The 39th European
Mask and Lithography
Conference

EMLC 2024

June 17 – 19, 2024
MINATEC / CEA-Leti
in Grenoble, France

www.emlc-conference.com

Picture: Courtesy of Toppan Photomasks

VDE VDI GMM

Welcome to the EMLC 2024 in Grenoble

The EMLC Conference annually brings together scientists, researchers, engineers and technicians from research institutes and companies from around the world to present their latest findings in mask and lithography techniques.

The EMLC Conference is dedicated to research, technology and related processes. It provides an overview of the current state of mask and lithography technologies and future strategy. Here, mask manufacturers and users have the opportunity to familiarize themselves with the latest developments and results.

May we offer you a fancy quick look through the telescope? Here is a brief summary of the conference programme:
The EMLC Conference 2024 will take place in the wonderful setting of MINATEC at CEA-Leti in Grenoble, France.

The conference will start on Monday, June 17th at 2 PM with a Tutorial Session, followed by a Session with student presentations. From 7 PM to 9 PM there will be a EMLC 2024 Get Together event at the MINATEC site.

On Tuesday, June 18th, the conference will be continued at 9 AM in the MINATEC Platine Auditorium with a 1st Plenary Session, followed by a Session on Data Analytics. In the afternoon, there will be Sessions on DUV and EUV Lithography and Mask Patterning and Processing, followed by the Poster Session.

On Wednesday, June 19th, EMLC 2024 is continued at 9 AM with the 2nd Plenary Session followed by a Session on Nano-Imprint Lithography. After lunch, there are Sessions on Mask Metrology, Tuning and Inspection and Optical & Electron Beam Direct Write. The 12th Session will complete the conference. The title of this Session will focus on a novel topic.

Uwe Behringer
Conference Chair

List of Contents

Committee Members 4-5

Organizers 6

Program Overview.. 7

Monday, June 17th, 2024 7

Tuesday, June 18th, 2024 10

Wednesday, June 19th, 2024 20

Conference Information 28

Conference Hours 28

Registration Hours 28

Technical Exhibition 28

EMLC Best Paper Award and Best Poster Award 29

Zeiss Awards for Talents in Photomask Industry............... 29

General Information 30

EMLC 2024 Office.. 30

Conference Fees 30

Conference Participation 31

Payment.. 31

Cancellation.. 31

Venue.. 31

Sponsors and Coopering Partners...................back page

The EMLC 2024 International Program Committee

Conference Chairs

Behringer, Uwe, UBC Microelectronics, Ammerbuch, Germany

Finders, Jo, ASML, Veldhoven, The Netherlands

Co-Conference Chairs

Connolly, Bríd, Toppan Photomasks GmbH, Dresden, Germany

Hayashi, Naoya, DNP, Saitama, Japan

Program Chairs

Stolberg, Ines, Vistec Electron Beam, Jena, Germany

Erdmann, Andreas, Fraunhofer IISB, Erlangen, Germany

Loeschner, Hans, IMS Nanofabrication, Brunn am Gebirge and Vienna, Austria

Co-Program Chairs

Peters, Jan Hendrik, bmbg consult, Radebeul, Germany

Other Members

Abboud, Frank, Intel Corporation, Santa Clara, CA, USA
Ehrmann, Albrecht, Carl Zeiss SMT, Oberkochen, Germany
Galler, Reinhard, Equicon, Jena, Germany
Le Gratiet, Bertrand, ST Microelectronics, Crolles, France
Jefferies, James, HOYA Europe, London, UK
Levinson, Harry J., HJL Lithography, Saratoga, CA, USA
Maly, Enrico, Photronics MZD GmbH, Dresden, Germany
Muehlberger, Michael, Profactor GmbH, Steyr-Gleink, Austria
Noack, Nico, AMTC Dresden, Germany
Pain, Laurent, CEA Leti, Grenoble, France
Ronse, Kurt, IMEC, Leuven, Belgium
Savari, Serap, Texas A&M University College Station, USA
Scheruebl, Thomas, Carl Zeiss SMT GmbH, Jena, Germany
Schnabel, Ronald, VDE/VDI GMM, Offenbach, Germany
Schneider, Jens, Infineon Technologies, Dresden, Germany
Schuch, Nivea, Applied Materials, Grenoble, France
Schulze, Steffen, Siemens EDA, Wilsonville, OR, USA
Seltmann, Rolf, RS litho consult, Dresden, Germany
Sundermann, Frank, STMicroelectronics, Crolles, France
Tiron, Raluca, CEA Leti, Grenoble, France
Tschinkl, Martin, Toppan Photomasks, Dresden, Germany
Varga, Ksenija, EV Group, St. Florian am Inn, Austria
Waelpoel, Jacques, ASML, Veldhoven The Netherlands
Wurm, Stefan, ATICE LLC, Albany, NY, USA
Yoshitake, Shusuke, NuFlare Technology, Yokohama, Japan
Zurbrick, Larry, Keysight Technologies, Santa Clara, CA, USA

Organizers

VDE/VDI Society Microelectronics Microsystems and Precision Engineering (GMM)
Dr. Ronald Schnabel
Merianstraße 28
63069 Offenbach am Main, Germany

