

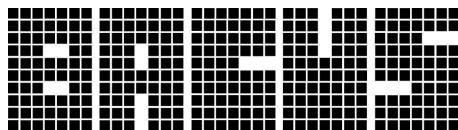
PROCEEDINGS OF SPIE

Photomask Technology 2016

Bryan S. Kasprowicz
Peter D. Buck
Editors

12–14 September 2016
San Jose, California, United States

Sponsored by



The international technical group of SPIE dedicated
to the advancement of photomask technology

SPIE.

Published by
SPIE

Volume 9985

Proceedings of SPIE 0277-786X, V. 9985

SPIE is an international society advancing an interdisciplinary approach to the science and application of light.

Photomask Technology 2016, edited by Bryan S. Kasprowicz, Peter D. Buck, Proc. of SPIE
Vol. 9985, 998501 · © 2016 SPIE · CCC code: 0277-786X/16/\$18 · doi: 10.1117/12.2256530

Proc. of SPIE Vol. 9985 998501-1

The papers in this volume were part of the technical conference cited on the cover and title page. Papers were selected and subject to review by the editors and conference program committee. Some conference presentations may not be available for publication. Additional papers and presentation recordings may be available online in the SPIE Digital Library at SPIDigitalLibrary.org.

The papers reflect the work and thoughts of the authors and are published herein as submitted. The publisher is not responsible for the validity of the information or for any outcomes resulting from reliance thereon.

Please use the following format to cite material from these proceedings:

Author(s), "Title of Paper," in *Photomask Technology 2016*, edited by Bryan S. Kasprovicz, Peter D. Buck, Proceedings of SPIE Vol. 9985 (SPIE, Bellingham, WA, 2016) Six-digit Article CID Number.

ISSN: 0277-786X

ISSN: 1996-756X (electronic)

ISBN: 9781510603745

ISBN: 9781510603752 (electronic)

Published by

SPIE

P.O. Box 10, Bellingham, Washington 98227-0010 USA

Telephone +1 360 676 3290 (Pacific Time) · Fax +1 360 647 1445

SPIE.org

Copyright © 2016, Society of Photo-Optical Instrumentation Engineers.

Copying of material in this book for internal or personal use, or for the internal or personal use of specific clients, beyond the fair use provisions granted by the U.S. Copyright Law is authorized by SPIE subject to payment of copying fees. The Transactional Reporting Service base fee for this volume is \$18.00 per article (or portion thereof), which should be paid directly to the Copyright Clearance Center (CCC), 222 Rosewood Drive, Danvers, MA 01923. Payment may also be made electronically through CCC Online at copyright.com. Other copying for republication, resale, advertising or promotion, or any form of systematic or multiple reproduction of any material in this book is prohibited except with permission in writing from the publisher. The CCC fee code is 0277-786X/16/\$18.00.

Printed in the United States of America.

Publication of record for individual papers is online in the SPIE Digital Library.

**SPIE. DIGITAL
LIBRARY**

SPIDigitalLibrary.org

Paper Numbering: *Proceedings of SPIE* follow an e-First publication model. A unique citation identifier (CID) number is assigned to each article at the time of publication. Utilization of CIDs allows articles to be fully citable as soon as they are published online, and connects the same identifier to all online and print versions of the publication. SPIE uses a six-digit CID article numbering system structured as follows:

- The first four digits correspond to the SPIE volume number.
- The last two digits indicate publication order within the volume using a Base 36 numbering system employing both numerals and letters. These two-number sets start with 00, 01, 02, 03, 04, 05, 06, 07, 08, 09, 0A, 0B ... 0Z, followed by 10-1Z, 20-2Z, etc. The CID Number appears on each page of the manuscript.

