PM - 6:00 PM Poster Session

6:30 PM – 8:00 PM Dinner (Pacific Lawn)

Friday, June 14, 2013

8:30 AM – 10:00 AM EUVL Workshop Steering Committee Meeting
(Kaeo Ballroom)

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(Please click on the link to open the presentation)

Wednesday, June 12, 2013

8:30 AM Welcome and Introduction

Introductions (Intro-1)
Vivek Bakshi
EUV Litho, Inc., Austin, TX, USA

Session 1: Keynote Presentations

EUVL in HVM: Prospects and Challenges (P1)
Sam Sivakumar
Portland Technology Development, Intel Corporation

EUVL Challenges for Next Generation Devices (P2)
Tatsuhiko Higashiki
TOSHIBA Corporation Center for Semiconductor & Storage Products Company
Lithography Process Technology Dept.

Break

Session 2: Panel Discussion: EUVL HVM Insertion and Scaling

Introduction: Vivek Bakshi (EUV Litho, Inc.) (P75)

Panelists Presentations:

Sam Sivakumar (P72)
Intel Corporation

Sushil Padiyar (P74)
Applied Materials

Tatsuhiko Higashiki (P71)
TOSHIBA

Pawitter Mangat (P73)
GlobalFoundries

11:35

Group Photograph

Lunch

Session 3: Contamination

Contamination Control in EUV Exposure Tools (P22) (Invited)
Katsuhiko Murakami, Noriaki Kandaka, Takashi Yamaguchi, Atsushi Yamazaki, Tsuneyuki Hagiwara, Tetsuya Oshino, Jiro Inoue and Kazuya Ota
Nikon Corporation

Outgassing, Photoablation and Photoionization of Organic Materials by the Electron-impact and Photon-impact Methods (P23) (Invited)
Grace H. Ho, Yen-H. Huang, Chih-H. Shao, Hung-M. Lin, Jia-J. Sung and Chen-Y. Yeh
Department of Applied Chemistry, National University of Kaohsiung, Nanzih, Kaohsiung 811, Taiwan

Measurements of the Role of Secondary Electrons in EUV Resist Exposures (P29) (Invited)
Greg Denbeaux
College of Nanoscale Science and Engineering, University at Albany, NY

Advancements in Understanding Plasma Cleaning (P27)
E. Kosmowska, D. Varley, R. Vane, and C. Moore
XEI Scientific, Redwood City, CA 94063

Break

Session 4: Optics

Multilayer Mirrors for EUVL: Progress status (P52) (Invited)
Yuriy Platonov, Michael Kriese, Vladimir Martynov, Raymond Crucet,
Yang Li, Bodo Ehlers, Jim Rodriguez, Licai Jiang
Rigaku Innovative Technologies, 1900 Taylor Rd., Auburn Hills, MI 48326, USA

EUV related Technology Development at L-3 Integrated Optical Systems (P51)
Keith Carrigan (Invited)
Commercial Optical Systems, L-3 Communications

GI Collectors for EUV/BEUV Sources for Metrology (P53) (Invited)
Ladislav Pina
Rigaku Innovative Technologies Europe, 142 21 Prague 4, Czech Republic

A New Design Method for Extreme Ultraviolet Lithographic Objective (P54)
Yanqiu Li, Zhen Cao, Fei Liu and Qiuli Mei
School of Optoelectronics, Beijing Institute of Technology, Beijing 100081, China

Adjourn: Time off for Networking

End Day 1

Day 2: Thursday, June 13, 2013

Welcome and Introduction (Intro-2)
Vivek Bakshi
EUV Litho, Inc.

