EUV Litho, Inc.

2008 International Workshop on EUV Lithography

Wailea Beach Marriott, Maui, Hawaii, USA

June 10-12, 2008

Workshop Agenda

Day 1: Tuesday, June 10, 2008

5:00 PM- 7:00 PM *Registration and Reception*

Day 2: Wednesday, June 11, 2008

8:00 AM – 4:15 PM *Oral Presentations*
4:30 PM - 6:00 PM *Poster Session and Reception*
7:00 PM *Dinner*

8:00 AM **Keynote Speech**

Imaging in the EUV Region
E. Spiller
Spiller X-Ray Optics, Livermore, CA

Session 1: EUV Source Technology

Session 1.1 Discharge Produced Plasma (DPP) based EUV Sources

Technological Aspects of DPP EUV Source Development for HVM Lithography
V. M. Borisov, G.N. Borisova, A. S. Ivanov, Y. B. Kirukhin, O. B. Khristoforov, V. A. Mishchenko, A. V. Prokofiev, A. Yu. Vinokhodov
The State Research Center of the Russian Federation - Troitsk Institute for Innovation and Fusion Research (SRC RF TRINITI) Moscow Region, Russia

Next Generation EUV Lithography Light Source (Invited)
P. Choi [1,2], S. V. Zakharov [2+], O. Sarroukh [2], R. Aliaga-Rossel [2], O. Benali[2], C. Leblanc[2], V. S. Zakharov [2*], C. Zaepffel [2]

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[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 , [+] also with RRC Kurchatov Institute, Moscow, Russia, [*] also with KIAM RAS, Moscow, Russia

Session 1.2 High Power Lasers

Multipass Slab CO_2 Amplifiers for Application in EUV lithography (Invited)
V. Sherstobitov*, A. Rodionov**, D. Goryachkin*, N. Romanov*, A. Endo***, K. Nowak***
**JSC "Laser Physics", St. Petersburg, Russia, **Vavilov Optical Institute, St. Petersburg, Russia, ***Gigaphoton Inc., 1200 Manda Hiratsuka, Kanagawa, 254-8567, Japan*

20kW Short Pulse CO_2 Laser System for LPP Sn EUV Source
K. Nowak, H. Hoshino, T. Suganuma, and A. Endo※
EUVA, ※Gigaphoton, Inc., 1200 Manda Hiratsuka, Kanagawa, 254-8567, Japan

High-power Cryogenic Yb:YAG Lasers and Optical Particle Targeting for LPP EUV Sources (Invited)
J. D. Hybl, T. Y. Fan, W. D. Herzog, T. H. Jeys, D. J. Ripin, and A. Sanchez
MIT Lincoln Laboratory, Lexington, MA, United States

10:00 AM Break (15 minutes)

Session 1.3 Laser Produced Plasma (LPP) Based EUV Sources

Efficient EUV Source by Use of a Micro-target Containing Tin Nanoparticles (Invited)
T. Higashiguchi, M. Kaku*, M. Katto*, and S. Kubodera*
*Utsunomiya University, Utsunomiya, Japan, *University of Miyazaki, Miyazaki, Japan*

Fundamental Investigation on CO_2 Laser-produced Sn plasma for an EUVL Source (Invited)
Y. Tao, M. S. Tillack, K. L. Sequoia, R. A. Burdt, and S. Yuspeh
Center for Energy Research, University of California, San Diego, CA 9500 Gilman Drive, La Jolla, CA 92093, United States

Investigating the Emission Angle, Charge, and Energy of Ions Produced from Laser Produced Extreme Ultraviolet Sources

A. O'Connor, P. Dunne, P. Hayden, O. Morris, G. O'Sullivan, F. O'Reilly, and E. Sokell
Atomic, Molecular, and Plasma Physics Group, School of Physics, Science Centre North, University College Dublin, Belfield, Dublin 4, Ireland

CO_2 Laser-produced Sn-plasma Source for High-volume Manufacturing EUV Lithography

