Program of EMLC2019

35th European Mask and Lithography Conference

Monday June 17th – Thursday, June 20th, 2019

Hilton Hotel in Dresden, Germany

Monday, June 17th, 2019

14:00 – 18:30	**EMLC2019 Tutorials**
14:00 – 15:20	**Welcome and Introduction of the 1st Tutorial Speaker** **by Uwe Behringer, UBC, EMLC2019 Conference Chair** **1st TUTORIAL: Andreas Erdmann, Fraunhofer Institute for Integrated Systems and Device Technology IISB**, Erlangen, Germany ***"Alternative Lithographic Techniques for Non-IC Applications"***
15:20 – 15:45	***Coffee Break***
15:45 – 17:05	**Introduction of the 2nd Tutorial Speaker** **by Jo Finders, ASML, EMLC2019 Conference Chair** **2nd TUTORIAL: Laurent Pain, CEA-LETI**, Grenoble, France ***"Lithography Alternative Solutions"***
17:05 – 18:25	**Introduction of the 3rd Tutorial Speaker** **by Martin Tschinkl, AMTC, EMLC2019 Session Chair** **3rd TUTORIAL: Martin Sczyrba, Advanced Mask Technology Center GmbH & Co. KG**, Dresden, Germany ***"Photomask Making Processes and Technologies"***
18:25 – 18:30	***Announcements: Uwe Behringer / EMLC2019 Conference Chair***
18:30 – 20:00	***Get Together & 1st Poster Session*** Details of the 1st Poster Session: see Session 5

Tuesday, June 18th, 2019

09:00 – 09:10 **Welcome and Introduction**
Uwe Behringer, UBC Microelectronics, Ammerbuch, Germany
EMLC2019 Conference Chair

09:10 – 09:35 **Greetings from the City of Dresden**
Robert Franke, Director Office of Economics Development – City of Dresden, Dresden, Germany **(INVITED)**
Smart City Dresden - Bringing Future Technologies on the Road

09:35 - 10:30 Session 1: 1st Plenary Session

Session Chair: Uwe Behringer / UBC Microelectronics (Germany)
Session Co-Chair: Stefan Wurm / ATICE LLC (USA)

09:35 – 10:05 **1st KEYNOTE: Udo Bischof**
Robert Bosch GmbH, Engineering Process Technology (ETP), Reutlingen, Germany
Future Trends and Drivers for Sensor Technologies

10:05 – 10:30 **Best Poster of BACUS Photomask Technology 2018 (INVITED)**
André Eilert, Michael Finken, Christian Bürgel, Mark Herrmann, Ronald Hellriegel, Rico Nesterl, Oliver Löffler, Frank Hübenthal, Rico Büttner, and Katja Steidel
Advanced Mask Technology Center GmbH & Co. KG, Dresden, Germany
Multiple exposure on single blank for electron-beam writer characterization

10:30 – 11:00 ***Coffee Break***

11:00 – 12:25 Session 2: 2nd Plenary Session

Session Chair: Brid Connolly / TOPPAN (Germany)
Session Co-Chair: Jed Rankin / GLOBALFOUNDRIES (USA)

11:00 – 11:30 **2nd KEYNOTE: Naoya Hayashi**
Dai Nippon Printing Co., Ltd., Fujimino, Saitama, Japan
Electron Multi-Beam Writing of Leading-Edge Masks and NIL Master Templates

11:30 – 12:00 **3rd KEYNOTE: Harry J. Levinson**
HJL Lithography, Saratoga, CA, USA
The Potential of EUV Lithography

12:00 – 12:25 **Best Paper of PMJ2019 (INVITED)**
Takahiro Mori and Akira Yamazaki
Mitsubishi Chemical Corporation, Toyohashi, Aichi, Japan
aquaSAVE™ : Antistatic Agent for Electron Beam Lithography

12:25 – 14:00 ***Lunch Break***

14:00 – 16:00 Session 3: Mask Patterning, Metrology, and Process

Session Chair: Martin Tschinkl / AMTC (Germany)
Session Co-Chair: Jan Hendrik Peters / BMBG (Germany)

