

PROCEEDINGS OF SPIE

Optical Microlithography XXV

Will Conley

Editor

13–16 February 2012

San Jose, California, United States

Sponsored

SPIE

Cosponsored by

Cymer, Inc. (United States)

Published by

SPIE

Volume 8326
Part One of Two Parts

Proceedings of SPIE, 0277-786X, v. 8326

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

The papers included 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. The papers published in these proceedings 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 this book:

Author(s), "Title of Paper," in *Optical Microlithography XXV*, edited by Will Conley, Proceedings of SPIE Vol. 8326 (SPIE, Bellingham, WA, 2012) Article CID Number.

ISSN 0277-786X

ISBN 9780819489821

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 © 2012, 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/12/\$18.00.

Printed in the United States of America.

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



SPIDigitalLibrary.org

Paper Numbering: Proceedings of SPIE follow an e-First publication model, with papers published first online and then in print and on CD-ROM. Papers are published as they are submitted and meet publication criteria. A unique, consistent, permanent citation identifier (CID) number is assigned to each article at the time of the first 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, print, and electronic versions of the publication. SPIE uses a six-digit CID article numbering system in which:

- 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. The complete citation is used on the first page, and an abbreviated version on subsequent pages. Numbers in the index correspond to the last two digits of the six-digit CID number.

Contents

Part One

xiii *Conference Committee*

OVERLAY TOPICS IN ADVANCED OPTICAL MICROLITHOGRAPHY: JOINT SESSION WITH CONFERENCE 8324

- 8326 02 **Overlay metrology for low- k_1 : challenges and solutions** [8326-01]
J. T. Neumann, Carl Zeiss SMT GmbH (Germany); J. Lee, K. Yang, B. Lee, T. Lee, J. Park, C. Lim, D. Yim, S. Park, Hynix Semiconductor Inc. (Korea, Republic of); E. Janda, K. Bhattacharyya, ASML Netherlands B.V. (Netherlands); C. Ryu, Y.-H. Min, K. Rhe, ASML Korea Co., Ltd. (Korea, Republic of); B. Geh, Carl Zeiss SMT Inc./ASML TDC (United States)
- 8326 04 **Spacer process and alignment assessment for SADP process** [8326-03]
L. Lattard, CEA-LETI (France); M. McCallum, R. Morton, Nikon Precision Europe GmbH (Germany); T. Fujiwara, K. Makino, A. Tokui, N. Takahashi, S. Sasamoto, Nikon Corp. (Japan)

INVITED SESSION

- 8326 05 **Extending the DRAM and FLASH memory technologies to 10nm and beyond (Invited Paper)** [8326-04]
K. Kim, U.-I. Chung, Y. Park, J. Lee, J. Yeo, D. Kim, SAMSUNG Electronics Co., Ltd. (Korea, Republic of)

SMO-MODELING

- 8326 07 **Lens heating challenges for negative tone develop layers with freeform illumination: a comparative study of experimental vs. simulated results** [8326-06]
S. Halle, IBM Research (United States); M. Crouse, A. Jiang, Y. van Dommelen, ASML (United States); T. Brunner, IBM Research (United States); B. Minghetti, ASML (United States); M. Colburn, IBM Research (United States); Y. Zhang, Brion Technologies, Inc. (United States)
- 8326 09 **Evaluation of various compact mask and imaging models for the efficient simulation of mask topography effects in immersion lithography** [8326-08]
V. Agudelo, Friedrich-Alexander-Univ. Erlangen-Nürnberg (Germany) and Fraunhofer Institute for Integrated Systems and Device Technology (Germany); P. Evanschitzky, Fraunhofer Institute for Integrated Systems and Device Technology (Germany); A. Erdmann, Friedrich-Alexander-Univ. Erlangen-Nürnberg (Germany) and Fraunhofer Institute for Integrated Systems and Device Technology (Germany); T. Fühner, Fraunhofer Institute for Integrated Systems and Device Technology (Germany)

- 8326 0A **A full-chip 3D computational lithography framework** [8326-09]
P. Liu, Z. Zhang, S. Lan, Q. Zhao, M. Feng, H. Liu, V. Vellanki, Y. Lu, Brion Technologies, Inc. (United States)