Phone: +49 69-6308-227
e-Mail: gmm@vde.com
During the conference:
Phone: +49 171 4695 118

UBC Microelectronics
Dr. Uwe Behringer
Auf den Beeten 5,
72119 Ammerbuch, Germany

Phone: +49-171-455-3196
Fax: +49-7073-50216
e-Mail: uwe.behringer.ubc@t-online.de

Location: TITANE 2 Conference Room (base floor)

14:00 - 14:10 **Welcome to EMLC 2024 – Part 1**
Uwe Behringer / UBC Microelectronics, Ammerbuch (Germany)
EMLC 2024 Conference Chair

14:10 - 16:00

Session 1: Tutorial Presentations

14:10 - 15:05 Introduction of the 1st Tutorial Speaker
Uwe Behringer / UBC Microelectronics (Germany)

1st TUTORIAL:
The challenges for the development of sustainable patterning
Laurent Pain / CEA-Leti, Grenoble (France)

15:05 - 16:00 Introduction of the 2nd Tutorial Speaker
Hans Loeschner / IMS Nanofabrication (Austria)

2nd TUTORIAL:
DSA for Advanced Patterning
Raluca Tiron / CEA-Leti, Grenoble (France)

16:00 - 16:30 ***Coffee Break****, sponsored by* ***Vistec*** *and* ***NUFLARE***

16:30 - 18:30

Session 2: Student Presentations

Chair: Andreas Erdmann / Fraunhofer IISB (Germany)
Co-Chair: Laurent Pain / CEA-Leti (France)
Co-Chair: Kurt Ronse / imec (Belgium)
Co-Chair: Ines Stolberg / Vistec Electron Beam (Germany)

16:30 - 16:45 **Training dataset optimization for deep learning grayscale free form masks design**
Merlin Moreau [1], Jean-Baptiste Henry [1], Gaby Bélot [2], Stéphane Bonnet [1]
[1] Univ. Grenoble Alpes, CEA-Leti, Grenoble (France)
[2] STMicroelectronics, Crolles (France)

16:45 - 17:00 **Imaging effects of particles on the surface of EUV mask and wafer**

Rawan Semaan[1], *Gerardo Bottiglieri*[2], *Andreas Erdmann*[3], *Gijsbert Rispens*[2], *Laurens de Winter*[2], *Steven Beekmans*[2]
[1] *Friedrich-Alexander-Universität Erlangen-Nürnberg (Germany)*
[2] *ASML Netherlands B.V. (The Netherlands)*
[3] *Fraunhofer IISB, Erlangen, (Germany)*

17:00 - 17:15 **Electro-liquefaction of chromium films for lithography applications**

Swapnendu N. Ghosh, *Santanu Talukder*
Department of Electrical Engineering & Computer Science, Indian Institute of Science Education & Research Bhopal (India)

17:15 - 17:30 **Modeling of Multi-Trigger Resists**

Thiago José dos Santos[1], *Zelalem Belete*[1], *Andreas Erdmann*[1], *Alex P. G. Robinson*[2,3], *Carmen Popescu*[2], *Alexandra McClelland*[2]
[1] *Fraunhofer IISB, Erlangen (Germany)*
[2] *Irresistible Materials, Birmingham (UK)*
[3] *School of Chemical Engineering, University of Birmingham, Birmingham (UK)*

17:30 - 17:45 **Self-assembly of shape-complementary DNA origamis for lithography applications**

Nicolas Triomphe[1,2], *Ludwig Rotsen*[1,2], *Allan Mills*[1], *Joséphine Lai-Kee-Him*[1], *Aurélie Ancelin*[1], *Guido Rademaker*[2], *Raluca Tiron*[2], *Gaëtan Bellot*[1]
[1] *Centre de Biologie Structurale, INSERM, CNRS, Université de Montpellier, Montpellier (France)*
[2] *Univ. Grenoble Alpes, CEA-Leti, Grenoble (France)*

17:45 - 18:00 **3D structures sidewalls tuning using smart grayscale photolithography mask strategies**
Gaby Bélot [1], *Aurélien Fay* [2], *Élodie Sungauer* [1], *Sébastien Bérard-Bergery* [1], *Merlin Moreau* [2], *Cécile Gourgon* [3]
[1] *STMicroelectronics, Crolles (France)*
[2] *Univ. Grenoble Alpes, CEA-Leti, Grenoble (France)*
[3] *Université Grenoble Alpes, CNRS, CEA/LETI-Minatec, Grenoble (France)*

18:00 - 18:15 **OCD measurement and modeling of large µlens objects**
Justine Grasland [1,2], *D. Le Cunff* [1], *M Besacier* [2], *JH Tortai* [2]
[1] *STMicroelectronics, Crolles (France)*
[2] *Univ. Grenoble Alpes, CNRS, CEA-LETI Minatec, LTM, Grenoble (France)*

18:15 - 18:30 **Assessment of the accuracy of 3D SEM metrology for microlenses**
Zeinab Abdallah, Aurélien Fay, Stéphane Bonnet / Univ. Grenoble Alpes, CEA-Leti, Grenoble (France)