14:00 – 14:25 **Masahiro Hashimoto (INVITED)**
HOYA Group, Blanks Division, Nagasaka,
Hokuto, Yamanashi, Japan **(Invited)**
Continuous challenges for next era of lithography"

14:25 – 14:50 **Annette Schnettelker, Mathias Tomandl, Christof Klein, Hans Loeschner, and Elmar Platzgummer (INVITED)**
IMS Nanofabrication GmbH, Vienna, Austria
MBMW-201 – The multi-beam mask writer advanced to the 2nd tool generation

14:50 – 15:15 **Ingo Bork, and Peter Buck (INVITED)**
Mentor, A Siemens Business, Fremont, CA, USA **(Invited)**
MPC for Multi-Beam Mask Writers

15:15 – 15:40 **Hiroshi Matsumoto, H. Kimura, R. Ueba, K. Yasui, and N. Nakayamada (INVITED)**
NuFlare Technology, Inc., Yokohama, Japan
Multi-beam mask writer MBM-1000

15:40 – 16:00 **Christian Bürgel, Martin Sczyrba, and Clemens Utzny,**
Advanced Mask Technology Center GmbH & Co. KG, Dresden, Germany
Necessity is the mother of invention: support vector machines for CD control

16:00 – 16:30 ***Break***

16:30 – 17:45 Session 4: Optical Lithography “More Moore” (193i and EUV) – Part 1

Session Chair: Jo Finders / ASML (The Netherlands)
Session Co-Chair: Albrecht Ehrmann / Carl Zeiss SMT (Germany)

16:30 – 16:55

Kurt Ronse, Rick Jonckheere, Emily Gallagher, Vicky Philipsen, Eric Hendricks, and Ryoung han Kim (INVITED)
IMEC, Leuven, Belgium
EUVL is being inserted in manufacturing in 2019. What are the mask related challenges remaining?

16:55 – 17:20

Claus Zahlten[1], Jan van Schoot[2], Peter Kuerz[1], and Winfried Kaiser[1] (INVITED)
[1] **Carl Zeiss SMT GmbH**, Oberkochen, Germany
[2] **ASML Netherlands B.V.**, Veldhoven, The Netherlands
High-NA EUV lithography – pushing the limits

17:20 – 17:45

Jo Finders (INVITED)
ASML Netherlands B.V., Veldhoven, The Netherlands
EUV Lithography: Update on Scanner and Infrastructure Progress

17:45 – 19:15 Session 5: 2nd Poster Session

Session Chair: Reinhard Galler / Equicon (Germany)
Session Co-Chair: Hans Loeschner / IMS Nanofabrication (Austria)

Poster: Optical Lithography – More Moore (193i&EUV)

P-invited

Best Poster of BACUS EUV Lithography 2018 and Update (INVITED)
Xiaolong Wang[1], Li-Ting Tseng[1], Michaela Vockenhuber[1], Iacopo Mochi[1], Lidia van Lent-Protasova[2], Rolf Custers[1], Gijsbert Rispens[2], Rik Hoefnagels[2], and Yasin Ekinci[1]
[1] **Paul Scherrer Institute**, Villigen PSI, Switzerland
[2] **ASML Netherlands B.V.**, Veldhoven, The Netherlands
Progress in EUV resists for Contact Holes Printing using EUV Interference lithography

P-1

Lokesh Devaraj[1], Gerardo Bottiglieri[1], Andreas Erdmann[2], Felix Wahlisch[1], Michiel Kupers[1], Eelco van Setten[1], and Timon Fliervoet
[1] **ASML Netherlands B.V.**, Veldhoven, The Netherlands
[2] **Fraunhofer Institute for Integrated Systems and Device Technology IISB**, Erlangen, Germany
Investigation of lithographic effects due to particles on high-NA EUV mask pellicle

P-2

Hazem Mesilhy[1], Andreas Erdmann[1], and Michael Patra[2]
[1] **Fraunhofer Institute for Integrated Systems and Device Technology IISB**, Erlangen, Germany
[2] **Carl Zeiss SMT GmbH,** Oberkochen, Germany
Mask options for printing structures down to 5 nm using EUV lithography