MULTIPLE PATTERNING I

- 8326 0B **Interactions between imaging layers during LPLE double patterning lithography** [8326-10]
S. Robertson, KLA-Tencor Corp. (United States); P. Wong, P. De Bisschop, N. Vandebroeck, V. Wiaux, IMEC (Belgium)
- 8326 0C **Stack effect implementation in OPC and mask verification for production environment** [8326-89]
E. Sungauer, F. Robert, STMicroelectronics (France)
- 8326 0D **Design compliance for spacer is dielectric (SID) patterning** [8326-12]
G. Luk-Pat, A. Miloslavsky, B. Painter, L. Lin, Synopsys, Inc. (United States); P. De Bisschop, IMEC (Belgium); K. Lucas, Synopsys, Inc. (United States)
- 8326 0E **Litho1-litho2 proximity differences for LELE and LPLE double patterning processes** [8326-13]
P. Wong, P. De Bisschop, IMEC (Belgium); S. Robertson, KLA-Tencor Corp. (United States); N. Vandebroeck, IMEC (Belgium); J. Biafore, KLA-Tencor Corp. (United States); V. Wiaux, J. Van de Kerckhove, IMEC (Belgium)
- 8326 0F **Characterization and decomposition of self-aligned quadruple patterning friendly layout** [8326-15]
H. Zhang, Y. Du, M. D. F. Wong, Univ. of Illinois at Urbana-Champaign (United States); R. O. Topaloglu, IBM Corp. (United States)

SOURCE AND MASK OPTIMIZATION

- 8326 0G **Source-mask optimization incorporating a physical resist model and manufacturability constraints** [8326-16]
T. Mülders, Synopsys GmbH (Germany); V. Domnenko, Synopsys (Russian Federation); B. Kuchler, H.-J. Stock, U. Klostermann, Synopsys GmbH (Germany); P. De Bisschop, IMEC (Belgium)
- 8326 0H **Computational process optimization of array edges** [8326-17]
B. Kuchler, Synopsys GmbH (Germany); A. Shamsuarov, SAMSUNG Electronics Co., Ltd. (Korea, Republic of); T. Mülders, U. Klostermann, Synopsys GmbH (Germany); S.-H. Yang, S. Moon, SAMSUNG Electronics Co., Ltd. (Korea, Republic of); V. Domnenko, Synopsys (Russian Federation); S.-W. Park, Synopsys (Korea, Republic of)
- 8326 0I **Mutual source, mask and projector pupil optimization** [8326-18]
T. Fühner, P. Evanschitzky, A. Erdmann, Fraunhofer Institute for Integrated Systems and Device Technology (Germany)
- 8326 0K **Application of illumination pupilgram control method with freeform illumination** [8326-20]
T. Matsuyama, N. Kita, R. Matsui, J. Ikeda, Nikon Corp. (Japan)

TOOLS AND PROCESS CONTROL I

- 8326 OL **Extending 1.35 NA immersion lithography down to 1x nm production nodes** [8326-21]
I. Bouchoms, M. Leenders, J. J. Kuit, R. Kazinczi, R. de Graaf, B. Paarhuis, P. Gunter, S. Weichselbaum, M. Beems, M. Verhoeven, R. van Ballegoij, ASML Netherlands B.V. (Netherlands)
- 8326 OM **Mix and match overlay optimization strategy for advanced lithography tools (193i and EUV)** [8326-22]
D. Laidler, K. D'havé, J. Hermans, S. Cheng, IMEC (Belgium)
- 8326 ON **Imaging optics setup and optimization on scanner for SMO generation process** [8326-23]
T. Matsuyama, T. Ogata, Y. Mizuno, Y. Ohmura, Nikon Corp. (Japan)
- 8326 OO **Model based OPC for implant layer patterning considering wafer topography proximity (W3D) effects** [8326-24]
S. Park, H. Youn, N. Chung, J. Maeng, S. Lee, J. Ku, SAMSUNG Electronics Co., Ltd. (Korea, Republic of); X. Xie, S. Lan, M. Feng, V. Vellanki, J. Kim, S. Baron, H. Liu, Brion Technologies, Inc. (United States); S. Hunsche, S.-S. Woo, S.-H. Park, J.-T. Yoon, ASML Korea Co., Ltd. (Korea, Republic of)
- 8326 OQ **Process window control using CDU master** [8326-26]
T. Fujiwara, T. Toki, D. Tanaka, M. Sato, J. Kosugi, R. Tanaka, N. Sakasai, T. Ohashi, R. Nakasone, A. Tokui, Nikon Corp. (Japan)

