PROCEEDINGS OF SPIE

Semiconductor Lasers and Applications XII

Wei Li Werner H. Hofmann Yikai Su Editors

5-11 December 2022 ONLINE, China

Sponsored by SPIE COS—Chinese Optical Society

Cooperating Organizations

Tsinghua University (China) • Peking University (China) • University of Science and Technology of China (China) • Zhejiang University (China) • Tianjin University (China) • Beijing Institute of Technology (China) • Beijing University of Posts and Telecommunications (China) • Nankai University (China) • Changchun University of Science and Technology (China) • Capital Normal University (China) • Huazhong University of Science and Technology (China) • Beijing Jiaotong University (China) • China Jiliang University (China) • Shanghai Institute of Optics and Fine Mechanics, CAS (China) • Changchun Institute of Optics, Fine Mechanics and Physics, CAS (China) • Institute of Semiconductors, CAS (China) • Institute of Optics and Electronics, CAS (China) • Institute of Physics, CAS (China) • Shanghai Institute of Technical Physics, CAS (China) • China Instrument and Control Society (China) • Optical Society of Japan (Japan) • Optical Society of Korea (Republic of Korea) • Australian and New Zealand Optical Society • Optics and Photonics Society of Singapore (Singapore) • European Optical Society

Supporting Organizations

China Association for Science and Technology (CAST) (China)
Department of Information of National Nature Science Foundation, China (NSFC) (China)

Published by SPIE

Volume 12311

Proceedings of SPIE 0277-786X, V. 12311

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

Semiconductor Lasers and Applications XII, edited by Wei Li, Werner H. Hofmann, Yikai Su Proc. of SPIE Vol. 12311, 1231101 © 2022 SPIE 0277-786X ⋅ doi: 10.1117/12.2669768

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 Semiconductor Lasers and Applications XII, edited by Wei Li, Werner H. Hofmann, Yikai Su, Proc. of SPIE 12311, Seven-digit Article CID Number (DD/MM/YYYY); (DOI URL).

ISSN: 0277-786X

ISSN: 1996-756X (electronic)

ISBN: 9781510656888

ISBN: 9781510656895 (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 Xi	Conference Committee
SESSION 1	APPLICATIONS OF LASER DIODES
12311 02	Optical domain controlled microwave signal processing technology (Invited Paper) [12311-1]
12311 03	Comparison of Kramers–Kronig and coherent receivers for few-mode long-haul optical transmission [12311-2]
12311 04	Absolute distance measurement based on laser self-mixing interferometry and deep neural network [12311-3]
12311 05	Fixed low-frequency pilot analysis for self-calibrated frequency response characterization of electro-absorption modulated lasers [12311-4]
12311 06	Self-reference photonic sampling measurement of photodiode chips with microwave de-embedding [12311-5]
12311 07	Estimation of displacement direction based on self-mixing interferometry and convolutional neural networks $[12311\text{-}7]$
SESSION 2	CHARACTERIZATION TECHNOLOGIES FOR LASER DIODES
SESSION 2 12311 08	CHARACTERIZATION TECHNOLOGIES FOR LASER DIODES Generation mechanics and reduction of "smile" of conduction cooled diode bars during the annealing process [12311-9]
	Generation mechanics and reduction of "smile" of conduction cooled diode bars during the
12311 08	Generation mechanics and reduction of "smile" of conduction cooled diode bars during the annealing process [12311-9] Study of thermal characteristics of high-power photonic crystal laser diodes with CS-mount
12311 08 12311 09	Generation mechanics and reduction of "smile" of conduction cooled diode bars during the annealing process [12311-9] Study of thermal characteristics of high-power photonic crystal laser diodes with CS-mount package [12311-10]
12311 08 12311 09 12311 0A	Generation mechanics and reduction of "smile" of conduction cooled diode bars during the annealing process [12311-9] Study of thermal characteristics of high-power photonic crystal laser diodes with CS-mount package [12311-10] The lateral leakage current restriction in the lateral direction of ridge diode lasers [12311-11] Analysis of thermal characteristics of microchannel-cooled photonic crystal laser diode bars
12311 08 12311 09 12311 0A 12311 0B	Generation mechanics and reduction of "smile" of conduction cooled diode bars during the annealing process [12311-9] Study of thermal characteristics of high-power photonic crystal laser diodes with CS-mount package [12311-10] The lateral leakage current restriction in the lateral direction of ridge diode lasers [12311-11] Analysis of thermal characteristics of microchannel-cooled photonic crystal laser diode bars [12311-12] Method to reduce the smile of high-power diode laser bar by balancing the thermal-induced

