2021 EUVL Workshop

June 5-10, 2021

Held Online

Workshop Proceedings

EUV
LITHO, INC.

2021 EUVL Workshop Sponsors

Organized by

EUV LITHO, INC.

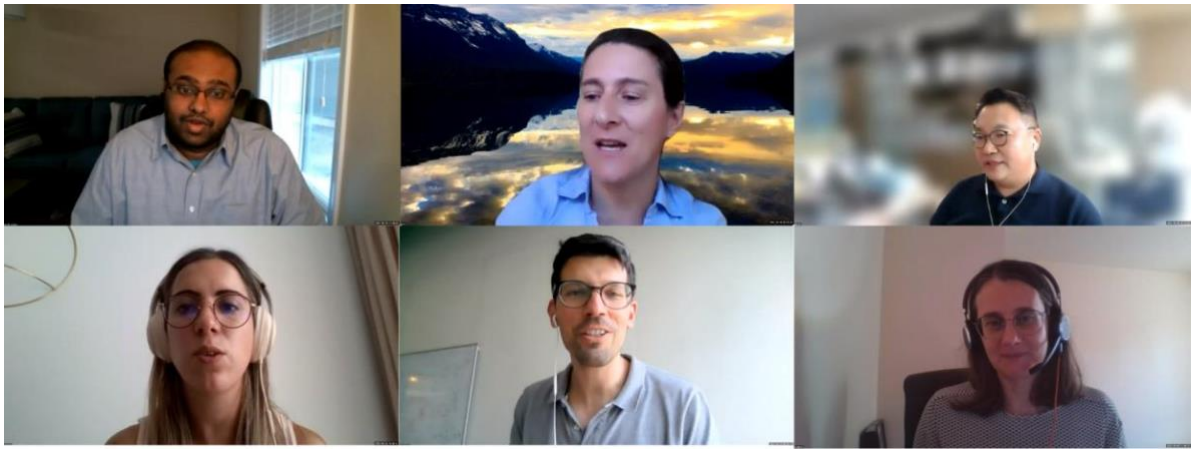
imec

Vivek Bakshi (EUV Litho, Inc.), Chair

Kurt Ronse (imec), Co-Chair

2021 EUVL Workshop: Keynote Presentations

Workshop: Various Invited Talks



Workshop Agenda Outline

2021 EUVL Workshop

June 5-10, 2021

All Event times are in US CDT Zone

Saturday, June 5, 2021

Advanced Photon Sources and Applications in Nanoscale Imaging Short Course
5:30 PM US CDT

Sunday, June 6, 2021

EUVL Short Course
5:30 PM US CDT

Monday, June 7, 2021

Session 1: imec Program Showcase
8:30 AM US CDT

Tuesday, June 8, 2021

Session 2: Keynote Presentations and EUV Mask-1
8:30 AM US CDT

Session 3: Keynote, EUV Mask -2, and EUV Resist and Patterning-1
6:00 PM US CDT

Wednesday, June 9, 2021

Session 4: EUV Resist and Patterning-2 and Speed Presentations
8:30 AM US CDT

Session 5: EUV Sources-1 and Speed Presentations
6:00 PM US CDT

Thursday, June 10, 2021

Session 6: EUV Sources-2 and High NA EUVL
8:30 AM US CDT

Monday, June 7, 2021

Session 1: imec Program Showcase (9:00 AM CDT)

Session Video Recording: Session 1

IMEC Introduction and Overview (P71)
Kurt Ronse
IMEC

Development and Manufacturing of Customized Devices with IMEC's Technology (P72)
Denis Marcon
IMEC

Tour of imec's Attolab (P73)
John Petersen
IMEC

One Planet: Nanoelectronics and Digital Technology for Food and Health (P74)
Chris Van Hoof
IMEC

Break (20 Minutes)

IMEC Envisions Smart Health (P77)
Liesbet Lagae
IMEC

Disruptive Pixel Technologies Enabling Affordable, High Quality Infrared Imaging (P75)
Pawel Malinoski
IMEC

Nanotechnology and the Energy Transition (P76)
Jef Poortmans
IMEC

Tuesday, June 8, 2021

Session 2: Keynote Presentations & EUV Mask-1 (9:00 AM CDT)

