

PROCEEDINGS OF SPIE

***Instrumentation, Metrology, and
Standards for Nanomanufacturing,
Optics, and Semiconductors VIII***

**Michael T. Postek
Ndubuisi G. Orji**
Editors

**20 August 2014
San Diego, California, United States**

Sponsored and Published by
SPIE

Volume 9173

Proceedings of SPIE 0277-786X, V. 9173

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

Instrumentation, Metrology, and Standards for Nanomanufacturing, Optics, and Semiconductors VIII,
edited by Michael T. Postek, Ndubuisi G. Orji, Proc. of SPIE Vol. 9173, 917301 · © 2014 SPIE
CCC code: 0277-786X/14/\$18 · doi: 10.1117/12.2081270

Proc. of SPIE Vol. 9173 917301-1

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 VIII*, edited by Michael T. Postek, Ndubuisi G. Orji, Proceedings of SPIE Vol. 9173 (SPIE, Bellingham, WA, 2014) Article CID Number.

ISSN: 0277-786X

ISBN: 9781628412000

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 © 2014, 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/14/\$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

v *Authors*
vii *Conference Committee*

SESSION 1 NANOMANUFACTURING METROLOGY I

- 9173 02 **Nanomanufacturing metrology for cellulosic nanomaterials: an update (Invited Paper)** [9173-1]
9173 04 **Recent advances of the metrological AFM at INRIM** [9173-3]
9173 05 **Technique for AFM tip characterization (Invited Paper)** [9173-4]

SESSION 2 TOOLS FOR NANOMANUFACTURING METROLOGY

- 9173 06 **Nanomanufacturing concerns about measurements made in the SEM Part III: vibration and drift (Invited Paper)** [9173-5]
9173 07 **Developing detection efficiency standards for atom probe tomography** [9173-6]
9173 08 **Recent advances in scanning Microwave Impedance Microscopy (sMIM) for nano-scale measurements and industrial applications** [9173-7]

SESSION 3 NANOMANUFACTURING METROLOGY II

- 9173 09 **Standardization of methods for extracting statistics from surface profile measurements (Invited Paper)** [9173-8]
9173 0A **Improved quality control of silicon wafers using novel off-line air pocket image analysis (Invited Paper)** [9173-9]
9173 0B **Interferometric measurement of dimensional and thermal stability of joints** [9173-10]

SESSION 4 NANOMANUFACTURING METROLOGY III

- 9173 0C **The refractive index of non-absorbing nanofluids and applications** [9173-12]
9173 0E **Mass sensing AIN sensors for waste water monitoring** [9173-14]

POSTER SESSION

- 9173 0I **Scatterometric characterization of diffractive optical elements** [9173-18]

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.

Amster, Oskar, 08
Barrera, R. G., 0C
Bellotti, R., 04
Castracane, J., 0E
Cizmar, Petr, 06
Contreras-Tello, Humberto, 0C
Dixson, Ronald G., 05
Foraida, Z., 0E
Friedman, Stuart, 08
García-Valenzuela, Augusto, 0C
Gattu, S., 0E
Geiser, Brian P., 07
Husu, Hannu, 0I
Itoh, Hiroshi, 05
Larson, David J., 07
Lassila, Antti, 0I
Laukkanen, Janne, 0I
Lawrence, Dan, 07
Lorenz, Hagen, 0B
Lydecker, L., 0E
Márquez-Islas, R., 0C
Olson, David, 07
Orji, Ndubuisi G., 05
Picotto, G. B., 04
Porrazzo, R., 0E
Postek, Michael T., 02, 06
Potter, G., 0E
Prosa, Ty J., 07
Saastamoinen, Toni, 0I
Sánchez-Pérez, C., 0C
Sanna, M. Cristina, 0A
Schödel, René, 0B
Siitonen, Samuli, 0I
Takacs, Peter Z., 09
Tokranova, N., 0E
Turunen, Jari, 0I
Valley, John F., 0A
Vladár, András E., 06
Wang, Chunmei, 05
Yang, Yongliang, 08

Conference Committee

Symposium Chairs

Satoshi Kawata, Osaka University (Japan)
Manijeh Razeghi, Northwestern University (United States)

Symposium Co-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 Co-chair

Ndubuisi G. Orji, National Institute of Standards and Technology
(United States)

Conference Program Committee

Bryan M. Barnes, National Institute of Standards and Technology
(United States)
Bernd Bodermann, Physikalisch-Technische Bundesanstalt (Germany)
Khershed P. Cooper, U.S. Naval Research Laboratory (United States)
Aaron Cordes, SEMATECH Inc. (United States)
Shouhong Tang, KLA-Tencor Corporation (United States)
Vladimir A. Ukraintsev, Nanometrology International, Inc.
(United States)
Xianfan Xu, Purdue University (United States)
Wei Zhou, Rudolph Technologies, Inc. (United States)

Session Chairs

- 1 Nanomanufacturing Metrology I
Michael T. Postek, National Institute of Standards and Technology
(United States)
Ndubuisi G. Orji, National Institute of Standards and Technology
(United States)

- 2 Tools for Nanomanufacturing Metrology
Bryan M. Barnes, National Institute of Standards and Technology
(United States)
Michael T. Postek, National Institute of Standards and Technology
(United States)
- 3 Nanomanufacturing Metrology II
Ndubuisi G. Orji, National Institute of Standards and Technology
(United States)
John F. Valley, SunEdison (United States)
- 4 Nanomanufacturing Metrology III
Shouhong Tang, KLA-Tencor Corporation (United States)
Ndubuisi G. Orji, National Institute of Standards and Technology
(United States)