

PROCEEDINGS OF SPIE

# ***Alternative Lithographic Technologies VIII***

**Christopher Bencher**  
**Joy Y. Cheng**  
*Editors*

**22–25 February 2016**  
**San Jose, California, United States**

*Sponsored by*  
Sokudo Co., Ltd. / SCREEN / DNS Electronics (United States)

*Published by*  
SPIE

**Volume 9777**

Proceedings of SPIE 0277-786X, V. 9777

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

Alternative Lithographic Technologies VIII, edited by Christopher Bencher, Joy Y. Cheng, Proc. of SPIE  
Vol. 9777, 977701 · © 2015 SPIE · CCC code: 0277-786X/15/\$18 · doi: 10.1117/12.2240686

Proc. of SPIE Vol. 9777 977701-1

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](http://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 *Alternative Lithographic Technologies VIII*, edited by Christopher Bencher, Joy Y. Cheng, Proceedings of SPIE Vol. 9777 (SPIE, Bellingham, WA, 2016) Six-Digit Article CID Number.

ISSN: 0277-786X  
ISSN: 1996-756X (electronic)  
ISBN: 9781510600126

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](http://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](http://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](http://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	<i>Authors</i>
xi	<i>Conference Committee</i>

---

## KEYNOTE SESSION

---

9777 02	<b>Lithography alternatives meet design style reality: How do they "line" up? (Keynote Paper)</b> [9777-1]
---------	---

---

## NANOIMPRINT LITHOGRAPHY PRODUCTION READINESS

---

9777 06	<b>Nanoimprint system development and status for high volume semiconductor manufacturing</b> [9777-5]
9777 08	<b>Design for nanoimprint lithography: total layout refinement utilizing NIL process simulation</b> [9777-7]

---

## NANOIMPRINT MODELING, PROCESSING, AND MATERIALS

---

9777 0A	<b>High throughput Jet and Flash Imprint Lithography for semiconductor memory applications</b> [9777-10]
9777 0B	<b>NIL defect performance toward high volume mass production</b> [9777-11]
9777 0C	<b>Defectivity and particle reduction for mask life extension, and imprint mask replication for high volume semiconductor manufacturing</b> [9777-12]
9777 0D	<b>Experiments towards establishing of design rules for R2R-UV-NIL with polymer working shims</b> [9777-13]
9777 0E	<b>Defectivity prediction for droplet-dispensed UV nanoimprint lithography, enabled by fast simulation of resin flow at feature, droplet, and template scales (Invited Paper)</b> [9777-9]

---

## DSA LINE-SPACE PATTERNING

---

9777 0F	<b>Pattern fidelity improvement of chemo-epitaxy DSA process for high volume manufacturing</b> [9777-14]
9777 0G	<b>DSA materials contributions to the defectivity performance of 14nm half-pitch LiNe flow at IMEC</b> [9777-15]

9777 OK **Sub-15nm patterning technology using directed self-assembly on nano-imprinting guide**  
[9777-19]

---

#### DSA VIA PATTERNING

---

9777 OL **DSA via hole shrink for advanced node applications** [9777-20]

9777 OM **New placement estimator for contact hole printed with DSA** [9777-21]

9777 ON **Directed Self Assembly (DSA) compliant flow with immersion lithography: from material to design and patterning** [9777-22]

9777 OO **Investigation of coat-develop track system for placement error of contact hole shrink process** [9777-23]

9777 OP **Manufacturability of dense hole arrays with directed self-assembly using the CHIPS flow**  
[9777-24]

---

#### DSA PROCESS AND INTEGRATION: JOINT SESSION WITH CONFERENCES 9777 AND 9779

---

9777 OR **DSA patterning options for FinFET formation at 7nm node** [9777-26]

9777 OT **Process highlights to enhance DSA contact patterning performances** [9777-28]

---

#### DSA MODELING AND DESIGN

---

9777 OY **Shape optimization for DSA** [9777-33]

9777 OZ **Modeling and parameter tuning for templated directed self-assembly** [9777-34]

9777 10 **Virtual fabrication using directed self-assembly for process optimization in a 14nm DRAM**  
[9777-35]

---

#### DIRECT-WRITE E-BEAM LITHOGRAPHY

---

9777 12 **Development of a MEMS electrostatic condenser lens array for nc-Si surface electron emitters of the Massive Parallel Electron Beam Direct-Write system (Invited Paper)** [9777-37]