Contents

vii *Authors*
xi *Conference Committee*

ADVANCED WRITERS

- 9985 05 **MBMW-101: World's 1st high-throughput multi-beam mask writer (Invited Paper)** [9985-4]
9985 06 **The technical consideration of multi-beam mask writer for production** [9985-5]
9985 07 **Improvement of Electron Beam Lithography modeling for overdose exposures by using Dill transformation** [9985-6]
9985 08 **Electron beam mask writer EBM-9500 for logic 7nm node generation** [9985-7]

ADVANCED MATERIALS

- 9985 0A **NXE pellicle: development update** [9985-9]
9985 0B **Development of a novel closed EUV pellicle for EUVL manufacturing** [9985-10]
9985 0C **Introducing the EUV CNT pellicle** [9985-11]
9985 0D **Development of advanced multi-tone mask by using two different transmittance modulation materials** [9985-12]

STUDENT SESSION

- 9985 0G **Influence of non-uniform intensity distribution of deformed pellicle for N7 patterning** [9985-14]
9985 0I **Impact of noise sources and optical design on defect sensitivity for EUV actinic pattern inspection** [9985-16]
9985 0K **Observation results of actual phase defects using micro coherent EUV scatterometry microscope** [9985-18]

INSPECTION AND METROLOGY

- 9985 0L **Reticle inspection equipment productivity increase using SEMI specification for reticle and pod management** [9985-57]
9985 0M **YieldStar based reticle 3D measurements and its application** [9985-20]

9985 0N **Evaluation of photomask flatness compensation for extreme ultraviolet lithography** [9985-21]

9985 0O **Take a byte out of MEEF: VAMPIRE: Vehicle for Advanced Mask Pattern Inspection Readiness Evaluations** [9985-22]

MASK MANUFACTURABILITY

9985 0R **Mask manufacturing of advanced technology designs using multi-beam lithography (part 2)** [9985-25]

9985 0T **Analyzing EUV mask costs** [9985-27]

END USER ANALYSIS

9985 0V **Comparing curvilinear vs Manhattan ILT shape efficacy on EPE and process window** [9985-71]

9985 0W **Experimental verification of AI decomposition-based source optimization for M1 two-bar building blocks in 0.33NA EUVL** [9985-30]

9985 0X **Quantifying imaging performance bounds of extreme dipole illumination in high NA optical lithography** [9985-31]

9985 0Y **UDOF direct improvement by modulating mask absorber thickness** [9985-32]

PROCESS

9985 12 **Comparative study on PS material of EAPSM for flat panel display** [9985-54]

9985 13 **Correction of placement error in EBL using model based method** [9985-112]

CLEANING AND REPAIR

9985 15 **Megasonic cleaning strategy for sub-10nm photomasks** [9985-38]

9985 16 **Identification of a new source of reticle contamination** [9985-39]

9985 17 **Phase-independent multilayer defect repair for EUV photomasks** [9985-40]

ADVANCED EDA

9985 19 **Software-based data path for raster-scanned multi-beam mask lithography** [9985-42]

9985 1A **OPC care-area feedforwarding to MPC** [9985-43]

9985 1C **The performance improvement of SRAF placement rules using GA optimization [9985-45]**

ALTERNATIVE LITHOGRAPHY

9985 1D **Writing next-generation display photomasks (Invited Paper) [9985-46]**

9985 1G **Nanoimprint wafer and mask tool progress and status for high volume semiconductor manufacturing [9985-49]**

POSTER SESSION: ADVANCED MATERIALS AND ADVANCED WRITERS

9985 1H **Prototyping 9-inch size PSM mask blanks for 450mm wafer process (2016) [9985-51]**

9985 1I **Evaluation of the properties of the permeability film material using cellulose nanofibers [9985-52]**

9985 1J **7-nm e-beam resist sensitivity characterization [9985-86]**

POSTER SESSION: STUDENTS

9985 1K **Mechanical stress induced by external forces in the extreme ultraviolet pellicle [9985-55]**

9985 1L **Investigation of fabrication process for sub 20-nm dense pattern of non-chemically amplified electron beam resist based on acrylic polymers [9985-56]**

POSTER SESSION: INSPECTION AND METROLOGY

9985 1M **The CD control improvement by using CDSEM 2D measurement of complex OPC patterns [9985-19]**

9985 1N **The study of CD side to side error in line/space pattern caused by post-exposure bake effect [9985-36]**

9985 1P **Scanning coherent scattering methods for actinic EUV mask inspection [9985-60]**

9985 1Q **To repair or not to repair: with FAVOR there is no question [9985-61]**

9985 1S **Improvement of photomask CD uniformity using spatially resolved optical emission spectroscopy [9985-64]**

