PROCEEDINGS OF SPIE

[SPIDigitalLibrary.org/conference-proceedings-of-spie](https://spiedigitallibrary.org/conference-proceedings-of-spie)

Front Matter: Volume 9207

, "Front Matter: Volume 9207," Proc. SPIE 9207, Advances in X-Ray/EUV Optics and Components IX, 920701 (8 October 2014); doi: 10.1117/12.2084731

SPIE.

Event: SPIE Optical Engineering + Applications, 2014, San Diego, California, United States

PROCEEDINGS OF SPIE

Advances in X-Ray/EUV Optics and Components IX

**Christian Morawe
Ali M. Khounsary
Shunji Goto**
Editors

**18–20 August 2014
San Diego, California, United States**

Sponsored and Published by
SPIE

Volume 9207

Proceedings of SPIE 0277-786X, V. 9207

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

Advances in X-Ray/EUV Optics and Components IX, edited by Christian Morawe,
Ali M. Khounsary, Shunji Goto, Proc. of SPIE Vol. 9207, 920701 · © 2014 SPIE
CCC code: 0277-786X/14/\$18 · doi: 10.1117/12.2084731

Proc. of SPIE Vol. 9207 920701-1

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 *Advances in X-Ray/EUV Optics and Components IX*, edited by Christian Morawe, Ali M. Khounsary, Shunji Goto, Proceedings of SPIE Vol. 9207 (SPIE, Bellingham, WA, 2014) Article CID Number.

ISSN: 0277-786X

ISBN: 9781628412345

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.

SPIEDigitalLibrary.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

vii	<i>Authors</i>
ix	<i>Conference Committee</i>
xi	<i>Introduction</i>

SESSION 1 REFRACTIVE OPTICS

9207 02	X-ray laminography and SAXS on beryllium grades and lenses and wavefront propagation through imperfect compound refractive lenses [9207-1]
9207 03	X-ray multilens interferometer based on Si refractive lenses [9207-2]
9207 04	Kinoform lens focusing of high-energy x-rays (50-100 keV) [9207-3]

SESSION 2 MULTILAYERS AND GRATINGS

9207 06	Variable line spacing diffraction grating fabricated by direct write lithography for synchrotron beamline applications [9207-6]
9207 07	Specific aspects of roughness and interface diffusion in non-periodic Mo/Si multilayers [9207-7]
9207 08	The effect of unequal bilayer thickness on stress in WSi_2/Si multilayers for multilayer Laue lens structures [9207-8]
9207 09	Thermal expansion properties of thin multilayer films [9207-9]

SESSION 3 NEW DEVELOPMENTS

9207 0A	Focusing x-rays in two dimensions upon refraction in an inclined prism [9207-10]
9207 0B	Flux monitoring by x-ray diffracting crystals under ambient air conditions [9207-11]
9207 0C	Diffractive 3D XUV optics at Helmholtz-Zentrum Berlin, recent developments [9207-12]

SESSION 4 SYNCHROTRON BEAMLINES

9207 0E	MagneDyn: the future beamline for ultrafast magnetodynamical studies at FERMI [9207-14]
9207 0F	Ray tracing simulation of 1-BM beamline at the Advanced Photon Source for polarization analyses of synchrotron optics [9207-15]

- 9207 OG **Optimisation of a compact optical system for the beamtransport at the x-ray fluorescence beamline at Elettra for experiments with small spots** [9207-16]

SESSION 5 THIN FILMS AND MULTILAYERS

- 9207 OH **Preparation and characterization of x-ray mirrors with three single layers of a-C, B₄C, and Ni onto two 820-mm long Si substrate** [9207-17]
- 9207 OI **APS deposition facility upgrades and future plans** [9207-18]
- 9207 OJ **Graded multilayers for fully polarization resolved resonant inelastic x-ray scattering in the soft x-ray range** [9207-19]

SESSION 6 SHORT PULSES

- 9207 OK **Phase characterization of attosecond multilayer mirrors: from EUV to soft x-rays** [9207-20]
- 9207 OL **Attosecond broadband multilayer mirrors for the water window spectral range** [9207-21]
- 9207 OM **Phase delay characterization of multilayer coatings for FEL applications** [9207-22]

SESSION 7 NEW MATERIALS

- 9207 OO **Characterization of thin HPHT IIa diamond by transmission and reflection measurements** [9207-24]
- 9207 OP **Low-energy repetitive plasma focus based neon soft x-ray lithography source** [9207-26]