9777 13 **Non-CAR resists and advanced materials for the Massively Parallel E-Beam Direct Write process integration** [9777-38]

9777 14 **Complete data preparation flow for Massively Parallel E-Beam lithography on 28nm node full field design** [9777-39]

9777 16 **Requirements of the e-beam shot quality for mask patterning of the sub-1X device**  
[9777-41]

9777 17 **Prediction of positioning error in EB lithography [9777-42]**

---

**NOVEL LITHOGRAPHY AND ALTERNATIVE PATTERNING I**

---

9777 18 **A paradigm shift in patterning foundation from frequency multiplication to edge-placement accuracy: a novel processing solution by selective etching and alternating-material self-aligned multiple patterning [9777-43]**

9777 19 **Contact hole patterning by electric-field assisted assembly of core-shell nanoparticles [9777-44]**

---

**NOVEL LITHOGRAPHY AND ALTERNATIVE PATTERNING II**

---

9777 1B **Enhanced patterning by tilted ion implantation [9777-47]**

9777 1C **Exploring the potential of Multiphoton Laser Ablation Lithography (MP-LAL) as a reliable technique for sub50nm patterning [9777-48]**

9777 1D **Design and fabrication of electrostatic microcolumn in multiple electron-beam lithography [9777-49]**

9777 1E **Dots-on-the-fly electron beam lithography [9777-50]**

---

**POSTER SESSION: NIL**

---

9777 1G **Nanoimprint lithography using disposable biomass template [9777-52]**

9777 1H **Nano-imprint lithography using poly (methyl methacrylate) (PMMA) and polystyrene (PS) polymers [9777-53]**

9777 1I **Improvement of sub-20nm pattern quality with dose modulation technique for NIL template production [9777-54]**

---

**POSTER SESSION: ALT-LITHO**

---

9777 1J **Resist roughness improvement by a chemical shrink process [9777-55]**

9777 1L **Nanoscale patterning in ambient conditions using liquid electromigration [9777-57]**

9777 1N **Deep-UV interference lithography combined with masked contact lithography for pixel wiregrid patterns [9777-46]**

---

**POSTER SESSION: DSA**

---

9777 1O **Control of morphological defects at the boundary between the periodic and non-periodic patterns in directed self-assembly process [9777-59]**

- 9777 1P **Directed self-assembly of Si-containing and topcoat free block copolymer** [9777-60]
- 9777 1Q **Numerical placement analysis in hole multiplication patterns for directed self-assembly** [9777-61]
- 9777 1S **Grapho-epitaxial sub-10-nm line and space patterning using lamellar-forming Si-containing block copolymer** [9777-63]
- 9777 1T **Sub-10nm lines and spaces patterning using grapho-epitaxial directed self-assembly of lamellar block copolymers** [9777-64]
- 9777 1U **Strategies to enable directed self-assembly contact hole shrink for tight pitches** [9777-65]
- 9777 1V **Chemoepitaxial guiding underlayers for density asymmetric and energetically asymmetric diblock copolymers** [9777-66]
- 9777 1W **A route for industry compatible directed self-assembly of high-chi PS-PDMS block copolymers** [9777-67]
- 9777 1Z **Improved cost-effectiveness of the block co-polymer anneal process for DSA** [9777-71]
- 9777 23 **Reversible nano-lithography for commercial approaches** [9777-75]

