PROCEEDINGS OF SPIE

Nanophotonics and Micro/Nano Optics IV

Zhiping Zhou Kazumi Wada Editors

12–13 October 2018 Beijing, 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) • University of Shanghai for Science and Technology (China) • Capital Normal University (China) • Huazhong University of Science and Technology (China) • Beijing Jiaotong University (China) • Shanghai Institute of Optics and Fine Mechanics (China) • Institute of Semiconductors (China) • Institute of Optics and Electronics (China) • Institute of Physics (China) • Shanghai Institute of Technical Physics (China) • China Instrument and Control Society (China) • Opticelectronics Technology Committee, COS (China) • Optical Society of Japan (Japan) • Optical Society of Korea (Korea, Republic of) • The Australian Optical Society (Australia) • Optics and Photonics Society of Singapore (Singapore) • European Optical Society

Supporting Organizations

CAST—China Association for Science and Technology (China) NSFC—National Nature Science Foundation (China)

Published by SPIF

Volume 10823

Proceedings of SPIE 0277-786X, V. 10823

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

Nanophotonics and Micro/Nano Optics IV, edited by Zhiping Zhou, Kazumi Wada, Proc. of SPIE Vol. 10823, 1082301 · © 2018 SPIE · CCC code: 0277-786X/18/\$18 · doi: 10.1117/12.2521085

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 Nanophotonics and Micro/Nano Optics IV, edited by Zhiping Zhou, Kazumi Wada, Proceedings of SPIE Vol. 10823 (SPIE, Bellingham, WA, 2018) Seven-digit Article CID Number.

ISSN: 0277-786X

ISSN: 1996-756X (electronic)

ISBN: 9781510622449

ISBN: 9781510622456 (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

Copyright © 2018, 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. 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/18/\$18.00.

Printed in the United States of America.

Publication of record for individual papers is online in the SPIE Digital Library.



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

vii	Authors
ix	Symposium Committee
xiii	Conference Committee
	SILICON PHOTONICS I
10823 07	A novel design method of large-aperture metalens and investigation of electrical focus-tuning mechanism with phase shifter structures [10823-6]
	SILICON PHOTONICS II
10823 08	Towards a fully integrated indium-phosphide membrane on silicon photonics platform (Invited Paper) [10823-7]
10823 09	Ultra-high efficiency III-V on Si MOS capacitor Mach-Zehnder modulator (Invited Paper) [10823-8]
10823 0A	Subwavelength grating devices for optical on-chip multiplexing (Invited Paper) [10823-9]
	SILICON PHOTONICS III
10823 OB	Reconfigurable photonic integrated devices on silicon (Invited Paper) [10823-10]
10823 0D	56 Gbps Si/GeSi integrated EAM (Invited Paper) [10823-12]
10823 0E	Two-dimensional photonic crystal bandedge resonance for perovskite laser on silicon [10823-13]
10823 OF	Reduction of threading dislocations by image force in Ge selective epilayers on Si [10823-14]
	INTEGRATED OPTICS
10823 OH	GaN photonics: simultaneous emission-detection phenomenon of multiple quantum well diode (Invited Paper) [10823-16]

10823 OJ	Analysis of bottleneck factors affecting precision manufacturing and possible solutions [10823-18]
	NONLINEAR PHOTONICS AND QUANTUM OPTICS
10823 OM	High-quality lead sulfide nanofilm deposited on silica fiber substrate by atomic layer deposition technology [10823-21]
10823 00	Raman spectroscopic characterization of interlayer coupling in twisted (2+2) and (3+3) layered graphenes [10823-23]
10823 OP	Surface-related nonlinear optical enhancement in graphene and G/CdS nanohybrids [10823-24]
	METAMATERIALS
10823 OR	Design and application of photonic devices based on photonic crystal near Dirac point [10823-26]
10823 OT	Dual-band total absorption via guided-mode resonance in a monolayer MoS $_2$ covered dielectric grating structure $[10823-28]$
	NANOPHOTONICS I
10823 OU	Germanium implanted photonic devices for post-fabrication trimming and programmable circuits (Invited Paper) [10823-29]
10823 OW	Molecular self-assembly-inspired attosecond nanomedicine crystal nanobiophotonic approach: challenges and opportunities [10823-31]
10823 0X	High-resolution laser fabrication of amplitude diffractive structures on thin metal films [10823-32]
	NANOPHOTONICS II
10823 OY	Upright dome nanostructure for enhanced light absorption in thin-film silicon solar cells (Invited Paper) [10823-33]
10823 OZ	Mode engineering for circular-side square microcavity lasers (Invited Paper) [10823-34]
10823 11	Functional nanocellulose films as fluorescent media [10823-36]