9985 1T **Development of actual EUV mask observation method for micro coherent EUV scatterometry microscope [9985-66]**

9985 1W **Registration performance on EUV masks using high-resolution registration metrology [9985-67]**

POSTER SESSION: MASK MANUFACTURABILITY AND END USER

- 9985 1X **Correction of deflection under mask's own weight by bending mask technology** [9985-29]
- 9985 1Y **Defect inspection and printability study for 14 nm node and beyond photomask** [9985-68]
- 9985 1Z **Reticle decision center: a novel applications platform for enhancing reticle yield and productivity at 10nm technology and beyond** [9985-69]
- 9985 20 **EBL2: high power EUV exposure facility** [9985-70]
- 9985 21 **Wafer hot spot identification through advanced photomask characterization techniques** [9985-89]

POSTER SESSION: CLEANING AND REPAIR

- 9985 22 **Defect management on photomasks with dry treatment assistance** [9985-72]
- 9985 23 **Carbon dioxide gas purification and analytical measurement for leading edge mask and wafer cleaning** [9985-73]
- 9985 24 **Acoustic characterization of two megasonic devices for photomask cleaning** [9985-74]

POSTER SESSION: ADVANCED EDA

- 9985 25 **Auto-score system to optimize OPC recipe parameters using genetic algorithm** [9985-76]
- 9985 27 **OPC model sampling evaluation and weakpoint "in-situ" improvement** [9985-78]
- 9985 28 **Suppressing rippling with minimized corner rounding through OPC fragmentation optimization** [9985-79]
- 9985 2A **Combining mask and OPC process verification for improved wafer patterning and yield** [9985-81]

POSTER SESSION: ALTERNATIVE LITHOGRAPHY

- 9985 2B **Fundamental study of green EUV lithography using natural polysaccharide for the use of pure water in developable process** [9985-82]
- 9985 2C **Approach of UV nanoimprint lithography using template with gas-permeable and gaseous adsorption for reduction of air-trapping issue** [9985-83]
- 9985 2D **Production and evaluation of measuring equipment for share viscosity of polymer melts included nanofiller with injection molding machine** [9985-84]
- 9985 2E **High-performance fabrication process for 2xnm hole-NIL template production** [9985-85]

Authors

Numbers in the index correspond to the last two digits of the six-digit citation identifier (CID) article numbering system used in Proceedings of SPIE. The first four digits reflect the volume number. Base 36 numbering is employed for the last two digits and indicates the order of articles within the volume. Numbers start with 00, 01, 02, 03, 04, 05, 06, 07, 08, 09, 0A, 0B...0Z, followed by 10-1Z, 20-2Z, etc.