P-3

Pim van den Berg[1], Lieve van Look[2], Gijs van Swaaij[1], Tasja van Rhee[1], Guido Schiffelers[1], and Joost Gielis[1]
[1] **ASML Netherlands B.V.**, Veldhoven, The Netherlands
[2] **IMEC**, Leuven, Belgium
A new concept to qualify pattern shift on EUV scanners

P-4

Frank J. Timmermans, Claire van Lare, and Jo Finders
ASML Netherlands B.V., Veldhoven, The Netherlands
Alternative mask materials for low-k1 EUV imaging

P-5

Olena Romanets, M. Kupers, F. Wahlisch, K. Ricken, C. Piliego, D. de Graaf, and P. Broman
ASML Netherlands B.V., Veldhoven, The Netherlands
Progress in imaging performance with EUV pellicles

P-6

Katrina Rook, Narasimhan Srinivasan, Vincent Ip, Meng H. Lee, and Tania Henry
Veeco Instruments, Plainview, NY, USA
Ion Beam Etch of High-k Absorber Materials for High-NA EUV Masks

P-7

Sang Jin Cho, Byoungpi Lee, Ji Hyang Kim, Won Kyeong Song, Hungue Choi, Gil Su Lee, Seung Wan Kim, and Ji Kang Kim,
FST Corp., Osan-si, Gyenonggi-do, Rep. of Korea
Haze and pellicle material selection for haze free

P-8 **Yael Sufrin[1], Avi Cohen[1], Ofir Sharoni[1], and Rolf Seltmann[2]**
[1] **Carl Zeiss SMT GmbH**, Bar Lev Industrial Park, Misgav, Israel
[2] **RS litho**, Dresden, Germany
Reduce probability of wafer intra-field process (printing) defects for logic & DRAM applications

Poster: Optical Lithography – More than Moore

P-9 **Varvara Brackmann[1], Michael Friedrich[1], Clyde Browning[2], Norbert Hanisch[1], and Benjamin Uhlig[1]**
[1] **Fraunhofer Institute for Photonic Microsystems IPMS**, Dresden, Germany
[2] **ASELTA Nanographics**, Grenoble, France
Influence of the dose assignment and fracturing type on the pattern exposure by the variable shape e-beam writer: simulation vs. experiment

P-10 **Leon Van Dijk[1], Anne-Laure Charley[2], Maarten Stokhof[3], Ronald Otten[1], Sven Van Elshocht[2], Bert Jongbloed[3], Philippe Leray[2], and Richard van Haren[1]**
[1] **ASML Netherlands B.V.**, Veldhoven, The Netherlands
[2] **IMEC**, Leuven, Belgium
[3] **ASM International**, Leuven, Belgium
Detection and mitigation of furnace anneal induced distortions at the wafer edge

P-11 **Kornelia Indykiewicz, Bartlomiej Paszkiewicz, Agnieszka Zawadzka, and Regina Paszkiewicz**
Wroclaw University of Science and Technology, Wroclaw, Poland
Chrome mask fabrication on Al2O3 substrate for new generation devices based on AlGaN/GaN heterostructure

19:20 **Meet at the Hilton Lobby for boat cruise**

19:30 – 23:00 ***EMLC2019 Conference Dinner on board the cruise ship "Krippen"***

Wednesday, June 19th, 2019

09:00 – 09:35

Session 6: Announcements and Multi-Beam Inspection

Chair: Uwe Behringer / UBC Microelectronics (Germany)
Co-Chair: Hans Loeschner / IMS Nanofabrication (Austria)

09:00 – 09:10

Announcement of EMLC2019 Best Poster
Uwe Behringer / UBC Microelectronics, Germany

Announcement of ‘BACUS’2019 conference
Jed Rankin / GLOBALFOUNDRIES, USA

Announcement of PMJ2020 conference
Naoya Hayashi / DNP, Japan

09:10 – 09:35

Weiming Ren, Xuedong Liu, Xuerang Hu, Ximan Luo, Xiaoyu Ji, Qingpo Xi, Kevin Chou, Martin Ebert, and Eric Ma (INVITED)
Hermes Microvision Inc (an ASML company), San Jose, CA, USA
Multi-Beam Technology for Defect Inspection of Wafer and Mask

09:35 – 10:40

Session 7: Optical Lithography “More than Moore” (incl. 3D integration / Non-IC applic.)