POSTER SESSION

10823 12	The inter-valley scattering between direct and indirect valleys in Ge for optimization of the germanium light [10823-37]
10823 13	Quantitative analysis of ceftazidime using SERS based on silver nanoparticles substrate [10823-38]
10823 15	Evaluation of free-radical scavenging and antioxidant activities of polydatin nanoethosomes [10823-40]
10823 16	Anti-hepatocarcinoma effects of puerarin-nanoethosomes against human HepG2 cells [10823-41]
10823 17	Enhancement of light extraction by ZnO nanostructures on vertical GaN light-emitting diodes [10823-42]
10823 18	Optical phased arrays based on silicon and GaAs photonic waveguides [10823-43]
10823 1A	In-situ characterization of surface-plasmon-enhanced photocatalysis of Ag decorated black TiO ₂ by IR-AFM [10823-45]
10823 1D	Surface-plasmon-enhanced SnO ₂ nanofiber gas sensor [10823-48]
10823 1E	Label-free DNA detection based on whispering gallery mode optofluidic microcavity biosensor [10823-49]
10823 11	Polarization-dependent reflective color filter incorporating an embedded silicon grating [10823-53]
10823 1J	Meta-Fresnel elements functioned by pixelated one-dimensional gratings with space-variant frequencies and orientations $[10823\text{-}54]$

Authors

Numbers in the index correspond to the last two digits of the seven-digit citation identifier (CID) article numbering system used in Proceedings of SPIE. The first five digits reflect the volume number. Base 36 numbering is employed for the last two digits and indicates the order of articles within the volume. Numbers start with 00, 01, 02, 03, 04, 05, 06, 07, 08, 09, 0A, 0B...0Z, followed by 10-1Z, 20-2Z, etc.

Abe, E., 0F
Aihara, T., 09
Bai, Xianhua, 0O
Banakar, M., 0D
Bazin, A., 0D
Bettotti, Paolo, 11
Chen, Bigeng, 0U
Chen, Cai-Yun, 12
Chen, Huacai, 13
Chen, Linsen, 11, 1J
Chen, Tong-sheng, 15, 16
Chen, Xia, 0U
Chen, Xiaogang, 1E
Chen, Xiao-He, 07

Cheng, Zuguo, 0J Dai, Daoxin, OB Domínguez Bucio, T., 0D Dong, Guoyan, OR Dong, Yanhua, 0M Du, Jia-zhen, 15 Fang, Yan, 0W Fu, Liang, 1E Fujii, T., 09 Fukuda, H., 09 Gao, Hongyi, 0J Gao, Jia-Min, 15, 16 Gao, Jin-Bo, 07 Gao, Jin-Song, 07 Gao, Ruo-Qian, 07 Gao, Yang, 18 Gardes, F. Y., 0D Grabska, K. M., 0D

Gu, Yu, 11, 1J Gu, Yuzong, 0P Guerrero, Raphael A., 11 Guo, Xiaowei, 0Y Hao, You-Zeng, 0Z Hasebe, K., 09 Hattasan, N., 0D He, Yanling, 1A, 1D Hiraki, T., 09 Hu, Jigang, 0T Huang, Jie, 13

Indias, Johanna Mae M., 11 Ishikawa, Y., 0F Jiao, Yuqing, 08 Kakitsuka, T., 09

Huang, Yong-Zhen, OZ

Huang, Shi-Hao, 12

Khokhar, Ali Z., OD, OU Korolkov, Victor P., OX Li, Hongju, OT Li, Jiaxing, 1A, 1D Li, Ruxin, OJ Li, Shaorong, OY

Li, Shaorong, 0Y Li, Xiaoli, 0O Li, Yuanjie, 17 Liang, Baolai, 0O Liao, Jiahui, 18 Liao, Jiali, 18 Lin, Jingyang, 1A, 1D Lin, Jin-Yang, 12

Lin, Jin-Yang, 12 Littlejohns, C., 0D Liu, Dajian, 0B Liu, Hai, 07 Liu, Lin, 0O Liu, Lu, 0A Liu, Wei, 0T Liu, Zhishuang, 0E Lu, Hengchang, 0Y Lu, Qijing, 1E Lu, Zhengzhong, 18 Ma, Lin, 18 Ma, Qingyan, 0E Mailis, Sakellaris, 0U

Malyshev, Anatoly I., 0X Mashanovich, G., 0D Mastronardi, L., 0D Matsuo, S., 09 Meng, Xiang-Ping, 16 Mikerin, Sergey L., 0X Milosevic, Milan M., 0U Muskens, Otto L., 0U Ng, Alan Man Ching, 1A, 1D Okotrub, Konstantin A., 0X Pan, Xiangping, 0M

