

PROCEEDINGS OF SPIE

Advances in Metrology for X-Ray and EUV Optics VI

**Lahsen Assoufid
Haruhiko Ohashi
Anand Krishna Asundi**
Editors

**29 August 2016
San Diego, California, United States**

Sponsored and Published by
SPIE

Volume 9962

Proceedings of SPIE 0277-786X, V. 9962

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

Advances in Metrology for X-Ray and EUV Optics VI, edited by Lahsen Assoufid,
Haruhiko Ohashi, Anand Krishna Asundi, Proc. of SPIE Vol. 9962, 996201
© 2016 SPIE · CCC code: 0277-786X/16/\$18 · doi: 10.1117/12.2256408

Proc. of SPIE Vol. 9962 996201-1

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 *Advances in Metrology for X-Ray and EUV Optics VI*, edited by Lahsen Assoufid, Haruhiko Ohashi, Anand Krishna Asundi, Proceedings of SPIE Vol. 9962 (SPIE, Bellingham, WA, 2016) Six-digit Article CID Number.

ISSN: 0277-786X

ISSN: 1996-756X (electronic)

ISBN: 9781510603158

ISBN: 9781510603165 (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

v	<i>Authors</i>
vii	<i>Conference Committee</i>

1D AND PENCIL BEAM PROFILOMETRY

9962 02	New operational mode of the pencil beam interferometry based LTP [9962-1]
9962 03	Nanometer accuracy with continuous scans at the ALBA-NOM [9962-2]
9962 04	Development of a long trace profiler at SPring-8 using a newly developed slope sensor [9962-3]

2D PROFILOMETRY, INTERFEROMETRY, AND SUBAPERTURE STITCHING

9962 07	Surface measurements in "grazing incidence" interferometry for long x-ray mirrors: theoretical limits and practical implementations [9962-6]
9962 08	Subaperture stitching interferometry with reduced reference errors for ultrasmooth surfaces [9962-7]

NOVEL INSTRUMENTATION AND TECHNIQUES

9962 0B	Measurement of aspheric mirror by nanoprofiler using normal vector tracing [9962-10]
9962 0C	Development of surface profiler for master mandrel of x-ray ellipsoidal mirror [9962-11]

MODELING AND SPECIFICATIONS OF OPTICS

9962 0F	Fiber-optic based in situ atomic spectroscopy for manufacturing of x-ray optics [9962-14]
9962 0G	Modeling surface topography of state-of-the-art x-ray mirrors as a result of stochastic polishing process: recent developments [9962-15]
9962 0H	Ray-tracing as a tool for efficient specification of beamline optical components [9962-16]

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.

Atanasoff, George, 0F
Campos, Juan, 03
Centers, Gary, 02, 0G
Colldelram, C., 0H
Endo, Katsuyoshi, 0B
Freijo Martín, Idoia, 07
Huang, Qiushi, 08
Kishimoto, H., 04
Kitayama, Takao, 0B
Ladrera, J., 0H
Llonch, M., 0H
Metting, Christopher J., 0F
Mimura, Hidekazu, 0C
Miura, T., 04
Nicolas, Josep, 03, 0H
Ohashi, H., 04
Pedreira, Pablo, 03, 0H
Ramírez, Claudio, 03
Ribó, L., 0H
Senba, Y., 04
Shen, Zhengxiang, 08
Shiraji, Hiroki, 0B
Šics, Igors, 03, 0H
Smith, Brian V., 02
Takei, Yoshinori, 0C
Tyurin, Yuri N., 0G
Tyurina, Anastasia, 0G
Vannoni, Maurizio, 07
von Bredow, Hasso, 0F
Wang, Zhanshan, 08
Xu, Xudong, 08
Yamamura, Kazuya, 0B
Yashchuk, Valeriy V., 02, 0G

Conference Committee

Program Track Chairs

Ali M. Khounsary, Illinois Institute of Technology (United States)
Ralph B. James, Brookhaven National Laboratory (United States)

Conference Chairs

Lahsen Assoufid, Argonne National Laboratory (United States)
Haruhiko Ohashi, Japan Synchrotron Radiation Research Institute
(Japan)
Anand Krishna Asundi, Nanyang Technological University (Singapore)

Conference Program Committee

Simon G. Alcock, Diamond Light Source Ltd. (United Kingdom)
Raymond Barrett, European Synchrotron Radiation Facility (France)
Daniele Cocco, SLAC National Accelerator Laboratory
(United States)
Ralf D. Geckeler, Physikalisch-Technische Bundesanstalt (Germany)
Kenneth A. Goldberg, Lawrence Berkeley National Laboratory
(United States)
Mikhail V. Gubarev, NASA Marshall Space Flight Center
(United States)
Mourad Idir, Brookhaven National Laboratory (United States)
Weiguo Liu, Xi'an University of Technology (China)
Hidekazu Mimura, The University of Tokyo (Japan)
Josep Nicolas, CELLS - ALBA (Spain)
Lorenzo Raimondi, Elettra-Sincrotrone Trieste S.C.p.A. (Italy)
Rajdeep Singh Rawat, National Institute of Education (Singapore)
Mark D. Roper, Daresbury Laboratory (United Kingdom)
Kawal Sawhney, Diamond Light Source Ltd. (United Kingdom)
Frank Siewert, Helmholtz-Zentrum Berlin für Materialien und Energie
GmbH (Germany)
Regina Soufli, Lawrence Livermore National Laboratory
(United States)
Peter Z. Takacs, Brookhaven National Laboratory (United States)
Muriel Thomasset, Synchrotron SOLEIL (France)
Amparo Vivo, European Synchrotron Radiation Facility (France)
Zhanshan Wang, Tongji University (China)
Kazuto Yamauchi, Osaka University (Japan)
Tanfer Yandayan, TÜBITAK UME (Turkey)

Valeriy V. Yashchuk, Lawrence Berkeley National Laboratory
(United States)

Brian W. Yates, Canadian Light Source Inc. (Canada)

Session Chairs

- 1 1D and Pencil Beam Profilometry
Haruhiko Ohashi, Japan Synchrotron Radiation Research Institute
(Japan)
Zhanshan Wang, Tongji University (China)
- 2 2D Profilometry, Interferometry, and Subaperture Stitching
Valeriy V. Yashchuk, Lawrence Berkeley National Laboratory
(United States)
Mikhail V. Gubarev, NASA Marshall Space Flight Center
(United States)
- 3 Novel Instrumentation and Techniques
Lahsen Assoufid, Argonne National Laboratory (United States)
Josep Nicolas, CELLS - ALBA (Spain)
- 4 At-Wavelength Metrology
Josep Nicolas, CELLS - ALBA (Spain)
Lahsen Assoufid, Argonne National Laboratory (United States)
- 5 Modeling and Specifications of Optics
Werner H. Jark, Elettra-Sincrotrone Trieste S.C.p.A. (Italy)