SESSION 4	MODELING AND DESIGN
12311 OE	Design of a 976nm 190-W fiber-coupled laser diode [12311-15]
12311 OF	Research on high frequency and high reliability laser technology [12311-37]
12311 0G	Performance enhancement of distributed feedback laser with a partial grating [12311-38]
SESSION 5	OPTICAL FREQUENCY COMBS
12311 OH	Generation of tunable and broadband optical frequency comb based on gain-switching vertical-cavity surface-emitting laser driven by square wave signal under optical injection [12311-16]
SESSION 6	SUBSYSTEMS USING LASER DIODES
12311 OJ	State boundary of period-one dynamics in a semiconductor laser with dual external optical feedback [12311-18]
12311 OL	The effect of multifrequency self-injection locking in the interaction of a semiconductor laser and a high-Q microcavity [12311-24]
SESSION 7	VCSELS
12311 00	Wet oxidation and its influence on high performance five-junction 940 nm VCSELs [12311-23]
	POSTER SESSION
12311 OP	Analysis of disturbances in the multi-radar environment and mitigation approaches [12311-6]
12311 0Q	Prototype demonstration of all-optical switches based on laser array [12311-8]
12311 OR	Thermal characterization of high-power GaSb-based laser [12311-26]
12311 0\$	Multi-channel chaos synchronization based on two asymmetric mutually coupled WRC-FPLDs [12311-27]
12311 OU	Development of non-magnetic VCSEL module for compact atomic magnetometer [12311-29]

12311 OV	Single transverse mode GaSb-based ridge waveguide lasers with low lateral beam divergence [12311-30]
12311 OW	A compact killowatt-level QCW high-power semiconductor laser array based on dual-chip integration [12311-31]
12311 OX	High-output power GaSb-based diode laser with narrow n-type cladding layer [12311-32]
12311 OY	Simulation study on the high-quality 32-tupling millimeter-wave signal generation based on a filter-free photonic scheme with four DP-MZMs [12311-33]

Symposium Committees

General Chairs

 Anita Mahadevan-Jansen, President, SPIE (United States) and Vanderbilt University (United States)
 Qihuang Gong, President, Chinese Optical Society (China) and Peking University (China)

General Co-chairs

Guangcan Guo, Past President, Chinese Optical Society (China) and University of Science and Technology of China (China)
 Zejin Liu, Vice President, Chinese Optical Society (China) and National University of Defense Technology (China)

Technical Program Chairs

Ruxin Li, Vice President, Chinese Optical Society (China) and Shanghai Institute of Optics and Fine Mechanics (China) Xingde Li, Johns Hopkins University (United States)

Technical Program Co-chairs

Tianchu Li, National Institute of Metrology (China)
Wei Huang, Northwestern Polytechnical University (China)
Ying Gu, Vice President, Chinese Optical Society (China) and Chinese People's Liberation Army General Hospital (China)
Huilin Jiang, Changchun University of Science and Technology (China)

Wenqing Liu, Vice President, Chinese Optical Society (China) and Anhui Institute of Optics and Fine Mechanics (China)

Guobin Fan, China Academy of Engineering Physics (China)

Suotang Jia, Vice President, Chinese Optical Society (China) and Shanxi University (China)

Xiaomin Ren, Vice President, Chinese Optical Society (China) and Beijing University of Posts and Telecommunications (China)

Qingming Luo, Hainan University (China)

Xiangang Luo, Institute of Optics and Electronics (China)

Ninghua Zhu, Institute of Semiconductors (China)

Organizing Committee

Suotang Jia, Vice President, Chinese Optical Society (China) and Shanxi University (China)