Abaidi, Mohamed, 07
Abdelghany, Hesham, 0O, 2A
Adelmann, Christoph, 0C
Agarwal, Ankita, 19
Aghili, Ali, 1G
Ahn, Byung-Sup, 06
Akima, Shinji, 1Y
Ando, Akihiko, 2E
Applegarth, Chuck, 23
Arnoux, Vincent, 1A
Asada, Hironori, 1L
Asthana, Abhishek, 25
Azuma, Hisanobu, 1G
Azumi, Minako, 1X
Babin, Sergey, 13
Badger, Karen D., 0O, 1Y
Ballman, Katherine, 0N
Bandoh, Hideaki, 1M
Baron, Stanislas, 1A
Barouch, Eytan, 0G
Bean, Alexander, 0N
Bendiksen, Aage, 0A
Beyer, Dirk, 1W
Biafore, John, 0X
Biyajima, Tsuneaki, 0B
Bolton, John, 1C
Borisov, Sergey, 13
Brinkley, David, 16
Broman, Par, 0A
Brouns, Derk, 0A
Browning, Matt, 23
Buck, Peter, 0V, 19
Bugata, Bharathi, 0L
Bugata, Raj, 1Z
Cao, Liang, 25
Casimiri, Eric, 0A
Chalom, Daniel, 0R
Chang, Peter, 15
Chen, Chien Kang, 1M
Chen, Chun-Jen, 1Z
Chen, Norman, 28
Chen, Po Tsang, 0Y
Chen, Yi Ting, 0Y
Cheng, James, 1M
Cheng, Jeffrey, 1M
Chiang, Kaiming, 1Z
Chishima, Tatsuya, 1H
Choi, Jin, 06
Choi, Jin, 1G
Choi, Min-Ki, 0D
Choi, Yohan, 0R, 21
Chou, William, 0Y, 1M
Colsters, Paul, 0A
de Graaf, Dennis, 0A
De Volder, Michael, 0C
de Winter, L., 0W
Dechene, Daniel J., 0O, 1Y
Deutz, Alex, 20
Dietze, Uwe, 15
Dillen, Harm, 0M
Dillon, Brian, 0R, 1A
Downey, Jack, 0L
Dress, Peter, 15
Dunn, Thomas, 0N
Ekinci, Y., 1P
Elshafie, Shady, 27
Fahrenkopf, Michael, 1J
Fan, Dongsheng, 0L
Faure, Thomas, 1J
Feng, Jui-Hsuan, 25
Finders, Jo, 0M, 0W
Fu, Nan, 27
Gallagher, Emily, 0C
Garetto, Anthony, 1Q
Ge, Haiming, 1N
Geller, Paul, 19
Giridhar, Dushyanth, 24
Gobrecht, J., 1P
Gopalakrishnan, Sandhya, 1Z
Graves, Trey, 0X
Green, Michael, 0R, 21
Grenon, Brian J., 16
Guo, Eric, 1N, 22
Hahn, Jae W., 1S
Ham, Young, 0R, 21
Hamaji, Masakazu, 1A
Hamaker, H. Christopher, 19
Hamouda, Ayman, 2A
Han, Hakseung, 1W
Hanabata, Makoto, 1I, 2C
Harada, Tetsuo, 0K, 1T
Harashima, Noriyuki, 1H
Harrold, Hilary, 0A
Hashimoto, Hiraku, 0K, 1T
Helfenstein, P., 1P
Hennus, Piet, 0A
Hess, Carl, 0L
Himmelhaus, Michael, 1Q

Holleman, Christiaan, 20
Hoogstrate, André, 20
Hoshino, Ryoichi, 1L
Hsu, Jyh-Wei, 15, 24
Hsu, Sheng-Chang, 1Z
Huang, Jin, 1N
Hudek, Peter, 0R
Hur, Ik Boum, 0R
Huyghebaert, Cedric, 0C
Hwa, George, 1Z
Ishikawa, Hisako, 0B
Iso, Hiroyuki, 1H
Isogawa, Takeshi, 1J
Itoh, Masamitsu, 2E
Iwakuma, Minako, 1L
Jang, Il-Yong, 1S
Janssen, Paul, 0A
Jeon, Chan-Uk, 06, 1S
Jeong, Jin-Woong, 12
Jeong, Woo-Gun, 0D, 12
Jones, Chris E., 1G
Jorge, Vasco Guerreiro, 0M
Jung, Junhwa, 1S
Jung, Sung-Mo, 0D, 12
Jurkovic, Michal, 0R
Kagawa, Masayuki, 1J
Kambayashi, Takashi, 1X
Kamberian, Henry, 0R
Kameda, Takao, 1I, 2C, 2D
Kamikubo, Takashi, 08
Kanamitsu, Shingo, 2E
Kang, Minwook, 1S
Kasprowicz, Bryan, 0R, 0T
Kato, Yasuo, 08
Katsap, Victor, 08
Kerkhof, Peter, 20
Keswani, Manish, 24
Kim, Byung-Gook, 1S
Kim, Guk-Jin, 0G
Kim, In-Seon, 0G, 1K
Kim, Kyu-Sik, 12
Kim, Min-Su, 0G
Kim, Sei-Min, 0D
Kim, Youngkeun, 1S
Kishimura, Yukiko, 1L
Klein, Christof, 05
Klikovits, Jan, 0R
Kobayashi, Ryohei, 08
Kohmura, Kazuo, 0B
Komagata, Tadashi, 13
Koster, Norbert, 20
Kramer, Ronald, 0A
Kruizinga, Matthias, 0A
Kuntzel, Henk, 0A
Lafarre, Raymond, 0A
Lai, Rick, 15
Lakkapragada, Suresh, 1Z
Lan, Andy, 21
Landoni, Cristian, 23
Last, T., 0W

