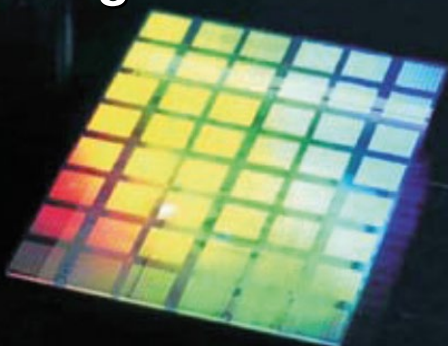
Program

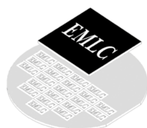


The 38th European Mask and Lithography Conference

EMLC 2023

June 19 – 21, 2023
Hilton Hotel, Dresden, Germany

www.emlc-conference.com



VDE VDI GMM

Welcome to the EMLC 2023 in Dresden

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 2023 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. Mask manufacturers and users have the opportunity to familiarize themselves with the latest developments and results.

We have the pleasure to announce following Tutorials:

"Technology of EUV Lithography Optics"
Bernhard Kneer, Carl Zeiss SMT, Oberkochen, Germany

"Current Status and Prospect for EUV Lithography"
Takeo Watanabe, University of Hyogo, Japan

Sessions on Tuesday, June 20th, 2023

- DUV and EUV Lithography
- Mask Patterning and Processing
- Mask and Resist Optimization

The first day ends with a Poster Session followed by the Conference Dinner Banquet at the "Pulverturm" in Dresden.

Sessions on Wednesday, June 20th, 2023

- Maskless Lithography and Metrology
- Mask Metrology, Tuning and Inspection and SC Sustainability
- Nano-Imprint Lithography (NIL)
- Data Analytics

At the end of the coneference the ZEISS Award for Talents in Photomask Industry for the Best Student Presentation will be presented.

Parallel to the EMLC 2023 conference, the „Technical Exhibition" will take place in the Hilton Hotel.

May we also suggest you to benefit from the technical sessions and the exhibition of the EMLC Conference 2023, but also to enjoy the beautiful flair of the City of Dresden!

Uwe Behringer
EMLC2023 Conference Chair

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The EMLC 2023 International Program Committee

Conference Chairs

Behringer, Uwe, UBC Microelectronics, Ammerbuch, Germany

Finders, Jo, ASML, Veldhoven, The Netherlands

Co-Conference Chairs

Connolly, Brid, Toppan Photomasks GmbH, Dresden, Germany

Gale, Chris, Applied Materials, 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, Vienna, Austria

Co-Program Chairs

Peters, Jan Hendrik, bmbg Consult Radebeul, Germany

Sarlette, Daniel, Infineon, Dresden, Germany

Other Members

Abboud, Frank, Intel Corporation, Santa Clara, CA, USA
Born, René, Photronics MZB GmbH, Dresden, Germany
Ehrmann, Albrecht, Carl Zeiss SMT Oberkochen, Germany
Farrar, Dave, HOYA Corporation, London, UK
Galler, Reinhard, Equicon, Jena, Germany
Le Gratiet, Bertrand, ST Microelectronics, Crolles, France
Levinson, Harry J., HJL Lithography, Saratoga, CA, USA
Muehlberger, Michael, Profactor GmbH, Steyr-Gleink, Austria
Noack, Nico, AMTC Dresden, Germany
Pain, Laurent, CEA Leti, Grenoble, France
Ronse, Kurt, IMEC, Leuven, Belgium
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Scheruebl, Thomas, Carl Zeiss SMT GmbH, Jena, Germany
Schnabel, Ronald, VDE/VDI-GMM, Offenbach am Main, Germany
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Shushuke, Yoshitake, NuFlare, Japan
Sundermann, Frank, STMicroelectronics, Crolles, France
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Wurm, Stefan, ATICE LLC, Albany, NY, USA
Zurbrick, Larry, Keysight Technologies, Santa Clara, CA, USA

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e-Mail: uwe.behringer.ubc@t-online.de

14:00 - 14:10 **Welcome to EMLC 2023 – Part 1**
Uwe Behringer / UBC Microelectronics, Ammerbuch (Germany)
EMLC 2023 Conference Chair

14:10 - 15:50

Session 1: TUTORIAL on EUV Lithography

14:10 - 15:00 Introduction of the 1st Tutorial Speaker by
Albrecht Ehrmann / Carl Zeiss SMT (Germany)

1st TUTORIAL:
Technology of EUV Lithography Optics
Bernhard Kneer / Carl Zeiss SMT, Oberkochen (Germany)

