

PROCEEDINGS OF SPIE

**3rd International Conference  
on Laser, Optics, and  
Optoelectronic Technology  
(LOPET 2023)**

**Xiaotian Li**  
**Manuel Filipe Costa**  
*Editors*

**26–28 May 2023**  
**Kunming, China**

*Organized by*  
Guangdong Engineering Laboratory of IoT IC and System Application Technologies (China)

*Sponsored by*  
AEIC–Academic Exchange Information Centre (China)

*Published by*  
SPIE

**Volume 12757**

Proceedings of SPIE 0277-786X, V. 12757

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

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 *3rd International Conference on Laser, Optics, and Optoelectronic Technology (LOPET 2023)*, edited by Xiaotian Li, Manuel Filipe Costa, Proc. of SPIE 12757, Seven-digit Article CID Number (DD/MM/YYYY); (DOI URL).

ISSN: 0277-786X

ISSN: 1996-756X (electronic)

ISBN: 9781510667624

ISBN: 9781510667631 (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 © 2023 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

xi *Conference Committee*

---

## INTEGRATED OPTICS APPLICATION AND TECHNOLOGY OPTIMIZATION

---

- 12757 02 **Ink layer thickness detection based on laser triangulation technology** [12757-8]
- 12757 03 **Qualitative and quantitative analysis of mixtures using terahertz spectroscopy combined with machine learning** [12757-53]
- 12757 04 **Wavefront phase reconstruction of plenoptic sensor based on centroid method** [12757-159]
- 12757 05 **Frequency-resolved optical mode decomposition of multimode quantum fields** [12757-161]
- 12757 06 **Study on optical properties and photocatalytic properties of layered MoO<sub>3</sub>** [12757-111]
- 12757 07 **Signal enhancement and mechanism analysis of pulse shaped femtosecond laser-induced breakdown spectroscopy of fused silica** [12757-13]
- 12757 08 **Effect of laser spot offsets on microstructures and mechanical properties of LZ91 and TC4 alloys laser welding joint** [12757-116]
- 12757 09 **Laser oscillation welding process control of LZ91 magnesium-lithium alloy/TC4 titanium alloys** [12757-77]
- 12757 0A **Efficient coupling interface for hybrid integration of DFB lasers on 3 $\mu$ m SOI waveguide platform** [12757-117]
- 12757 0B **Research on hyperspectral polarization detection for unexploded ordnance target identification** [12757-74]
- 12757 0C **Thick-mask optimization based on particle swarm optimization algorithm** [12757-25]
- 12757 0D **Elliptical polarization characterization of scattered light in dark field defect inspection technology** [12757-35]
- 12757 0E **Micro-angle attitude measurement technology and research progress based on quantum weak value measurement** [12757-145]
- 12757 0F **Planar crystal array spectrometer for simultaneous spectrum and integrated time spectrum measurement of pulse characteristic x-ray** [12757-91]
- 12757 0G **Applications of GaN HEMT: current state and future trends** [12757-120]

- 12757 OH **Research on precise proportioning method of matrine by applying spectral analysis technique** [12757-89]
- 12757 OI **Simulation research on adaptive nulling technology based on wavelength selective switching delay network** [12757-46]
- 12757 OJ **Research on the observation modes of high-precision automated ground-solar-sky radiometer** [12757-137]
- 12757 OK **Complex non-diffracting bessel-like beams shaping method based on separable radial and azimuthal dependence phase designing** [12757-43]
- 12757 OL **Free-space optical link for quantum key distribution using unmanned vehicle** [12757-39]
- 12757 OM **High-finesse optical enhancement cavity and its finesse measurement** [12757-54]
- 12757 ON **A data processing system for range optical measurement** [12757-62]
- 12757 OO **A thermo-optic switch based on RAMZI with graphene heater** [12757-108]
- 12757 OP **Research on the application of sagnac interference combined with multimode interference in vibration measurement** [12757-80]
- 12757 OQ **Research on temperature control technology for laser molding of thermoplastic composite materials** [12757-61]
- 12757 OR **Optical imaging method of space target based on compressive sensing** [12757-100]
- 12757 OS **Research on the effect of pulsed UV light on microbial photoreactivation** [12757-42]
- 12757 OT **Creating a spatial quasi-spherical focal spot and optical ring with controllable characteristics based on orthogonally superimposed dipoles antenna** [12757-28]
- 12757 OU **Ultra wideband flexible frequency conversion for integrated electronic systems** [12757-70]
- 12757 OV **The demonstration of integrated coupled DFB lasers to generate tunable microwave signal** [12757-69]

