

PROCEEDINGS OF SPIE

***Laser Applications in  
Microelectronic and  
Optoelectronic Manufacturing  
(LAMOM) XXIV***

**Tetsuya Makimura  
Gediminas Račiukaitis  
Carlos Molpeceres**  
*Editors*

**4–6 February 2019  
San Francisco, California, United States**

*Sponsored by*  
SPIE

*Cosponsored by*  
Okamoto Optics Works (Japan)  
Plymouth Grating Laboratory (United States)

*Published by*  
SPIE

**Volume 10905**

Proceedings of SPIE 0277-786X, V. 10905

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](http://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 *Laser Applications in Microelectronic and Optoelectronic Manufacturing (LAMOM) XXIV*, edited by Tetsuya Makimura, Gediminas Račiukaitis, Carlos Molpeceres, Proceedings of SPIE Vol. 10905 (SPIE, Bellingham, WA, 2019) Seven-digit Article CID Number.

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

ISBN: 9781510624528  
ISBN: 9781510624535 (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](http://SPIE.org)

Copyright © 2019, 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](http://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/19/\$18.00.

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](http://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 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

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

---

## FRONTIER IN LASER MICROMACHINING

---

10905 0D	<b>Laser grooving of multi stack material modeling: implementation of a high accuracy tool for laser-grooving and dicing application</b> [10905-12]
10905 0E	<b>Modifications of surface topography by acoustic resonance induced by laser ablation with ultrashort laser pulses</b> [10905-13]
10905 0F	<b>Selective etching of ultrafast laser modified sapphire</b> [10905-14]
10905 0H	<b>Fused silica ablation by double femtosecond laser pulses with variable delays</b> [10905-16]
10905 0I	<b>Ultrafast lasers for advanced manufacturing of flat panel displays</b> [10905-17]

---

## LASER-INDUCED FORWARD TRANSFER

---

10905 0K	<b>Reusable laser-absorbing layers for LIFT</b> [10905-19]
10905 0M	<b>Laser-Induced Forward Transfer of silver-based pastes for metallization of photovoltaic devices</b> [10905-21]

---

## FUNDAMENTAL ASPECTS OF LASER-MATERIALS INTERACTION I

---

10905 0O	<b>Study of plasma formation in solid dielectrics with the help of low-order harmonic emission (Invited Paper)</b> [10905-23]
----------	---

---

## MATERIALS SYNTHESIS AND FABRICATION I

---

10905 0X	<b>Laser induced crystal defects in monocrystalline silicon</b> [10905-32]
10905 0Z	<b>Low-temperature, high-concentration laser doping of 4H-SiC for low contact resistance</b> [10905-34]

---

**MATERIALS SYNTHESIS AND FABRICATION II**

---

10905 12     **Direct writing of Cu-based flexible thermal detectors using femtosecond laser-induced reduction (Invited Paper) [10905-37]**

---

**NANOSCALE PROCESSING**

---

10905 14     **Focused laser spike (FLaSk) thermocapillary patterning of micro/nanostructures (Invited Paper) [10905-39]**

---

**POSTER SESSION**

---

10905 19     **Strain sensing using electrically conductive structures composed of  $\beta$ -SiC fabricated by femtosecond laser direct modification of PDMS (Best Student Poster Award) [10905-43]**

10905 1C     **Development of soft x-ray laser irradiation beamline for ablation and damage study [10905-46]**