A. Endo
EUVA, Gigaphoton Inc., 1200 Manda Hiratsuka, Kanagawa, 254-8567, Japan

Session 1.4 Alternate EUV Source Concepts

EUVL Source Based on the Tabletop Storage Ring MIRRORCLE (Invited)

H. Yamada and D. Minkov
Ritsumeikan University, Kusatsu, Shiga Prefecture, Japan

Production of Narrow Band Tunable EUV Radiation Using Optimized High Field Optical Undulators

J. Madey, E. Szarmes and S. Kan
Department of Physics, University of Hawai'i at Manoa, Honolulu, HI 96822,United States

12:00 PM ***Lunch***

01:00 PM Session 1.5 EUV Source Panel Discussion

Reliable High Power EUV Source Technology for HVM: LPP or DPP?

Organizer: V. Bakshi
EUV Litho, Inc., 2006 Alta Vista Avenue, Austin, TX 78704, United States

02:00 PM Session 2: EUVL R&D Status Panel Discussion

The Role of Universities and National Laboratories in EUV Lithography

Organizer: D. Attwood
Lawrence Berkeley National Lab, MS 2-400, 1 Cyclotron Rd, Berkeley, CA 94720, United States

03:00 PM Break (15 minutes)

3:15 PM **Session 3: Contamination**

EUVL Contamination Control: What Research and Development is Needed for HVM? (Invited)

D. N. Ruzic, R. Raju, J. Sporre, H. Shin, W. M. Lytle, S. N. Srivastava[1], V. Bakshi[2]
Center for Plasma Material Interactions at the University of Illinois Urbana-Champaign, Urbana, Illinois 61801, United States, Current affiliation: [1]CYMER Inc, [2] EUV Litho Inc,

Study of the Ionic Outgassing from Photoresist Compositions at 13.5 nm

G. H. Ho, Chih- Jen Liu, Chih- H. Yen, Ming- H. Ho, Shih-Y. Wu, and Yu-H. Shih
Department of Applied Chemistry, National University of Kaohsiung, Kaohsiung 811, Taiwan

EUV-photoresist Outgassing: Characterization Tools and Techniques at NIST

C. Tarrio, [a] B. A. Benner, [a] R. E. Vest, [a] S. Grantham, [a] S. B. Hill, [a] T. B. Lucatorto, [a] J. H. Hendricks, [a] P. Abbott, [a] K-W. Choi[b]
[a] NIST, 100 Bureau Drive, Gaithersburg, MD 2089, [b] Intel Corporation, 255 Fuller Road, Albany, NY 12203, United States

Extreme Ultraviolet Resist Outgassing and Its Effect on Nearby Optics

R. Garg[a], C. Mbanaso[a], J. Waterman[a], L. Yankulin[a], A. Antohe[a], Y. J. Fan[a], W. Montgomery[a], Y. Wei[b], O. Wood[c], Chiew-Seng Koay[d], E. Gullikson[e], A. Aquila[e], C. Tarrio[f], S. Grantham[f], S. Bajt[g], G. Denbeaux[a]
[a]College of Nanoscale Science and Engineering, University at Albany, Albany, NY 12203 UNITED STATES, [b]Qimonda, 255 Fuller Road, Albany, NY 12203 UNITED STATES, [c]AMD, 255 Fuller Road, Albany, NY 12203 UNITED STATES, [d]IBM, 255 Fuller Road, Albany, NY 12203 UNITED STATES
[f]Center for X-ray Optics, Lawrence Berkeley National Laboratory, Berkeley, CA 94720 UNITED STATES, [e]NIST, Gaithersburg, MD 20899 UNITED STATES, [g]DESY, Hamburg, Germany

Control technology of EUV Optics Contamination: Modeling, mitigation and cleaning for lifetime extension

Iwao Nishiyama
MIRAI-Semiconductor Leading Edge Technologies, Inc. (Selete)

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04:30 PM Session 4: Poster Session

EUV Radiation from Laser Triggered Tin Target Discharge Produced Plasma
Q. Zhu, J. Yamada, N. Kishi, M. Watanabe, A. Okino, E. Hotta
Department of Energy Sciences, Tokyo Institute of Technology, 4259-J2-35, Nagatsuta, Midori-ku, Yokohama 226-8502, Japan