---

#### ELECTROMAGNETIC WAVE AND SUPERCONDUCTOR MATERIAL RESEARCH

- 12757 OW **Research on the current modulated short coherent light source based on semiconductor laser** [12757-131]
- 12757 OX **Numerical analysis of thermal lens effects in a nonplanar ring oscillator** [12757-115]
- 12757 OY **Study of the polarization conversion characteristics of surface liquid crystal vertical cavity surface emitting lasers** [12757-20]

- 12757 0Z **Preparation and properties study of double flame agent synergetic radiation yellow light illuminant** [12757-2]
- 12757 10 **Experimental study on the photocatalytic reduction of CO<sub>2</sub> by Bi<sub>2</sub>WO<sub>6</sub>/g-C<sub>3</sub>N<sub>4</sub> composite photocatalyst** [12757-84]
- 12757 11 **Coherent square pulse generation based on continuous wave phase modulation for SSMB** [12757-119]
- 12757 12 **Study on polarization characteristics of LC-VCSEL arrays by liquid crystal rotation angle** [12757-130]
- 12757 13 **Liquid zoom lens through remote control** [12757-15]
- 12757 14 **The hydrogen peroxide sensors based on localized surface plasmon resonance in Ag-PVA nanocomposite** [12757-55]
- 12757 15 **Optical chirality signal enhancement of spherical particles based on polarization vortex beams** [12757-52]
- 12757 16 **Electro-optical transient response study of pulsed VCSEL arrays** [12757-154]
- 12757 17 **Emergence of topological phases in the anisotropic electromagnetic media** [12757-71]
- 12757 18 **Slippery liquid infused surface with corrosion resistance fabricated through temporally shaped femtosecond laser processing** [12757-136]
- 12757 19 **Study on the influence of laser pulse width on nanosecond pulse laser cleaning of 2A12 aluminum alloy surface composite coating** [12757-143]
- 12757 1A **The influence of laser power on the effect of different paint layers on the surface of 2024 aluminum alloy with nanosecond pulse laser** [12757-141]
- 12757 1B **Femtosecond laser ablation evolution of ultrahard double-layer films** [12757-156]
- 12757 1C **Life prediction of lithium titanate batteries for high energy laser systems** [12757-19]
- 12757 1D **Femtosecond laser surface treatment of aerospace high modulus CFRP composites and its effect on surface wettability** [12757-118]
- 12757 1E **Ultrafast carrier dynamics in metallic Ti<sub>2</sub>CT<sub>x</sub> and semiconductor-like Nb<sub>4</sub>C<sub>3</sub>T<sub>x</sub> MXenes** [12757-134]
- 12757 1F **Theoretical analysis of rotational Doppler effect when vortex beam is misaligned with rotational axis** [12757-31]
- 12757 1G **Analysis of the effect of surface recombination on the results of microwave photoconductive decay method for measuring minority carrier lifetime of HgCdTe epilayers** [12757-124]

- 12757 1H **A frequency-hopping system based on optical frequency comb** [12757-60]
- 12757 1I **Research on calculation of heliostat spot center point based on openCV** [12757-73]
- 12757 1J **High sensitivity sensing by all-dielectric metasurface via dual bound states in the continuum** [12757-66]
- 12757 1K **Optical-carrier radio-frequency phase stabilization transfer based on phase lock loop** [12757-38]
- 12757 1L **Research on PV power fluctuation smoothing control strategy based on ESS** [12757-121]
- 12757 1M **Sum frequency generation of semiconductor laser based on V-shaped spectral beam combining** [12757-128]
- 12757 1N **Design of a power supply protection circuit with EMI suppression function** [12757-94]
- 12757 1O **Study of window functions for the Moiré fringe phase demodulation** [12757-135]
- 12757 1P **Improved center strip extraction algorithm based on Steger algorithm** [12757-10]