15:00 - 15:50 Introduction of the 2nd Tutorial Speaker by
Hans Loeschner / IMS Nanofabrication (Austria)

2nd TUTORIAL:
The Dawn of EUV Lithography Technology, and its Current Status and Future Prospect
Takeo Watanabe / University of Hyogo (Japan)

15:50 - 16:20 ***Coffee Break*** *sponsored by* ***HOYA***

16:20 - 18:40

Session 2: Student Presentations

Chair: Andreas Erdmann / Fraunhofer IISB (Germany)
Co-Chair: Laurent Pain / CEA-Leti (France)

16:20 - 16:40 **Understanding the impact of rinse on SEM images and contact patterning variability**
Elvire Soltani et al. / STMicroelectronics, Crolles (France)

16:40 - 17:00 **SEMI-CenterNet: A Machine Learning Facilitated Approach for Semiconductor Defect Inspection**
Vic De Ridder / IMEC, Leuven (Belgium)

17:00 - 17:20 **3d SEM metrology of microstructures for high volume manufacturing**
Zeinab Abdallah et al. / Univ. Grenoble Alpes, CEA Leti, Grenoble (France)

17:20 - 17:40 **YOLOv8 for defect inspection of hexagonal directed self-assembly patterns: a data-centric approach**
Enrique Dehaerne et al. / KU Leuven; Interuniversity Microelectronics Center (IMEC), Leuven (Belgium)

17:40 - 18:00 **Investigation of the resolution limit of Talbot lithography with compact EUV exposure tools**
Bernhard Lüttgenau et al. / RWTH, Aachen (Germany)

18:00 - 18:20 **Training Dataset Optimization for Deep Learning applied to Optical Proximity Correction on non-regular hole masks**
Mathis Urard et al. / STMicroelectronics, Crolles (France)

18:20 - 18:40 **Pathfinding the perfect EUV mask: Mask imperfections and their impact on the imaging**
Hazem S. Mesilhy et al. / Fraunhofer IISB, Erlangen (Germany)

18:40 - 19:00 **Predicting resist pattern collapse in EUVL using machine learning**
Sean D'Silva et al. / Fraunhofer IISB, Erlangen (Germany)

19:00 - 21:00

EMLC 2023 Get Together

sponsored by ***AMTC, EQUIcon, Infineon, Toppan, VISTEC and ZEISS***

The EMLC 2023 Get Together takes place in the Piano Bar of the Hilton Hotel Dresden

09:00 - 09:20 **Welcome to EMLC 2023 – Part 2**
Uwe Behringer / UBC Microelectronics, Ammerbuch (Germany)
EMLC 2022 Conference Chair

Announcement of SPIE Photomask Technology ('BACUS') & EUV Lithography 2023
by Henry Kamberian (Photronics), BACUS Vice-President

Announcement of Photomask Japan 2024
by Hiroshi Nakata (DNP), PMJ Program Chair

09:20 - 10:30

Session 3: 1st PLENARY

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

KEYNOTE
09:20 - 09:55 **Neuromorphic Intelligence: mixed-signal spiking neural networks for on-line sensory processing at the edge**
Giacomo Indiveri / Univ Zurich and ETH Zurich (Switzerland)

KEYNOTE
09:55 - 10:30 **Photomask technology as a key enabler of EUV in high volume manufacturing**
Joe English / INTEL, Leixlip (Ireland)

10:30 - 11:00 ***Coffee Break*** *sponsored by*
SIEMENS and PHOTRONICS

11:00 - 12:25

Session 4: DUV and EUV Lithography

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

KEYNOTE
11:00 - 11:35 **Taking lithography to the max**
Jo Finders / ASML, Veldhoven (The Netherlands)

INVITED
11:35 - 12:00 **Emergence of next generation EUV optics: status, outlook and future**
Björn Butscher et al. / Carl Zeiss SMT, Oberkochen (Germany)

INVITED
12:00 - 12:25 **Exploration of imaging solutions for high NA EUV lithography by combination of dual monopole exposure strategies with low-n absorbers**
Andreas Erdmann et al. / Fraunhofer IISB, Erlangen (Germany)

12:30 - 14:00 ***Lunch Break*** *sponsored by* ***ADVANTEST***

14:00 - 15:30

Session 5: Mask Patterning and Processing

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

INVITED
14:00 - 14:25 **The History of E-beam Mask Writing and Innovations for EUV Mask Patterning**
Sang-Hee Lee / Samsung Electronics, Hwaseong (South-Korea)