## 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.

Aghili, Ali, 0C  
Ahn, Chi Won, 23  
Akbulut, Mustafa, 10  
Allampalli, Vasanth, 10  
Ando, Toshiaki, 0C  
Angelakos, Evangelos, 1C  
Aoyama, Hisako, 10  
Argitis, Panagiotis, 1C  
Argoud, Maxime, 0O, 0T  
Arias-Zapata, J., 1W  
Arisawa, Yukiyasu, 11  
Arnaud, S., 1W  
Arnold, John, 0L, 0R  
Asai, Masaya, 0O  
Azuma, Hisanobu, 0C  
Azuma, Tsukasa, 1S, 1T  
Bayana, Hareem, 0G  
Bérard-Bergery, Sébastien, 0T, 14  
Böhme, S., 1W  
Bos, S., 0T  
Bouanani, S., 0T  
Brandt, Pieter, 13, 14  
Browning, Clyde, 14  
Burns, Sean, 0R  
Buttard, D., 1W  
Cao, Yi, 0G, 0P  
Cayrefourcq, I., 0T  
Chagoya, Alexandre, 14  
Chamiot-Maitral, G., 0T  
Chan, Boon Teik, 0G, 0P, 1Z  
Chartoire, Jacky, 14  
Chen, Chen, 1D  
Chen, Weichien, 0F  
Chen, Yijian, 18  
Chevalier, X., 0T  
Chi, Cheng, 0L, 1U  
Choi, Eun Hyuk, 0B  
Choi, Jin, 06, 0C  
Choi, Jin, 16  
Colburn, Matthew, 0L, 0R  
Cottle, Hongyun, 0L  
Cross, Andrew, 0G  
Dal'Zotto, Bernard, 13  
Datta, Anurup, 1D  
Delachat, F., 0T  
Delaney, Kris, 0Y  
Demmerle, W., 0Z  
DeSilva, Anuja, 0L  
Dhagat, P., 0Z  
Du, Zhidong, 1D  
Durairaj, Baskaran, 0G  
D'Urzo, Lucia, 0G  
Emoto, Keiji, 06, 0C  
Esashi, M., 12  
Essomba, Cyrille, 13  
Faken, Daniel, 10  
Farrell, Richard, 0L, 0R  
Farys, V., 0M  
Fay, Aurélien, 14  
Felix, Nelson M., 0L, 0R, 1U  
Fenger, Germain, 0N  
Fenouillet-Beranger, C., 0M  
Fletcher, Brian, 0A, 0C  
Fouquet, A., 0T  
Franke, Elliott, 0R  
Fredrickson, Glenn, 0Y  
Fried, David, 10  
Fukushima, Jiro, 1G  
Furukawa, Tsuyoshi, 0L, 1U  
Garnier, J., 1W  
Genjima, H., 1Q  
Gharbi, Ahmed, 0O, 0T  
Gibou, Frederic, 0Y  
Girardot, C., 1W  
Goda, Kazuo, 17  
Greiner, Ken, 10  
Gronheid, Roel, 0G, 0P, 1Z  
Guillom, Michael, 0R  
Guo, Pengfei, 1N  
Guo, Xuexue, 19  
Hagihara, Kazuki, 11  
Han, Ting, 18  
Hanabata, Makoto, 1G  
Harukawa, Ryota, 0G  
Harumoto, Masahiko, 0O  
Hatano, Masayuki, 08, 0B  
Hattori, Tadashi, 0C  
Hayakawa, Teruaki, 1S  
Hayashi, Tatsuya, 06  
Hazard, Jérôme, 0T, 14  
Henderson, Clifford L., 1V  
Hetzer, David, 0L, 0R  
Hiura, Mitsuru, 0C  
Hong, Le, 0N  
Hong, Sung Eun, 0G  
Hosoya, Masanori, 0F  
Ido, Yasuyuki, 0F  
Ikegami, N., 12

Im, Ji-Young, 08  
Irving, J. W., 0A, 0C  
Isotalo, Tero J., 1E  
Ito, Kiyohito, 0F  
Ito, Masamitsu, 1I  
Iwanaga, Takehiko, 0C  
Jang, Hyun Ik, 23  
Jeon, Chan-Uk, 16  
Jeon, Seok Woo, 23  
Jiravanichsakul, Phubes, 1O  
Jones, Chris, 0C  
Jung, Wooyung, 0B  
Kameda, Takao, 1G  
Kamon, Mattan, 10  
Kanai, Hideki, 1O, 1S, 1T  
Kanamitsu, Shingo, 1I  
Kaneyama, Koji, 0O  
Kanno, Masahiro, 0K  
Kasahara, Yusuke, 1S, 1T  
Kashiwagi, Hiroyuki, 0B  
Kato, Kimihiko, 1B  
Kawamonzen, Yoshiaki, 1S, 1T  
Kawamura, Daiji, 0L  
Kawanobe, Yoshio, 0C  
Khaira, Daman, 0N  
Khusnatdinov, Niyaz, 0A  
Kihara, Naoko, 1S, 1T  
Kim, Hee Yeoun, 23  
Kim, Sang Wan, 1B  
Kim, Woo Choong, 23  
Kimura, Atsushi, 06  
Kimura, Masaki, 17  
Kitano, Takahiro, 0F, 0G, 1Q  
Knaepen, Werner, 1Z  
Ko, Akiteru, 0R  
Kobayashi, Katsutoshi, 1O, 1S, 1T  
Kobayashi, Kei, 0B  
Kobayashi, Sachiko, 08, 1I, 1O  
Kodera, Katsuyoshi, 1O, 1S, 1T  
Kojima, A., 12  
Komori, Motofumi, 08  
Kono, Takuya, 08, 0B  
Koshida, N., 12  
Kubota, Hitoshi, 1S, 1T  
Kumar, Praveen, 1L  
Kurosawa, Tsuyoshi, 1P  
Kye, Jongwook, 0N  
Laachi, Nabil, 0Y  
LaBrake, Dwayne, 0A  
Lai, Kafai, 0L, 0R, 0Z  
Lapeyre, Celine, 0O, 0T  
Lattard, Ludovic, 13, 14  
Lee, Boram, 16  
Lee, Jongsu, 0P  
Lei, Junjiang, 0N  
Lepinay, Kevin, 13  
Levinson, Harry J., 0N  
Li, Jin, 0G  
Lie, Fee Li, 0R  
Lin, Guanyang, 0G