---

#### OPTOELECTRONIC DEVICE AND MACHINE VISION ANALYSIS

---

- 12757 1Q **High repetition rate passively Q-switched microchip laser at 1.5  $\mu\text{m}$**  [12757-30]
- 12757 1R **An improved iterative nearest point registration method for vehicle-mounted laser point cloud** [12757-110]
- 12757 1S **Large bandwidth and high efficiency silicon nitride grating coupler with bottom reflector** [12757-148]
- 12757 1T **A wavelength-multiplexed photonic tensor processor based on Mach-Zehnder modulator** [12757-160]
- 12757 1U **Flexible non-fullerene organic photodetectors enabled by a tin ions-chelated polymer cathode interfacial layer** [12757-152]
- 12757 1V **Design of 21 mega-pixel mobile phone lens** [12757-14]
- 12757 1W **Ultra-broadband and low loss silicon photonic power splitter with enhanced coupling of subwavelength waveguides** [12757-22]
- 12757 1X **Research on the quantitative analysis for detection sulfate using laser Raman spectroscopy** [12757-86]
- 12757 1Y **Effect of scanning strategy on the temperature field of selective laser melting of AISi10Mg** [12757-26]

- 12757 1Z **Preparation of Bi<sub>2</sub>S<sub>3</sub> nanorod and their photocatalytic activity** [12757-146]
- 12757 20 **Parameters affecting the plasma block acceleration driven by a linearly polarized laser pulse** [12757-56]
- 12757 21 **The change of reflectivity of CFRP femtosecond laser ablation based on pump-probe** [12757-76]
- 12757 22 **Ultra-broadband, compact, low-loss 3-dB power splitter using adiabatic subwavelength grating in silicon-on-insulator** [12757-51]
- 12757 23 **Research on the detection method of gold based on laser-induced breakdown spectroscopy** [12757-23]
- 12757 24 **Femtosecond laser rapidly targets gene transfection and regulates cell expression** [12757-44]
- 12757 25 **A single-pass two-stage Nd: YVO<sub>4</sub> picosecond laser system** [12757-9]
- 12757 26 **Multi-wavelength mode-locked erbium-doped fiber laser employing NPR and multi-mode fiber** [12757-3]
- 12757 27 **3.8 kW high brightness MOPA fiber laser** [12757-12]
- 12757 28 **Experimental study on spectral morphological changes of narrow pulse width picosecond lasers** [12757-5]
- 12757 29 **Repetitive frequency broad tunable high beam quality 1064 nm laser** [12757-7]
- 12757 2A **Antireflective micro hole array on ZnS surface by femtosecond laser** [12757-151]
- 12757 2B **Experimental and numerical study on molten pool dynamics and porosity formation mechanism of laser beam oscillation welding of titanium and aluminum** [12757-59]
- 12757 2C **Effects of laser parameters on microgrooves morphology of SiC/SiC composites fabricated by femtosecond laser** [12757-155]
- 12757 2D **Femtosecond laser controllable processing of micro/nano structures on zinc surfaces** [12757-34]
- 12757 2E **An improved active quenching equivalent circuit model for single-photon avalanche photodiodes with avalanche self-sustainability** [12757-85]
- 12757 2F **Detection of E. coli O157:H7 via GO-modified fiber optic SPR sensor with Au nanoparticle signal amplification** [12757-157]
- 12757 2G **Exploring the processing capability of femtosecond laser two-photon polymerization pathway** [12757-72]
- 12757 2H **Ultra-large FSR filter based on Bragg grating-subwavelength grating slot microring resonator** [12757-24]