Lee, Adder, 1M
Lee, Changmin, 1S
Lee, Christopher, 0N
Lee, Ho-Jin, 12
Lee, Hong Jen, 1M
Lee, Hyun-Ju, 1K
Lee, Jae Uk, 0C
Lee, Jong-Hwa, 0D
Lee, Myungjun, 0X
Lee, Sang Hee, 06
Lercel, Michael, 0T
Levy, Ady, 0X
Lin, Chia-Shih, 15
Lin, Howard, 21
Lin, Yen-Hung, 0L
Lio, En Chuan, 0Y
Lu, Colbert, 1M
Lu, Max, 1N, 22
Lung, Mike, 21
Ma, Ai-Jay, 15
Macchi, Giorgio, 23
Madhusudhan, Saikiran, 0V
Mancuso, Andrea, 0A
Matsui, Hideki, 08
Matsuoka, Yoichi, 1G
McMurrin, Jeff, 0R, 21
Militsin, Vladimir, 13
Miyamoto, Nobuo, 08
Mizuno, Makoto, 1G
Mochi, I., 1P
Mohacs, I., 1P
Molkenboer, Freek, 20
Morishita, Keiko, 2E
Motokawa, Takeharu, 2E
Mulwijk, Pim, 20
Mulckhuysen, Wouter, 20
Muramatsu, Tomoyuki, 1A
Nakagawa, Kazuki, 1G
Nakahashi, Satoshi, 08
Nakajima, Shinya, 1I
Nakajima, Shinya, 2C
Nakayama, Takahiro, 1G
Nakayamada, Noriaki, 08
Nam, Kee-Soo, 0D
Nash, Steven, 1J
Naulleau, Patrick, 0I
Neureuther, Andy, 0I
Nijland, Björn, 20
Ning, Guoxiang, 25, 27
Nomura, Haruyuki, 08
Ochiai, Shunsuke, 1L
Ockwell, David, 0A
Ogasawara, Munehiro, 08
Oh, Hye-Keun, 0G, 1K
Ohara, Shuichiro, 1A
Okada, Nagaya, 24
Okubo, Atsushi, 0B
Ono, Yosuke, 0B
Oostdijk, Bastiaan, 20
Park, Eun-Sang, 1K