Peng, Jiahui, 1A, 1D Pogoretskiy, Vadim, 08 Qi, Haiyan, 13 Qing, Yeming, 0T Qu, Hongwei, 0E Reed, Graham T., 0U Ren, Yongze, 0T

Peacock, Anna C., 0U

Runge, Antoine F. J., 0U Rutirawut, T., 0D Saito, Shinichi, 0U

Sametov, Alexander R., 0X

Scarpa, Marina, 11

Shi, Fan, 15

Shi, Keji, 1A, 1D

Shi, Lili, 1A

Shi, Yafang, 0O

Song, Qi, 07

Su, Caiyun, 0M

Sun, Mingfei, 0E

Sun, Wenci, 17

Sun, Yanling, 18

Takeda, K., 09

Tang, Min, 0Z

Tang, Yunxiang, 1D

Thomson, David J., 0U

Tsuchizawa, T., 09

van der Tol, Jos J. G. M., 08

van Engelen, Jorn P., 08

Wada, K., OF

Wang, Fangfang, OP

Wang, Fangzhen, 0W

Wang, Han-Cong, 12

Wang, Hong, 17

Wang, Longlong, 00

Wang, Shipeng, OB

Wang, Tingyun, 0M

Wang, Xiao-Yi, 07

Wang, Xin, 0H

Wang, Yi-fei, 15, 16 Wang, Yongjin, 0H

Wang, Yufei, 0E

Wang, Zhijie, 0E

Wang, Zhi-ping, 15, 16

Wang, Zihao, 18

Wen, Jianxiang, 0M

Weng, Hai-Zhong, 0Z

Wu, Fan, 0H

Wu, Shangliang, 11, 1J

Wu, Xiaohang, 0T

Xiao, Jin-Long, 0Z

Xie, Shunsen, 1E

Xie, Weiqiang, 0T

Xie, Wen-Ming, 12

Xu, Zhizhan, OJ

Yako, M., OF

Yang, Li, 18

Yang, Yue-De, 0Z

Yao, Enxu, OT

Ye, Hong, 11, 1J

Ye, Yan, 11, 1J

Yu, Xingshi, 0U Yuan, Jialei, 0H

Yun, Feng, 17

Zhang, Juan, 0Y

Zhang, Minyan, 17

Zhang, Xizheng, OY

Zhao, Shuhui, 13

Zhao, Xiaohui, 0O

Zheng, Jiajia, 0M

Zheng, Qi-Qiang, 12

Zheng, Wanhua, 0E

Zhou, Wenguang, 00 Zhou, Zhiping, 0A Zhu, Baohua, OP

viii

Symposium Committees

General Chairs

Maryellen Giger, *President*, SPIE and The University of Chicago (United States)

Qihuang Gong, *President,* Chinese Optical Society and Peking University (China)

General Co-chairs

Arthur Chiou, National Yang-Ming University (Taiwan, China)
 Guangcan Guo, Past President, Chinese Optical Society and University of Science and Technology of China (China)
 Zejin Liu, Vice President, Chinese Optical Society and National University of Defense Technology (China)

Technical Program Chairs

Ruxin Li, Vice President, Chinese Optical Society 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 and PLA General Hospital (China)
 Huilin Jiang, Changchun University of Science and Technology

Huilin Jiang, Changchun University of Science and Technology (China)

Local Organizing Committee Chair

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

Local Organizing Committee Co-chairs

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

Guobin Fan, China Academy of Engineering Physics (China)

Local Organizing Committee

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

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

Wenjie Wang, Vice President, Chinese Optical Society and Sunny Group Company, Ltd. (China)

Qingming Luo, Huazhong University of Science and Technology (China)

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

Wei Zhao, Xi'an Institute of Optics and Precision Mechanics (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, Zhejing 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, Academy of Optoelectronics, CAS (China)

Xiaoying Li, Tianjin University (China)

Yan Li, Deputy Secretary General, Chinese Optical Society 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)

Yihua Hu, College of Electronic Engineering, National Univ. of Defense Technology (China)

Secretaries-General

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

Executive Organizing Committee

David J. Bergman, Tel Aviv University (Israel)

Qionghai Dai, Tsinghua University (China)

Keisuke Goda, The University of Tokyo (Japan)

Qihuang Gong, Peking University (China)

Ying Gu, Chinese PLA General Hospital (China)

Guang-Can Guo, University of Science and Technology of China (China)

Byoung S. Ham, Gwangju Institute of Science and Technology (Korea, Republic of)