A study of Metamorphosis of Discharge Produced Plasma in Tin Vapor as EUV Source
G.N. Borisova, V.M. Borisov, A.S.Ivanov, A.Yu.Vinokhodov
The State Research Center of the Russian Federation - Troitsk Institute for Innovation and Fusion Research (SRC RF TRINITI)

Measurement of Ionic and Neutral Debris in a DPP EUV Source and Investigation of Reflectivity Degradation of EUV mirrors
R. Raju, J. Sporre, H. Shin, D .N. Ruzic
Center for Plasma Material Interactions, University of Illinois at Urbana-Champaign, Urbana, Illinois, 61801, United States

Liquid Metal Collector Mirrors for EUV Lithography
K. Fahy, G. O'Sullivan, P. Dunne, P. Hayden & F. O'Reilly
UCD School of Physics, University College Dublin, Belfield, Dublin 4, Ireland

Comparison between Atomic Structure Calculations and Laser Produced Plasma Spectra for Tin
P. Hayden[a,b], G. O'Sullivan[a] and P. Dunne[a]
a School of Physics, University College Dublin, Belfield, Dublin 4, Ireland
b School of Physical Sciences, Dublin City University, Glasnevin, Dublin 9, Ireland

Laser Probing of Tin Based Laser Produced Plasmas
P. Hayden, P. Hough, J. Dardis and J. T. Costello
School of Physical Sciences, Dublin City University, Glasnevin, Dublin 9, Ireland

Optical Particle Targeting for LPP EUV Sources
J. D. Hybl, W. D. Herzog, T. H. Jeys, A. Sanchez, and S. M. Tysk
MIT Lincoln Laboratory, 244 Wood Street, Lexington, MA 02420, United States

Ablation Dynamics of Tin Micro-droplet Target used in LPP-based EUV Light Source
D. Nakamura, T. Akiyama, K. Tamaru, A. Takahashi, T. Okada
Kyushu University, Japan

Beaming of CO_2 laser-produced Sn plasma along B-field for Efficient Exhaustion

Y. Ueno, T. Suganuma and A. Endo*
*EUVA, 1200 Manda Hiratsuka, Kanagawa, 254-8567, Japan, *Gigaphoton Inc., 1200 Manda Hiratsuka, Kanagawa, 254-8567, Japan*

Absolute Characterization of Xenon EUV radiation Generated by a Compact ECR Plasma Source for Lithographic Applications

R. Bista[a,#], R. Bruch[a], and H. Merabet[b]
[a]*Department of Physics, University of Nevada, Reno, NV 89557 UNITED STATES*
[b]*Mathematics and Sciences Unit, Dhofar University, Salalah 211, Sultanate of Oman*

Effect of Resonant Secondary-electron Emission on Damage Rates of EUV Optics

S. B. Hill[a], N. S. Faradzhev[b], S. Grantham[a], C. Tarrio[a], T. B. Lucatorto[a], T. E. Madey[b], B. V. Yakshinskiy[b], E. Loginova[b] , S. Yulin[c]
a NIST, 100 Bureau Drive, Stop 8411, Gaithersburg, MD 20853-8411, UNITED STATES
b Rutgers University, Department of Physics and Astronomy, Piscataway, NJ 08854-8019,UNITED STATES c Fraunhofer-Institut für Angewandte Optik und Feinmechnik, Jena, Germany

Plasma Assisted Cleaning by Electrostatics (PACE) of Nano-Scale Contaminant Particles from EUV Masks

R. Raju, W. M. Lytle, C. Das, M.J. Neumann, D. N. Ruzic
Center for Plasma Material Interactions at University of Illinois Urbana Champaign, Urbana, Illinois 6180, UNITED STATES

Smoothing Based Model for Images of Buried EUV Multilayer Defects Near Absorber Features

C. H. Clifford and A. R. Neureuther
Electrical Engineering and Computer Sciences, University of California, Berkeley, UNITED STATES

X-Ray Diffraction Microscopy: Reconstruction with Partial Magnitude and Spatial a Priori Information

