PROCEEDINGS OF SPIE

Photomask Japan 2023: XXIX Symposium on Photomask and Next-Generation Lithography Mask Technology

Yosuke Kojima
Editor

25–27 April 2023
Online Only, Japan

Organized by
Photomask Japan and SPIE

Co-organized by
BACUS and EMLC

In cooperation with
SEMI Japan

Published by
SPIE

Volume 12915

Proceedings of SPIE 0277-786X, V. 12915

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

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 SPIEDigitalLibrary.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 *Photomask Japan 2023: XXIX Symposium on Photomask and Next-Generation Lithography Mask Technology*, edited by Yosuke Kojima, Proc. of SPIE 12915, Seven-digit Article CID Number (DD/MM/YYYY); (DOI URL).

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

ISBN: 9781510670907
ISBN: 9781510670914 (electronic)

Published by
SPIE
P.O. Box 10, Bellingham, Washington 98227-0010 USA
Telephone +1 360 676 3290 (Pacific Time)
SPIE.org
Copyright © 2023 Society of Photo-Optical Instrumentation Engineers (SPIE).

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 fees. To obtain permission to use and share articles in this volume, visit Copyright Clearance Center 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.

Printed in the United States of America by Curran Associates, Inc., under license from SPIE.

Publication of record for individual papers is online in the SPIE Digital Library.

SPIE. DIGITAL LIBRARY

SPIEDigitalLibrary.org

Paper Numbering: A unique citation identifier (CID) number is assigned to each article in the Proceedings of SPIE 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 seven-digit CID article numbering system structured as follows:

- The first five 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 Conference Committee

EUV INSPECTION AND REPAIR

12915 02 **Actinic patterned mask inspection for EUV lithography (Invited Paper)** [12915-24]

12915 03 **AFM clean and nanomachining repair technology for future mask nodes** [12915-19]

NIL I

12915 04 **Development of nanoimprint templates for dual damascene processing** [12915-18]

12915 05 **Nanoimprint performance improvements for high volume semiconductor device manufacturing** [12915-14]

12915 06 **Nanoimprint post processing techniques to address edge placement error** [12915-15]

NIL II

12915 07 **Ultra-high throughput electron beam lithography for wafer size nanoimprint mold fabrication** [12915-22]

EUV LITHOGRAPHY AND SOURCE

12915 08 **Reducing systematic LCDU of dense contact hole arrays on wafer via source optimization** [12915-26]

12915 09 **High-brightness LDP source** [12915-29]

OPENING SESSION: DAY 2

12915 0A **Exploring photomask etching capabilities for new extreme ultraviolet absorber materials** [12915-4]

12915 0B **Study of EB resist dissolution contrast and chemical blur impact on the ultimate resolution** [12915-25]

MASK DATA HANDLING

12915 0C **The impact of real curve layout in mask data preparation (Invited Paper)** [12915-28]

12915 0D **New multi-beam mask data preparation method for EUV high volume data** [12915-8]

OPENING SESSION: DAY 3

12915 0E **11th annual eBeam initiative survey reports EUV fueling photomask growth (Invited Paper)** [12915-9]

12915 0F **MoSi stain defect reduction in photo resist strip process** [12915-13]

PATTERNING TECHNOLOGIES

12915 0G **Pixel-based data preparation for digital scanner (Invited Paper)** [12915-16]

12915 0H **Throughput limits for ultra-low voltage electron-beam lithography** [12915-7]

12915 0I **Present situation of research on stereophonic lithography using a pair of parabolic mirrors** [12915-12]

AI UTILIZATION

12915 0J **Automated measurement method with human-pose estimation model for cross-sectional SEM images of semiconductor devices** [12915-10]

12915 0K **Approach to AI defect classification for photomask inspection equipment using EOI-AI software package developed by HTL** [12915-17]

POSTER SESSION

12915 0L **Evaluation of suprathermal ions in a laser-produced plasma beyond-EUV source** [12915-27]

12915 0M **Carbon/boron multilayer for beyond EUV lithography** [12915-30]

12915 0N **Application of pattern matching on single die photomask for AIMS reference image searching** [12915-20]

12915 0O **Sidewall angle calculation on CD-SEM metrology** [12915-23]

12915 0P **Study of photomask manufacture process based on AI technology** [12915-21]