SESSION 8 MICROSCOPES AND TELESCOPES

- 9207 OQ **Development of achromatic full-field hard x-ray microscopy and its application to x-ray absorption near edge structure spectromicroscopy** [9207-27]
- 9207 OR **Toward achromatic soft x-ray imaging system with sub-10-nm spatial resolution** [9207-28]
- 9207 OS **Development of optical components for METIS instrument** [9207-29]
- 9207 OT **X-ray monitoring for astrophysical applications** [9207-30]

SESSION 9 IMAGING

- 9207 OU **Phase contrast imaging using a micro focus x-ray source** [9207-31]
- 9207 OV **Reflection on multilayer mirrors: beam profile and coherence properties** [9207-32]
- 9207 OX **Phase imaging using polycapillary optics** [9207-34]

9207 0Y **Simulations and surface quality testing of high asymmetry angle x-ray crystal monochromators for advanced x-ray imaging applications [9207-35]**

POSTER SESSION

- 9207 0Z **Saw-tooth refractive lens for high energy x-ray focusing [9207-4]**
- 9207 11 **X-ray harmonics suppression by compound refractive lenses [9207-37]**
- 9207 12 **Diffractive focusing optics design at Helmholtz-Zentrum Berlin [9207-38]**
- 9207 14 **Measurement of the refractive index of nematic liquid crystals 5CB by means of x-ray interferometry [9207-40]**
- 9207 15 **Damage of EUV optical coatings induced by alpha-particles bombardment [9207-41]**
- 9207 16 **Novel space communication technology based on modulated x-ray source [9207-42]**

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.

Antimonov, Mikhail A., 0Z	Giglia, Angelo, 0K
Antipov, Sergey P., 0B	Goetze, Kurt, 0I
Antonucci, E., 0S, 15	Gorenstein, P., 0T
Artemiev, N. A., 06	Goto, Shunji, 0O
Assoufid, Lahsen, 08, 0I	Grenci, Gianluca, 0A
Balyan, M. K., 14	Guggenmos, A., 0L
Baryshev, Sergey V., 0B	Gullikson, E. M., 06, 0L
Bashir, Sajid, 0X	Hallmann, Jörg, 02
Bourassin-Bouchet, Charles, 0K	Helfen, Lukas, 02
Braicovich, L., 0J	Hofstetter, M., 0L
Brankov, Jovan G., 0U	Holz, T., 0V
Braun, Stefan, 07	Hudec, R., 0T
Brookes, N. B., 0J	Inneman, A., 0T
Brzhezinskaya, Maria, 0C, 12	Inubushi, Yuichi, 0O
Buchheim, Jana, 0H	Ishikawa, T., 0Q
Burns, Clement, 0F	Izzo, Scott, 0I
Burrows, D., 0T	Jakubek, J., 0T
Cash, W., 0T	Jark, Werner, 0A, 0G
Cerna, D., 0T	Jergel, M., 0Y
Cheng, Xianchao, 09	Kalaiselvi, S. M. P., 0P
Conley, Raymond, 08, 0I	Kenesei, P., 04
Corso, Alain J., 0M, 0S, 15	Khounsary, Ali M., 0Z
Dadalyan, T. K., 14	Kino, H., 0Q
Dell'Angela, Martina, 0E	Kleineberg, U., 0L
Delmotte, Franck, 0K	Kohmura, Y., 0Q
Demydenko, M., 0Y	Kohn, V., 03
de Rossi, Sébastien, 0K	Korytár, D., 0Y
Dietsch, R., 0V	Krämer, M., 0V
Dobročka, E., 0Y	Kuhlmann, Marion, 0H
Doi, Kenji, 0O	Kujala, Naresh, 0F
Dreossi, D., 0V	Kuyumchyan, A. V., 14
Egawa, Satoru, 0R	Kuznetsov, S., 03
Eichert, Diane, 0G	Kwaśniewski, Paweł, 02
Emi, Y., 0Q	Lauer, Kenneth, 0I
Erdmann, Mark, 0I	Lee, P., 0P
Erko, Alexei, 0C, 12	Lengeler, Bruno, 02
Evans-Lutterodt, K., 04	Leson, Andreas, 07
Ferrari, C., 0Y	Liu, Yong-an, 16
Fineschi, S., 0S, 15	Luehl, Lars, 0G
Firsov, Alexander, 0C, 12	Lum, P., 06
Firsov, Anatoly, 12	Lyubomirskiy, M., 03
Fischer, S., 0L	MacDonald, C. A., 0X
Friedrich, Wolfgang, 07	MacDowell, A. A., 0V
Gambitta, Alessandro, 0G	Macrander, Albert T., 08, 0F
Gao, Xuan, 0F	Madsen, Anders, 02
Gasparyan, L. G., 14	Mahne, Nicola, 0E
Gawlitza, Peter, 07	Majidi, Keivan, 0U
Gerlin, F., 15	Malvestuto, Marco, 0E
Ghiringhelli, G., 0J	Mancini, L., 0V

