

# PROCEEDINGS OF SPIE

## ***13th International Photonics and OptoElectronics Meetings (POEM 2021)***

**Xinliang Zhang  
Perry Shum  
Jianji Dong**  
*Editors*

**6–8 November 2021  
Wuhan, China**

*Organized by*  
Huazhong University of Science and Technology (China)  
Wuhan National Laboratory for Optoelectronics (China)  
Optics Valley Laboratory (China)

*Published by*  
SPIE

**Volume 12154**

Proceedings of SPIE 0277-786X, V. 12154

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

13th International Photonics and OptoElectronics Meetings (POEM 2021), edited by Xinliang Zhang, Perry Shum, Jianji Dong, Proc. of SPIE Vol. 12154, 1215401 · © 2022 SPIE · 0277-786X · doi: 10.1117/12.2631534

Proc. of SPIE Vol. 12154 1215401-1

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 [SPIDigitalLibrary.org](http://SPIDigitalLibrary.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 *13th International Photonics and OptoElectronics Meetings (POEM 2021)*, edited by Xinliang Zhang, Perry Shum, Jianji Dong, Proc. of SPIE 12154, Seven-digit Article CID Number (DD/MM/YYYY); (DOI URL).

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

ISBN: 9781510651845  
ISBN: 9781510651852 (electronic)

Published by  
**SPIE**  
P.O. Box 10, Bellingham, Washington 98227-0010 USA  
Telephone +1 360 676 3290 (Pacific Time)  
[SPIE.org](http://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](http://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.

**SPIE. DIGITAL LIBRARY**  
[SPIDigitalLibrary.org](http://SPIDigitalLibrary.org)

---

**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

---

## OPTICAL FIBERS, FIBER-BASED DEVICES AND APPLICATIONS (OFDA)

---

- 12154 02 **Fabry-Perot cavity filled with PDMS for high sensitivity gas pressure sensor** [12154-6]
- 12154 03 **Nonlinear trellis-coded precoding for MISO visible light communication system** [12154-45]
- 12154 04 **Fabrication and characterization of liquid-core hydrogel optical fiber** [12154-39]
- 12154 05 **Security-enhanced chaotic communication system based on nonlinear double-phase-perturbation encryption** [12154-44]
- 12154 06 **High-speed secure key distribution based on chaos synchronization and optical frequency comb technology** [12154-40]
- 12154 07 **160Gbit/s Apol-FSK modulation format for 5G backhaul network** [12154-50]
- 12154 08 **Optical fiber fluorescent temperature sensor based on capillary glass tube encapsulation** [12154-37]
- 12154 09 **High precision distributed optical fiber temperature sensing system based on intensity compensation** [12154-18]
- 12154 0A **Highly sensitive magnetic field measurement based on etched fiber Bragg grating and optoelectronic oscillator** [12154-61]
- 12154 0B **Linewidth-tolerant carrier phase recovery in probabilistically shaped M-QAM systems with generalized circular harmonic expansion** [12154-31]
- 12154 0C **Frequency stabilized ultra-low-noise DFB fiber laser based on intracavity dual mode frequency self-reference mechanism** [12154-2]
- 12154 0D **L-band extended Er-doped sodium silicate glass based on Pharaoh's snake technology** [12154-46]

---

## OPTOELECTRONIC DEVICES AND INTEGRATION (OEDI)

---

- 12154 0E **Effect of perovskite light-emitting diodes by heating at proper temperature** [12154-57]
- 12154 0F **Performance improvement of InGaAs/InP SAGCM avalanche photodiode by optimizing the multiplication layer** [12154-47]
- 12154 0G **Optical true time delay based on multimode waveguide gratings** [12154-28]

- 12154 OH **Aluminum scandium nitride waveguide in the near-infrared** [12154-64]
- 12154 OI **Direct modulation bandwidth enhancement of DFB laser with groove-in-trench waveguide structure** [12154-13]
- 12154 OK **Design of double-layer silicon nitride-based optical phased array** [12154-1]
- 12154 OL **Fabrication of high Q microtoroid cavity on a silicon wafer by wet etching** [12154-27]
- 12154 OM **Vanadium dioxide metasurfaces structures with infrared radiation protection properties** [12154-9]
- 12154 ON **Design and characterization of long path absorption cell and digital lock-in amplifier for multi-channel infrared gas sensor** [12154-56]
- 12154 OO **Theoretical analysis of polymer optical waveguide with Gaussian-shaped core** [12154-66]
- 12154 OP **Viscosity-driven flexible 2D Ag nanowire/PVA film, converted from 3D hybrid hydrogel** [12154-55]
- 12154 OQ **Integrated optical phased array at 2 $\mu$ m wavelength band on silicon** [12154-14]
- 12154 OR **Design of portable bacterial vaginosis detection system** [12154-51]
- 12154 OS **Programmable switching of soliton microcomb states in a Si<sub>3</sub>N<sub>4</sub> micro-resonator** [12154-54]
- 12154 OT **The excess noise characteristics of InGaAs/InP APD in consideration of nonlinearity effect** [12154-42]

---

#### PHOTONICS FOR ENERGY (PE)

---

- 12154 OU **Synthesis and characterization of porous anodic aluminum oxide with precise controllable pore diameter** [12154-48]
- 12154 OV **Dye adsorption of single crystalline macro-microporous MOF** [12154-53]

---

#### LASER SCIENCE AND TECHNOLOGY (LST)

---

- 12154 OW **Improving the detection sensitivity of  $\mu$ LIBS with second excitation by orthogonal target-plasma** [12154-4]
- 12154 OX **Single-frame measurement of the complete spatiotemporal field of ultrashort laser pulses using carrier frequency distinguished spectral interferometry** [12154-24]
- 12154 OY **Influence of diffraction by a circular aperture on the femtosecond laser direct-written waveguides** [12154-35]

12154 0Z **The characteristics of BGSM beam in atmosphere and its application in free-space optical communication** [12154-36]

12154 10 **Surface modification of single-crystal silicon by hybrid laser treatment** [12154-68]

---

#### THZ AND MICROWAVE PHOTONICS (TMWP)

---

12154 11 **System construction and imaging experiment of a focused 300G terahertz FMCW systems** [12154-5]

12154 12 **OPLL-based reconfigurable broadband LFM waveform generation via heterodyne-beating** [12154-7]

12154 13 **Human identification by mean of optoelectronic reservoir computing** [12154-19]

12154 14 **Linearization in the digital domain for photonic sampling analog-to-digital conversion** [12154-29]

12154 15 **Research of microwave photonic phased array radar based on optical beamforming network** [12154-58]

---

#### NANO-OPTICS AND META-DEVICES (NOMD)

---

12154 16 **Inverse design nanorod hyperbolic metamaterial by transformer** [12154-10]

12154 17 **Mg<sup>2+</sup> enhanced information point fluorescence contrast for aggregation-induced emission optical storage** [12154-20]

12154 18 **Design of tunable dual-gas sensor based on phase transition of VO<sub>2</sub> in metasurface** [12154-43]

12154 19 **Optical interconnection between multilayer chips based on evanescent coupling with taper structure** [12154-59]