Lin, Lan, 19  
Liu, Chi-Chun Charlie, 0L, 0R, 1U  
Liu, Hongyi, 18  
Liu, Tsu-Jae King, 1B  
Liu, Weijun, 0A  
Lombardo, David, 1N  
Longsine, Whitney, 0A  
Ludovice, Peter J., 1V  
Ma, Yuansheng, 0N  
Maeda, Shimon, 08, 1O  
Maes, Jan Willem, 1Z  
Mallik, Arindam, 1Z  
Manouras, Theodoros, 1C  
Marconot, O., 1W  
Marokkey, S., 0Z  
Matsumiya, Tasuku, 1P  
Matsumoto, Takahiro, 06  
Matsumoto, Yoko, 1G  
Matsuura, Yuriko, 1J  
Matsuzaki, K., 1Q  
Mayer, Theresa S., 19  
Meli, Luciana, 0L  
Meliorisz, B., 0Z  
Metz, Andrew, 0L  
Mimotogi, Akiko, 08  
Minegishi, Shinya, 1S, 1T  
Mitra, Joydeep, 0N  
Miyagi, Ken, 1P  
Miyagi, Ken, 1S, 1T  
Miyaguchi, H., 12  
Monget, Cedric, 0O, 0T  
Morita, Seiji, 0K  
Motokawa, Takeharu, 1I  
Mülders, T., 0Z  
Muramatsu, Makoto, 0F, 1Q  
Muroyama, M., 12  
Nagahara, Tatsuro, 1J  
Naka, Yoshihiro, 1O  
Nakajima, Shinya, 1G  
Nakamura, Satoru, 0F  
Nakano, Hitoshi, 0C  
Nakano, T., 1Q  
Nam, Jaewoo, 0P  
Nafion, Benjamin D., 1V  
Navarro, C., 0T  
Nees, Dieter, 0D  
Nicolet, C., 0T  
Niemi, Tapio, 1E  
Nishi, Takanori, 0F  
Nishimura, Naosuke, 06  
Nishino, Kota, 1U  
Nomura, Satoshi, 1S, 1T  
Ohmori, Katsumi, 1P, 1T  
Ohshima, Masahiro, 1O  
Osaki, Hitoshi, 1U  
Ouaknin, Gaddiel, 0Y  
Palfinger, Ursula, 0D  
Pan, Liang, 1D  
Pap, Andras, 10  
Park, Jae Hong, 23