Marsikova, V., 0T	Tan, T. L., 0P
Maser, Jörg, 08	Tessarolo, Enrico, 0M, 15
Matsuyama, S., 0Q	Tichy, V., 0T
Meltchakov, Evgueni, 0K	Tiedtke, Kai, 0H
Menzel, Maik, 07	Vagovič, P., 0Y
Metzler, M., 04	Venkatesan, S., 0L
Mikloška, M., 0Y	Voronov, D. L., 06
Mikulík, P., 0Y	Warwick, T., 06
Mimura, Hidekazu, 0R	Wochnik, A., 0L
Miura, Ayumi, 0O	Yabashi, Makina, 0O, 0Q
Mkrtychyan, V. P., 14	Yakhov-Harris, F., 0J
Mooney, Tim, 0I	Yamauchi, K., 0Q
Morawe, Christian, 09, 0J, 0V	Yamazaki, Hiroshi, 0O
Naletto, G., 0S, 15	Yunkin, V., 03
Nannarone, Stefano, 0K	Zangrando, Marco, 0E
Napolitani, E., 15	Zápravný, Z., 0Y
Nardello, Marco, 0M, 0S, 15	Zhang, Lin, 09
Naulleau, P., 06	Zhao, Bao-sheng, 16
Nickel, B., 0L	Zhou, Wei, 0U
Ohashi, Haruhiko, 0O	Zuccon, Sara, 0M, 0S, 15
Padmore, H. A., 06	Zuppella, Paola, 0M, 0S, 15
Parkinson, D. Y., 0V	
Parmigiani, Fulvio, 0E	
Peffen, Jean-Christophe, 09, 0J	
Pelizzo, Maria G., 0M, 0S, 15	
Petrucelli, Jonathan C., 0X	
Pilz, Alexander, 0H	
Pina, L., 0T	
Ploenjes, Elke, 0H	
Polikarpov, Maxim, 11	
Rack, A., 0V	
Rack, T., 0V	
Radünz, S., 0L	
Raimondi, Lorenzo, 0E	
Rauhut, R., 0L	
Rawat, R. S., 0P	
Reininger, Ruben, 0F	
Roth, Thomas, 02	
Salmassi, F., 06	
Samoylova, Liubov, 02	
Scheu, C., 0L	
Schmidt, Jürgen, 07	
Shastri, S. D., 04	
Sheffield, R. L., 04	
Sheng, Li-zhi, 16	
Shi, Bing, 08, 0I	
Shi, Xianbo, 0F	
Sieger, L., 0T	
Siewert, Frank, 0H, 0V	
Šiffalovič, P., 0Y	
Snigirev, Anatoly, 03, 11	
Snigireva, Irina, 03, 11	
Stein, A., 04	
Störmer, Michael, 0H	
Stoupin, Stanislav, 0B	
Supruangnet, R., 0J	
Svetina, Cristian, 0E	
Svintsov, Alexander, 12	
Tahir, Sajjad, 0X	
Talebitaher, A., 0P	

Conference Committee

Program Track Chairs

Carolyn A. MacDonald, University at Albany (United States)
Ralph B. James, Brookhaven National Laboratory (United States)

Conference Chairs

Christian Morawe, European Synchrotron Radiation Facility (France)
Ali M. Khounsary, X-ray Optics, Inc. (United States) and Illinois Institute of Technology (United States)
Shunji Goto, Japan Synchrotron Radiation Research Institute (Japan)