INVITED - BACUS 2023 Best Paper
18:30 - 18:50 **Improvements on pattern fidelity at high curvature region of curvilinear mask with a novel method of MPC**
Ai Kaneko [1], *Taigo Fujii* [1], *Itaru Ono* [1], *Ahmad Syukri Bin Abdollah* [1], *Yohei Torigoe* [1], *Mincheol Kim* [2], *Sukho Lee* [2], *Eokbong Kim* [2], *Sanghee Lee* [2],
[1] *Nippon Control System Corp. (Japan);*
[2] *SAMSUNG Electronics Co., Ltd. (Republic of Korea)*

19:00 - 21:00 **EMLC 2024 Get Together**
sponsored by ***Advantest, ST*** *and* ***Zeiss***

The EMLC 2024 Get Together takes place at the Palladium (base floor).

Location: PLATINE Auditorium (first floor)

09:00 - 09:20 **Welcome to EMLC 2024 - Part 2**
Uwe Behringer / UBC Microelectronics, Ammerbuch (Germany)
EMLC 2024 Conference Chair

09:20 - 10:40

Session 3: 1st Plenary

Chair: Ines Stolberg / Vistec Electron Beam (Germany)
Co-Chair: Stefan Wurm / ATICE LLC (USA)

KEYNOTE
09:20 - 09:50 **Pioneering sustainable edge AI technologies: a vision for our future**
Serge Nicoleau / STMicroelectronics, Crolles (France) - Group Vice-President Technology

KEYNOTE
09:50 - 10:20 **Recent progress in NIL system development and applications**
Masayuki Kagawa / CANON Corp, Utsunomiya (Japan)

INVITED
10:20 - 10:40 **Semiconductor Device Patterning Equipment: market status and perspectives**
Taguhi Yeghoyan, Gaël Giusti, Merle Zhao, John West / Yole Group, Villeurbanne / Lyon (France)

10:40 - 11:10 ***Coffee Break,*** *sponsored by* ***AMTC***

11:10 - 12:30

Session 4: Data Analytics

Chair: Bertrand Le Gratiet / STMicroelectronics (France)
Co-Chair: Reinhard Galler / EQUIcon (Germany)

INVITED

11:10 - 11:30 **Mask management in optimized photolithography scheduling of a high-mix semiconductor manufacturing facility**

Renaud Roussel [1], Camille Babin [1], Abdel Bitar [2], Sebastian Knopp [2]
[1] STMicroelectronics, Crolles (France)
[2] Planimize, Gardanne (France)

11:30 - 11:45 **Computational overlay as enabler for smarter sampling and enhanced process control**

Leon van Dijk [1], Auguste Lam [2], Kedir Adal [1], Niyam Haque [1], Manav Tyagi [1], Bertrand Le-Gratiet [2], Richard van Haren [1]
[1] ASML Netherlands B.V., Veldhoven (The Netherlands)
[2] STMicroelectronics, Crolles (France)

11:45 - 12:00 **Using emulated images for training a neuronal network applied to SEM contour detection**

Sven Bauerdick, K. Reuther, P. Weber, F. Imeri, S. Meyer, K. Gieb, Ulrich Hofmann / GenISys GmbH, Taufkirchen (Germany)

12:00 - 12:15 **The role of the pattern feature space signature to train etch machin learning model from single pattern SEM contours**

François Weisbuch [1], Nivea Schuch [2], Thiago Figueiro [2]
[1] GlobalFoundries, Dresden (Germany)
[2] Applied Materials, Grenoble (France)

12:15 - 12:30 **Optimization-enabled inverse design for displacement Talbot lithography masks**
Zhixin Wang, Li Wang, Harun H. Solak / Eulitha AG, Würenlos (Switzerland)

12:30 - 14:00 ***Lunch Break,*** *sponsored by* ***Estion*** *and* ***Infineon***

14:00 - 15:10

Session 5: DUV and EUV Lithography

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

INVITED
14:00 - 14:20 **The next step in Moore's Law: High NA EUV imaging and overlay performance**
Jan van Schoot [1], Sjoerd Lok [1], Rob van Ballegoij [1], Eelco van Setten [1], Guido Schiffelers [1], Rudy Peeters [1], Jara Garcia SantaClara [1], Peter Vannoppen [1], Paul Graeupner [2], Peter Kuerz [2], Thomas Stammler [2]
[1] ASML Netherlands B.V., Veldhoven (The Netherlands)
[2] Carl Zeiss SMT GmbH, Oberkochen (Germany)

INVITED
14:20 - 14:40 **DUV lithography optics for today's markets with the future in mind**
Stefan Baueregger, Wolfgang Emer / Carl Zeiss SMT GmbH, Oberkochen (Germany)

14:40 - 14:55 **Stitching at resolution for High NA: an experimental process window study**
Lieve Van Look [1], Vincent Wiaux [1], Natalia Davydova [2], Guillaume Libeert [1], Tatiana Kovalevich [1], Nick Pellens [1], AtakIti Weldeslassie [1], Frank Timmermans [2], Laura Huddleston [2]
[1] imec, Leuven (Belgium)
[2] ASML Netherlands B.V., Veldhoven (The Netherlands)