Session Video Recording: Session 2

Quantum Computing--A Brief History and Current Status (P1)
John Gillaspy
NSF/NST

EUV Ecosystem Expansion into DRAM Manufacturing (P2)
Stephen Snyder
Micron

High-NA EUV Progress and Outlook (P3)
Jan van Schoot
ASML

Break

EUV masks: Prospects and Challenges (Invited) (P11)
Vicky Philipsen, Devesh Thakare, Joost Bekaert, Peter De Bisschop, Joern-Holger Franke, Andreas Frommhold, Emily Gallagher, Rik Jonckheere, Tatiana Kovalevich, Lieve Van Look, Vincent Wiaux, Eric Hendrickx
IMEC

Comparison of Deposition Techniques for Mo/Si Multilayers for EUV Mask Blanks (Invited) (P12)
Antonio Checco
Veeco

Correction and Verification with Compact EUV Stochastic Models (P13)
Yunqiang Zhang
Synopsys

Session 3: Keynote, EUV Mask-2, & EUV Resist and Patterning-1 (6:00 PM CDT)

Session Video Recording: Session 3

Potential of EUV for High-volume Manufacturing of DRAM (P4)
Changmoon Lim
S K Hynix

EUV Lithography in Volume Manufacturing and Future Extensions (P5)
Steven Carson
Intel

Break

Materials Perspectives for EUV Pellicle Solutions (P14)
Seong Ju Wi[1], Dongwook Kim[2], Kyeongjae Cho[2] and Jinho Ahn[1]
[1]*Division of Materials Science and Engineering, EUV-IUCC (Industry University Collaboration Center), Hanyang University*
[2]*Department of Materials Science and Engineering, University of Texas at Dallas*

Development of Advanced Blank Defect Avoidance Technique Using Actinic Review System (Invited) (P15)
Dong Gun Lee and Byun Gook Kim
ESOL

Synthesis of Organic-Inorganic Hybrid EUV Resists by Atomic Layer Deposition (Invited) (P21)
Chang-Yong Nam[1], Jiyoung Kim[2]
[1]*Center for Functional Nanomaterials, Brookhaven National Laboratory*
[2]*Department of Materials Science and Engineering, University of Texas at Dallas*

Investigations of Photoresists using Synchrotron Light Sources (Invited) (P22)
Luke Long,[1] Terry McAfee,[1] Patrick Naulleau,[1] and Slavomír Nemšák[2]
[1]*Center for X-ray Optics, Lawrence Berkeley National Laboratory*
[2]*Advanced Light Source, Lawrence Berkeley National Laboratory*

Exploring Backbone Ionization in EUV Resists Using Computational Chemistry (P23)
Jonathan Ma
CXRO

EUV Resist Development Program at NewSUBARU (Invited) (P24)
Takeo Watanabe, Shinji Yamakawa, Tetsuo Harada
University of Hyogo

Investigation of Stochastic Effects on EUV Ready Indium Based Metal-Organic Cluster Resist (P39)
Satinder K. Sharma, Manvendra Chauhan, Subrata Ghosh, Kenneth. E. Gonsalves
IIT Mandi

Wednesday, June 9, 2021

Session 4: EUV Resist and Patterning-2 and Speed Presentations (9:00 AM CDT)

Session Video Recording: Session 4

A Stochastic Resist Model Based Comparison of 0.33NA and 0.55NA Lithography (P25)
Ruben Maas, Gijsbert Rispens, Eelco van Setten, John McNamara, Jan van Schoot
ASML

A Decade of Progress in EUV Resists (Invited) (P26)
Yasin Ekinci
PSI

EUV Lithography using Multi-Trigger Resist (Invited) (P27)
C. Popescu[a], G. O'Callaghan[a], A. McClelland[a], J. Roth[b], T Lada[b], T Kudo[c], M Moinpour[c], Y Cao[c] , A.P.G. Robinson[a,b]
[a]*Irresistible Materials*
[b]*Nano-C*
[c] *EMD Performance Materials Corp*

Exploration of Thin Films for High NA EUV Lithography (P28)
Joren Severi
IMEC

Experimental Characterization of Model Polymers (Invited) (P29)
Oleg Kostko,[1,2] Terry McAfee,[2] Jonathan Ma,[2,3] Patrick Naulleau[2]
[1]*Chemical Sciences Division, Lawrence Berkeley National Laboratory*
[2]*Center for X-Ray Optics, Lawrence Berkeley National Laboratory*
[3]*Department of Physics, University of California, Berkeley*