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

Werner H. Hofmann, Technische Universität Berlin (Germany)

Minghui Hong, National University of Singapore (Singapore)

Bahram Jalali, University of California, Los Angeles (United States)

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

Satoshi Kawata, Osaka University (Japan)

Tina E. Kidger, Kidger Optics Associates (United Kingdom)

Baojun Li, Jinan University (China)

Ming Li, Institute of Semiconductors (China)

Ruxin Li, Shanghai Institute of Optics and Fine Mechanics (China)

Xingde Li, Johns Hopkins University (United States)

Jian Liu, PolarOnyx, Inc. (United States)

Tiegen Liu, Tianjin University (China)

Yongfeng Lu, University of Nebraska-Lincoln (United States)

Qingming Luo, Huazhong University of Science and Technology (China)

Yuji Sano, ImPACT (Japan)

Yunlong Sheng, Université Laval (Canada)

Kebin Shi, Peking University (China)

Tsutomu Shimura, The University of Tokyo (Japan)

Upendra N. Singh, NASA Langley Research Center (United States)

Michael G. Somekh, The Hong Kong Polytechnic University (Hong Kong, China)

Yuguo Tang, Suzhou Institute of Biomedical Engineering and Technology (China)

Masahiko Tani, University of Fukui (Japan)

Kimio Tatsuno, Koga Research Institute, Ltd. (Japan)

Kevin K. Tsia, The University of Hong Kong (Hong Kong, China)

Kazumi Wada, Massachusetts Institute of Technology (United States)

Yongtian Wang, Beijing Institute of Technology (China)

Rongshi Xiao, Beijing University of Technology (China)

Hongxing Xu, Wuhan University (China)

Toru Yoshizawa, Tokyo University of Agriculture and Technology (Japan) and 3D Associates (Japan)

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

Chongxiu Yu, Beijing University of Posts and Telecommunications (China)

Xiao-Cong Yuan, Shenzhen University (China)

Xiaoyan Zeng, Huazhong University of Science and Technology (China)

Cunlin Zhang, Capital Normal University (China)

Song Zhang, Purdue University (United States)

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

Xinliang Zhang, Wuhan National Laboratory for Optoelectronics (China)

Xuping Zhang, Nanjing University (China)

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

Zhiping Zhou, Peking University (China)

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

Ning Hua Zhu, Institute of Semiconductors (China)

Conference Committee

Conference Chairs

Zhiping Zhou, Peking University (China) **Kazumi Wada**, Massachusetts Institute of Technology (United States)

Conference Program Committee

Eric Cassan, Centre de Nanosciences et de Nanotechnologies (France)

Tao Chu, Zhejiang University (China)

David S. Citrin, Georgia Institute of Technology (United States)

Hiroshi Fukuda, NTT Device Technology Laboratories (Japan)

Min Gu, RMIT University (Australia)

El-Hang Lee, INHA University (Korea, Republic of)

Ching-Fuh Lin, National Taiwan University (Taiwan, China)

Gong-Ru Lin, National Taiwan University (Taiwan, China)

Yan-Qing Lu, Nanjing University (China)

Jurgen Michel, Massachusetts Institute of Technology (United States)

Takahiro Nakamura, Photonics Electronics Technology Research Association (PETRA) (Japan)

Andrew W. Poon, Hong Kong University of Science and Technology (Hong Kong, China)

Haisheng Rong, Intel Corporation (United States)

Yikai Su, Shanghai Jiao Tong University (China)

Hon Ki Tsang, The Chinese University of Hong Kong

(Hong Kong, China)

Dan-Xia Xu, National Research Council Canada (Canada)

Koji Yamada, National Institute of Advanced Industrial Science and Technology (Japan)

Changhe Zhou, Jinan University (China)

Weidong Zhou, The University of Texas at Arlington (United States)

Session Chairs

Silicon Photonics I

Zhiping Zhou, Peking University (China)

2 Silicon Photonics II

Kotaro Takeda, NTT Device Technology Laboratories (Japan)

3 Silicon Photonics III

Yuqing Jiao, Technische Universiteit Eindhoven (Netherlands)

- 4 Integrated Optics **Daoxin Dai**, Zhejiang University (China)
- 5 Nonlinear Photonics and Quantum Optics **Juan Gonzalo Wangüemert-Pérez**, Universidad de Málaga (Spain)
- 6 Metamaterials
 - **Yongzhen Huang**, Beijing University of Posts and Telecommunications (China)
- Nanophotonics I
 Xiaowei Guo, University of Electronic Science and Technology of China (China)
- 8 Nanophotonics II **Xia Chen**, University of Southampton (United Kingdom)