PROCEEDINGS OF SPIE

International Conference on Extreme Ultraviolet Lithography 2022

Toshiro Itani Patrick P. Naulleau Paolo A. Gargini Kurt G. Ronse Editors

26–29 September 2022 Monterey, California, United States

Sponsored and Published by SPIE

Volume 12292

Proceedings of SPIE 0277-786X, V. 12292

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 *International Conference on Extreme Ultraviolet Lithography 2022*, edited by Toshiro Itani, Patrick P. Naulleau, Paolo A. Gargini, Kurt G. Ronse, Proc. of SPIE 12292, Seven-digit Article CID Number (DD/MM/YYYY); (DOI URL).

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

ISBN: 9781510656390 ISBN: 9781510656406 (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.



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

MOVING EUV TO MANUFACTURING

- 12292 02 Direct print EUV patterning of tight pitch metal layers for Intel 18A process technology node [12292-1]
- 12292 03 The trade-off between local critical dimension uniformity and sensitivity for contact hole high-NA printing in chemically amplified resists [12292-2]
- 12292 06 EUV optics at ZEISS: status and outlook [12292-5]

RESIST MECHANISM AND CHARACTERIZATION

- 12292 07 Chemical reactions induced by low-energy electron exposure on a novel inorganic-organic hybrid dry EUV photoresist deposited by molecular atomic layer deposition (MALD) [12292-6]
- 12292 08 Spatially resolved dissolution monitoring using AFM [12292-7]
- 12292 09 Effect of surface free energy of organic underlayer on dissolution kinetics of poly(4-hydroxystyrene) film in tetramethylammonium hydroxide aqueous developer [12292-8]

IMAGING

- 12292 0E Toward the resolution limit of Talbot lithography with compact EUV exposure tools [12292-13]
- 12292 0G **Proposal of plane-parallel resonator configuration for high-NA EUV lithography** [12292-15]
- 12292 0H Image contrast metrology for EUV lithography [12292-16]

PSM MASK: JOINT SESSION WITH PHOTOMASK AND EUV CONFERENCES

- 12292 0J Novel high-k mask absorber for next generation EUV lithography [12292-22]
- 12292 0M Comprehensive extreme ultraviolet blank defect avoidance system [12292-25]

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

- 12292 00 Study of RLS trade-off mitigation utilizing an organotin-containing chemically amplified resist for high sensitivity patterning [12292-18]
- 12292 OP Recent accomplishments in EUV lithography patterning for multi-trigger resist [12292-19]
- 12292 OR Recent status of the stochastic issues of photoresist materials in EUV lithography [12292-21]

METROLOGY AND SOURCE

- 12292 0S High-brightness LDP source for EUVL mask inspection [12292-26]
- 12292 0U Diagnosing phenomena that influence missing contacts and pillars [12292-28]
- 12292 0V Extraction of roughness measurements from thin resists with low signal-to-noise-ratio (SNR) SEM images by applying deep learning denoiser [12292-29]
- 12292 0W Early defect detection for EUV self-aligned litho-etch litho-etch patterning with EPE [12292-30]

HIGH-NA EUV MASK: JOINT SESSION WITH PHOTOMASK AND EUV CONFERENCES

- 12292 0X Low-n mask progressing insights: focus on isolated features [12292-31]
- 12292 0Y Does high-NA EUV require tighter mask roughness specifications: a simulation study [12292-32]

RESIST MATERIALS AND PROCESS II

12292 15 Influence of photoresist thinning and underlayer film on e-beam using eP5 for high-NA patterning [12292-38]

EUV METROLOGY

- 12292 1A The power of algorithmic employed in a metrology system: AIMS EUV Digital Flex Illu [12292-43]
- 12292 1C Reflective grazing incidence EUV nanoscope for wafer metrology [12292-45]

12292 1D New wave front phase sensor used for 3D shape measurements of patterned silicon wafers [12292-46]

POSTER SESSION

12292 1K	Controlled sequence peptoids as photoresist platforms for high-resolution DUV/EUV photoresists [12292-54]
12292 1L	Rapid profile reconstruction of phase defects via machine-learning regression model [12292-55]
12292 1M	Estimation of mechanical stability of EUV pellicle by the collision of the particle defect [12292-56]
12292 10	Study on rinse material for pattern collapse mitigation in EUV lithography [12292-59]
12292 1P	The measurement of the refractive index n and k value of the EUV resist which used EUV reflectivity measurement method [12292-62]
12292 1U	Scaling and readiness of underlayers for high-NA EUV lithography [12292-68]
12292 1V	Single mask solution to pattern BLP and SNLP using 0.33NA EUV for next-generation DRAM manufacturing [12292-69]
12292 1X	High-power LPP-EUV source for semiconductor HVM: lithography and other applications [12292-83]