14:55 - 15:10 **Optical investigation of stacked absorber type black border on EUV Masks**
Daimu Ikeya, Yohei Ikebe, Tsutomu Shoki / HOYA Group LSI Division, Tokyo (Japan)

15:10 - 15:40 *Coffee Break,* *sponsored by* ***Thales***

15:40 - 17:20

Session 6: Mask Patterning and Processing

Chair: Frank E. Abboud / INTEL - IMO (USA)
Co-Chair: Martin Tschinkl / TOPPAN Photomasks (Germany)

INVITED
15:40 - 16:00 **Progress in Resolving Mask Making Challenges to Enable HVM Curvilinear Patterning**
Frank E. Abboud, Mahesh Chandramouli / Intel Mask Operations (IMO), Intel Corporation, Santa Clara, California (USA)

INVITED
16:00 - 16:20 **The merchant mask shop journey to MultiBeam Writers**
Nico Noack [1], Birk Brummack [1], Bríd Connolly [2]
[1] Advanced Mask Technology Center Dresden GmbH & Co.KG (AMTC), Dresden (Germany)
[2] Toppan Photomask Dresden GmbH, Dresden (Germany)

16:20 - 16:35 **Study of EB resist lithographic performance for CAR extension toward future generation**
Kei Yamamoto, Kotaro Takahashi / FUJIFILM Corporation, Shizuoka, (Japan)

16:35 - 16:50 **Recent progress of multi-beam mask writer MBM-3000**
Issei Aibara, Hiroshi Matsumoto, Jumpei Yasuda, Kenichi Yasui, Tomoo Motosugi, Hayato Kimura, Michihiro Kawaguchi, Yoshinori Kojima, Masato Saito, Noriaki Nakayamada / NuFlare Technology, Inc., Yokohama (Japan)

16:50 - 17:05 **MBMW-100 Flex, a versatile multi-beam mask writer for mature and advanced mask nodes**

Mustapha Chouiki, Mathias Tomandl, Christof Klein, Hans Loeschner, Elmar Platzgummer / IMS Nanofabrication GmbH, Brunn am Gebirge and Vienna (Austria)

17:05 - 17:20 **Model- and Multilayer Compensation Methods for Thermal Position Drifts**

Andreas Weu [1], Thomas Ding [1], Benedikt Roland [1], Simon Aigner [1], Achim Jehle [1], Matthias Wahl [1], Kwangsik Jo [2], Jonghak Kim [2], Sungjin Choi [2], Bonghoi Hur [2]

[1] Heidelberg Instruments Mikrotechnik GmbH, Heidelberg (Germany)

[2] Microimage Co.,Ltd., Sejong (Republic of Korea)

17:30 - 19:00

Session 7: Poster Session

Chair: Enrico Maly / Photronics (Germany)
Co-Chair: Uwe Behringer / UBC (Germany)

P-1 **Resist stabilization with UV harden processing for high energy implant and wet etch processes**
Steffen Poegel [1], Heiko Assmann [1], Jens Schneider [1], Moritz Anton Kuettner [2]
[1] Infineon Technologies Dresden GmbH, Dresden (Germany)
[2] University of Applied Science (HTW), Dresden (Germany)

P-2 **Accelerating Yield Marginality Understanding with Massive Electron Beam Metrology and CD SEM Contour Analysis**
Nicolas Lesire, Bertrand Le-Gratiet Bertrand, Aurelie Le Pennec, Louis-Victor Oudin, Alestra Romain, Clementine Madec, Lucie Mourier, Florent Dettoni, Pierre Marie Deleuze, Audrey Menis / STMicroelectronics, Crolles (France)

P-3 **Impact of lithography shape on epitaxy profiles**
Sylvain Moulis, Nicolas Guitard / STMicroelectronics, Crolles (France)

P-4 **Nanostructuration of Hybrid Organic-Inorganic perovskite via Thermal Nanoimprint to tailor light-matter interactions for optoelectronic devices**
Raphael Mermet-Lyaudoz, Ha My Dang Nguyen, Tam Trong Nguyen, Florian Berry, Emmanuel Drouard, Christian Seassal, Céline Chevalier, Hai Son Nguyen / Univ Lyon, Ecole Centrale de Lyon, CNRS, INSA Lyon, Univ Claude Bernard Lyon 1, CPE Lyon, CNRS, Ecully (France)

P-5 **Health inspection of EUV pellicles with emphasis on thickness and transparency of CNT pellicles**
Emile van Veldhoven [1], Jochen Mielke [2]
[1] Canatu Oy, Vantaa (Finland)
[2] Horiba Europe GmbH, Oberursel/Taunus (Germany)

P-6 **Nanopillars imprinted on 200 mm GaN/SOI wafers for bottom-up µleds fabrication**
Cécile Gourgon [1], N. Labchir [1], J. Rêche [2], C. Petit Etienne [1], S. Labau [1], M. Panabière [1], B. Alloing [3], P.M. Coulon [3], M. Charles [2]
[1] Université Grenoble Alpes, CNRS, CEA/LETI-Minatec, Grenoble (France)
[2] Université Grenoble Alpes, CEA-LETI, 17 Rue des Martyrs (France)
[3] Université Cote d'Azur, CRHEA-CNRS, Valbonne (France)

