

PROCEEDINGS OF SPIE

Plasmonics IV

Hongxing Xu
Satoshi Kawata
Min Qiu
Editors

22–23 October 2019
Hangzhou, 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) • 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) • Japan Optical Society (Japan) • Korea Optical Society (Korea, Republic of) • Australia Optical Society (Australia) • Singapore Optical Society (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 11194

Proceedings of SPIE 0277-786X, V. 11194

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

Plasmonics IV, edited by Hongxing Xu, Satoshi Kawata, Min Qiu, Proc. of SPIE Vol. 11194, 1119401
© 2019 SPIE · CCC code: 0277-786X/19/\$21 · doi: 10.1117/12.2563703

Proc. of SPIE Vol. 11194 1119401-1

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 *Plasmonics IV*, edited by Hongxing Xu, Satoshi Kawata, Min Qiu, Proceedings of SPIE Vol. 11194 (SPIE, Bellingham, WA, 2019) Seven-digit Article CID Number.

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

ISBN: 9781510631052
ISBN: 9781510631069 (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 © 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 \$21.00 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/19/\$21.00.

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**

SPIEDigitalLibrary.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 *Authors*
vii *Symposium Committees*
xi *Conference Committee*

PLASMONIC-ENHANCED SENSING AND LIGHT HARVESTING II

- 11194 05 **Metamaterial absorber-empowered light-harvesting devices** [11194-4]

HOT CARRIER DYNAMICS, PHOTOCATALYSIS, AND PHOTOTHERMAL EFFECTS IN PLASMONIC NANOSTRUCTURES I

- 11194 09 **Au nanoparticle controlled luminescence emission of single NaYF₄:Eu³⁺ particle (Invited Paper)** [11194-8]

HOT CARRIER DYNAMICS, PHOTOCATALYSIS, AND PHOTOTHERMAL EFFECTS IN PLASMONIC NANOSTRUCTURES II

- 11194 0A **Gap mode induced photocatalytic reactions of p-methyl thiophenol and relating molecules (Invited Paper)** [11194-9]

GRAPHENE, ACTIVE, AND MULTIDISCIPLINARY PLASMONICS II

- 11194 0H **Optical tuning of terahertz plasmonic resonances in graphene-based heterostructures (Invited Paper)** [11194-16]
11194 0J **Synthesis and luminescence properties of rare-earth doped NaLaF₄ nanoparticles** [11194-18]
11194 0K **Enhancement of up- and downconversion photoluminescence from Yb³⁺, Er³⁺ co-doped CaF₂ nanoparticles deposited on two-dimensional plasmonic arrays** [11194-19]

POSTER SESSION

- 11194 0L **Surface-enhanced Raman spectroscopy of organoluminophores adsorbed on quartz surfaces modified by hydrosols of silver and gold nanoparticles** [11194-20]

- 11194 OM **Near-field imaging and revealing dynamics of ultrafast surface plasmons using photoemission electron microscopy** [11194-21]
- 11194 OR **Dynamically tunable perfect absorbers based on periodic microstructures** [11194-26]
- 11194 OU **Design of metamaterials using neural networks** [11194-29]

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.

Akai, Keitaro, 0A
Akashi, Naoto, 0U
Ding, Lan, 0H
Fu, Zhengkun, 09, 0J
Futamata, Masayuki, 0A
Gao, Yuan, 0K
Govorov, Alexander O., 05
Guo, Taiyang, 0H
Ji, Boyu, 0M
Jin, Nana, 09
Kajikawa, Kotaro, 0U
Kalinnikov, Dmitry S., 0L
Li, Jinping, 0J
Lin, Jingquan, 0M
Liu, Jian, 0H
Ma, Bowen, 0J
Matveeva, Karina I., 0L
Murai, Shunsuke, 0K
Qin, Yulu, 0M
Samusev, Iliia G., 0L
Song, Xiaowei, 0M
Tabei, Kanae, 0A
Tamura, Sayaka, 0K
Tanaka, Katsuhisa, 0K
Toma, Mana, 0U
Tomita, Koji, 0K
Wang, Zhiming, 05
Xu, Yang, 0M
Yu, Peng, 05
Zhang, Chengyun, 09, 0J
Zhang, Zhenglong, 09, 0J
Zheng, Gaige, 0R
Zheng, Hairong, 09, 0J
Zhou, Peng, 0R
Zhou, Senlu, 0H
Zou, Xiujuan, 0R
Zyubin, Andrey Y., 0L

Symposium Committees

General Chairs

Jim M. Oschmann, *President*, SPIE and Ball Aerospace (United States)
Qihuang Gong, *President*, Chinese Optical Society and Peking University (China)

General Co-chairs

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 (China)
Wenqing Liu, *Vice President*, Chinese Optical Society, and Anhui Institute of Optics and Fine Mechanics (China)
Guobin Fan, China Academy of Engineering Physics (China)
Suotang Jia, *Vice President*, Chinese Optical Society, and Shanxi University (China)
Xiaomin Ren, *Vice President*, Chinese Optical Society, and Beijing University of Posts and Telecommunications (China)

