

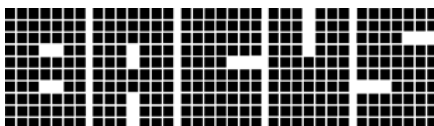
PROCEEDINGS OF SPIE

Photomask Technology 2022

Bryan S. Kasprowicz
Editor

26–29 September 2022
Monterey, California, United States

Sponsored by



The international technical group of SPIE dedicated
to the advancement of photomask technology

SPIE.

Published by
SPIE

Volume 12293

Proceedings of SPIE 0277-786X, V. 12293

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 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 *Photomask Technology 2022*, edited by Bryan S. Kasprovicz, Proc. of SPIE 12293, Seven-digit Article CID Number (DD/MM/YYYY); (DOI URL).

ISSN: 0277-786X

ISSN: 1996-756X (electronic)

ISBN: 9781510656413

ISBN: 9781510656420 (electronic)

Published by

SPIE

P.O. Box 10, Bellingham, Washington 98227-0010 USA

Telephone +1 360 676 3290 (Pacific Time)

SPIE.org

Copyright © 2022 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**

SPIDigitalLibrary.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*

INSPECTION/REPAIR

- 12293 06 **Mask inspection technologies for expanding EUV lithography (Invited Paper)** [12293-7]
- 12293 07 **Introduction of new visual analysis program using defect image segmentation for EUV mask mass product at modern load port** [12293-8]
- 12293 08 **AFM clean and nanomachining repair technology for future mask nodes** [12293-9]
- 12293 0A **Towards improving challenging stochastic defect detection in SEM images based on improved YOLOv5** [12293-11]

CURVILINEAR MASKS

- 12293 0C **A study of ILT-based curvilinear SRAF with a constant width** [12293-2]
- 12293 0D **You don't need 1nm contours for curvilinear shapes: pixel-based computing is the answer** [12293-3]
- 12293 0E **Assessment of contour modeling readiness for curvilinear masks** [12293-4]
- 12293 0F **A method for calibrating a curvature-based pre-bias model for advanced mask process correction applications** [12293-5]

ADVANCED CLEANING

- 12293 0H **In-situ cavitation measurements with a wireless sensor array: applications in megasonic photomask cleaning** [12293-18]
- 12293 0I **Removal behavior of Sn and Pb contaminants on EUV mask after EUV exposure** [12293-19]

PSM MASK: JOINT SESSION WITH PHOTOMASK AND EUV CONFERENCES

- 12293 0M **A study of patterning 36nm-pitch logic contact holes in a metal oxide resist using a high-reflectance phase-shifting mask that results in image reversal** [12293-23]

RESIST MATERIALS AND PROCESS I: JOINT SESSION WITH PHOTOMASK AND EUV CONFERENCES

12293 0N **Robust and reliable actinic ptychographic imaging of highly periodic structures in EUV photomasks [12293-50]**

ALTERNATIVE APPLICATIONS

12293 0P **Nanoimprint performance improvements for high volume semiconductor device manufacturing [12293-13]**

12293 0Q **Characteristics of fine feature hole templates for nanoimprint lithography toward 2nm and beyond [12293-14]**

MASK PROCESS CORRECTION

12293 0U **Benefits of SEM field-of-view contour averaging for contour-based MPC modeling [12293-24]**

12293 0V **A neural network assisted etch model for mask process correction [12293-26]**

12293 0W **Mask process correction for laser writers [12293-27]**

MASK METROLOGY

12293 0Z **Investigation of stochastic roughness effects for nanoscale grating characterization with a stand-alone EUV spectrometer [12293-30]**

12293 10 **Direct correlation between mask registration and on-wafer measurements for individual logic device features [12293-31]**

12293 12 **Extreme ultraviolet lithography reticle local CD uniformity correlation to wafer local CD uniformity [12293-33]**

WRITE AND PROCESS

12293 14 **Study of EB resist dissolution contrast and chemical blur impact on the ultimate resolution [12293-34]**

12293 17 **Multibeam mask requirements for advanced EUV patterning [12293-38]**

POSTER SESSION

- 12293 19 **Bayesian optimization-based estimation of effective reaction radius of chemically amplified resist in acid catalyzed deprotection reaction** [12293-39]
- 12293 1A **Single-pass frame generation for multi-layer 3D circuits** [12293-40]
- 12293 1C **Aerial image metrology (AIMS) based mask-model accuracy improvement for computational lithography** [12293-42]
- 12293 1D **The feasibility of alternative blank substrate materials for large-scale FPD mask process and manufacturing** [12293-43]
- 12293 1E **A study of rare contamination defects come in a vacuum chamber** [12293-44]
- 12293 1F **Data preparation for digital scanner** [12293-45]
- 12293 1G **Depth of focus in high-NA EUV lithography: a simulation study** [12293-46]
- 12293 1H **Haze classification based on location for COG mask** [12293-49]
- 12293 1J **Research of high-transmission phase-shift mask on critical dimension uniformity in ArF lithography** [12293-52]
- 12293 1K **Precise optical constants: determination and impact on metrology, simulation, and development of EUV masks** [12293-53]