PROCEEDINGS OF SPIE

SPIDigitalLibrary.org/conference-proceedings-of-spie

Front Matter: Volume 11333

, "Front Matter: Volume 11333," Proc. SPIE 11333, AOPC 2019: Advanced Laser Materials and Laser Technology, 1133301 (18 December 2019); doi: 10.1117/12.2563994

Event: Applied Optics and Photonics China (AOPC2019), 2019, Beijing, China

PROCEEDINGS OF SPIE

AOPC 2019: Advanced Laser Materials and Laser Technology

**Pu Zhou
Jian Zhang
Wenxue Li
Shibin Jiang
Takunori Taira**
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)
National University of Defense Technology (China)
East China Normal University (China)
Jiangsu Normal University (China)
Infrared and Laser Engineering (China)

Published by
SPIE

Volume 11333

Proceedings of SPIE 0277-786X, V. 11333

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

AOPC 2019: Advanced Laser Materials and Laser Technology, edited by Pu Zhou, Jian Zhang,
Wenxue Li, Shibin Jiang, Takunori Taira, Proc. of SPIE Vol. 11333, 1133301 · © 2019 SPIE
CCC code: 0277-786X/19/\$21 · doi: 10.1117/12.2563994

Proc. of SPIE Vol. 11333 1133301-1

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 *AOPC 2019: Advanced Laser Materials and Laser Technology*, edited by Pu Zhou, Jian Zhang, Wenxue Li, Shibin Jiang, Takunori Taira, Proceedings of SPIE Vol. 11333 (SPIE, Bellingham, WA, 2019) Seven-digit Article CID Number.

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

ISBN: 9781510634381
ISBN: 9781510634398 (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

vii	<i>Authors</i>
ix	<i>Conference Committees</i>
xi	<i>Introduction</i>

ADVANCED LASER MATERIALS AND LASER TECHNOLOGY

11333 02	Experimental and theoretical research of quasi-three level Ho^{3+}-doped fluorotellurite photonic crystal fiber lasers [11333-2]
11333 06	6.2 kW spectral beam combination by means of edge filters [11333-6]
11333 07	A type of lidar sensor uses a 1645 nm laser using TiS_2 as a saturable absorber [11333-7]
11333 08	Direct AlGaAs LD pumped 2.1 μm Tm/Ho composite laser [11333-9]
11333 09	Few-layer NiPS_3 as a saturable absorber for pulse laser generation [11333-11]
11333 0A	Athermalisation design and analysis of the opto-mechanical structure based on laser radar launching system [11333-12]
11333 0B	The investigation of the ramping length of the stainless steel railway vehicle laser welding seam [11333-13]
11333 0C	Polarization properties of a stochastic electromagnetic ultrashort pulse laser beam in the atmospheric turbulence [11333-15]
11333 0D	High efficiency slab Tm:YAP laser dual-end-pumped by fiber coupled laser diodes [11333-16]
11333 0E	Surface modification and infrared-radar stealth performance of $\text{La}_{0.7}\text{Ba}_{0.3}\text{MnO}_3$ powder [11333-17]
11333 0F	L-band tunable and switchable multi-wavelength erbium-doped fiber laser [11333-18]
11333 0G	Discussion and implementation of LDPC and PPM joint coding in laser underwater data transmission [11333-21]
11333 0H	First principles study electronic and optical properties of LaBr_3 and $\text{LaBr}_3\text{:Ce}$ crystal [11333-22]
11333 0I	The characteristic of wedge waves propagating along wedge with periodic V-defects by laser ultrasound technique [11333-23]

- 11333 OJ **Realization of 7-channel beam coherent beam combination based on coherent fiber-optics-array collimator** [11333-24]
- 11333 OK **Intensity distribution of vortex beams from multilayered topological insulator slab** [11333-25]
- 11333 OL **Effect of spot size on laser damage single crystal silicon** [11333-27]
- 11333 OM **LD end-pumped 12J-10Hz Nd:YAG pulse laser** [11333-28]
- 11333 OO **Research on design of laser pyrotechnic system for high temperature-resistant transmission path** [11333-30]
- 11333 OP **Research on the application of laser pyrotechnic device to airborne escape system** [11333-31]
- 11333 OQ **Evolution properties of array laser beams through an atmospheric turbulence and shock-wave layer** [11333-32]
- 11333 OR **A review of carbon-based microwave absorbing composites** [11333-33]
- 11333 OS **Summarize the damage caused by different types of laser beams** [11333-34]
- 11333 OT **An approach to effect-based laser weapon design** [11333-35]
- 11333 OU **Deep transfer learning for underwater vehicle wake recognition in infrared imagery** [11333-36]
- 11333 OV **Hybrid laser-arc welding process of full penetration T joint in high speed railway vehicle bogie** [11333-37]
- 11333 OW **Theoretical evaluation of V-pumped thin-disk DPALs** [11333-38]
- 11333 OX **Effect of lateral index step on the performance of high-power broad-area 970-nm diode lasers based a large-optical-cavity waveguide structure** [11333-39]
- 11333 OY **Control Airy-Talbot effect via initial launch angles in dynamic linear index potentials** [11333-40]
- 11333 IO **Finite element analysis of focus tunable micro-lens based on electric field modulated liquid crystal** [11333-42]
- 11333 II **Point-by-point fiber gratings inscription by using high repetition rate femtosecond laser** [11333-43]
- 11333 I2 **Numerical study on flow and heat transfer of a finned-tube heat exchanger with trapezoid vortex generators in CO₂ lasers** [11333-44]
- 11333 I4 **Vortex structures in the photoelectron momentum distributions of negative hydrogen ions induced by a short laser pulse** [11333-46]