LITHOGRAPHY AT THE INTERSECTION OF OPTICS AND CHEMISTRY: JOINT SESSION WITH CONFERENCE 8325

- 8326 OR **The development of a fast physical photoresist model for OPE and SMO applications from an optical engineering perspective** [8326-27]
D. Flagello, Nikon Research Corp. of America (United States); R. Matsui, K. Yano, T. Matsuyama, Nikon Corp. (Japan)

TOOLS AND PROCESS CONTROL II

- 8326 OT **High overlay accuracy for double patterning using an immersion scanner** [8326-29]
Y. Shiba, K. Makino, Y. Morita, C. Motoyoshi, H. Yamamoto, J. Udagawa, T. Kikuchi, Y. Shirata, Y. Ishii, Nikon Corp. (Japan)
- 8326 OU **Modeling for field-to-field overlay error** [8326-30]
K. D'havé, S. Cheng, IMEC vzw (Belgium)
- 8326 OV **Free form source and mask optimization for negative tone resist development for 22nm node contact holes** [8326-31]
T. H. Coskun, Cadence Design Systems (United States); H. Dai, Applied Materials, Inc. (United States); V. Kamat, Cadence Design Systems (United States); C.-M. Hsu, G. Santoro, C. Ngai, Applied Materials, Inc. (United States); M. Reybrouck, G. Grozev, FUJIFILM Electronic Materials (Europe) N.V. (Belgium); H.-T. Huang, Cadence Design Systems (United States)

8326 0W **Process development using negative tone development for the dark field critical layers in a 28nm node process** [8326-32]
J. Versluijs, V. Truffert, G. Murdoch, P. De Bisschop, D. Trivkovic, V. Wiaux, E. Kunnen, L. Souriau, S. Demuynck, M. Ercken, IMEC vzw (Belgium)

8326 0X **Process requirements for pitch splitting LELE double patterning at advanced logic technology node** [8326-33]
R. C. Peng, I. H. Huang, H. H. Liu, H. J. Lee, J. Lin, Taiwan Semiconductor Manufacturing Corp. (Taiwan); A. Lin, KLA-Tencor Corp. (Taiwan); A. Chang, B. S.-M. Lin, Cymer Southeast Asia, Ltd. (Taiwan); I. Lalovic, Cymer, Inc. (United States)

MULTIPLE PATTERNING/INNOVATIVE LITHOGRAPHY

8326 0Y **Scanning interference evanescent wave lithography for sub-22 nm generations (Best Student Paper Award)** [8326-34]
P. Xie, B. W. Smith, Rochester Institute of Technology (United States)

8326 0Z **A solid immersion interference lithography system for imaging ultra-high numerical apertures with high-aspect ratios in photoresist using resonant enhancement from effective gain media** [8326-35]
P. Mehrotra, Univ. of Canterbury (New Zealand); C. A. Mack, The Univ. of Texas at Austin (United States); R. J. Blaikie, Univ. of Canterbury (New Zealand)

8326 10 **Doubling the spatial frequency with cavity resonance lithography** [8326-36]
H. Lee, R. Verma, Tanner Research, Inc. (United States)

8326 11 **Pupil wavefront manipulation for optical nanolithography** [8326-37]
M. Kemsell Sears, Rochester Institute of Technology (United States); J. Bekaert, IMEC vzw (Belgium); B. W. Smith, Rochester Institute of Technology (United States)

8326 12 **14nm M1 triple patterning** [8326-38]
Q. Li, P. Ghosh, D. Abercrombie, P. LaCour, S. Kanodia, Mentor Graphics Corp. (United States)

OPTICAL/DFM: JOINT SESSION WITH CONFERENCE 8327

8326 13 **Sub-20nm logic lithography optimization with simple OPC and multiple pitch division** [8326-39]
M. C. Smayling, Tela Innovations, Inc. (United States); V. Axelrad, Sequoia Design Systems, Inc. (United States); K. Tsujita, Canon Inc. (Japan); H. Yaegashi, Tokyo Electron, Ltd. (Japan); R. Nakayama, Canon Inc. (Japan); K. Oyama, Tokyo Electron, Ltd. (Japan); Y. Gyoda, Canon Inc. (Japan)