L. B. Rad, I. Downes, J. Y., P. A. Pianetta, and R. F. W. Pease
Department of Electrical Engineering, Stanford University, Stanford, California 94305, United States

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EUV Transmission Grating Spectrometer for Absolute Intensity Measurements from 2 to 250 nm

S. Bergeson[1], N. Grey[1], M. Harrison[1], L. Knight[1], O. Yakushev[2] and A. Shevelko[1,2]
[1] Brigham Young University, Provo, Utah 84602,[2] P.N.Lebedev Physical Institute, Moscow, Russia, 119991

Process Control of Lithography and CMP by Innovative Optical Methods

L. Pfitzner, A. Nutsch, G. Roeder
Fraunhofer Institute of Integrated Systems and Device Technology (Fraunhofer-IISB, Schottkystrasse 10, 91058 Erlangen, Germany

Investigation on Characteristics of W-B-C-N Diffusion Barrier According to Nitrogen Concentration through Applications of Various Thickness Measurement Technique

H. Ju.Sohn[a], D. Kim[a], W. Choi[a], M. Park[a]
[a]Nano Electro-Physics, KSA(Korea Science Academy), 614-100 Busan, Korea

Resist Process Development for the EUV Alpha Demo Tool at IMEC

Anne-Marie Goethals[1], A. Niroomand[2], F. Van Roey[1], J. Hermans[1], G. F. Lorusso[1], B. Baudemprez[1], I. Pollentier[1], Jean-Francois de Marneffe[1], R. Jonckheere[1] and K. Ronse[1]
1 IMEC, Kapeldreef 75, B-3001 Leuven, Belgium 2, on assignment from Micron Technology

Day 3: Thursday June 12, 2008

8:00 AM – 04:10 PM Oral Presentations

7:00 PM Dinner

8:00 AM Session 5: Mask

Overview of EUV Reticle Protection Technology: Progress and Current Status (Invited Review Paper)

K. Ota, M. Amemiya, T. Taguchi and O. Suga
MIRAI-Semiconductor Leading Edge Technologies, Inc. (MIRAI-Selete)
16-1, Onogawa, Tsukuba, Ibaraki 305-8569, Japan

Nanoparticle Contamination Control in EUVL Systems: Carrier, Scanner and Metrology (Review Paper)

D. Y. H. Pui[1], J. Wang[1], C. Asbach[2] and H. Fissan[2]
[1]Particle Technology Laboratory, University of Minnesota, Minneapolis, MN 55455 UNITED STATES,[2]Institute of Energy and Environmental Technology (IUTA), 47229 Duisburg, Germany

EUV Mask Inspection system

H. Kinoshita[1, 4], T. Yoshizumi[1, 4], M. Osugi[1,4] J. Kishimoto[1,4], T. Sugiyama[3], N. Sakaya[2,3] K. Hamamoto[2,3] and T. Watanabe[1,4]
1 Laboratory of Advanced Science and Technology for Industry, University of Hyogo 3-1-2 Koto, Kamigori-cho, Ako-gun, Hyogo 678-1205, Japan, 2 HOYA Corporation R&D Center, 3 Asahi Glass Co., LTD, R & D Center, 4 CREST-JST

OPC Flare and Optical Modeling Requirements

L. Zavyalova, B. Ward*, P. Brooker, K. Lucas
*Synopsys, 1301 South Mopac Expressway, Austin, TX 78746, *Synopsys assignee to IMEC, Leuven, Belgium B3001*

A Study of Attenuated PSM Structure for EUVL to Minimize Mask Shadowing Effect

S. Lee[1], C. Y. Jeong[1], T. G. Kim[1], Hyun-Duck Shin[1], E. J. Kim[2], Hye-Keun Oh[2] and J. Ahn[1]
[1] Division of Advanced Materials Science and Engineering, Hanyang University, [2] Department of Applied Physics, Hanyang University, Korea

Mask Panel Discussion

Will Defects be the Last Issue Standing in the Way of EUVL?
Organizer: K. Kimmel, AMTC
Advanced Mask Technology Center GmbH & Co. KG, Raehnitzer Allee 9, D-01109 Dresden, GERMANY