- 11333 15 **Adaptive temporal shape control of fiber laser** [11333-47]
- 11333 16 **Dynamic error modeling and analysis based on angle intersection measurement system**
[11333-48]
- 11333 17 **Research on fiber transceiver collimator based on optical fiber bundles** [11333-49]
- 11333 18 **Optical fiber bundles converting pulsed lasers into continuous waves for improved
measurement linearity in spectrophotometry** [11333-50]
- 11333 19 **Coherent beam combination based on particle swarm optimization algorithm** [11333-51]
- 11333 1A **Magnetic-field-assisted femtosecond laser drilling of bone in ambient environment** [11333-52]
- 11333 1B **A novel denoising algorithm for photon-counting laser data based on LDBSCAN** [11333-53]
- 11333 1D **Research of heat dissipation structure with conical quartz tube for pump combiner** [11333-56]
- 11333 1E **Influence of thermal treatment on tensile strength of fiber splicing point** [11333-57]
- 11333 1F **Effect of scanning speed on microstructure and properties of 30Cr3Ni2 alloy steel prepared by
direct laser deposition** [11333-59]
- 11333 1G **Effect of laser scanning rate on microstructure and wear resistance of SLM high speed steel
layer** [11333-60]
- 11333 1H **High temperature oxidation behavior of pre-laid laser melting 45CrNiMoY alloy steel reinforced
by TA15 powder** [11333-61]
- 11333 1I **Research for surface characteristics of aluminum mirrors made by laser additive manufacturing**
[11333-62]
- 11333 1J **Tunable and switchable multi-wavelength ytterbium-doped fiber laser based on nonlinear
polarization rotation effect** [11333-65]
- 11333 1K **Contrasted behavior of ripple morphology evolution on metals irradiated with temporally
shaped femtosecond laser pulse** [11333-67]
- 11333 1M **Electro-optically gated in-line saturable absorbers for fibre lasers** [11333-69]

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.

An, Guofei, 0W	Jiang, Zongfu, 09
Bian, Jintian, 0S	Jiao, Jiancao, 1I
Cao, Chunqiang, 0O, 0P	Jiao, Li, 1K
Cen, Jing, 17	Jiao, Ruiyun, 0Y
Chang, Hongxiang, 15, 17	Jin, Guangyong, 0D
Chang, Qi, 15, 19	Jing, Bo, 0O, 0P
Chen, Fan, 06	Jing, Wei, 0R
Chen, Guoliang, 0F	Jing, Xufeng, 18
Chen, Jianhong, 14	Kang, Nan, 1I
Chen, Jianhua, 0O, 0P	Kobtsev, Sergey, 1M
Chen, Jianzhong, 1I	Kokhanovskiy, Alexey, 1M
Chen, Jun-nan, 16	Kovacevic, Radovan, 0B
Chen, Suiyuan, 1F, 1G, 1H	Li, Bin, 0C
Chen, Tao, 02	Li, Guoqiang, 07
Chen, Tao, 16	Li, Guoyuan, 1B
Chen, Wuchao, 0R	Li, Hong, 0L
Chen, Xueting, 1F	Li, J. H., 08
Cui, Tong, 1F	Li, Kai, 0B, 0V
Dai, Wanjun, 0M	Li, Min, 0H
Deng, J., 08	Li, Xiaolong, 10
Deng, Junjie, 0R	Li, Xiumei, 0G
Du, Weichuan, 0X	Li, Yan, 0C
Du, Yongcheng, 0U	Li, Yang, 0U
Gan, Haiyong, 18	Li, Yi, 0X
Gao, Songxin, 0X	Liang, Jing, 1F, 1G, 1H
Gao, Ze, 1K	Liao, Dongjun, 0Q
Ge, Y., 08	Lin, Niuniu, 0K
Gladush, Yury, 1M	Lin, W. X., 08
Guan, Yingchun, 1A	Lin, Yandong, 18
Guo, Ming, 0L	Liu, Bing, 0Y
Han, Juhong, 0W	Liu, Changsheng, 1F, 1G, 1H
Han, Qingbang, 0I	Liu, Fang, 0H
Han, Xiao, 1I	Liu, Hui, 12
Hao, Yue, 0E	Liu, Jiawei, 0E
He, Aifeng, 0O, 0P	Liu, Sen, 0Q
He, Binggao, 0A	Liu, Xiangliang, 18
He, Guangzhong, 0B, 0V	Liu, Xiaoxu, 0W
He, Ning, 0G	Liu, Yanxiang, 0K
He, Yingwei, 18	Liu, Yuan, 0R
Hou, Tianyue, 15, 19	Liu, Zhongbo, 1I
Hu, Huayu, 0Q	Long, Jinhui, 0J
Huang, H. Z., 08	Lv, Min, 0F, 1J
Huang, J. H., 08	Ma, Jun, 06
Ivanenko, Aleksey, 1M	Ma, Pengfei, 0J, 15, 17, 19
Jia, Jing, 0I	Ma, Yanxing, 0J, 15, 17, 19
Jia, Wuming, 1G	Ma, Yue, 0O, 0P
Jiang, Hongyan, 0G	Ma, Yun-liang, 1D, 1E
Jiang, Xinying, 0M	Ming, Gao, 0C
Jiang, Xueping, 0I	Mkrtychyan, Aram, 1M