8326 14 **Fast source independent estimation of lithographic difficulty supporting large scale source optimization** [8326-40]
D. DeMaris, IBM Systems & Technology Group (United States); M. Gabrani, S. S. Sarkar, N. Casati, R. Luijten, IBM Zürich Research Lab. (Switzerland); K. Lai, K. Tian, IBM Semiconductor Research and Development (United States)

- 8326 15 **Generator of predictive verification pattern using vision system based on higher-order local autocorrelation** [8326-41]
T. Matsunawa, S. Maeda, Toshiba Corp. (Japan); H. Ichikawa, Toshiba Microelectronics Corp. (Japan); S. Nojima, S. Tanaka, S. Mimotogi, Toshiba Corp. (Japan); H. Nosato, H. Sakanashi, M. Murakawa, E. Takahashi, National Institute of Advanced Industrial Science and Technology (Japan)
- 8326 16 **Demonstration of an effective flexible mask optimization (FMO) flow** [8326-42]
C. Beylier, STMicroelectronics (France); N. Martin, Brion Technologies, Inc. (United States); V. Farys, F. Foussadier, E. Yesilada, F. Robert, STMicroelectronics (France); S. Baron, R. Dover, H. Liu, Brion Technologies, Inc. (United States)
- 8326 17 **Full field lithographical verification using scanner and mask intrafield fingerprint** [8326-43]
J. Planchot, STMicroelectronics (France); L. Depre, Brion Technologies, Inc. (United States); E. Yesilada, F. Robert, F. Sundermann, STMicroelectronics (France); H. Y. Liu, L. Cai, F. Chen, Brion Technologies, Inc. (United States)
- 8326 18 **Pattern selection in high-dimensional parameter spaces** [8326-44]
G. Viehoveer, Synopsys GmbH (Germany); B. Ward, Synopsys, Inc. (United States); H.-J. Stock, Synopsys GmbH (Germany)

OPC

- 8326 19 **Multiple-image-depth modeling for hotspot and AF printing detections** [8326-45]
Y. P. Tang, C. S. Chou, W. C. Huang, R. G. Liu, T. S. Gau, Taiwan Semiconductor Manufacturing Co. (Taiwan)
- 8326 1A **Process optimization through model based SRAF printing prediction** [8326-46]
R. Viswanathan, J. Tirapu Azpiroz, P. Selvam, IBM Semiconductor Research and Development Ctr. (United States)
- 8326 1B **Finite element models of lithographic mask topography** [8326-47]
J. K. Tyminski, R. Popescu, Nikon Precision Inc. (United States); S. Burger, J. Pomplun, L. Zschiedrich, JCMwave GmbH (Germany); T. Matsuyama, T. Noda, Nikon Corp. (Japan)
- 8326 1C **Resist loss in 3D compact modeling** [8326-48]
X. Zheng, J. Huang, F. Chin, A. Kazarian, Synopsys, Inc. (United States); C.-C. Kuo, Synopsys Taiwan Ltd. (Taiwan)
- 8326 1D **Binary modeling method to check the sub-resolution assist features (SRAFs) printability** [8326-49]
J. Li, Synopsys, Inc. (United States); W. Gao, Synopsys, Inc. (Belgium); Y. Fan, J. Xue, Q. Yan, K. Lucas, Synopsys, Inc. (United States); P. De Bisschop, IMEC (Belgium); L. S. Melvin III, Synopsys, Inc. (United States)

Part Two

TOOLS

- 8326 1E **A study of vertical lithography for high-density 3D structures** [8326-50]
S.-I. Hirai, N. Saito, Y. Goto, H. Suda, K.-I. Mori, S. Miura, Canon Inc. (Japan)
- 8326 1F **A reliable higher power ArF laser with advanced functionality for immersion lithography** [8326-51]
A. Kurosu, M. Nakano, M. Yashiro, M. Yoshino, H. Tsushima, H. Masuda, T. Kumazaki, S. Matsumoto, K. Kakizaki, T. Matsunaga, S. Okazaki, J. Fujimoto, H. Mizoguchi, Gigaphoton Inc. (Japan)
- 8326 1G **Advanced light source technologies that enable high-volume manufacturing of DUV lithography extensions** [8326-52]
T. Cacouris, R. Rao, R. Rokitski, R. Jiang, J. Melchior, B. Burfeindt, K. O'Brien, Cymer, Inc. (United States)
- 8326 1H **Immersion and dry ArF scanners enabling 22nm HP production and beyond** [8326-53]
Y. Uehara, J. Ishikawa, H. Kohno, E. Tanaka, M. Ohba, Y. Shibasaki, Nikon Corp. (Japan)
- 8326 1I **Driving imaging and overlay performance to the limits with advanced lithography optimization** [8326-54]
J. Mulkens, J. Finders, H. van der Laan, P. Hinnen, M. Kubis, M. Beems, ASML Netherlands B.V. (Netherlands)