Recent Progress in a Dry Deposited and Dry Developed EUV Photoresist System (Invited) (P30)
Nader Shamma
LAM

EUV Resists: Pushing the Limits (Invited) (P31)
Anna Lio
Intel

Break

Resist Screening with EUV Interference Lithography: from Omelet lithography to State-of-the-art Performance Resists (P32)
T. Allenet[a], M. Vockenhuber[a], C-K Yeh[a], J. G. Santaclara[b], L. Van Lent-Protasova[b], Y. Ekinci[a]
[a] *Laboratory for Micro- and Nanotechnology, Paul Scherrer Institut*
[b] *ASML*

Combined Atomic Absorption /Optical Emission Spectroscopy for In-Situ Control of EUVL and X-Ray Optics Manufacturing (P41)
George Atanasoff, Christopher Metting
AccuStrata

Large area Nanopatterning and Industrial Resist Testing with an in-lab EUV Dual Beamline (P33)
Bernhard Lüttgenau[a,b], Sascha Brose[a,b], Serhiy Danylyuk[c], Jochen Stollenwerk[a,b,c], Peter Loosen[a,b,]
[a] *RWTH Aachen University, Chair for Technology of Optical Systems*
[b] *JARA – Fundamentals of Future Information Technology*
[c] *Fraunhofer Institute for Laser Technology*

Material-Specific Analysis of Multi-Layers with XUV Coherence Tomography (P40)
Silvio Fuchs[1,2,3], Felix Wiesner[1], Martin Wünsche[1,2,3], Julius Reinhard[1,2], Johann Jakob Abel[1], Jan Nathanael[1,2], Slawomir Skruszewicz[1], Christian Rödel[1,2], Gerhard G. Paulus[1,2]
[1] *Institute of Optics and Quantum Electronics*
[2] *Helmholtz Institute Jena* [3] *Indigo Optical Systems*

High-speed AFM for Full-strength, Spatially Resolved, In-situ Dissolution Rate Monitoring (P36)
Luke Long[1,2], Jiajun Chen[2], Andrew Neureuther[1,2], Patrick Naulleau[2], and Paul Ashby[2]
[1]*University of California at Berkeley*
[2]*Lawrence Berkeley National Lab*

Evaluation Results of the Rapid Probe Microscope, RPM, to Address EUV mask 3D Metrology Requirements (P16)
M. Tedaldi[a], E. Gallagher[b], A. Frommhold[b], L. Feng[a], A.D.L. Humphris[a], J. Goulden[a]
[a]*Infinitesima Ltd.*
[b]*IMEC*

Measuring In-pattern EUV Phase Deviations with Linearized Scatterometry (P17)
Stuart Sherwin[a], Ryan Miyakawa [b], Isvar Cordova[b], Markus Benk[b], Laura Waller[a], Andrew Neureuther[a], Patrick Naulleau[b]
[a]*UC Berkeley, Dept. of Electrical Engineering and Computer Science*
[b]*Lawrence Berkeley National Lab, Center for X-Ray Optics*

EUV Phase-Sensitive Imaging Reflectometer (P18)
Yuka Esashi
JILA, University of Colorado-Boulder

Session 5: EUV Sources 1 and Speed Presentations (6:30 PM CDT)

Session Video Recording: Session 5

Update of >300W High Power LPP-EUV Source Challenge for Semiconductor HVM (Invited) (P42)
Hakaru Mizoguchi, Hiroaki Nakarai, Tamotsu Abe, Hiroshi Tanaka, Yukio Watanabe, Tsukasa Hori, Yutaka Shiraishi, Tatsuya Yanagida, Georg Soumagne, Tsuyoshi Yamada and Takashi Saitou
Gigaphoton

Improvement of the Modeling of Atomic Processes in Plasmas for the Study of EUV Source based on a Data Driven Approach (P43)
Akira Sasaki
QST

Progress of Tsinghua SSMB EUV Light Source Development (P44)
Xiujie Deng, on behalf of Tsinghua SSMB Task force
Tsinghua University