Nasibulin, Albert G., 1M	Xue, Qiao, 0M
Nei, Lei, 16	Yan, Xiang, 12
Nyushkov, Boris, 1M	Yan, Xiongwei, 0M
Ouyang, Xiaoping, 0H	Yang, Jiao, 0W
Ren, Shenhe, 0C, 0K	Yang, Xin, 0X
Rui, Zhong, 0U	Yang, Xiongdan, 1B
Shan, Minglei, 0I	Yang, Yan, 0F, 1J
Shang, Fanmin, 1G	Yang, Zhendong, 0Y
Shen, Changyu, 18	Yao, Ke, 0M
Shi, Lijuan, 0A	Yao, Xianghong, 0E
Shi, Xinyao, 09	Ye, Fanghong, 1B
Si, Lei, 0J	Yuan, Qiang, 0E
Si, Xu, 1D, 1E	Yuan, Shengfu, 17
Song, Keyu, 0F, 1J	Yue, Jianbao, 12
Song, Peng, 02	Zhan, Kaiyun, 0Y
Song, Yang, 1A	Zhang, Fan, 0M
Su, Jingqin, 0M	Zhang, Hai-kun, 02
Su, Juan, 07	Zhang, Jiabo, 1K
Su, Rongtao, 0J, 15, 17, 19	Zhang, Kai, 09
Sun, Miao, 1H	Zhang, Kaihu, 1K
Sun, Xiangyang, 0A	Zhang, Kouli, 0Q
Sun, Xiaoquan, 0S	Zhang, Liu-gang, 16
Tang, Chun, 0X	Zhang, Mingji, 10
Wan, Jun, 0T	Zhang, Mingqian, 0J
Wang, Chao, 1I	Zhang, Tianyun, 14
Wang, Chunsheng, 0B, 0V	Zhang, Wenying, 0L
Wang, Haoyu, 0O, 0P	Zhang, Ya-ping, 02
Wang, Hongxiao, 0B, 0V	Zhang, Yongxiang, 0L
Wang, Jianjiang, 0E	Zhang, Yuxuan, 0F, 1J
Wang, Jianmin, 1B	Zhao, Da-xing, 16
Wang, Jin, 09	Zhao, Heng, 12
Wang, Jing, 0Y	Zhao, Shubin, 0T
Wang, Lei, 0W	Zheng, Jiangang, 0M
Wang, Lei, 1K	Zheng, Kuixing, 0M
Wang, Mei, 1F, 1G, 1H	Zheng, Liyan, 1K
Wang, Mingjun, 0K	Zheng, Wanguo, 0M
Wang, Tao, 09	Zheng, Xiaoping, 14
Wang, Tianyu, 0S	Zhi, Dong, 0Q
Wang, Wei, 1I	Zhou, Cheng, 02
Wang, Weimin, 18	Zhou, Kun, 0X
Wang, Xibin, 1K	Zhou, Pu, 09, 0J, 15, 19
Wang, You, 0W	Zhu, Qihua, 0M
Wang, Zhenguo, 0M	Zhu, Rihong, 06
Wang, Zhenming, 1B	Zhu, Yining, 1F
Wei, Cong, 06	
Wei, Mingwei, 1H	
Wen, Ya, 0D	
Wu, Chi, 07	
Wu, Chunting, 0D	
Wu, Jian, 09, 0J, 17	
Wu, L. X., 08	
Wu, Wenlong, 0M	
Xia, Zhi-peng, 16	
Xiao, Yike, 18	
Xie, Dongping, 1B	
Xie, Renwei, 0T	
Xiong, Zhi, 16	
Xu, Cheng-lin, 1D, 1E	
Xu, Gan, 18	
Xu, YINUO, 18	

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)
Daixin 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 Würzburg (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 Pallechi, 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 Solid State Laser Technology and Applications
Takunori Taira, Institute for Molecular Science (Japan)
- 2 Advance Laser Technology
Minglie Hu, Tianjin University (China)
- 3 Ultrafast Laser
Dingyuan Tang, Jiangsu Normal University (China)
- 4 Mid-Infrared Laser
Jian Zhang, Shanghai Institute of Ceramics, Chinese Academy of Sciences (China)
- 5 Fiber Lasers
Pu Zhou, National University of Defense Technology (China)
- 6 Laser Materials
Deyuan Shen, Jiangsu Normal 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