Park, Jongmun, 16  
 Park, Jun Yong, 23  
 Park, Sinjeung, 16  
 Pathangi, Hari, 0G, 1Z  
 Pieczulewski, Charles, 0O  
 Pimenta Barros, P., 0T  
 Pitera, Jed W., 0L, 1U  
 Postnikov, Sergei, 14  
 Pourteau, Marie-Line, 13  
 Pradelles, Jonathan, 13  
 Pratap, Rudra, 1L  
 Preil, Moshe, 0N  
 Raghunathan, A., 0Z  
 Rubin, Leonard, 1B  
 Ruttloff, Stephan, 0D  
 Ryoichi, Inanami, 0B  
 Sah, Kaushik, 0G  
 Saib, Mohamed, 14  
 Saito, Masato, 1I  
 Saito, Yusuke, 0F  
 Sakai, Fumio, 0C  
 Sanchez, Martha, 0L, 1U  
 Sanders, Daniel, 0L, 0R, 1U  
 Sarangan, Andrew, 1N  
 Sarrazin, A., 0T  
 Sasao, Norikatsu, 0K  
 Sato, Chiaki, 0C  
 Sato, Hironobu, 1S, 1T  
 Schavione, Patrick, 14  
 Schmidt, Kristin, 0L, 1U  
 Schneider, L., 0M  
 Schumaker, Phil, 06  
 Seino, Yuriko, 1S, 1T  
 Sekiguchi, Atsushi, 1G  
 Sekito, Takashi, 1J  
 Serret, E., 0M  
 Servin, Isabelle, 0O, 0T, 13  
 Seshimo, Takehiro, 1P  
 Shah, Piyush, 1N  
 Shin, In Kyun, 16  
 Shiraishi, Masayuki, 1S, 1T  
 Shy, Shyi-Long, 1H  
 Sieg, Stuart, 0R  
 Singh, Arjun, 0P  
 Singh, Lovejeet, 0L  
 Smayling, Michael C., 02  
 Somervell, Mark, 0F, 0G, 0R  
 Stachowiak, Tim, 0A  
 Stadlober, Barbara, 0D  
 Stock, H.-J., 0Z  
 Stokes, Harold, 0O  
 Stokhof, Maarten, 1Z  
 Suenaga, Machiko, 1I  
 Sugahara, Kigen, 1G  
 Sugimura, Shinobu, 0K  
 Sugino, Naoto, 1G  
 Takabayashi, Tsuneo, 0C  
 Takabayashi, Yukio, 06, 0C  
 Takashima, Tsuneo, 06  
 Takei, Satoshi, 1G  
 Talukder, Santanu, 1L  
 Tanaka, Yuji, 0O  
 Taylor, Hayden K., 0E  
 Tetsuro, Nakasugi, 0B  
 Thompson, Ecron, 0A  
 Ting, Yung-Chiang, 1H  
 Tiron, Raluca, 0O, 0T, 1W  
 Tobana, Toshikatsu, 0F  
 Tobana, Toshikatsu, 1T  
 Tokue, Hiroshi, 0B  
 Tomita, T., 1Q  
 Torres, J. Andres, 0N  
 Totsu, K., 12  
 Traub, Matthew, 0A  
 Traverso, Luis, 1D  
 Truong, Hoa, 0R  
 Truskett, Van, 0A  
 Tsai, Hsin-yu, 0R  
 Ugajin, Kunihiko, 1I  
 Vaid, Varun, 0G, 1Z  
 Vamvakaki, Maria, 1C  
 Vandenbroeck, Nadia, 0G, 1Z  
 Wang, Yan, 0N  
 Wen, Ye, 1D  
 Wieland, Marco, 13  
 Word, James, 0N  
 Wu, Hengpeng, 0P  
 Xu, Xianfan, 1D  
 Xu, Yongan, 0L  
 Yagawa, Keisuke, 1I  
 Yamada, Tomotaka, 1P  
 Yamamoto, K., 1Q  
 Yamamoto, Kiyohito, 0C  
 Yamamoto, Ryosuke, 0K  
 Yamano, Hitoshi, 1P  
 Yamano, Hitoshi, 1S, 1T  
 Yamashita, Kyoji, 0B  
 Yan, Yiguang, 1O  
 Ye, Zhengmao, 0A, 0C  
 Yin, Jian, 0P  
 Yoshida, Akihisa, 1O  
 Yoshida, S., 12  
 Yoshida, T., 12  
 Yoshimoto, Kenji, 1O  
 You, Gen, 0F  
 Yuan, Lei, 0N  
 Yun, Hae Su, 23  
 Zelsmann, M., 1W  
 Zhang, Wei, 0A  
 Zheng, Peng, 1B