INVITED – Best Poster of BACUS 2022

14:25 - 14:50 **State-of-the-art EUV mask process development by the combination of MBMW and ultra-high resolution CAR**
Shingo Yoshikawa et al. / DNP, Saitama (Japan)

14:50 - 15.10 **Current Performance of Electron Multi-beam Mask Writers and Plans Going Forward in High-NA EUV Era**
Yoshinori Kojima, et al. / NuFlare Technology, Yokohama (Japan)

15:10 - 15.30 **Multi-Beam Mask Writing opens up New Fields of Application**
Mathias Tomandl et al. / IMS Nanofabrication, Brunn am Gebirge and Vienna (Austria)

15:30 - 16:00 ***Coffee Break*** *sponsored by* ***POZZETTA***

16:00 - 17:20

Session 6: Mask and Resist Optimization

Chair: Kurt Ronse / IMEC, Leuven (Belgium)
Co-Chair: Andreas Erdmann / Fraunhofer IISB (Germany)

16:00 - 16:20 **Study of EB resist dissolution contrast and chemical blur impact on the ultimate resolution**
Kei Yamamoto et al. / FUJIFILM, Yoshida (Japan)

16:20 - 16:40 **Mask Optimization for High-NA critical features: a balancing act**
Parul Dhagat et al. / ASML, Veldhoven (The Netherlands)

16:40 - 17:00 **Development of an e-beam/i-line stepper intra-level mix and match approach with the photoresist mr-EBL 6000.5 for PIC related structures such as waveguides, ring resonators and coupling structures**
Christian Helke et al. / Fraunhofer ENAS, Chemnitz (Germany)

17:00 - 17:20 **Test Pattern Generation by Optimization of the Parameter Space Signature**
François Weisbuch / GLOBALFOUNDRIES Dresden Module Two, Dresden (Germany)

17:30 - 19:00

Session 7: Poster Session

Chair: René Born / Photronics (Germany)
Co-Chair: Uwe Behringer / UBC (Germany

P-1 **Automatic laser writing parameters setting for mature mask production**
Giorgio Borzini et al. / DNP Photomask Europe, Agrate (Italy)

P-2 **Efficient mask characterization through automated contour and corner rounding extraction**
Rainer Zimmermann et al. / Synopsys Europe (Germany)

P-3 **Nanoimprinting of micro and nanostructures as opportunities in Life Science applications**
Michael Haslinger et al. / PROFACTOR, Steyr-Glenk (Austria)

P-4 **Sustainability Aspects of Nanoimprint Lithography**
Michael Mühlberger et al. / PROFACTOR, Steyr-Gleink (Austria)

P-5 **Opportunities of polarization-resolved EUV Scatterometry on Photomasks**
Victor Soltwisch et al. / PTB, Braunschweig (Germany)

P-6 **CD-SEM image sharpness score monitoring**
Nicolas Kubler / STMicroelectronics, Crolles (France)

P-7 **Quantum computing applications of VSB-type e-beam lithography on 200 mm and 300 mm wafers in semiconductor FAB environment**
Varvara Brackmann et al. / Fraunhofer IPMS CNT, Dresden (Germany)

P-8 **Health inspection of EUV pellicles with emphasis on CNT pellicles**
Jochen Mielke / Horiba Europe, Oberursel / Taunus (Germany)

P-9 **A Deep Learning Facilitated Approach for SEM Image Denoising Towards Improved Contour Detection for DRAM (SNLP+BLP) Structures (2D)**
Stewart Wu et al. / Siemens EDA (USA)

P-10 **KrF Multi-focal Imaging (MFI): System operation – computational application to CIS Customer use cases**
Will Conley et al. / ASML-Cymer, San Diego (USA), ASML, Veldhoven (The Netherlands), ASML-Brion, San José (USA)

P-11 **AIMS® EUV High-NA: Actinic EUV mask qualification for next generation lithography**
Matthias Roesch et al. / Carl Zeiss SMT, Oberkochen (Germany)

Student Posters (StP)

StP-INVITED
Photronics Student Award – 1st Place at SPIE Photomask Technology (‘BACUS’) 2022
Investigation of stochastic roughness effects for nanoscale grating characterization with a stand-alone EUV spectrometer
Sven Glabisch / RWTH Aachen (Germany)

STUDENT POSTER in addition to STUDENT ORAL

StP-1 **Understanding the impact of rinse on SEM images and contact patterning variability**
Elvire Soltani et al. / STMicroelectronics, Crolles (France)

StP-2 **SEMI-CenterNet: A Machine Learning Facilitated Approach for Semiconductor Defect Inspection**
Vic De Ridder / IMEC, Leuven (Belgium)