POSTER SESSION

- 8326 1J **Modelling of side-wall angle for optical proximity correction for self-aligned double patterning** [8326-11]
S. Moulis, V. Farys, STMicroelectronics (France); J. Belledent, J. Foucher, CEA-LETI (France)
- 8326 1K **New methodology to predict pattern collapse for 14nm and beyond** [8326-55]
A. Dave, Mentor Graphics Corp. (United States); K. Yoshimoto, GLOBALFOUNDRIES Inc. (United States); J. Sturtevant, Mentor Graphics Corp. (United States)
- 8326 1L **Building 3D aerial image in photoresist with reconstructed mask image acquired with optical microscope** [8326-56]
C. S. Chou, Y. P. Tang, F. S. Chu, W. C. Huang, R. G. Liu, T. S. Gau, Taiwan Semiconductor Manufacturing Co. (Taiwan)
- 8326 1N **Wafer CD variation for random units of track and polarization** [8326-58]
G. Ning, GLOBALFOUNDRIES Inc. (Germany); P. Ackmann, GLOBALFOUNDRIES Inc. (United States); F. Richter, K. Kurth, S. Maelzer, M. Hsieh, GLOBALFOUNDRIES Inc. (Germany); F. Schurack, Advanced Mask Technology Ctr. GmbH & Co. KG (Germany); F. H. GN, GLOBALFOUNDRIES Inc. (Singapore)

- 8326 1O **Field performance availability improvements in lithography light sources using the iGLX Gas Management System** [8326-59]
K. O'Brien, D. J. Riggs, J. Thornes, N. Han, A. Chakravorty, P. Belitz, Cymer, Inc. (United States)
- 8326 1P **Can fast rule-based assist feature generation in random-logic contact layout provide sufficient process window?** [8326-60]
A. Omran, Mentor Graphics Corp. (Egypt); G. Lippincott, Mentor Graphics Corp. (United States); J. Schacht, Mentor Graphics Corp. (Taiwan); J. Lei, L. Hong, L. Friedrich, Mentor Graphics Corp. (United States); R. Shen, R. Chou, Mentor Graphics Corp. (Taiwan)
- 8326 1Q **ZERODUR: bending strength data for tensile stress loaded support structures** [8326-61]
T. Bizjak, P. Hartmann, T. Westerhoff, SCHOTT AG (Germany)
- 8326 1R **OPC model prediction capability improvements by accounting for mask 3D-EMF effects** [8326-62]
J. Cheng, J. Schramm, D. Q. Zhang, Y. M. Foong, GLOBALFOUNDRIES Inc. (Singapore); C. Zuniga, T. Do, E. Tejnil, J. Sturtevant, A. Chung, K. Jantzen, Mentor Graphics Corp. (United States)
- 8326 1S **Defects reduction at BEOL interconnect within 300mm manufacturing environment** [8326-63]
C.-H. S. Lee, Y. Wei, M. Kelling, S. Law, M. Mobley, K. C. Chai, GLOBALFOUNDRIES Inc. (United States)
- 8326 1T **CDU prediction based on in-situ image measurements** [8326-64]
A. Bourov, J. R. Cheng, L. Duan, J. Yang, J. Min, Shanghai Microelectronics Equipment Co. (China)
- 8326 1U **Edge placement error reduction and ringing effect suppression using model based targeting techniques** [8326-65]
C. Cork, Synopsys SARL (France); X. Li, S. Jang, Synopsys, Inc. (United States)
- 8326 1V **Source mask optimization methodology (SMO) and application to real full chip optical proximity correction** [8326-66]
D. Zhang, G. Chua, Y. Foong, Y. Zou, GLOBALFOUNDRIES Inc. (Singapore); S. Hsu, S. Baron, M. Feng, H.-Y. Liu, Z. Li, Brion Technologies, Inc. (United States); J. Schramm, T. Yun, C. Babcock, B. I. Choi, S. Roling, A. Navarra, T. Fischer, A. Leschok, GLOBALFOUNDRIES Inc. (Singapore); X. Liu, W. Shi, J. Qiu, R. Dover, Brion Technologies, Inc. (United States)
- 8326 1W **Source optimization incorporating margin image average with conjugate gradient method** [8326-67]
J.-C. Yu, P. Yu, National Chiao Tung Univ. (Taiwan); H.-Y. Chao, ANSYS, Inc. (United States)
- 8326 1X **Integration of pattern matching into verification flows** [8326-68]
T. Desouky, O. Saeed, Mentor Graphics Egypt (Egypt)
- 8326 1Y **Advanced mask aligner lithography (AMALITH)** [8326-69]
R. Voelkel, U. Vogler, A. Bramati, T. Weichelt, SUSS MicroOptics SA (Switzerland); L. Stuerzebecher, U. D. Zeitner, Fraunhofer-Institut für Angewandte Optik und Feinmechanik (Germany); K. Motzek, A. Erdmann, Fraunhofer Institute for Integrated Systems and Device Technology (Germany); M. Hornung, R. Zoberbier, SUSS MicroTec Lithography GmbH (Germany)