Wenjie Wang, Vice President, Chinese Optical Society (China) and Sunny Optical Technology Group (China)

Ping Jia, Changchun Institute of Optics, Fine Mechanics and Physics (China)

Yudong Zhang, Chengdu Branch, Chinese Academy of Sciences (China)

Ninghua Zhu, Institute of Semiconductors (China)

Yongtian Wang, Beijing Institute of Technology (China)

Xiaocong Yuan, Shenzhen University (China)

Limin Tong, Zhejiang University (China)

Weimin Chen, Chongging University (China)

Yidong Huang, Tsinghua University (China)

Tiegen Liu, Tianjin University (China)

Zhiping Zhou, Peking University (China)

Changhe Zhou, Jinan University (China)

Yiping Cui, Southeast University (China)

Zhongwei Fan, Aerospace Information Research Institute (China)

Xiaoying Li, Tianjin University (China)

Yan Li, Deputy Secretary General, Chinese Optical Society (China) and Peking University (China)

Caiwen Ma, Xi'an Institute of Optics and Precision Mechanics (China) **Xinliang Zhang**, Huazhong University of Science and Technology

(China)

Jianxin Chen, Fujian Normal University (China)

Yanging Lu, Nanjing University (China)

Secretaries-General

Xu Liu, Secretary General, Chinese Optical Society (China) and Zhejiang University (China)

Yan Li, Deputy Secretary General, Chinese Optical Society (China) and Peking University (China)

Bo Gu, Deputy Secretary General, Chinese Optical Society (China)

Hong Yang, Deputy Secretary General, Chinese Optical Society (China) and Peking University (China)

Tianrui Zhai, Deputy Secretary General, Chinese Optical Society (China) and Beijing University of Technology (China)

Local Organizing Committee Chair

Yan Li, Deputy Secretary General, Chinese Optical Society (China) and Peking University (China)

Local Organizing Committee Co-chairs

Hong Yang, Deputy Secretary General, Chinese Optical Society (China) and Peking University (China)
Quan Sun, Peking University (China)
Kebin Shi, Peking University (China)

Local Secretaries

Wei Xiong, Chinese Optical Society (China) Xiaowen Gu, Peking University (China) Yu Xiang, Peking University (China)

Local Organizing Committee

Jian Xu, Peking University (China)
Hailin Wang, Peking University (China)
Shuting Jiang, Peking University (China)
Xiaoyan Zhang, Peking University (China)
Yuhua Cao, Peking University (China)
Quanquan Zheng, Peking University (China)
Xiao Li, Chinese Optical Society (China)
Jianxin Sun, Chinese Optical Society (China)

Technical Organizing Committee

 Mohammad Hossein Asghari, Loyola Marymount University (United States) and Tachyonics Inc. (United States)
 Liangcai Cao, Tsinghua University (China)
 P. Scott Carney, University of Rochester (United States)
 Benyong Chen, Zhejiang University of Science and Technology

(China) **Qionghai Dai**, Tsinghua University (China)

Gerd Ehret, Physikalisch-Technische Bundesanstalt (Germany)

Xinyu Fan, Shanghai Jiao Tong University (China)

Zheyu Fang, Peking University (China) and Rice University (United States)

Ying Gu, Chinese People's Liberation Army General Hospital (China)

Sen Han, University of Shanghai for Science and Technology (China) and Suzhou H&L Instruments LLC (China)

Ingmar Hartl, Deutsches Elektronen-Synchrotron (Germany)

Qiongyi He, Peking University (China)

Werner Hofmann, Technische Universität Berlin (Germany)

Minghui Hong, National University of Singapore (Singapore)

Shibin Jiang, AdValue Photonics, Inc. (United States)

Tina Kidger, Kidger Optics Associates (United Kingdom)

Dai-Sik Kim, Ulsan National Institute of Science and Technology (Republic of Korea)

Wei Li, Institute of Semiconductors (China)

Baojun Li, Jinan University (China)

Xingde Li, Johns Hopkins University (United States)

Ming Li, Institute of Semiconductors (China)

Chuan-Feng Li, University of Science and Technology of China (China)