# Conference Committee

## *Symposium Chair*

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

## *Symposium Co-chair*

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

## *Conference Chair*

**Christopher Bencher**, Applied Materials, Inc. (United States)

## *Conference Co-chair*

**Joy Y. Cheng**, Taiwan Semiconductor Manufacturing Company  
(Taiwan)

## *Conference Program Committee*

**Frank E. Abboud**, Intel Corporation (United States)

**Alan D. Brodie**, KLA-Tencor Corporation (United States)

**Kenneth R. Carter**, University of Massachusetts Amherst (United States)

**Juan J. de Pablo**, The University of Chicago (United States)

**Elizabeth A. Dobisz**, HGST (United States)

**Michael A. Guillorn**, IBM Thomas J. Watson Research Center  
(United States)

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

**Daniel J. C. Herr**, The University of North Carolina at Greensboro  
(United States)

**Tatsuhiko Higashiki**, Toshiba Corporation (Japan)

**James A. Liddle**, National Institute of Standards and Technology  
(United States)

**Shy-Jay Lin**, Taiwan Semiconductor Manufacturing Company Ltd.  
(Taiwan)

**Chi-Chun Liu**, IBM Corporation (United States)

**Hans Loeschner**, IMS Nanofabrication AG (Austria)

**John G. Malfabes**, Hewlett-Packard Laboratories (United States)

**Dan B. Millward**, Micron Technology, Inc. (United States)

**Laurent Pain**, CEA-LETI (France)

**Ivo W. Rangelow**, Technische Universität Ilmenau (Germany)

**Benjamin M. Rathsack**, Tokyo Electron America, Inc. (United States)

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

**Ricardo Ruiz**, HGST (United States)

**Frank M. Schellenberg**, Consultant (United States)

**Helmut Schiff**, Paul Scherrer Institut (Switzerland)

**Ines A. Stolberg**, Vistec Electron Beam Lithography Group (Germany)  
**Kevin T. Turner**, University of Pennsylvania (United States)  
**Marco J. Wieland**, MAPPER Lithography (Netherlands)  
**Wei Wu**, The University of Southern California (United States)  
**Todd R. Younkin**, Intel Corporation (United States)

*Conference Review Committee*

**Damon M. Cole**, Intel Corporation (United States)  
**Christoph K. Hohle**, Fraunhofer-Institut für Photonische Mikrosysteme  
(Germany)  
**Todd R. Younkin**, Intel Corporation (United States)

*Session Chairs*

- 1 Keynote Session  
**Christopher Bencher**, Applied Materials, Inc. (United States)  
**Joy Y. Cheng**, Taiwan Semiconductor Manufacturing Company Ltd.  
(Taiwan)
- 2 Nanoimprint Lithography Production Readiness  
**Douglas J. Resnick**, Canon Nanotechnologies, Inc. (United States)  
**John G. Maltabes**, Jordan Valley Semiconductors, Inc. (United States)
- 3 Nanoimprint Modeling, Processing, and Materials  
**Naoya Hayashi**, Dai Nippon Printing Company, Ltd. (Japan)  
**Tatsuhiko Higashiki**, Toshiba Corporation (Japan)
- 4 DSA Line-Space Patterning  
**Ricardo Ruiz**, HGST, Inc. (United States)  
**Chi-Chun Liu**, IBM Corporation (United States)
- 5 DSA Via Patterning  
**Todd R. Younkin**, Intel Corporation (United States)  
**Raluca Tiron**, CEA-LETI (France)
- 6 DSA Process and Integration: Joint Session with Conferences 9777 and  
9779  
**Dan B. Millward**, Dow Chemical Company (United States)  
**Mark H. Somervell**, Tokyo Electron America, Inc. (United States)
- 7 DSA Materials and Processes: Joint Session with Conferences 9777  
and 9779  
**Roel Gronheid**, IMEC (Belgium)  
**Benjamin M. Rathsack**, Tokyo Electron America, Inc. (United States)

- 8 DSA Modeling and Design  
**Michael A. Guillorn**, IBM Thomas J. Watson Research Center  
(United States)  
**Hsinyu Tsai**, IBM Thomas J. Watson Research Center (United States)
- 9 Direct-Write E-Beam Lithography  
**Marco J. Wieland**, MAPPER Lithography (Netherlands)  
**Moshe E. Preil**, GLOBALFOUNDRIES Inc. (United States)
- 10 Novel Lithography and Alternative Patterning I  
**Shy-Jay Lin**, Taiwan Semiconductor Manufacturing Company Ltd.  
(Taiwan)  
**Alan D. Brodie**, KLA-Tencor Corp. (United States)
- 11 Novel Lithography and Alternative Patterning II  
**Frank M. Schellenberg**, Consultant (United States)  
**John G. Malfabes**, Jordan Valley Semiconductors, Inc. (United States)