Session Chair: Ines Stolberg / VISTEC (Germany)
Session Co-Chair: Kurt Ronse / IMEC (Belgium

09:35 – 10:00

Bertrand Le-Gratiet (INVITED)
STMicroelectronics, Crolles, France
Lithographic Challenges for Optical Sensors

10:00 – 10:20

Philipp Kulse, S. Jätzlau, K. Schulz, and M. Wietstruck
IHP – Leibniz-Institut für innovative Mikroelektronik, Frankfurt (Oder), Germany
Dual platform stepper/scanner based overlay evaluation method

10:20 – 10:40

Matthias Wahl[1], Ulrich Hofmann[2], Nezih Unal[2], and Steffen Diez[1]
[1] **Heidelberg Instruments Mikrotechnik GmbH**, Heidelberg, Germany
[2] **GenISys GmbH**, Taufkirchen, Germany
Software-based optimization methods for the ULTRA Semiconductor Maskwriter

10:40 – 11:10 *Coffee Break*

11:10 – 12:30

Session 8: Optical Lithography "More Moore" (193i and EUV) – Part 2

Session Chair: Jo Finders / ASML (The Netherlands)
Session Co-Chair: Albrecht Ehrmann / Carl Zeiss SMT (Germany)

11:10 – 11:35

Best Paper of BACUS Photomask Technology 2018 (INVITED)
Andreas Erdmann, Faunhofer IISB, Erlangen, Germany
on behalf of **Vicky Philipsen, IMEC**, Leuven, Belgium

Vicky Philipsen[1], Vu Luong[1], Karl Opsomer[1], Erich Hendrickx[1], Andreas Erdmann[2], Peter Evanschitzky[2], Robbert van de Kruijs[3], Zahra Heidarnia-Fathabad[3], Frank Scholze[4], and Christian Laubis[4]
[1] **IMEC**, Leuven, Belgium
[2] **Fraunhofer IISB**, Erlangen, Germany
[3] **University of Twente**, Twente, The Netherlands
[4] **PTB**, Braunschweig, Germany
Novel EUV mask absorber evaluation in support of next-generation EUV imaging

11:35 – 11:55

Paolo Alagna[1], Will Conley[1], Yaobin Feng[2], Zhiyang Song[2], Dean Wu[2], Simon Hsieh[1], James Bonafede[1], Stephen Hsu[3], Junwei Lu[3], Victor Peng[3], Beeri Nativ[4], Ijen van Mil[4], Herman Nicolai[4], Shao-Shun Zhou[4], Karel Arkema[4], and Fei Jia[4]
[1] **Cymer (ASML)**, San Diego, USA,
[2] **Yangtze Memory Technologies Co., Ltd. (YMTC)**, Wuhan, China,
[3] **ASML Brion**, San Jose, USA, and
[4] **ASML Netherlands B.V.**, Veldhoven, The Netherlands
Quantifying global and local CD variation for an advanced 3D NAND layer

11:55 – 12:15

Bartosz Bilski[1], Jörg Zimmermann[1], Matthias Rösch[1], Jack Liddle[1], Eelco van Setten[2], Gerardo Bottoglieri[2], and Jan van Schoot[2]
[1] **Carl Zeiss SMT GmbH**, Oberkochen, Germany
[2] **ASML Netherlands B.V.**, Veldhoven, The Netherlands
High-NA EUV imaging: challenges and outlook

12:15 – 12:35 **Philippe Leray[1], Eren Canga[1], Avi Cohen[2], Vladimir Dmitriev[2], Kuhan Gorhad[2], and Yael Sufrin[2]**
[1] **IMEC**, Leuven, Belgium,
[2] **Carl Zeiss SMT GmbH**, Bar Lev Industrial Park, Misgav, Israel
Enhanced Wafer Overlay Residuals Control; Deep Sub-Nanometer at Sub-Millimeter Lateral Resolution

12:35 – 14:00 ***Lunch Break***

14:00 – 15:00 Session 9: Novel Applications of Lithographic Patterning

Session Chair: Daniel Sarlette / INFINEON (Germany)
Session Co-Chair: Harry J. Levinson / HJL Lithography (USA)