P-7 **In situ measurements of electrostatic charges on photomasks and critical questioning of ESD limit values in corresponding standards and guidelines**
Thomas Sebald / ESTION Technologies GmbH, Griesheim (Germany)

P-8 **AIMS® EUV verification of High-NA mask phase effects**
Matthias Roesch, Grizelda Kersteen, Andreas Verch, Maximilian Albert, Philip Heringlake, Klaus Gwosch, Renzo Capelli / Carl Zeiss SMT GmbH, Oberkochen (Germany)

P-9 **Layout curvilinear representations impact on High-NA masks: a comparative study**
Benjamin Venitucci, Jean-François Bougron, Nivea Schuch, Frederic Robert, Thiago Figueiro / Applied Materials, Grenoble (France)

P-10 **Cost–effective Nanoscale Process Control Enabled by EVG's Metrology Systems**
Frank Bögelsack, Tobias Zenger, Thomas Stöttinger / EV Group, St. Florian (Austria),

P-11 **Metrospection holistic AI-driven process control software platform dedicated to metrology and defectivity for lithography process at pattern and wafer levels**

Julien Baderot, Ali Hallal, Martin Jacob, Sergio Martinez, Johann Foucher / POLLEN Metrology, Moirans (France)

P-12 **Model-based determination of optimum segment length of piecewise linear (PWL) mask shapes**

Kushlendra Mishra [1], Rachit Sharma [1], Ingo Bork [2], Mary Zuo [2], Christof Zillner [3]

[1] Siemens Digital Industries Software, Bangalore (India)

[2] Siemens Digital Industries Software, Fremont, California (USA)

[3] IMS Nanofabrication GmbH, Brunn am Gebirge and Vienna (Austria)

P-13 **Automatic wafer defect detection and accurate classification using machine learning based analysis of SEM images**

Sanghyun Choi [1], Nathan Greeneltch [2], Mohan Govindaraj [2], Srividya Jayaram [2], Mark Pereira [3], Sayani Biswas [3], Samir Bhamidipati [3], Ilhami Torunoglu [2]

[1] Siemens EDA (South Korea)

[2] Siemens EDA (USA)

[3] Siemens EDA (India)

P-14 **High NA EUV single patterning of advanced metal logic nodes: Inverse lithography techniques in combination with alternative mask absorbers**

Ana-Maria Armeanu [1], Nick Pellens [2], Vicky Philipsen [2], Evgeny Malankin [3], Dongbo Xu [4], Keisuke Mizuuchi [5], Gabriel Curvacho [3], Chih-I Wei [4], Neal Lafferty [3], Germain Fenger [3],

[1] Siemens Digital Industries Software (France)

[2] imec, Leuven (Belgium)

[3] Siemens Digital Industries Software (USA)

[4] Siemens Digital Industries Software (Belgium)

[5] Siemens Digital Industries Software (Japan)

Student Poster (STP)

StP-1 **Training dataset optimization for deep learning grayscale free form masks design**
Merlin Moreau [1], Jean-Baptiste Henry [1], Gaby Bélot [2], Stéphane Bonnet [1]
[1] Univ. Grenoble Alpes, CEA-Leti, Grenoble (France)
[2] STMicroelectronics, Crolles (France)

StP-2 **Imaging effects of particles on the surface of EUV mask and wafer**
Rawan Semaan [1], Gerardo Bottiglieri [2], Andreas Erdmann [3], Gijsbert Rispens [2], Laurens de Winter [2], Steven Beekmans [2]
[1] Friedrich-Alexander-Universität Erlangen-Nürnberg (Germany)
[2] ASML Netherlands B.V. (The Netherlands)
[3] Fraunhofer IISB, Erlangen, (Germany)

StP-3 **Electro-liquefaction of chromium films for lithography applications**
Swapnendu N. Ghosh, Santanu Talukder / Department of Electrical Engineering & Computer Science, Indian Institute of Science Education & Research Bhopal (India)

StP-4 **Modeling of Multi-Trigger Resists**
Thiago José dos Santos [1], Zelalem Belete [1], Andreas Erdmann [1], Alex P. G. Robinson [2,3], Carmen Popescu [2], Alexandra McClelland [2]
[1] Fraunhofer IISB, Erlangen (Germany)
[2] Irresistible Materials, Birmingham (UK)
[3] School of Chemical Engineering, University of Birmingham, Birmingham (UK)

StP-5 **Self-assembly of shape-complementary DNA origamis for lithography applications**
Nicolas Triomphe [1,2], Ludwig Rotsen [1,2], Allan Mills [1], Joséphine Lai-Kee-Him [1], Aurélie Ancelin [1], Guido Rademaker [2], Raluca Tiron [2], Gaëtan Bellot [1]
[1] Centre de Biologie Structurale, INSERM, CNRS, Université de Montpellier, Montpellier (France)
[2] Univ. Grenoble Alpes, CEA-Leti, Grenoble (France)

