

PROCEEDINGS OF SPIE

Instrumentation, Metrology, and Standards for Nanomanufacturing, Optics, and Semiconductors V

**Michael T. Postek
Victoria A. Coleman**
Editors

**24–25 August 2011
San Diego, California, United States**

Sponsored by
SPIE

Technical Cosponsor
National Institute of Standards and Technology (United States)

Published by
SPIE

Volume 8105

Proceedings of SPIE, 0277-786X, v. 8105

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 *Instrumentation, Metrology, and Standards for Nanomanufacturing, Optics, and Semiconductors V*, edited by Michael T. Postek, Victoria A. Coleman, Proceedings of SPIE Vol. 8105 (SPIE, Bellingham, WA, 2011) Article CID Number.

ISSN 0277-786X
ISBN 9780819487155

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 © 2011, 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/11/\$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, 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

v *Conference Committee*

SESSION 1 INTRODUCTORY REMARKS AND KEYNOTE SESSION

- 8105 03 **Challenges and opportunities in nanomanufacturing (Invited Paper)** [8105-02]
K. P. Cooper, U.S. Naval Research Lab. (United States); R. F. Wachter, Office of Naval Research (United States)
- 8105 04 **Nanoparticles and metrology: a comparison of methods for the determination of particle size distributions (Invited Paper)** [8105-03]
V. A. Coleman, Å. K. Jämting, H. J. Catchpoole, M. Roy, J. Herrmann, National Measurement Institute of Australia (Australia)

SESSION 2 NANOMETROLOGY AND STANDARDS I

- 8105 05 **Strategies for nanoscale contour metrology using critical dimension atomic force microscopy** [8105-04]
N. G. Orji, R. G. Dixon, A. E. Vlădar, M. T. Postek, National Institute of Standards and Technology (United States)
- 8105 06 **Sidewall slope sensitivity of CD-AFM** [8105-05]
A. Cordes, B. Bunday, SEMATECH North (United States); E. Cottrell, Bruker AXS, Inc. (United States)
- 8105 07 **High precision surface-profile metrology by scanning the repetition rate of femtosecond pulses** [8105-06]
W.-D. Joo, Y.-J. Kim, Y. Kim, J. Park, S.-W. Kim, Korea Advanced Institute of Science and Technology (Korea, Republic of)

SESSION 3 NANOMETROLOGY AND STANDARDS II

- 8105 09 **Verification of scatterometer design** [8105-09]
W. Zhao, C. Hahlweg, H. Rothe, Helmut Schmidt Univ. (Germany)
- 8105 0A **IR nanoscale spectroscopy and imaging** [8105-11]
E. Kennedy, F. Yarrow, J. H. Rice, Univ. College Dublin (Ireland)

SESSION 4 INSTRUMENTATION AND METROLOGY I

- 8105 0D **Linear variable filter based oil condition monitoring systems for offshore windturbines** [8105-14]
B. R. Wiesent, D. G. Dorigo, Ö. Şimşek, A. W. Koch, Technische Univ. München (Germany)

8105 0E **Two-photon fluorescence near-field pH measurement for mitochondria activity** [8105-16]
Y. Kanazashi, Y. Li, T. Onojima, K. Iwami, Y. Ohta, N. Umeda, Tokyo Univ. of Agriculture and
Technology (Japan)

8105 0G **Light confinement by structured metal tips for antenna-based scanning near-field optical
microscopy** [8105-18]
J. D. Jambrech, Fraunhofer-IISB (Germany); M. Böhmler, Ludwig-Maximilians-Univ. München
(Germany); M. Rommel, Fraunhofer-IISB (Germany); A. Hartschuh, Ludwig-Maximilians-Univ.
München (Germany); A. J. Bauer, Fraunhofer-IISB (Germany); L. Frey, Fraunhofer-IISB
(Germany), Friedrich-Alexander-Univ. (Germany), and Erlangen Graduate School in
Advanced Optical Technologies (Germany)

SESSION 5 INSTRUMENTATION AND METROLOGY II

8105 0H **See-through-silicon inspection application studies based on traditional silicon imager**
[8105-19]
W. Zhou, D. Hart, N. Bock, R. Shervey, Rudolph Technologies, Inc. (United States)