- 8326 1Z **Improved flexibility with grayscale fabrication of calcium fluoride homogenizers** [8326-70]
J. Brown, JENOPTIK Optical Systems, Inc. (United States); P. Brakhage, JENOPTIK Optical Systems GmbH (Germany); L. Simmons, JENOPTIK Optical Systems, Inc. (United States); R. Mueller, JENOPTIK Optical Systems GmbH (Germany)
- 8326 20 **Technological merits, process complexity, and cost analysis of self-aligned multiple patterning** [8326-71]
Y. Chen, Q. Cheng, W. Kang, Peking Univ. (China)
- 8326 21 **The near field characteristics of the focused field embedded in the super-RENS layer applied to lithography** [8326-72]
A. C. Assafrao, S. F. Pereira, H. P. Urbach, Delft Univ. of Technology (Netherlands)
- 8326 23 **Impact of non-uniform polarized illumination on hyper-NA lithography** [8326-74]
X. Guo, Y. Li, Beijing Institute of Technology (China)
- 8326 24 **Three-dimensional polarization aberration in hyper-numerical aperture lithography optics** [8326-75]
J. Wang, Y. Li, Beijing Institute of Technology (China)
- 8326 25 **The overlay performance optimization based on overlay manager system** [8326-76]
G. Sun, J. Zhu, S. X. Li, F. L. Mao, L. F. Duan, Shanghai Micro Electronics Equipment Co., Ltd. (China)
- 8326 26 **A hybrid model/pattern based OPC approach for improved consistency and TAT** [8326-77]
T. Desouky, Mentor Graphics Egypt (Egypt)
- 8326 27 **High hydrophobic topcoat approach for high volume production and yield enhancement of immersion lithography** [8326-78]
N. Sagawa, K. Nakano, Y. Ishii, Nikon Corp. (Japan); K. Kusabiraki, M. Shima, JSR Corp. (Japan)
- 8326 28 **A computation of partially coherent imaging illuminated by a polarized source via the stack pupil shift matrix approach** [8326-79]
Y. Chen, Y. Liu, Wuxi Nanotech Inc. (China)
- 8326 29 **In-situ measurement of lens aberrations in lithographic tools using CTC-based quadratic aberration model** [8326-80]
X. Wu, S. Liu, S. Xu, X. Zhou, W. Liu, Huazhong Univ. of Science and Technology (China)
- 8326 2A **Robust resolution enhancement optimization methods to process variations based on vector imaging model** [8326-81]
X. Ma, Y. Li, X. Guo, L. Dong, Beijing Institute of Technology (China)
- 8326 2B **Gradient-based resolution enhancement optimization methods based on vector imaging model** [8326-82]
X. Ma, Y. Li, L. Dong, Beijing Institute of Technology (China)