StP-6 **3D structures sidewalls tuning using smart grayscale photolithography mask strategies**
Gaby Bélot [1], Aurélien Fay [2], Élodie Sungauer [1], Sébastien Bérard-Bergery [1], Merlin Moreau [2], Cécile Gourgon [3]
[1] STMicroelectronics, Crolles (France)
[2] Univ. Grenoble Alpes, CEA-Leti, Grenoble (France)
[3] Université Grenoble Alpes, CNRS, CEA/LETI-Minatec, Grenoble (France)

StP-7 **OCD measurement and modeling of large µlens objects**
Justine Grasland [1,2], D. Le Cunff [1], M Besacier [2], JH Tortai [2]
[1] STMicroelectronics, Crolles (France)
[2] Univ. Grenoble Alpes, CNRS, CEA-LETI Minatec, LTM, Grenoble (France)

StP-8 **Assessment of the accuracy of 3D SEM metrology for microlenses**
Zeinab Abdallah, Aurélien Fay, Stéphane Bonnet
Univ. Grenoble Alpes, CEA-Leti, Grenoble (France)

19:00 Departure from MINATEC / CEA-Leti

19:30 - 22:00

EMLC 2024 Conference Dinner

sponsored by ***IMS, Pozzetta*** *and* ***Toppan***

The EMLC 2024 Conference Dinner will be at

Les Jardins de Sainte Cécile
18 Rue de L'Alma, 38000 GRENOBLE
http://www.lesjardinsdesaintececile.com

Location: PLATINE Auditorium (first floor)

09:00 - 09:30

Zeiss Award and Announcement of BACUS 2024 and PMJ 2025

ZEISS Award for Talents in Photomask Industry
on the occasion of the 39th European Mask and Lithography Conference 2024 (EMLC 2024) in Grenoble / France
by Thomas Franz Karl Scheruebl
Carl Zeiss Semiconductor Mask Solutions (SMS)

Announcement of SPIE Photomask Technology ('BACUS') & EUVL 2024 conference
by t.b.d.

Announcement of PMJ (Photomask Japan) 2025 conference
by Hiroshi Nakata
DNP - Program Committee Chair of Photomask Japan .

09:30 - 11:20

Session 8: 2nd Plenary

Chair: Laurent Pain / CEA-Leti (France)
Co-Chair: Naoya Hayashi / DNP (Japan)

KEYNOTE

09:30 - 10:00 **FAMES**
The EU Chip Act pilot line program and its ecosystem to support FD-SOI technology extension down to 7nm node
Jean-René Lèquepeys / CTO CEA-Leti, Grenoble (France),

KEYNOTE

10:00 - 10:30 **High NA EUV patterning ecosystem readiness to continue the logic scaling roadmap**
Kurt Ronse / Advanced Patterning Program Director imec, Leuven (Belgium)

10:30 - 11:00 ***Coffee Break,*** *sponsored by* ***GenIsys*** *and* ***Nuflare***

INVITED – PMJ 2024 Best Poster Award

11:00 - 11:20 **Ultimate mask resolution challenges for the beyond 2nm Technology**
Izumi Hotei, Tsukasa Abe, Yukihiro Fujimura, Mei Ebisawa, Masataka Yamaji, Issei Sakai, Hideyuki Mitsui, Yasutaka Morikawa, Tatsuya Tomita, Shingo Yoshikawa, Naoya Hayashi / Dai Nippon Printing, Saitama (Japan)

11:20 - 12:30

Session 9: Mask Metrology, Tuning and Inspection

Chair: Thomas Franz Karl Scheruebl / Carl Zeiss SMT (Germany)
Co-Chair: Nico Noack / AMTC (Germany)

INVITED

11:20 - 11:40 **30 years AIMS® – from DUV to EUV**
Ute Buttgereit, Thomas Scheruebel / Carl Zeiss SMT GmbH, Jena (Germany)

INVITED

11:40 - 12:00 **High-NA EUV mask pattern characterization using advanced mask mask CD-SEM metrology**
Joost Bekaert [1], Balakumar Baskaran [1], Vicky Philipsen [1], Lieve Van Look [1], Ardavan Niroomand [1], Eric Hendrickx [1], Hideaki Komami [2], Tatsuro Okawa [2], Soichi Shida [2], Shinichi Kojima [3], Toshimichi Iwai [2]
[1] imec, Leuven (Belgium)
[2] Advantest Corporation (USA)
[3] Advantest America, Inc. (USA)

12:00 - 12:15 **New Optical Metrology Method for Measuring Shape of a Lithography Photo Mask**

Guillermo Castro Luis [1], Kiril Ivanov Kurtev [1,3], Miguel Jiménez [1,3], Juan M. Trujillo Sevilla [1], Jose Manuel Ramos-Rodríguez [1], Jan O. Gaudestad [2,3]

[1] Wooptix SL, La Laguna, Tenerife Canary Islands (Spain)

[2] Wooptix SL, San Francisco, California (USA)

[3] Industrial Engineering Department, Universidad de La Laguna, ESIT, La Laguna, Tenerife Canary Islands (Spain)

12:15 - 12:30 **Survey of critical applications for AFM in mask development, manufacturing, and mask repair**

