## PROCEEDINGS OF SPIE

## Vertical-Cavity Surface-Emitting Lasers XXVII

Chun Lei Luke A. Graham Editors

1–2 February 2023 San Francisco, California, United States

Sponsored and Published by SPIE

**Volume 12439** 

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 *Vertical-Cavity Surface-Emitting Lasers XXVII*, edited by Chun Lei, Luke A. Graham, Proc. of SPIE 12439, Seven-digit Article CID Number (DD/MM/YYYY); (DOI URL).

ISSN: 0277-786X

ISSN: 1996-756X (electronic)

ISBN: 9781510659834

ISBN: 9781510659841 (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.



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**

v Conference Committee

	NOVEL CONFIGURATIONS AND APPLICATIONS
12439 02	Polarization multiplexing in VCSEL-arrays (Invited Paper) [12439-1]
12439 03	High efficiency 10-micron-pitch 64x64 addressable VCSEL array with intracavity structure [12439-2]
12439 04	Depletion-mode and inversion-mode dual-laser nonlinear optoelectronic tunneling junction microwave CMOS VCSEL for integrated system-on-chip lasing RF ASIC, high-power pulsed and CW lasers: performance advantages over traditional VCSEL [12439-3]
12439 05	Fourier beam analysis of photonic crystal coupled triangular VCSEL array [12439-4]
12439 06	HCG MEMS tunable VCSEL with intracavity integrated detector [12439-30]
	LIDAR APPLICATIONS
12439 07	3D integrated 45 W peak power 2D addressable VCSEL array and laser driver for true solid-state LiDAR (Invited Paper) [12439-6]
12439 08	Single-mode multi-junction VCSELs with integrated transverse mode filter [12439-8]
12439 09	ViBO: VCSEL with integrated backside optics for LiDAR applications [12439-9]
12439 OA	1D-addressable multi-channel VCSELs with SPAD arrays for short- to medium-range LiDARs [12439-31]
	DATA COMMUNICATIONS
12439 OB	100G VCSELs for bidirectional multi-mode links (Invited Paper) [12439-10]
12439 OC	Effects of detuning on wide-temperature behavior of 25 Gbaud 850nm VCSELs [12439-13]

## **FABRICATION AND CHARACTERIZATION** 12439 0D Reliability and failure mode analysis of high-speed 850nm oxide-confined multi-mode VCSELs for space applications [12439-17] 12439 OE Analysis of defect-related optical degradation of VCSILs for photonic integrated circuits [12439-18] **SENSORS** 12439 OF **650nm red VCSELs with improved temperature performance (Invited Paper)** [12439-19] Polarization-sensitive imaging using optical coherence tomography and a HCG-VCSEL laser 12439 0G [12439-22] 12439 OH VCSEL as sensing element to measure distance changes in the nm-range [12439-23] DESIGN, GROWTH, AND FABRICATION SERVICES 12439 01 Near unity internal quantum efficiency and reliable vertical-cavity surface-emitting lasers [12439-27] 12439 OJ Full vectorial analysis of surface relief VCSEL [12439-28]