14:00 – 14:20 **Michael J. Haslinger, et al., A.R. Moharana, E. Guillén, D. Fechtig, and M. Mühlberger**
PROFACTOR GmbH, Austria
Nanoimprinting of Antireflective Moth-Eyes on Freeform Surfaces

14:20 – 14:40 **Loic Perraud, Patrick Quéméré, Sébastien Bérard-Bergery, and Aurélien Fay**
CEA-LETI, Grenoble, France
Theoretical impact of the optical lithography mask grade on silicon photonics transmission losses

14:40 – 15:00 **Michael Rüb[1,2], Shavkat Akhmadaliev[3], Constantin Csato[1], and Florian Krippendorf[1]**
[1] **mi2-Factory GmbH**, Jena, Germany
[2] **Ernst-Abbe-Hochschule Jena**, Jena, Germany
[3] **Helmholtz-Zentrum Dresden-Rossendorf**, Dresden, Germany
Energy Filter for Ion Implantation in Power Semiconductor Device Manufacturing

15:00 – 15:30 ***Coffee Break***

15:30 – 16:35 Session 10: Modeling / Simulations

Session Chair: Andreas Erdmann / Fraunhofer IISB (Germany)
Session Co-Chair: Rolf Seltmann / RS litho (Germany)

15:30 – 15:55 **Martin Heusinger[1], M. Banasch[2], D. Michaelis[3], T. Flügel-Paul[3], E.B. Kley[1,3], and U. D. Zeitner[1,3] (INVITED)**
[1] **Friedrich Schiller University Jena**, Jena, Germany
[2] **Vistec Electron Beam GmbH**, Jena, Germany
[3] **Fraunhofer IOF**, Jena, Germany
Optical micro- and nano-structures with (sub-)nanometer accuracy

15:55 – 16:15

Peter Evanschitzky, and Andreas Erdmann
Fraunhofer Institute for Integrated Systems and Device Technology IISB, Erlangen, Germany
Mask defect assessment from SEM images aided by deep learning methods

16:15 – 16:35

Ulrich Welling[1], Joren Severi[2], Danilo de Simone[2], and Hans-Jürgen Stock[1]
[1] **Synopsys GmbH**, Aschheim / Dornach, Germany
[2] **IMEC**, Leuven, Belgium
Modeling of CAR alternatives for EUV lithography

16:35 – 18:00

Session 11: Using AI, Big Data, and Fab Automation

Session Chair: Bertrand Le-Gratiet / STMicroelectronics (France)
Session Co-Chair: Serap Savari / Texas A&M University (USA)

16:35 – 17:00

Dirk Ortloff, (INVITED)
camLine GmbH, Petershausen, Germany
Applying Big Data technologies to high tech manufacturing

17:00 – 17:20

Philipp-Immanuel Schneider[1], M. Hammerschmidt[1], X. Garcia Santiago[1,3], L. Zschiedrich[1], and S. Burger[1,2]
[1] **JCMwave GmbH**, Berlin, Germany
[2] **Zuse Institute Berlin (ZIB),** Berlin,
[3] **Karlsruhe Institute of Technology (KIT)**, Karlsruhe, Germany
A machine learning method for efficient design optimization and parameter reconstruction

17:20 – 17:40

N. Chaudhary, and Serap A. Savari
Texas A&M University, College Station, TX, USA
Towards a visualization of deep neural networks for rough line images

17:40 – 18:00

Dereje S. Woldeamanual, Thomas Mülders, and Hans-Jürgen Stock
Synopsys GmbH, Aschheim, Germany
Speed up of rigorous 3D resist simulation: using machine learning

18:00

Uwe Behringer: Thanks to Presenters and Participants and Announcement of EMLC2020 in Leuven / Belgium

End of EMLC2019 conference

Thursday, June 20th, 2019

09:15 **Bus Departure at the Hilton Hotel**

10:00 – 12:00

Cleanroom Tour at Fraunhofer IPMS

Maria-Reiche-Str. 2
01109 Dresden

The Cleanroom Tour is limited to max. 15 persons.