Park, Jinback, 1W
 Park, Jin-Goo, 0G
 Park, Joong Hee, 0R
 Park, Youngjin, 1D
 Peng, Ming Chun, 0Y
 Peng, Yi-Hsing, 1A
 Pirola, Simona, 23
 Platzgummer, Elmar, 05
 Plug, Reinder, 0M
 Pocobiej, Wojciech, 0M
 Pollentier, Ivan, 0C
 Qi, Zhengqing John, 17
 Rabellino, Larry, 23
 Rajagopalan, Archana, 19
 Rajeev, R., 1P
 Rankin, Jed, 0O, 1J
 Rao, Nagswara, 19
 Riddle Vogt, Sarah, 23
 Rolling, Stefan, 27
 Saib, Mohamed, 07
 Saito, Kenichi, 08
 Saito, Masato, 2E
 Sakai, Fumio, 1G
 Sakamoto, Yoshifumi, 1J
 Samayoa, Martin, 15
 Sandstrom, Tor, 1D
 Santo, Izumi, 1M
 Sato, Chiaki, 1G
 Schellekens, Twan, 0M
 Scheruebl, Thomas, 1Q, 1W
 Schiavone, Patrick, 07
 Schulz, Kristian, 1Q
 Seki, Junichi, 1G
 Seki, Kazunori, 0O, 1Y
 Seo, Seong-Min, 0D
 Shi, Irene, 22
 Shin, Cheol, 0D
 Shin, In Kyun, 06
 Sijben, Anko, 0M
 Smith, Daniel, 0A
 Smith, Mark D., 0X
 Solowan, Hans-Michael, 1W
 Song, Jin-Han, 12
 Sonoda, Manae, 1L
 Steinert, Steffen, 1W
 Succi, Marco, 23
 Suenaga, Machiko, 2E
 Sukanuma, Mizuna, 08
 Sugino, Naoto, 1I, 2C, 2D
 Tabbone, Gilles, 1Q
 Takabayashi, Yukio, 1G
 Takayama, Tomohiro, 1L
 Takei, Satoshi, 1I, 2B, 2C, 2D
 Tamamushi, Shuichi, 06
 Tanabe, Mana, 2E
 Taneichi, Daiki, 0B
 Taylor, Ron, 0L
 te Sligte, Edwin, 20
 ten Berge, Peter, 0M
 Tian, Mingjing, 1N
 Timmermans, Marina, 0C
 Toda, Yusuke, 1J
 Tolani, Vikram, 1Z
 Tortai, Jean-Hervé, 07
 Tritchkov, Alexander, 0V
 Tsunoda, Dai, 1A
 Tuo, Laurent, 15, 1Z
 Turley, Christina, 0O
 Tzeng, Alex CP, 1M
 Vaenkatesan, Vidya, 0M
 van Adrichem, P., 0W
 van de Weg, David, 0A
 van der Walle, Peter, 20
 van Dijck, Jurgen, 0M
 van Putten, Michel, 20
 Vanpaemel, Johannes, 0C
 Wahlsten, Mikael, 1D
 Wakatsuki, Tetsuro, 13
 Wang, Changan, 1C
 Wang, Jingyu, 28
 Wang, Ran, 1N
 Wang, Yow-Gwo, 0I
 Wang, Z., 0W
 Watanabe, Takeo, 0K, 1T
 Wei, Alexander, 28
 Wei, Chih I, 0Y
 Wiley, Jim, 0A
 Wilkinson, William, 1C, 25, 28
 Wistrom, Richard, 1J
 Wood, Jeffrey, 0L
 Word, James, 0V
 Wu, Yijun, 1N
 Wylie, Mark, 0L
 Xu, Yan, 1C
 Yagami, Takashi, 1X
 Yagawa, Keisuke, 2E
 Yam, Petrie, 24
 Yamamoto, Kiyohito, 1G
 Yamanaka, Eiji, 2E
 Yan, Shichuan, 1N
 Yang, Chin-Ting, 1Z
 Yang, Ray, 1M
 Yang, Richer, 21
 Yashima, Jun, 08
 Yeung, Michael, 0G
 Yonetani, Masashi, 1Y
 Yoon, Young-Jin, 12
 Yoshitake, S., 1P
 Yu, Chun Chi, 0Y
 Yu, Tuan-Yen, 0Y
 Yun, Sang-Pil, 12
 Zahedmanesh, Houman, 0C
 Zanelli, Claudio, 24
 Zhang, Bidan, 1C
 Zhang, Dan, 0V
 Zhang, Hao, 1M
 Zhang, Jie, 25
 Zhang, Xiaolong, 1A
 Zhao, Shuo, 17
 Zimmerman, John, 0N

Zou, Yi, 1A
Zweber, Amy, 1J

Conference Committee

Symposium Chair

Bryan S. Kasprowicz, Photronics, Inc. (United States)

Symposium Co-chair

Peter D. Buck, Mentor Graphics Corporation (United States)

Conference Chair

Bryan S. Kasprowicz, Photronics, Inc. (United States)

Conference Co-chair

Peter D. Buck, Mentor Graphics Corporation (United States)

BACUS Steering Committee

Frank E. Abboud, Intel Corporation (United States)

Paul W. Ackmann, GLOBALFOUNDRIES Inc. (United States)

Paul C. Allen, Toppan Photomasks, Inc. (United States)

Michael D. Archuleta, RAVE LLC (United States)

Artur P. Balasinski, Cypress Semiconductor Corporation
(United States)

Uwe F. W. Behringer, UBC Microelectronics (Germany)

Peter D. Buck, Mentor Graphics Corporation (United States)

Brian Cha, SAMSUNG Electronics Company, Ltd.
(Korea, Republic of)

Jerry Cullins, Hoya Corporation (United States)

Thomas B. Faure, GLOBALFOUNDRIES Inc. (United States)

Brian J. Grenon, RAVE LLC (United States)

Jon Haines, Micron Technology, Inc. (United States)

Naoya Hayashi, Dai Nippon Printing Company, Ltd. (Japan)