Sean Hand, Jason Osborne, Jorge Olivares Roriguez, Peter De Wolf / Bruker Nano Surfaces and Metrology, Santa Barbara, California (USA)

12:30 - 13:30 ***Lunch Break**, sponsored by **Heidelberg Instruments** and **Vistec***

13:30 - 15:00

Session 10: Optical and E-Beam Direct Write, with Applications for Photonics, AR/VR and Quantum Computing

Chair: Ksenija Varga / EV Group (Austria)
Co-Chair: Ines Stolberg (Germany)

INVITED

13:30 - 13:50 **Character-projection e-beam lithography for micro- and nano-optical applications**

Uwe D. Zeitner [1,2], Falk Eilenberger [1]

[1] Fraunhofer Institute of Applied Optics and Precision Engineering, Jena (Germany)

[2] University of Applied Sciences Munich, Munich (Germany)

INVITED

13:50 - 14:10 **Optimal shape approximation and writing strategy for integrated photonic waveguides using variable-shaped e-beam direct lithography**

Kevin Edelmann [1], S. Fasold [2], M. Greul [1], J. Hartbaum [1], E. Linn [2], I. Stolberg [2], U. Weidenmueller [2]

[1] Institut für Mikroelektronik Stuttgart, Stuttgart (Germany)

[2] Vistec Electron Beam GmbH, Jena (Germany)

INVITED

14:10 - 14:30 **Traceability in Automotive Enabled by Digital Lithography**

Ksenija Varga [1], M. Weinhart [1], R. Holly [1], T. Zenger [1], B. Považay [1], T. Uhrmann [1], H. Takishita [2], Y. Taguchi [2], J. Koch [3], M. Schicke [3]

[1] EV Group, St Florian am Inn (Austria)

[2] Fujifilm Electronic Materials Japan, Yokohama, (Japan)

[3] Fujifilm Electronic Materials Europe, Zwijndrecht (Belgium)

14:30 - 14:45 **Innovative photoresists and photopolymers enabling advanced manufacture of photonic and micro-optical applications**

Arne Schleunitz, C. Schuster, A. Voigt, M. Russew, M. Lohse, M. Heinrich, G. Grützner / micro resist technology GmbH, Berlin (Germany)

14:45- 15:00 **E-beam lithography for quantum optics with lithium niobate on insulator**

Victor Brasch [1], N. Hoppe [1], M. Kaschel [2], S. Valligatl [1]

[1] Q.ANT GmbH, Stuttgart (Germany)

[2] Institut für Mikroelektronic Stuttgart (IMS Chips), Stuttgart (Germany)

15:00 - 15:30 ***Coffee Break,*** *sponsored by* ***ASML***

15:30 - 17:05

Session 11: Nano-Imprint Lithography (NIL)

Chair: Bríd M. Connolly / Toppan Photomasks
Co-Chair: Michael Muehlberger / PROFACTOR (Austria)

INVITED

15:30 - 15:50 **NIL mastering using advanced manufacturing imaging technology**
Bríd Connolly [1], Martin Sczyrba [2]
[1] Toppan Photomask Company, Dresden (Germany)
[2] Advanced Mask Technology Center GmbH & Co. KG (AMTC), Dresden (Germany)

15:50 - 16:05 **Step-and-repeat Nanoimprint Lithography for master fabrication for Nanophotonic engineering**
Céline Chevalier, Lydie Ferrier, Ha My Dang Nguyen, Jean-Louis Leclercq, Christian Seassal / CNRS, INSA Lyon, Ecole Centrale de Lyon, Universite Claude Bernard Lyon, Villeurbanne (France)

16:05 - 16:20 **Manufacturing of 2D/3D features on NIL masters**
Haiko Rolff, M. Sczyrba, M. Kristlib / Advanced Mask Technology Center GmbH & Co. KG (AMTC), Dresden (Germany)

16:20 - 16:35 **High potential of Nanoimprint lithography for LIDAR application**
Jérôme Rêche [1], Michael Haslinger [2], Martin Eibelhuber [3], Mikko Poutanen [4], Kazuki Origuchi [4]
[1] Univ. Grenoble Alpes, CEA-Leti, Grenoble (France)
[2] PROFACTOR GmbH, Steyr (Austria)
[3] EV Group, E.Thallner GmbH, St. Florian am Inn (Austria)
[4] Inkron Oy, Espoo (Finland)

16:35 - 16:50 **Utilizing Inkjet Coating and Nanoimprinting for Complex 3D Patterns with Gradual Height Increase and Minimal Residual Layer**

Thomas Achleitner, Johanna Rimböck, Lisa Vsetecka, Patrick Schuster / EV Group, St. Florian am Inn (Austria)

16:50 - 17:05 **Soft-Nano-Imprint-Lithography for Tunable Optical Metasurfaces: From Passive to Active Photonic Component**

Yudha Ramanda [1], Oumaima Meskini [1,2], Marco Abbarchi [2], Badre Kerzabi [2], Victor Malgras [1], Magali Putero [3], David Grosso [1,2]

[1] Center for Interdisciplinary for Nanoscience of Marseille, CINaM, Campus de Luminy, Marseille (France)

[2] Solnil SAS, Marseille (France)