Conference Program Committee

Lucia Alianelli, Diamond Light Source Ltd. (United Kingdom)
Lahsen Assoufid, Argonne National Laboratory (United States)
Stefan Braun, Fraunhofer IWS Dresden (Germany)
Shih-Lin Chang, National Tsing Hua University (Taiwan)
Raymond Conley Jr., Brookhaven National Laboratory (United States)
Sultan B. Dabagov, Istituto Nazionale di Fisica Nucleare (Italy)
Christian David, Paul Scherrer Institut (Switzerland)
Hans M. Hertz, KTH Royal Institute of Technology (Sweden)
Keiichi Hirano, High Energy Accelerator Research Organization (Japan)
Werner H. Jark, Elettra-Sincrotrone Trieste S.C.p.A. (Italy)
Yasushi Kagoshima, University of Hyogo (Japan)
George A. Kyrala, Los Alamos National Laboratory (United States)
Eric Louis, FOM Institute DIFFER (Netherlands)
Carolyn A. MacDonald, University at Albany (United States)
Howard A. Padmore, Lawrence Berkeley National Laboratory (United States)
Ladislav Pina, Czech Technical University in Prague (Czech Republic)
Yuriy Ya Platonov, Rigaku Innovative Technologies, Inc. (United States)
Seungyu Rah, Pohang University of Science and Technology (Korea, Republic of)
Peter Revesz, Cornell University (United States)
Horst Schulte-Schrepping, Deutsches Elektronen-Synchrotron (Germany)
Regina Soufli, Lawrence Livermore National Laboratory (United States)
Stanislav Stoupin, Argonne National Laboratory (United States)
Joerg Wiesmann, Incoatec GmbH (Germany)

Makina Yabashi, RIKEN (Japan) and Japan Synchrotron Radiation Research Institute (Japan)
Kazuto Yamauchi, Osaka University (Japan)
Brian W. Yates, Canadian Light Source Inc. (Canada)

Session Chairs

- 1 Refractive Optics
Werner H. Jark, Elettra-Sincrotrone Trieste S.C.p.A. (Italy)
Stefan Braun, Fraunhofer IWS Dresden (Germany)
- 2 Multilayers and Gratings
Christian Morawe, European Synchrotron Radiation Facility (France)
Raymond Conley Jr., Argonne National Laboratory (United States)
- 3 New Developments
Ali M. Khounsary, X-ray Optics, Inc. (United States) and Illinois Institute of Technology (United States)
Ladislav Pina, Czech Technical University in Prague (Czech Republic)
- 4 Synchrotron Beamlines
Shunji Goto, Japan Synchrotron Radiation Research Institute (Japan)
Alexander Rack, European Synchrotron Radiation Facility (France)
- 5 Thin Films and Multilayers
Stefan Braun, Fraunhofer IWS Dresden (Germany)
Bing Shi, Argonne National Laboratory (United States)
- 6 Short Pulses
Dmitriy L. Voronov, Lawrence Berkeley National Laboratory (United States)
Ladislav Pina, Czech Technical University in Prague (Czech Republic)
- 7 New Materials
Ali M. Khounsary, X-ray Optics, Inc. (United States) and Illinois Institute of Technology (United States)
Lucia Alianelli, Diamond Light Source Ltd. (United Kingdom)
- 8 Microscopes and Telescopes
Christian Morawe, European Synchrotron Radiation Facility (France)
Michael Störmer, Helmholtz-Zentrum Geesthacht (Germany)
- 9 Imaging
Shunji Goto, Japan Synchrotron Radiation Research Institute (Japan)
Werner H. Jark, Elettra-Sincrotrone Trieste S.C.p.A. (Italy)

Introduction

This volume contains papers presented at the conference on "Advances in X-Ray/EUV Optics and Components IX", held in San Diego, CA, USA, 18–20 August 2014, as part of the SPIE 2014 International Symposium on Optics + Photonics.

The conference was composed of 9 oral sessions covering the fields Refractive Optics; Multilayers and Gratings; New Developments; Synchrotron Beamlines; Thin Films and Multilayers; Short Pulses; New Materials; Microscopes and Telescopes; and Imaging. It was complemented by a rich poster session.

This conference was focused on technological developments in X-ray/EUV optics for synchrotron and FEL beamlines, laboratory sources, laser and plasma physics, medical imaging, and astronomy. Accordingly, the applications covered a wide spectral range from vacuum ultra violet to hard X-rays. Topics related to metrology, adaptive optics, and computational methods were largely presented in independent conferences belonging to the same program track.

Scheduled for nearly two days of oral presentations accompanied by an evening poster session, this conference was well attended and we would like to thank the authors, speakers, session chairs, program committee members, and the conference participants for their contributions, and the SPIE staff for their help in making it a success.

Christian Morawe
Ali M. Khounsary
Shunji Goto