- 8326 2C **Consideration for application of NTD from OPC and simulation perspective** [8326-83]
M. Kim, J. Moon, B. Nam, S. Oh, H. Yang, D. Yim, Hynix Semiconductor Inc. (Korea, Republic of)
- 8326 2D **Predictable turn-around time for post tape-out flow** [8326-85]
T. Endo, M. Park, P. Ghosh, Mentor Graphics Corp. (United States)
- 8326 2G **Lithographic tool dynamic coordinate calibration for CDU improvement** [8326-90]
Z. Yang, F. Mao, A. Bourov, J. Cheng, L. He, Shanghai Micro Electronics Equipment Co., Ltd. (China)
- 8326 2H **RET and DFM techniques for sub 30nm** [8326-91]
E. Yesilada, STMicroelectronics (France); J. Entradas, Mentor Graphics Development Crolles (France); C. Gardin, J. N. Pena, A. Villaret, V. Farys, C. Beylier, F. Robert, STMicroelectronics (France); S. Postnikov, A. M. Armeanu, C. Moyroud, F. Chaoui, Mentor Graphics Development Crolles (France); F. B. Granger, STMicroelectronics (France); O. Toublan, Mentor Graphics Development Crolles (France)
- 8326 2J **Studies of the source and mask optimization for 20nm node in the active layer** [8326-94]
C. I. Wei, R. H. Hsu, Y. F. Cheng, M. J. Chen, United Microelectronics Corp. (Taiwan)
- 8326 2K **Influence of SRAF size on main feature CD variation on advanced node** [8326-95]
W. C. Lo, Y. C. Chen, Y. F. Cheng, M. J. Chen, United Microelectronics Corp. (Taiwan)
- 8326 2L **Complementary polarity exposures for cost-effective line-cutting in multiple patterning lithography** [8326-96]
F. T. Chen, W.-S. Chen, M.-J. Tsai, T.-K. Ku, Industrial Technology Research Institute (Taiwan)
- 8326 2N **Reconstruction of dynamical perturbations in optical systems by opto-mechanical simulation methods** [8326-98]
H. Gilbergs, N. Wengert, K. Frenner, P. Eberhard, W. Osten, Univ. of Stuttgart (Germany)
- 8326 2O **Enhancing lithography process control through advanced, on-board beam parameter metrology for wafer level monitoring of light source parameters** [8326-99]
J. Choi, SAMSUNG Electronics Co., Ltd. (Korea, Republic of); N. Seong, O. Zurita, J. Thornes, Y. Won, S. Rokitski, Cymer, Inc. (United States); Y. Kang, SAMSUNG Electronics Co., Ltd. (Korea, Republic of); B. Burfeindt, Cymer, Inc. (United States); C. Park, SAMSUNG Electronics Co., Ltd. (Korea, Republic of)
- 8326 2P **Lithography target optimization with source-mask optimization** [8326-100]
Y. Deng, GLOBALFOUNDRIES Inc. (United States); T. H. Coskun, Cadence Design Systems, Inc. (United States); J. Kye, H. J. Levinson, GLOBALFOUNDRIES Inc. (United States)
- 8326 2Q **Weighting evaluation for improving OPC model quality by using advanced SEM-contours from wafer and mask** [8326-101]
D. Fuchimoto, D. Hibino, H. Shindo, Y. Hojyo, Hitachi High-Technologies Corp. (Japan); T. Do, I. Kusunadi, J. L. Sturtevant, Mentor Graphics Corp. (United States)

- 8326 2R **Full-chip correction of implant layer accounting for underlying topography** [8326-103]
M. Oh, H. Youn, N. Chung, J. Maeng, S. Lee, J. Ku, SAMSUNG Electronics Co., Ltd. (Korea, Republic of); A. Dave, J. L. Sturtevant, U. Hollerbach, T. Do, Y. Granik, K. Adam, J. Kim, C. Zhu, S. W. Jung, Mentor Graphics Corp. (United States)
- 8326 2T **Symmetric polarization aberration compensation method based on scalar aberration control for lithographic projection lens** [8326-105]
Y. Tu, X. Wang, Shanghai Institute of Optics and Fine Mechanics (China) and Graduate School of the Chinese Academy of Sciences (China); S. Li, Shanghai Institute of Optics and Fine Mechanics (China); L. Duan, Shanghai Institute of Optics and Fine Mechanics (China) and Graduate School of the Chinese Academy of Sciences (China); P. Bu, Shanghai Institute of Optics and Fine Mechanics (China)
- 8326 2V **Computing exact Fourier series coefficients of IC rectilinear polygons from low-resolution fast Fourier coefficients** [8326-107]
R. Scheibler, P. Hurley, IBM Research (Switzerland)