[3] Institut of Materials Microelectronics and Nanosciences of Provence, IM2NP, Marseille (France)

17:05 - 18:05

Session 12: Pattern Fidelity

Chair: Jan Hendrik Peters (Germany)
Co-Chair: Harry J. Levinson (USA)

INVITED
17:05 - 17:25 **Your IQ: Understanding Image Quality In Advanced Photomask Applications**
Christopher Progler / Photronics, Inc., Plano, Texas (USA)

INVITED
17:25 - 17:45 **Revolutionizing Semiconductor Design and Manufacturing: from Manhattan to Curvilinear**
Ryoung-han Kim / imec, Leuven (Belgium)

INVITED
17:45 - 18:05 **The Challenges and Limits to Patterning Using EUV Lithography**
Harry J. Levinson / HJL Lithography, Saratoga, California (USA)

18:05 - 18:15 **Thanks to all EMLC 2024 Presenters & Participants and Announcement EMLC 2025, Dresden, June 16-18, 2025**
Uwe Behringer, Conference Chair

End of EMLC 2024 Conference

Notes

Conference Information

Conference Hours

Monday, June 17th, 2024	02:00 pm to 07:00 pm
Tuesday, June 18th, 2024	09:00 am to 07:00 pm
Wednesday, June 19th, 2024	09:00 am to 06:30 pm

Registration Hours

Monday, June 17th, 2024	01:00 pm to 06:00 pm
Tuesday, June 18th, 2024	08:00 am to 05:00 pm
Wednesday, June 19th, 2024	08:00 am to 02:00 pm

Technical Exhibition

Parallel to the conference presentations we offer you to take part in the technical exhibition on

Tuesday, June 18th,	from 10:00 am to 6:00 pm and
Wednesday, June 19th,	from 10:00 AM to 4:00 pm.

If you intend to participate in the technical exhibition as an exhibitor, please contact

UBC Microelectronics
Dr. Uwe Behringer
Auf den Beeten 5,
72119 Ammerbuch, Germany

Phone: +49 171-455-3196
e-Mail: uwe.behringer.ubc@t-online.de

EMLC Best Paper Award and Best Poster Award

All conference attendees will elect the Best Paper and the Best Poster Award of the EMLC 2024.

Both EMLC 2024 Award Winners will be invited either to present at at the SPIE Photomask Technology ('BACUS') & EUV Lithography Conference 2024 or at the Photomask Japan Conference (PMJ) 2025 in Yokohama, Japan.

Zeiss Award for talents in Photomask Industry

VDE is happy to announce that the industry supports student participation by presenting student best paper awards sponsored by ZEISS Semiconductor Mask Solutions (SMS).

Winners will be awarded a ZEISS certificate and a trophy. In addition, the winner will be invited to present his or her work at SPIE Photomask Technology + Extreme Ultraviolet Lithography Conference 2024 in Monterey / CA. He or she receives a donation of 2,500 EUR to cover the travel expenses.

General Information

EMLC 2024 Office

For detailed information please contact:

VDE/VDI Society Microelectronics Microsystems and Precision Engineering (GMM)
Dr. Ronald Schnabel
Merianstraße 28
63069 Offenbach am Main, Germany

Phone: +49 69-6308-227
e-Mail: gmm@vde.com

During the conference:
Phone: +49 171 4695 118

Conference Fees

	until May 21st, 2024	after May 21st, 2024
Regular	€ 780.00	€ 880.00
VDE, VDI Members*	€ 750.00	€ 850.00
Lecturer, Program Committee Members	€ 590.00	€ 690.00
Exhibitors	€ 450.00	€ 450.00
Students**	€ 150.00	€ 200.00

* Participants claiming for the membership fee must verify their membership.

** A copy of the student card must be attached.

Conference Participation includes

- Coffee / tea and beverages during the conference breaks at the MINATEC Congress Center on Monday, June 17th, afternoon, Tuesday, June 18th morning and afternoon, and Wednesday, June 19th morning and afternoon
- Participation at EMLC2024 Get Together at the PALLADIUM on Monday, June 17th, early evening.
- Lunch and beverages at the MINATEC Congress Center on Monday, June 18th and Wednesday, June 19th, 2024.
- •Conference Dinner Banquet on Tuesday evening, June 19th, 2024 (Location to be defined).
- Free Access to the EMLC 2024 Technical Exhibition at the MINATEC Congress Center..

Payment of Conference Fee

Payment for registration, including bank charges and processing fees, must be made in Euro. The conference fee has to be fully paid in advance by credit card. Your registration can only be confirmed if VDE-Conference Services has recorded receipt of your full payment.

Cancellation

In case of cancellation, provided that VDE-Conference Services has received written notice until 30 days before the event, the registration fee will be fully refunded less a handling fee of 80,-EUR. In case of cancellation after this date, no refund will be made.

Conference Venue

MINATEC Congress Center
3 parvis Louis Néel,
38054 Grenoble, France

© MINATEC

The VDE GMM and the members of the EMLC 2024 Program Committee of the 39th European Mask and Lithography Conference, EMLC 2024, would like to express their sincere appreciation to all the sponsors and coopering partners mentioned below for their support.

Seeing beyond