Bryan S. Kasprowicz, Photronics, Inc. (United States)

Patrick M. Martin, Applied Materials, Inc. (United States)

Shane Palmer, Nikon Research Corporation of America
(United States)

Jan Hendrik Peters, Carl Zeiss SMT GmbH (Germany)

Moshe Preil, KLA-Tencor Corporation (United States)

Douglas J. Resnick, Canon Nanotechnologies, Inc.
(United States)

Thomas Struck, Infineon Technologies AG (Germany)

Bala Thumma, Synopsys, Inc. (United States)

Michael Watt, Shin-Etsu MicroSi, Inc. (United States)

Jim N. Wiley, ASML US, Inc. (United States)
Larry S. Zurbrick, Keysight Technologies, Inc. (United States)

Conference Program Committee

Frank E. Abboud, Intel Corporation (United States)
Paul W. Ackmann, GLOBALFOUNDRIES Inc. (United States)
Lucien Bouchard, Photronics Inc. (United States)
Ron R. Bozak, RAVE, LLC (United States)
Russell B. Cinque, JEOL USA Inc. (United States)
Matthew E. Colburn, IBM Corporation (United States)
Uwe Dietze, SUSS MicroTec Inc. (United States)
Aki Fujimura, D2S, Inc. (United States)
Emily E. Gallagher, IMEC (Belgium)
Naoya Hayashi, Dai Nippon Printing Company, Ltd. (Japan)
Byung-Gook Kim, SAMSUNG Electronics Company, Ltd.
(Korea, Republic of)
Paul A. Morgan, Micron Technology, Inc. (United States)
Takahiro Onoue, HOYA Corporation (Japan)
Thomas Scheruebl, Carl Zeiss SMT GmbH (Germany)
Anna Tchikoulaeva, Lasertec U.S.A., Inc. Zweigniederlassung
Deutschland (Germany)
Laurent C. Tuo, Taiwan Semiconductor Manufacturing Co. Ltd.
(Taiwan)
Thomas I. Wallow, ASML Brion (United States)
Banqiu Wu, Applied Materials, Inc. (United States)
Shusuke Yoshitake, NuFlare Technology, Inc. (Japan)

Session Chairs

- 1 Keynote and Invited Session
Bryan S. Kasprowitz, Photronics, Inc. (United States)
Peter Buck, Mentor Graphics Corporation (United States)
- 2 Advanced Writers
Frank E. Abboud, Intel Corporation (United States)
Steffen F. Schulze, Mentor Graphics Corporation (United States)
- 3 Advanced Materials
Takahiro Onoue, HOYA Corporation (Japan)
Banqiu Wu, Applied Materials, Inc. (United States)
- 4 PMJ 2016
Peter Buck, Mentor Graphics Corporation (United States)
Larry S. Zurbrick, Keysight Technologies, Inc. (United States)

- 5 Student Session
Peter Buck, Mentor Graphics Corporation (United States)
Larry S. Zurbrick, Keysight Technologies, Inc. (United States)
- 6 Inspection and Metrology
Paul C. Allen, Toppan Photomasks, Inc. (United States)
Jim N. Wiley, ASML US, Inc. (United States)
- 7 Mask Manufacturability
Thomas B. Faure, GLOBALFOUNDRIES Inc. (United States)
Naoya Hayashi, Dai Nippon Printing Co., Ltd. (Japan)
- 8 End User Analysis
Emily E. Gallagher, IMEC (Belgium)
Shane R. Palmer, Nikon Research Corporation of America
(United States)
- 10 Process
Uwe Dietze, SUSS MicroTec Inc. (United States)
Paul A. Morgan, Micron Technology, Inc. (United States)
- 11 Cleaning and Repair
Uwe F. W. Behringer, UBC Microelectronics (Germany)
Brian J. Grenon, RAVE LLC (United States)
- 12 Advanced EDA
Bala Thumma, Synopsys, Inc. (United States)
Shuichiro Ohara, Nippon Control System Corporation (United States)
- 13 Alternative Lithography
Douglas J. Resnick, Canon Nanotechnologies, Inc. (United States)
Ron R. Bozak, RAVE, LLC (United States)