- 12757 2I **Design and modal analysis of fs-laser turning module** [12757-79]
- 12757 2J **Ultrafast dynamics of femtosecond laser irradiation of silicon with different fluence** [12757-158]
- 12757 2K **Adjustable MMI for dynamic on-chip monitoring based on nano-opto-electro-mechanical interaction** [12757-111]
- 12757 2L **Geometric and electronic structure of low-index Cu<sub>2</sub>O surfaces based DFT** [12757-6]
- 12757 2M **Analysis of ground state and excited state of powder according to laser polarization response** [12757-63]
- 12757 2N **Correcting tristimulus colorimeters via spectrum-enhanced algorithm** [12757-139]

---

#### OPTICAL FIBER COMMUNICATION AND OPTOELECTRONIC INFORMATION PROCESSING

---

- 12757 2O **Multi-source target detection based on pixel-level fusion and decision-level fusion** [12757-129]
- 12757 2P **Doubling the temporal resolution of SOFI with two-color sequence coupling** [12757-57]
- 12757 2Q **Distributed optical fiber strain sensing under ultra-low temperature based on Rayleigh backscattering** [12757-75]
- 12757 2R **Study on model of laser interference on UAV detector** [12757-132]
- 12757 2S **Segmented mirror co-focus and co-phasing experiment based on pyramid wavefront sensor** [12757-149]
- 12757 2T **Self-focusing pin-like optical vortex beams resist atmospheric turbulence propagation for the space optical communication** [12757-123]
- 12757 2U **Optical image encryption scheme based on random phase mask and phase shift digital holography** [12757-41]
- 12757 2V **Influence of multiple-beam interference on diffractive waveguide imaging** [12757-125]
- 12757 2W **Visual modeling of eucalyptus forest using LiDAR data** [12757-106]
- 12757 2X **FMCW LiDAR based on integrated coherent receiver chip** [12757-126]
- 12757 2Y **A path planning method for large-aperture non-spherical surface detection profilometer** [12757-17]
- 12757 2Z **U-L-shaped silicon modulator for efficient and high-speed transmission** [12757-50]



- 12757 30 **Simulation of two PMTs layout differences for the imaging atmospheric Cherenkov Telescope** [12757-18]
- 12757 31 **Three-dimensional surface reconstruction based on known point cloud normal vector** [12757-47]
- 12757 32 **Study on nitrate detection method in water using UV full-spectrum combined with PCA-BPNN** [12757-99]
- 12757 33 **Fiber optical in-situ sensor for accurate monitoring the discharge quantity of lead-acid batteries** [12757-162]
- 12757 34 **Adaptive star extraction algorithm in high dynamic** [12757-147]
- 12757 35 **Fabrication of a Fabry-Pérot dielectric filter with sub-nanometer narrow bandwidth** [12757-21]
- 12757 36 **Design of improved Gram-Schmidt orthonormalization method for phase extraction of random phase shifting grating projection interferograms** [12757-16]
- 12757 37 **An infrared and visible image fusion method based on multi-head attention feature and autoencoder** [12757-58]
- 12757 38 **Multichannel coherent channelized reception of high frequency broadband signals based on cascaded modulation dual combs** [12757-67]
- 12757 39 **Cavity gain drop caused by revisited Gouy phase** [12757-33]
- 12757 3A **System design of microscopic ghost imaging** [12757-109]
- 12757 3B **Coded aperture compressive imaging using dynamic range modulation for optical communication** [12757-78]
- 12757 3C **Binocular three-dimensional display with super multiviews enabled by pixelated nanogratings** [12757-138]
- 12757 3D **Transparent 3D display enabled by flat glass waveguide and pixelated nano-gratings** [12757-68]
- 12757 3E **Transmission and reflection mode switching terahertz metasurface for wavefront manipulation** [12757-49]
- 12757 3F **Noise-robust hyperspectral anomaly detection via relative total variation collaborative representation** [12757-87]
- 12757 3G **Subcutaneous vein display device based on dual wavelength LED source** [12757-107]
- 12757 3H **Improved algorithm for laser Doppler velocimetry based on spectrum analysis** [12757-32]
- 12757 3I **Generation, verification, and imaging of ultrafast rotating optical field based on a pure optical method** [12757-45]