PROCEEDINGS OF SPIE

AOPC 2019: Optical Spectroscopy and Imaging

Jin Yu
Zhe Wang
Vincenzo Palleschi
Mengxia Xie
Yuegang Fu
Editors

7–9 July 2019
Beijing, China

Sponsored by
Chinese Society for Optical Engineering (China)

Cosponsored by
SPIE

Organized by
Chinese Society for Optical Engineering (China)
Photoelectronic Technology Committee, Chinese Society of Astronautics (China)
Science and Technology on Low-light-level Night Vision Laboratory (China)
Science and Technology on Electro-Optical Information Security Control Laboratory (China)
Academy of Opto-Electronics of Electronics Technology of China (China)
Infrared and Laser Engineering (China)

Published by
SPIE

Volume 11337

Proceedings of SPIE 0277-786X, V. 11337

AOPC 2019: Optical Spectroscopy and Imaging, edited by Jin Yu, Zhe Wang, Vincenzo Palleschi, Mengxia Xie, Yuegang Fu, Proc. of SPIE Vol. 11337, 1133701 · © 2019 SPIE
CCC code: 0277-786X/19/$21 · doi: 10.1117/12.2564824

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 *AOPC 2019: Optical Spectroscopy and Imaging*, edited by Jin Yu, Zhe Wang, Vincenzo Palleschi, Mengxia Xie, Yuegang Fu, Proceedings of SPIE Vol. 11337 (SPIE, Bellingham, WA, 2019) Seven-digit Article CID Number.

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

ISBN: 9781510634466
ISBN: 9781510634473 (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

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

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.

Conference Committees

Conference Chairs

Guangjun Zhang, Southeast University (China)
Byoungho Lee, Seoul National University (Korea, Republic of)
John Greivenkamp, The University of Arizona (United States)

Conference Review Committee

Desheng Jiang, Wuhan University of Technology (China)
Dianyuan Fan, Shenzhen University (China)
Huilin Jiang, Changchun University of Science and Technology (China)
Junhao Chu, Shanghai Institute of Technical Physics, Chinese Academy of Sciences (China)
Jianyu Wang, Chinese Academy of Sciences, Shanghai Branch (China)
Jianquan Yao, Tianjin University (China)
Jiancheng Fang, Beihang University (China)
Jiubin Tan, Harbin Institute of Technology (China)
Lin Li, University of Manchester (United Kingdom)
Lijun Wang, Changchun Institute of Optics, Fine Mechanics and Physics, Chinese Academy of Sciences (China)
Min Gu, University of Shanghai for Science and Technology (China)
Qionghai Dai, Tsinghua University (China)
Shibin Jiang, AdValue Photonics, Inc. (United States)
Shenggang Liu, University of Electronic Science and Technology of China (China)
Shouhuan Zhou, North China Research Institute of Electro-Optics (China)
Toyohiko Yatagai, Utsunomiya University (Japan)
Wenqing Liu, Anhui Institute of Optics and Fine Mechanics, Chinese Academy of Sciences (China)
Wei Wang, Beijing Institute of Aerospace Control Device of CASC (China)
Yueguang Lv, Chinese Academy of Engineering (China)
Zuyan Xu, The Technical Institute of Physics and Chemistry of the Chinese Academy of Sciences (China)

Conference Program Committee

Chaoyang Lu, University of Science and Technology of China (China)
Daoxin Dai, Zhejiang University (China)
Dong Liu, Zhejiang University (China)
Haimei Gong, Shanghai Institute of Technical Physics, Chinese Academy of Sciences (China)
Hongbo Sun, Tsinghua University (China)
Jin Lu, Tianjin Jinhang Institute of Technical Physics (China)
Jinxue Wang, SPIE