Author Index

Conference Committee

Symposium Chairs

Donis G. Flagello, Nikon Research Corporation of America (United States)

Harry J. Levinson, GLOBALFOUNDRIES Inc. (United States)

Conference Chair

Will Conley, Dynamic Intelligence (United States)

Conference Cochair

Kafai Lai, IBM Corporation (United States)

Program Committee

Pary Baluswamy, Micron Technology, Inc. (United States)

Peter D. Brooker, Synopsys, Inc. (United States)

Peter D. Buck, Toppan Photomasks, Inc. (United States)

Mircea V. Dusa, ASML US, Inc. (United States)

Andreas Erdmann, Fraunhofer Institute for Integrated Systems and Device Technology (Germany)

Nigel R. Farrar, Cymer, Inc. (United States)

Carlos Fonseca, Tokyo Electron America, Inc. (United States)

Tsai-Sheng Gau, Taiwan Semiconductor Manufacturing Company Ltd. (Taiwan)

Bernd Geh, Carl Zeiss SMT Inc./ASML TDC (United States)

Yuri Granik, Mentor Graphics Corporation (United States)

Soichi Inoue, EUVL Infrastructure Development Center, Inc. (Japan)

Jongwook Kye, GLOBALFOUNDRIES Inc. (United States)

Suk Joo Lee, SAMSUNG Electronics Company, Ltd. (Korea, Republic of)

Wilhelm Maurer, Infineon Technologies AG (Germany)

Soichi Owa, Nikon Corporation (Japan)

Xuelong Shi, Semiconductor Manufacturing International Corporation (China)

Sam Sivakumar, Intel Corporation (United States)

Bruce W. Smith, Rochester Institute of Technology (United States)

Kazuhiro Takahashi, Canon Inc. (Japan)

Geert Vandenberghe, IMEC (Belgium)

Session Chairs

- 1 Overlay Topics in Advanced Optical Microlithography: Joint Session with Conference 8324
Bernd Geh, Carl Zeiss SMT Inc./ASML TDC (United States)
Will Conley, Dynamic Intelligence (United States)
- 2 Invited Session
Will Conley, Dynamic Intelligence (United States)
Kafai Lai, IBM Corporation (United States)
- 3 SMO-Modeling
Andreas Erdmann, Fraunhofer Institute for Integrated Systems and Device Technology (Germany)
Nigel R. Farrar, Cymer, Inc. (United States)
- 4 Multiple Patterning I
Peter D. Brooker, Synopsys, Inc. (United States)
Will Conley, Dynamic Intelligence (United States)
- 5 Source and Mask Optimization
Carlos Fonseca, Tokyo Electron America, Inc. (United States)
Will Conley, Dynamic Intelligence (United States)
- 6 Tools and Process Control I
Yuri Granik, Mentor Graphics Corporation (United States)
Soichi Inoue, EUVL Infrastructure Development Center, Inc. (Japan)
- 7 Lithography at the Intersection of Optics and Chemistry: Joint Session with Conference 8325
Mark H. Somervell, Tokyo Electron America, Inc. (United States)
Will Conley, Dynamic Intelligence (United States)
- 8 Tools and Process Control II
Jongwook Kye, GLOBALFOUNDRIES Inc. (United States)
Wilhelm Maurer, Infineon Technologies AG (Germany)
- 9 Multiple Patterning/Innovative Lithography
Sam Sivakumar, Intel Corporation (United States)
Peter D. Brooker, Synopsys, Inc. (United States)
Pary Baluswamy, Micron Technology, Inc. (United States)
- 10 Optical/DFM: Joint Session with Conference 8327
Will Conley, Dynamic Intelligence (United States)
Mark E. Mason, Texas Instruments Inc. (United States)

- 11 Joint Session with Conference 8327
John L. Sturtevant, Mentor Graphics Corporation (United States)
Kafai Lai, IBM Corporation (United States)
- 12 OPC
Bruce W. Smith, Rochester Institute of Technology (United States)
Kazuhiro Takahashi, Canon Inc. (Japan)
- 13 Tools
Soichi Owa, Nikon Corporation (Japan)
Kafai Lai, IBM Corporation (United States)
- Poster Session
Peter D. Buck, Toppan Photomasks, Inc. (United States)
Geert Vandenberghe, IMEC (Belgium)