Break

Vapor-phase Infiltration for High-sensitivity Hybrid Nanolithography Resists Synthesis (P34)
Nikhil Tiwale[1], Ashwanth Subramanian[2], Kim Kisslinger[1], Ming Lu[1], Aaron Stein[1], Jiyoung Kim[3], and Chang-Yong Nam[1,2]
[1]Center for Functional Nanomaterials, Brookhaven National Laboratory
[2]Department of Materials Science & Chemical Engineering, Stony Brook University
[3]Department of Materials Science and Engineering, University of Texas at Dallas

Introduced E-beam Resists Using VaporPhase Infiltration (P35)
Su Min Hwang[1], Aditya Raja Gummadelly[1], Dan N. Le[1], Yong Chan Jung,[1] Jinho Ahn[2], Chang-Yong Nam[3] Jiyoung Kim[1]*
[1]The University of Texas at Dallas
[3]Brookhaven National Laboratory

EUV Mask Imaging Performance Enhancement through Aerial Image Optimization (P19)

Deukgyu Kim[1, 3], Dongmin Jeong[2, 3], Yunsoo Kim[2, 3], Minsun Cho[1, 3], and Jinho Ahn[1, 2, 3]
[1]*Division of Nanoscale Semiconductor Engineering*
[2]*Division of Materials Science and Engineering*
[3]*EUV-IUCC (Industry University Collaboration Center), Hanyang University*

Study on the degradation of EUV transmittance for EUV pellicle during exposure process (P20)

Chang Soo Kim[1,4], Yong Ju Jang[2,4], Seong Ju Wi[3,4], Ha Neul Kim[3,4], and Jinho Ahn[1,2,3,4]
[1]*Department of convergence nanoscience*
[2]*Division of Nanoscale Semiconductor Engineering*
[3]*Division of Materials Science and Engineering*
[4]*EUV-IUCC (Industry University Collaboration Center), Hanyang University*

Progress in Metal-Organic Cluster Resists Towards the Deployment of Second Generation EUV lithography (P38)

Manvendra Chauhan[1], Subrata Ghosh[2], Satinder K. Sharma[*1], Kenneth. E. Gonsalves[2*]
[1]*School of Computing & Electrical Engineering (SCEE),*
[2]*School of Basic Sciences (SBS), Indian Institute of Technology (IIT)*

Cyclotrimeric Organotin Based Single Component Resist for Patterning at Single Nanometer Regime Using Electron-Beam Lithography (P37)

Santu Nandi[1], Lalit Khillare[1], Mohamad G. Moinuddin[2], Satinder K. Sharma[2], Subrata Ghosh[1]*, Kenneth. E. Gonsalves[1]*
Indian Institute of Technology Mandi

Thursday, June 10, 2021

Session 6: EUV Sources-2 and High NA EUVL (8:30 AM CDT)

Session Video Recording: Session 6

Towards Solid-State-Laser-Driven Plasma Sources of EUV light: An Update on ARCNL's Source Research Program (Invited) (P45)
Oscar Versolato
ARCNL

Control of the Pressure-impulse Distribution in Laser-induced Tin Droplet Deformation for Extreme-ultraviolet Nanolithography (P46)
Javier Hernandez-Rueda
ARCNL

Optimizing the Performance of the EQ-10 Electroless Z-Pinch™ EUV Light Source (Invited) (P47)
Wolfram Neff
Energetiq

Compact Storage Ring FEL: a kW-scale EUV Lithography Source (P48)
Rod Loewen
Lyncean Technologies, Inc.

Break

Progress and Outlook Towards High-NA EUV Lithography (Invited) (P51)
Jara G. Santaclara, Rik Hoefnagels, Lidia van Lent-Protasova, Nadia Zuurbier, Herman Nicolai, Gijsbert Rispens, Arame Thiam, Joost Bekaert
ASML

High NA EUV Optics: a Big Step in Lithographic Resolution (Invited) (P52)
Lars Wischmeier, Paul Graeupner, Peter Kuerz
Zeiss

Progress in Metal Oxide Photoresists for High NA EUV Lithography (Invited) (P53)
Amrit K. Narasimhan
Inpria Corporation

High NA EUV Research at Lawrence Berkeley National Laboratory (Invited) (P54)
Patrick Naulleau
Center for X-ray Optics, Berkeley Lab

Announcements
Vivek Bakshi
EUV Litho, Inc.

Workshop Adjourned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