Jun Liu, Shanghai Institute of Optics and Fine Mechanics (China)

Qingming Luo, Hainan University (China)

Gang-Ding Peng, The University of New South Wales (Australia)

Ting-Chung Poon, Virginia Polytechnic Institute and State University (United States)

Yuji Sano, Institute for Molecular Science (Japan)

Kebin Shi, Peking University (China)

Tsutomu Shimura, The University of Tokyo (Japan)

Samuel Stranks, University of Cambridge (United Kingdom)

Yikai Su, Shanghai Jiao Tong University (China)

Takuo Tanaka, RIKEN (Japan)

Masahiko Tani, University of Fukui (Japan)

Limin Tong, Zhejiang University (China)

Kazumi Wada, Massachusetts Institute of Technology (United States)

Jianpu Wang, Nanjing University of Technology (China)

Yongtian Wang, Beijing Institute of Technology (China)

Rengmao Wu, Zhejiang University (China)

Rongshi Xiao, Beijing University of Technology (China)

Minghong Yang, Wuhan University of Technology (China)

Jianhua Yao, Zhejiang University of Technology (China)

Hiroshi Yoshikawa, Nihon University (Japan)

Changyuan Yu, The Hong Kong Polytechnic University (Hong Kong, China)

Xiao-Cong Yuan, Shenzhen University (China)

Xuping Zhang, Nanjing University (China)

Xinliang Zhang, Wuhan National Research Centre for Optoelectronics (China)

Xi-Cheng Zhang, University of Rochester (United States)

Cunlin Zhang, Capital Normal University (China)

Zhenrong Zheng, Zhejiang University (China)

Haizheng Zhong, Beijing Institute of Technology (China)

Changhe Zhou, Shanghai Institute of Optics and Fine Mechanics (China)

Zhiping Zhou, Peking University (China)

Rui Zhu, Peking University (China)

Dan Zhu, Huazhong University of Science and Technology (China)

Conference Committee

Conference Chairs

Wei Li, Institute of Semiconductors, Chinese Academy of Sciences (China)

Werner H. Hofmann, Technische Universität Berlin (Germany)

Yikai Su, Shanghai Jiao Tong University (China)

Conference Program Committee

Minghua Chen, Tsinghua University (China)

Xiangfei Chen, Nanjing University (China)

Nan Chi, Fudan University (China)

Brian Corbett, Tyndall National Institute (Ireland)

Dawei Di, Zhejiang University (China)

Qianggao Hu, Accelink Technologies Co., Ltd. (China)

Weisheng Hu, Shanghai Jiao Tong University (China)

Ming Li, Institute of Semiconductors, Chinese Academy of Sciences (China)

Xianjie Li, China Electronics Technology Group Corporation (China)

Yong Liu, University of Electronic Science and Technology of China (China)

Xiaoyu Ma, Institute of Optics and Electronics, Chinese Academy of Sciences (China)

Frank Hudson Peters, Tyndall National Institute (Ireland)

Edwin Y. Pun, City University of Hong Kong (Hong Kong, Ching)

Hong-Bo Sun, Tsinghua University (China)

Lijun Wang, Changchun University of Science and Technology (China)

Yixin Wang, Institute for Infocomm Research (Singapore)

Guang-Qiong Xia, Southwest University (China)

Kun Xu, Beijing University of Posts and Telecommunications (China)

Lianshan Yan, Southwest Jiaotong University (China)

Jinlong Yu, Tianjin University (China)

Siyuan Yu, University of Bristol (United Kingdom)

Li Zeng, Huawei Technologies Co., Ltd. (China)

Baoping Zhang, Xiamen University (China)

Guo-yi Zhang, Peking University (China)

Shangjian Zhang, University of Electronic Science and Technology of China (China)

Xinliang Zhang, Wuhan National Research Center for Optoelectronics (China)

Zhiping Zhou, Peking University (Ching)

Ning Hua Zhu, Institute of Semiconductors, Chinese Academy of Sciences (China)

Sha Zhu, Beijing University of Technology (China) **Xihua Zou**, Southwest Jiaotong University (China)