10:20 AM ***Break***

10:35 AM Session 6: ML Optics and Optics Design

High-NA Optical Systems for EUV lithography (Production and Development) (Invited)
R. Hudyma
Hyperion Development LLC, 358 South Overlook Dr., San Ramon, CA 94582, United States

Diffractive Optical Elements and Their Potential Role in High Efficiency Illuminators
P. Naulleau
Lawrence Berkeley National Lab, MS 2-400, 1 Cyclotron Rd, Berkeley, CA 94720, United States

Multilayer Mirrors for EUV Lithography – Pushing Technological Limits (Invited)
T. Feigl, S. Yulin, M. Perske, M. Schürmann, N. Kaiser, A. Tünnermann
Fraunhofer-Institut für Angewandte Optik und Feinmechanik, Albert-Einstein-Str. 7, 07745 Jena, Germany

11:30 AM ***Break***

12:00 PM ***Lunch***

01:00 PM Session 7: Metrology

A Survey of EUV At-Wavelength Optical Testing (Invited Review Paper)
K. A. Goldberg and P. Naulleau
Lawrence Berkeley National Lab, MS 2-400, 1 Cyclotron Rd, Berkeley, CA 94720

New prospects in short wavelength materials science and spectroscopy using various EUV sources (Invited)
N. Sarukura
Inst. for Laser Engineering, Osaka University, Japan

Development of Coherent EUV Scattering Microscopy

J. Kishimoto , T. Watanabe and H. Kinoshita, Dong gun Lee*, Seong-Sue Kim*, and Han-Ku Cho*

*Laboratory of Science and Technology for Industry, University of Hyogo, Japan, *Samsung Electronics Co., Ltd., Korea*

Characterization of Performance and Lifetime of EUV Source Collectors with a Full Size EUV Collector Reflectometer

U. Hinze [1], B. N. Chichkov [1],T. Feigl [2], U. D. Zeitner [2], C. Damm [2], D. Bolshukhin [3], J. Kleinschmidt [3], G. Schriever [3], Max-C. Schürmann [3]

[1] Laser Zentrum Hannover e.V. (LZH), Hannover, Germany, [2] Fraunhofer IOF Jena (IOF), Germany, [3] XTREME technologies GmbH (XTREME), Germany

02:10 PM ***Break***

02:25 PM Session 8: Resist and Patterning

Sensitization Mechanisms of Chemically Amplified Resists and Resist Design for 22 nm node (Invited)

T. Kozawa and S. Tagawa

The Institute of Scientific and Industrial Research, Osaka University, 8-1 Mihogaoka, Ibaraki, Osaka 567-0047, Japan

Harnessing EUV photons to Design Fast and High Resolution Resists (Invited)

J. W. Thackeray, E. Aqad, M. F. Cronin, K. Spear-Alfonso

Rohm and Hass, Inc., United States

Progress in EUV Resist Development (Invited)

T. Kai, D. Shimizu, K. Maruyama, A. Saitou, T. Shimokawa, Y. Hishiro†,

Semiconductor Materials Laboratory, JSR Corporation, Yokkaichi Plant, 100, Kawajiri-cho, Yokkaichi Mie 510-8552 Japan, †JSR Micro, INC., 1280 N. Mathilda Ave., Sunnyvale, CA 94089, United States

Stochastic Approach to Modeling Line Edge Roughness in Photolithography

C. Mack

Lithoguru.com, 1605 Watchhill Rd., Austin, TX 78703, United States

Our Approaches to EUV Resist Materials

N. Ohshima

Fujifilm, Japan

Influences of Polymer Protection Groups on EUV Resist Performances

J. Lee, J. Kim, Hyun-Jin KIM, Jae-Woo Lee, Deog- Bae Kim, J. Kim
Dongjin Semichem Co., Ltd., 625-3 Yodang-Ri, Yanggam-Myun, Hwasung-Si Gyeonggi-Do, 445-931 Korea

04:10 PM	***Break***
7:00 PM	***Dinner and Adjourn***

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