Session 5: Regional Review of EUVL Activities

EUVL Activities in Japan (P61)
Takeo Watanabe
Hyogo University

EUVL Activities in Europe (P62)
Padraig Dunne
University College Dublin, Ireland

EUVL Activities in USA (P63)
Gregory Denbeaux
University of Albany, USA

EUVL Activities in S. Korea (P64)
Jinho Ahn
Hanyang University, S. Korea

EUVL Activities in Taiwan (P65)
Yang-Tung Huang
National Chiao Tung University, Taiwan

EUVL Activities in China (P66)
Yanqui Li
Beijing Institute of Technology, China

Break

Session 6: EUV Sources

Progress in Laser-Plasma Sources – 13.5 nm & Beyond (P12)
Padraig Dunne[1], Takeshi Higashiguchi[2], Takamitsu Otsuka[1,2], Weihua Jiang[3], Akira Endo[4], Bowen Li[1], Colm O'Gorman[1], Thomas Cummings[1], Patrick Hayden[1], Tony Donnelly[1] Fergal O'Reilly[1] and Gerry O'Sullivan[1]
[1]*School of Physics, University College Dublin, Belfield, Dublin 4, Ireland*
[2]*Utsunomiya University, Utsunomiya, Japan*
[3]*Nagaoka University of Technology, Nagaoka, Japan*
[4]*HiLASE Project, Institute of Physics AS, CR, Prague 8, Czech Republic*

Modeling of Laser-plasma Interaction for EUV Sources toward Higher Power and Efficiency (P14)

Akira Sasaki
Quantum Beam Science Directorate, Japan Atomic Energy Agency, 8-1 Umemidai, Kizugawa-shi, Kyoto 619-0215, Japan

Electrodeless Z-Pinch EUV Source for Metrology Applications (P15) (Invited)

Deborah Gustafson, Stephen F. Horne, Matthew M. Besen, Donald K. Smith, Matthew J. Partlow, Paul A. Blackborow
Energetiq Technology, Inc., 7 Constitution Way, Woburn, MA, USA 01801

High Brightness LPP Light Source for Inspection Applications at High Volume Manufacturing (P16)

Bob Rollinger
ETH Zurich, Switzerland

Lunch

Session 7: EUV Masks

Remaining Challenges for EUV masks for HVM introduction (P33) (Invited)

Pawitter Mangat
Global Foundries

Recent Activities of the Actinic Mask Inspection using the EUV Microscope at Center for EUVL (P32) (Invited)

Takeo Watanabe, Tetsuo Harada, and Hiroo Kinoshita
Center for EUVL, University of Hyogo

Improved Photon Shot Noise Effect on LWR by using attenuated PSM for EUVL (P31)

Seejun Jeong[1], SeongChul Hong[2], Jae Uk lee[2], Seung Min Lee[2], Jung Sik Kim[3], and Jinho Ahn[1,2,3]
[1]Department of Convergence NanoScience, [2]Department of Materials Science and Engineering, [3]Department of Nanoscale Semiconductor Engineering, Hanyang University, Seoul 133-791, Korea

Break

Session 8: EUV Resist and Patterning

Development of Novel Molecular Resist Materials based on Ladder-Type Cyclic Oligomers for Extreme Ultraviolet Laser Exposure System (P41) (Invited)

Hiroto Kudo and Shuhei Matsubara
Department of Chemistry and Materials Engineering, Faculty of Chemistry, Materials and Bioengineering, Kansai University, Suita-shi, Osaka, 564-8680, Japan

New Approach for Reducing the Out of Band effect and Outgassing by Applying Top Coat Materials (Outgassing and Out-of Band Protection Layer: OBPL) (P42) (Invited)
Rikimaru Sakamoto, Ryuji Onishi, Noriaki Fujitani, Hiroaki Yaguchi
Nissan Chemical Industries, LTD, Electronic Materials Research La, 635 Sasakura, Fuchu-machi, Toyama, 939-2792, Japan

EUV Resist Development for 16 nm Half Pitch (P43) (Invited)
Yoshi Hishiro
JSR Micro Inc.

Stochastic Effects in Chemically Amplified Resists for Extreme Ultraviolet Lithography (P44) (Invited)
Takahiro Kozawa[1], Julius Joseph Santillan[2], and Toshiro Itani[2]
[1]The Institute of Scientific and Industrial Research, Osaka University
[2]EUVL Infrastructure Development Center, Inc. (EIDEC)
8-1 Mihogaoka, Ibaraki, Osaka 567-0047, Japan (Osaka Univ.)