Jin Yu, Shanghai Jiao Tong University (China)
Jian Zhang, Shanghai Institute of Ceramics, Chinese Academy of Sciences (China)
Min Gu, University of Shanghai for Science and Technology (China)
Min Qiu, Westlake University (China)
Michelle Sander, Boston University (United States)
Mengxia Xie, Beijing Normal University (China)
Pu Zhou, National University of Defense Technology (China)
Sven Hofling, Universität Wurzburg (Germany)
Shibin Jiang, AdValue Photonics, Inc. (United States)
Suijian Xue, National Astronomical Observatories, Chinese Academy of Sciences (China)
Takunori Taira, RIKEN SPring-8 Center (Japan)
Vincenzo Palleschi, Institute of Chemistry of Organic Metallic Compounds (Italy)
Wenxue Li, East China Normal University (China)
Xiaocong Yuan, Shenzhen University (China)
Xuejun Zhang, Changchun Institute of Optics, Fine Mechanics and Physics, Chinese Academy of Sciences (China)
Yadong Jiang, University of Electronic Science and Technology of China (China)
Yongtian Wang, Beijing Institute of Technology (China)
Yuegang Fu, Changchun University of Science and Technology (China)
Zhiping Zhou, Peking University (China)
Zhe Wang, Tsinghua University (China)
Ziyang Zhang, Westlake University (China)

Session Chairs

1 New Frontiers in Laser-Induced Breakdown Spectroscopy
Vincenzo Palleschi, Applied and Laser Spectroscopy Laboratory, Institute of Chemistry of Organometallic Compounds (Italy)

2 Applications of Optical Spectroscopy and Imaging
Zhe Wang, Tsinghua University (China)

3 Ultrafast Spectroscopy and Molecular Dynamics
Yi Lv, Sichuan University (China)

4 Advanced Spectroscopic Techniques, Nanoparticles and Surface Enhancement
Mengxia Xie, Beijing Normal University (China)

5 Raman Spectroscopy and Biomedical Applications
Mohamad Sabsabi, National Research Council Canada (Canada)

6 Elemental Analysis and Spectroscopic Data Processing
Jin Yu, Shanghai Jiao Tong University (China)

Introduction

AOPC 2019, the Annual Conference of Chinese Society of Optical Engineering (CSOE), was one of the largest academic and industrialization activities in the field of optical and optoelectronic technology in China. The Organizing Committee intended to build a potential platform together with academic exchanges, industry exhibitions, and cooperation negotiations in one. There were 11 technical conferences and 38 conference sessions, and we sincerely hope that the research and development of optoelectronic technology were promoted, and that international cooperation in industry and in the optical and optoelectronic fields were enhanced.

AOPC 2019 was sponsored by SPIE and the Chinese Society for Optical Engineering; the Optical Society of Korea (OSK), Optics and Photonics Society of Singapore (OPSS), European Optical Society (EOS), Optical Society of Japan (OSJ) were the technical co-sponsors. There were also 48 Cooperative Organizations that supported the conference.

We received over 930 total contributions from more than 15 countries, including United States, United Kingdom, Germany, France, Spain, Australia, Canada, Mexico, Brazil, Japan, the Republic of Korea, Thailand, Singapore, the Russian Federation, China, and so on. There were 554 contributions published in SPIE Proceedings.

After careful discussion, we suggested four keynote speeches which were presented by famous scientists from Germany, Australia, Japan, and China. There were 110 excellent invited talks, 45 of them are from overseas, their inclusion represented a first-class level in the field of optics and photonics technology. On behalf of the Organizing Committee of AOPC, I express the thanks to all the invited speakers and authors for their contributions and supports to the conference.

Finally, on behalf of the Chairmen and the Organizing Committee of AOPC, I would like to heartily thank for our sponsors and Cooperating Organizations for all they have done for the conference, to all of the participants and friends for their interests and efforts in helping us to make the conference success. Also, thanks to the Program Committee for their effective work and valuable advice; especially the AOPC 2019 Secretariat and SPIE for their tireless effort and outstanding services in preparing the conference and publishing the Proceedings.

We are glad that AOPC 2019 had great success! Hope to see you next year!

Guofan Jin