8105 0I **Common-path laser encoder system for nanopositioning** [8105-21]
C.-C Wu, Tamkang Univ. (Taiwan); C.-C. Hsu, Yuan Ze Univ. (Taiwan); J.-Y. Lee, National
Central Univ. (Taiwan); C.-Y. Cheng, Tamkang Univ. (Taiwan)

8105 0J **Laser-based imaging of time depending microscopic scenes with strong light emission**
[8105-22]
C. Hahlweg, E. Wilhelm, H. Rothe, Helmut Schmidt Univ. (Germany)

8105 0L **Development of cavity ring-down ellipsometry with spectral and submicrosecond time
resolution** [8105-27]
V. Papadakis, Foundation for Research and Technology, Hellas (Greece); M. A. Everest,
Foundation for Research and Technology, Hellas (Greece) and George Fox Univ. (United
States); K. Stamataki, Foundation for Research and Technology, Hellas (Greece) and Univ.
of Crete (Greece); S. Tzortzakis, B. Loppinet, Foundation for Research and Technology,
Hellas (Greece); T. P. Rakitzis, Foundation for Research and Technology, Hellas (Greece)
and Univ. of Crete (Greece)

POSTER SESSION

8105 0N **Whole field curvature and residual stress determination of silicon wafers by reflectometry**
[8105-20]
C. S. Ng, Nanyang Technological Univ. (Singapore) and Infineon Technologies (Singapore);
A. K. Asundi, Nanyang Technological Univ. (Singapore)

8105 0P **Rapid defect detections of bonded wafer using near infrared polariscope** [8105-24]
C. S. Ng, Nanyang Technological Univ. (Singapore) and Infineon Technologies (Singapore);
A. K. Asundi, Nanyang Technological Univ. (Singapore)

Author Index

Conference Committee

Symposium Chairs

David L. Andrews, University of East Anglia Norwich (United Kingdom)
James G. Grote, Air Force Research Laboratory (United States)

Conference Chair

Michael T. Postek, National Institute of Standards and Technology
(United States)

Conference Cochairs

Victoria A. Coleman, National Measurement Institute of Australia
(Australia)
Zu-Han Gu, Surface Optics Corporation (United States)

Program Committee

John A. Allgair, GLOBALFOUNDRIES Inc. (Germany)
Russell A. Chipman, College of Optical Sciences, The University of
Arizona (United States)
Khershed P. Cooper, U.S. Naval Research Laboratory (United States)
Thomas A. Germer, National Institute of Standards and Technology
(United States)
Daniel J. C. Herr, Semiconductor Research Corporation (United States)
Mark D. Hoover, The National Institute for Occupational Safety and
Health (United States)
Alexei A. Maradudin, University of California, Irvine (United States)
Ndubuisi G. Orji, National Institute of Standards and Technology
(United States)
Nora Savage, U.S. Environmental Protection Agency (United States)
John Small, National Institute of Standards and Technology (United
States)
Shouhong Tang, KLA-Tencor Corporation (United States)
John F. Valley, Raytex USA Corporation (United States)
Xianfan Xu, Purdue University (United States)

Session Chairs

- 1 Introductory Remarks and Keynote Session
 Michael T. Postek, National Institute of Standards and Technology
 (United States)
 Victoria A. Coleman, National Measurement Institute of Australia
 (Australia)
- 2 Nanometrology and Standards I
 Ndubuisi G. Orji, National Institute of Standards and Technology
 (United States)
- 3 Nanometrology and Standards II
 Ndubuisi G. Orji, National Institute of Standards and Technology
 (United States)
 Xianfan Xu, Purdue University (United States)
- 4 Instrumentation and Metrology I
 Khershed P. Cooper, U.S. Naval Research Laboratory (United States)
 Russell A. Chipman, College of Optical Sciences, The University of
 Arizona (United States)
- 5 Instrumentation and Metrology II
 Shouhong Tang, KLA-Tencor Corporation (United States)
 Alexei A. Maradudin, University of California, Irvine (United States)