Secretaries-General

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

Yan Li, *Deputy Secretary General*, Chinese Optical Society, and
Peking University (China)
Daoxin Dai, Zhejiang University (China)

Local Organizing Committee Chair

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

Local Organizing Committee Co-chairs

Jianrong Qiu, Zhejiang University (China)
Daoxin Dai, Zhejiang University (China)

Local Secretaries

Wei Xiong, Chinese Optical Society (China)
Qing Yang, Zhejiang University (China)

Local Organizing Committee

Qing Yang, Zhejiang University (China)
Lan Wu, Zhejiang University (China)
Yaocheng Shi, Zhejiang University (China)
Dong Liu, Zhejiang University (China)
Yungui Ma, Zhejiang University (China)
Ke Si, Zhejiang University (China)
Yang Yang, Zhejiang University (China)
Xinyong Dong, China Jiliang University (China)
Le Wang, China Jiliang University (China)
Fei Tong, Chinese Optical Society (China)

Technical Organizing Committee

Mohammad Hossein Asghari, Loyola Marymount University
(United States) and Tachyonics Inc. (United States)
Pablo Benítez, Universidad Politécnica de Madrid (Spain)
Liangcai Cao, Tsinghua University (China)
P. Scott Carney, University of Rochester (United States)
Benyong Chen, Zhejiang University of Science and Technology
(China)
Hongqiang Chen, GE Global Research (United States)
Daoxin Dai, Zhejiang University (China)
Qionghai Dai, Tsinghua University (China)
Qihuang Gong, Peking University (China)
Ying Gu, Chinese PLA General Hospital (China)

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

Byoung Seung 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)

Zuyuan He, Shanghai Jiao Tong University (China)

Werner H. Hofmann, Technische Universität Berlin (Germany)

Minghui Hong, National University of Singapore (Singapore)

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

Satoshi Kawata, Osaka University (Japan)

Baojun Li, Jinan University (China)

Ming Li, Institute of Semiconductors, CAS (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)

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

Osamu Matoba, Kobe University (Japan)

Min Qiu, Westlake University (China)

Yuji Sano, ImPACT (Japan)

Yunlong Sheng, Université Laval (Canada)

Kebin Shi, Peking University (China)

Tsutomu Shimura, The University of Tokyo (Japan)

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

Michael G. Somekh, Shenzhen University (China)

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

Masahiko Tani, University of Fukui (Japan)

Limin Tong, Zhejiang University (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)

Jianhua Yao, Zhejiang University of Technology (China)

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

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

Xiao-Cong Yuan, Shenzhen University (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)

Zhenrong Zheng, Zhejiang 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, CAS (China)

Conference Committee

Symposium Chairs

Jacobus M. Oschmann, Ball Aerospace (United States)
Qihuang Gong, Peking University (China)

Conference Chairs

Hongxing Xu, Wuhan University (China)
Satoshi Kawata, Osaka University (Japan)
Min Qiu, Westlake University (China)

Conference Program Committee

David J. Bergman, Tel Aviv University (Israel)
Che Ting Chan, Hong Kong University of Science and Technology
(Hong Kong, China)
Hongsheng Chen, Zhejiang University (China)
Zheyu Fang, Peking University (China) and Rice University
(United States)
Francisco Javier García de Abajo, ICFO - Institut de Ciències
Fotòniques (Spain)
Min Gu, RMIT University (Australia)
Xin Guo, Zhejiang University (China)
Minghui Hong, National University of Singapore (Singapore)
Zhi-Yuan Li, Institute of Physics (China)
Ai Qun Liu, Nanyang Technological University (Singapore)
Peter Nordlander, Rice University (United States)
Ruwen Peng, Nanjing University (China)
Atsushi Taguchi, Hokkaido University (Japan)
Din Ping Tsai, Research Center for Applied Sciences - Academia
Sinica (Taiwan, China)
Jianfang Wang, The Chinese University of Hong Kong
(Hong Kong, China)
Hong Wei, Institute of Physics (China)
Jianbin Xu, The Chinese University of Hong Kong (Hong Kong, China)
Lei Zhou, Fudan University (China)
Shining Zhu, Nanjing University (China)
Xing Zhu, Peking University (China)

Session Chairs

- 1 Plasmonic-Enhanced Sensing and Light Harvesting I
Hongxing Xu, Wuhan University (China)

- 2 Plasmonic-Enhanced Sensing and Light Harvesting II
Satoshi Kawata, Osaka University (Japan)
- 3 Hot Carrier Dynamics, Photocatalysis, and Photothermal Effects in Plasmonic Nanostructures I
Qiang Li, Zhejiang University (China)
- 4 Hot Carrier Dynamics, Photocatalysis, and Photothermal Effects in Plasmonic Nanostructures II
Qiang Li, Zhejiang University (China)
- 5 Graphene, Active, and Multidisciplinary Plasmonics I
Satoshi Kawata, Osaka University (Japan)
- 6 Graphene, Active, and Multidisciplinary Plasmonics II
Hongxing Xu, Wuhan University (China)