StP-3 **3d SEM metrology of microstructures for high volume manufacturing**
Zeinab Abdallah et al. / Univ. Grenoble Alpes, CEA Leti, Grenoble (France)

StP-4 **YOLOv8 for defect inspection of hexagonal directed self-assembly patterns: a data-centric approach**
Enrique Dehaerne et al. / KU Leuven, Interuniversity Microelectronics Center (IMEC), Leuven (Belgium)

StP-5 **Investigation of the resolution limit of Talbot lithography with compact EUV exposure tools**
Bernhard Lüttgenau et al. / RWTH, Aachen (Germany)

StP-6 **Training Dataset Optimization for Deep Learning applied to Optical Proximity Correction on non-regular hole masks**
Mathis Urard et al. / STMicroelectronics, Crolles (France)

StP-7 **Pathfinding the perfect EUV mask: Mask imperfections and their impact on the imaging**
Hazem S. Mesilhy et al. / Fraunhofer IISB, Erlangen (Germany)

StP-8 **Predicting resist pattern collapse in EUVL using machine learning**
Sean D'Silva et al. / Fraunhofer IISB, Erlangen (Germany)

19:30 - 22:00

EMLC 2023 Conference Dinner

*sponsored by **ASML and eBeam Initiative***

The Conference Dinner takes place at the "Pulverturm" (near the Dresden Hilton Hotel)

09:00 - 11:05

Session 8: 2nd PLENARY

Chair: Naoya Hayashi / DNP (Japan)
Co-Chair: Daniel Sarlette / INFINEON (Germany)

KEYNOTE

09:00 - 09:35 **Bosch Dresden – from Greenfield to High Yield**
Christian Koitzsch / BOSCH, Dresden (Germany)

KEYNOTE

09:35 - 10:10 **Infineon Dresden's growth to a European Manufacturing and Development Hub**
Dominik Thron / INFINEON, Dresden (Germany)

10:10 - 10:40 ***Coffee Break*** *sponsored by* ***APPLIED MATERIALS***

INVITED

10:40 - 11:05 **PMJ 2023 Best Poster**
A Study of Photomask Manufacture Process based on AI Technology
Hiroshi Nakata, DNP, Saitama (Japan)

11:05 - 12:30

Session 9: Maskless Lithography and Metrology

Chair: Jan Hendrik Peters / bmbg consult (Germany)
Co-Chair: Rolf Seltmann / RS litho consult (Germany)

INVITED

11:05 - 11:30 **LITHOSCALE® Features Accomplish Dual Exposure and High Resolution Patterning**
Ksenija Varga et al. / EV Group, St. Florian am Inn (Austria)

11:30 - 11:50 **New optical metrology technique for shape measurements of blank and patterned silicon wafers**
Jan O. Gaudestad / Wooptix SL, San Francisco (USA)

11:50 - 12:10 **High-performance computing architecture (HW/SW) for Mask CDSEM Design Based Metrology**
Tatsuro Okawa et al. / Advantest Japan, Saitama (Japan) and Advantest America, San Jose (USA)

12:10 - 12:30 **Exposure of optical devices using Vistec's Shaped Beam System**
Eike Linn et al. / Vistec Electron Beam, Jena (Germany)

12:30 - 13:30 ***Lunch Break*** *sponsored by* ***HEIDELBERG INSTRUMENTS***

13:30 - 15:00

Session 10: Mask Metrology, Tuning and Inspection and SC Sustainability

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

INVITED
13:30 - 13:55 **Leading Control of Wafer Overlay and CDU Residuals Beyond the Available DUV and/or EUV Lithography Knobs**
Avi Cohen et al. / Carl Zeiss SMT, Bar Lev Industrial Park, Misgav (Israel)

INVITED
13:55 - 14:20 **EUV Mask Defect Inspection for the 3nm Technology Node**
Yannick Hermans et al. / IMEC, Leuven (Belgium), Carl Zeiss SMT, Roßdorf and Oberkochen (Germany), and Carl Zeiss MultiSEM, Oberkochen (Germany)

14:20 - 14:40 **Divide et impera: A short talk about the importance of feature and model engineering**
Jacob König-Otto et al. / AMTC, Dresden (Germany)

14:40 - 15:00 **Lessons from Moore's Law applied to sustainability challenges in semiconductor industry**
Robert J. (Bob) Naber et al. / Exergy Systems, Bay Area (U.S.A.)

