

PROCEEDINGS OF SPIE

Infrared, Millimeter-Wave, and Terahertz Technologies XII

Cunlin Zhang
Xi-Cheng Zhang
Masahiko Tani
Editors

13–14 October 2025
Beijing, 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) • Optical Society of Japan (Japan) • Optical Society of Korea (Republic of Korea) • Australian and New Zealand Optical Society • Optics and Photonics Society of Singapore (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 13726

Proceedings of SPIE 0277-786X, V. 13726

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.

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 *Infrared, Millimeter-Wave, and Terahertz Technologies XII*, edited by Cunlin Zhang, Xi-Cheng Zhang, Masahiko Tani, Proc. of SPIE 13726, Seven-digit Article CID Number (DD/MM/YYYY); (DOI URL).

ISSN: 0277-786X

ISSN: 1996-756X (electronic)

ISBN: 9781510694040

ISBN: 9781510694057 (electronic)

Published by

SPIE

P.O. Box 10, Bellingham, Washington 98227-0010 USA

Telephone +1 360 676 3290 (Pacific Time)

SPIE.org

Copyright © 2025 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. 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

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

- v *Symposium Committees*
- ix *Conference Committee*

IR SENSING, SPECTROSCOPY, AND IMAGING

- 13726 02 **Frequency multiplexed truncated-correlation tomography (FM-TCT) (Invited Paper)**
[13726-1]
- 13726 03 **Research on high-resolution laser heterodyne spectroscopy technology for whole layer atmospheric greenhouse gas detection** [13726-4]
- 13726 04 **Study of in vivo diagnosis of traumatic brain injury in mice based on Raman spectroscopy**
[13726-5]
- 13726 05 **Mechanisms of electroacupuncture effects visualized by infrared imaging** [13726-6]
- 13726 06 **Unsupervised thermographic clustering for ancient jade dagger assessment using self-organising maps** [13726-7]

THZ SOURCES, DETECTORS, AND SENSORS

- 13726 09 **Development of second-order gradient DC SQUIDs for the readout of superconducting TES detectors** [13726-12]

THZ MEASUREMENT, SPECTROSCOPY, AND IMAGING

- 13726 0A **Terahertz metamaterials based on high-temperature superconducting thin films** [13726-13]
- 13726 0B **Proposal of sensitivity enhancement in terahertz time-domain spectroscopic ellipsometry for characterizing thin layer conduction on semiconductor surface** [13726-14]
- 13726 0C **Application of 120GHz frequency-modulated continuous wave technology in nondestructive testing of hot-melt joints for polyethylene pipes** [13726-15]

POSTER SESSION

- 13726 0K **Study on the optical characteristics of brain edema and the optimal source-detection distance based on Monte Carlo simulation** [13726-21]
- 13726 0L **Simulation and analysis of thermal properties of high-power ultrashort laser pumped photoconductive antenna** [13726-22]

- 13726 0M **Characteristics of TE₁₁ terahertz wave transmission through aluminum metal slit with types of subwavelength microstructures** [13726-23]
- 13726 0O **A multifunctional metasurface reflector for multiband polarization transformation** [13726-25]
- 13726 0P **GRAM: a graph reasoning and attention-enhanced Mamba model for detecting infrared small targets** [13726-26]
- 13726 0U **Dynamical properties of self-mixing interference in terahertz frequency combs based on quantum cascade lasers** [13726-31]
- 13726 0W **Theoretical modeling and simulation of self-mixing interferometric measurement using distributed feedback quantum cascade lasers** [13726-33]
- 13726 0Y **An integrated approach for cultural relics property assessment using infrared thermography and 3D scanning** [13726-35]
- 13726 0Z **Study on key technologies in EPHC-based beamforming networks for phased array radar** [13726-36]
- 13726 10 **Multiband terahertz quarter-wave plate achieved by stacking dipole-ring metasurface layers** [13726-37]
- 13726 11 **Encoded laser pulse simulator with nanosecond pulse delay and pulse width modulation accuracy** [13726-38]
- 13726 12 **Research on inverse modeling method of infrared radiation characteristics for ship targets** [13726-40]
- 13726 14 **Machine-learning-enhanced instantaneous frequency measurement based on optical power monitoring** [13726-42]
- 13726 15 **Research on the consistency of material complex refractive index using reflection and transmission terahertz time-domain spectroscopy** [13726-43]
- 13726 17 **Mesa-structured near-infrared avalanche photodiodes based on silicon-germanium alloy absorption layer** [13726-45]
- 13726 18 **Optimized wavelength-extended high-In component InGaAs epitaxial film with designed InAlAs transition layer structure** [13726-46]