Recent Activities of the EUV Resist Research and Development at Center for EUVL (P45) (Invited)
Takeo Watanabe, Tetsuo Harada, and Hiroo Kinoshita
Center for EUVL, University of Hyogo

Sub-10nm HP Patterning using EUV based Self-Aligned Double Patterning (P46)
Sushil Padiyar
Applied Materials

EUVL Workshop Summary (2013 EUVL Workshop Summary)
Vivek Bakshi
EUV Litho, Inc.

Break

5:00- 6:00 PM Poster Session

Session 10: Poster Session

STAN – A Compact Light Source for EUV and Beyond (P13)
Padraig Dunne[1,2], Fergal O'Reilly[1,2], Paul Sheridan[1,2] and Kenneth Fahy[1,2]
[1]School of Physics, University College Dublin, Belfield, Dublin 4, Ireland
[2] NewLambda Technologies, Science Centre North, Belfield, Dublin 4, Ireland.

Characteristics of Ion Debris from Laser Produced Tin Plasma in Ambient Gas and Magnetic Field (P11)
Wang Xinbing[1], Zuo DuLuo[1], Lu Peixiang[2]
[1]Wuhan National Laboratory for Optoelectronics, Huazhong University of Science and Technology, Wuhan 430074, China
[2] School of Physics, Huazhong University of Science and Technology, Wuhan 430074, China

Experimental Study of EUV Vacuum Material Outgassing (P21)
Xiaobin Wu[1], Caixing Li[2]
[1]Academy of Opto-Electronics, Chinese Academy of Sciences, Beijing 100094,China
[2]Bureau of High-Tech Research and Development, Chinese Academy of Sciences,Beijing,100864,China

Electron-impact and Photon-impact Ionization of Organic Solvents in the Threshold-200 eV Range (P24)
Yen-H. Huang, Zin-X. Yang, Grace H. Ho*, Hung-M. Lin, Chia-Y. Chou, Chao-C. Yang, Pei-C. Lo
Department of Applied Chemistry, National University of Kaohsiung, Nanzih, Kaohsiung 811, Taiwan

Optical Properties and Photoablation of Photosensitive Films by 13.5 and 6.7 nm Light (P25)
Chen-Y. Yeh,[1] Jia-J. Sung,[1] Grace H. Ho*,[1] Hsuan-T. Chang,[1] Yi-Y Kuo,[1] Yu-C. Tzeng,[1] Chih-W. Yeh,[1] Hok-S. Fung[2] 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 300, Taiwan

Quantitative Outgassing Study of Photosensitive Films upon Irradiation at 13.5 and 6.7 nm (P26)
Hung-M. Lin, Yen-H. Huang, Chi-H. Shao, Grace H. Ho,* Chen-Y. Yeh, Chieh Huang, Ho-X. Yen, Yen-H. Huang and Jia-H. Kang
Department of Applied Chemistry, National University of Kaohsiung, Nanzih, Kaohsiung 811, Taiwan

Comparison of O_2-N_2 and H_2 Plasma Cleaning for EUV Applications (P28)
E. Kosmowska, D. Varley, R. Vane, and C. Moore
XEI Scientific, Redwood City, CA 94063

Calculation of the Optical Constants Using X-ray Reflectometer for Verifying the Optical Design of the Attenuated Phase Shift Mask (P34)

Seung Min Lee[1], Jae Uk Lee[1], Seongchul Hong[1], Seejun Jeong[2], Jung Sik Kim[3], and Jinho Ahn[1,2,3]

[1]Department of Materials Science and Engineering, [2]Department of Convergence NanoScience, [3]Department of Nanoscale Semiconductor Engineering, Hanyang University, Seoul 133-791, Korea

Attenuated PSM for mitigating PSN effect in EUVL (P35)

[1]Seongchul Hong, [2*]Seejun Jeong, [1]Jae Uk lee, [1]Seung Min Lee and [1,2]Jinho Ahn

[1]Department of Materials Science and Engineering, [2]Department of Convergence NanoScience, Hanyang University, Seoul 133-791, Korea

Friday, June 14, 2013

8:30 AM - 10:00 AM

EUVL Workshop Steering Committee Meeting (Kaeo Ballroom)

8:30 AM - 9:00 AM Breakfast

9:00 AM – 10:00 AM Steering Committee Meeting

EUV
LITHO, INC.