15:00 - 15:30 ***Coffee Break*** *sponsored by* ***NuFlare***

15:30 - 16:35

Session 11: Nano-Imprint Lithography (NIL)

Chair: Rolf Seltmann / RS litho consult (Germany)
Co-Chair: Michael Mühlberger / PROFACTOR (Austria)

INVITED
15:30 - 15:55 **Manufacturing of NIL Masters for AR/VR Applications and Metalenses using Photomask Technology**
Martin Sczyrba et al. / AMTC and TOPPAN Photomask, Dresden (Germany)

15:55 - 16:15 **Direct patterning of functional materials using nanoimprint lithography**
Michael Mühlberger et al. / PROFACTOR, Steyr-Gleink (Austria)

16:15 - 16:35 **Nanoimprinted waveguides made of high refractive index inkject-able materials**
Michael Haslinger et al. / PROFACTOR, Steyr-Gleink (Austria)

16:35 - 17:40

Session 12: Data Analytics

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

INVITED

16:35 - 17:00 **The image lab sandbox, pulling image computing in wafer fab metrology environment**
Florent Dettoni, Bertrand Le-Gratiet / STMicroelectronics, Crolles (France)

17:00 - 17:20 **Improving the on-product overlay performance after optimization of the etch-induced contributions**
Oktay Yildirim et al. / ASML, Veldhoven (The Netherlands), and IMEC, Leuven (Belgium)

17:20 - 17:40 **The Use of Cross-Validation for Overlay Model Selection**
Clemens Utzny, Sungwoo Jung / Qoniac, Dresden (Germany)

17:40 - 18:00 **Announcement**
ZEISS Award for Talents in Photomask Industry
on the occasion of the 38th European Mask and Lithography Conference 2023 in Dresden, Germany by ZEISS Semiconductor Mask Solutions (SMS)

Thanks to EMLC 2023 Presenters & Participants

Announcement of EMLC 2024, in Grenoble, France

Uwe Behringer / EMLC 2023 & EMLC 2024 Conference Chair

End of EMLC 2023 conference

Conference Information

Conference Hours

Monday, June 19th, 2023	02:00 pm to 07:00 pm
Tuesday, June 20th, 2023	09:00 am to 07:00 pm
Wednesday, June 21st, 2023	09:00 am to 06:00 pm

Registration Hours

Monday, June 19th, 2023	01:00 pm to 06:00 pm
Tuesday, June 20th, 2023	08:00 am to 05:00 pm
Wednesday, June 21st, 2023	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 20th, from 10:00 am to 6:00 pm and
Wednesday, June 21st, 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
Fax: +49 7073-50216
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 2023.

Both EMLC 2023 Award Winners will be invited either to present at the SPIE Photomask Technology (‘BACUS’) & EUV Lithography Conference 2023 in Monterey, CA (USA) or at the Photomask Japan (PMJ) Conference 2024 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 2023 in Monterey / CA. He or she receives a donation of 2,500 EUR to cover the travel expenses.

General Information

EMLC 2023 Office

For detailed information please contact:

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Fax: +49 69-6308-9828
e-Mail: gmm@vde.com

During the conference:
Phone: +49 171 4695 118

Conference Fees

	until May 17th, 2023	after May 17th, 2023
Regular	€ 630.00	€ 730.00
VDE, VDI Members*	€ 600.00	€ 700.00
Lecturer, Program Committee Members	€ 490.00	€ 570.00
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 Hilton Hotel Dresden on Monday, June 19th, afternoon, Tuesday, June 20th morning and afternoon, and Wednesday, June 21st morning and afternoon.
- Participation at EMLC 2023 Get Together at the Hilton Hotel's Piano Bar on Monday, June 19th, early evening.
- Lunch sandwiches and beverages at the Dresden Hilton Hotel on Tuesday, June 20th and Wednesday, June 21st.
- Conference Dinner Banquet at the "Pulverturm" in Dresden (within five minutes' walk from the Hilton Hotel) on Tuesday evening, June 20th.
- Free Access to the EMLC 2023 Technical Exhibition at the Hilton Hotel Dresden.

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

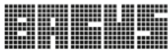
In case of cancellation, provided that VDE-Conference Services has received written notice until 30 days before the event, the registration fee will be fully refunded less a handling fee of 80,-EUR. In case of cancellation after this date, no refund will be made.

Conference Venue

Hilton Dresden
An der Frauenkirche 5,
01067 Dresden, Germany
phone: +49 (0)351 8642-0
E-Mail: info@hiltondresden.com

The VDE GMM and the members of the EMLC 2023 Program Committee of the 38th European Mask and Lithography Conference, EMLC 2023, would like to express their sincere appreciation to all the sponsors and coopering partners mentioned below for their support.

Cooperating Partners



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