PROCEEDINGS OF SPIE

Quantum Sensing and Nano Electronics and Photonics XX

Manijeh Razeghi
Giti A. Khodaparast
Miriam S. Vitiello
Editors

28 January – 1 February 2024
San Francisco, California, United States

Sponsored and Published by
SPIE

Volume 12895

Proceedings of SPIE 0277-786X, V. 12895

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

Quantum Sensing and Nano Electronics and Photonics XX, edited by Manijeh Razeghi, Giti A. Khodaparast, Miriam S. Vitiello, Proc. of SPIE Vol. 12895, 1289501
© 2024 SPIE · 0277-786X · doi: 10.1117/12.3029934

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 *Quantum Sensing and Nano Electronics and Photonics XX*, edited by Manijeh Razeghi, Giti A. Khodaparast, Miriam S. Vitiello, Proc. of SPIE 12895, Seven-digit Article CID Number (DD/MM/YYYY); (DOI URL).

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

ISBN: 9781510670501
ISBN: 9781510670518 (electronic)

Published by
SPIE
P.O. Box 10, Bellingham, Washington 98227-0010 USA
Telephone +1 360 676 3290 (Pacific Time)
SPIE.org
Copyright © 2024 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
SPIEDigitalLibrary.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

vii *Conference Committee*

QUANTUM SENSING DEVICES I

12895 02 **Free-space communications and quantum photonics: advancements in mid-infrared interband cascade lasers (Keynote Paper)** [12895-3]

QUANTUM SENSING DEVICES II

12895 03 **Development of high power, InP-based quantum cascade lasers on alternative epitaxial platforms (Invited Paper)** [12895-4]

12895 04 **Ultrafast time-resolved single-photon detection using two-color comb based asynchronous optical sampling for quantum applications** [12895-5]

12895 05 **Decoupling the dark count rate contributions in Ge-on-Si single photon avalanche diodes** [12895-6]

QUANTUM SENSING DEVICES III

12895 06 **Does one still need to shut up and calculate? (Invited Paper)** [12895-85]

12895 07 **Piccolo gated: a CMOS 32x32 SPAD camera with all-solid-state nanosecond time gating and PCIe readout for single-photon time-domain DCS and near-infrared optical tomography** [12895-10]

QUANTUM SENSING DEVICES IV

12895 08 **Lithium niobate tuning forks as piezoelectric transducers in photoacoustic spectroscopy** [12895-14]

12895 09 **Real-time monitoring of a chemical reaction through a dual-gas QEPAS sensor** [12895-15]

12895 0A **High-performance cavity-enhanced photoacoustic trace-gas sensing** [12895-16]

12895 0B **III-Nitride/Ga_2O_3 heterostructure for future power electronics: opportunity and challenges (Invited Paper)** [12895-7]

ADVANCES IN QUANTUM MATERIALS I

12895 0C **High-sensitivity mid-wave resonant cavity infrared detectors (Invited Paper)** [12895-18]

12895 0D **Electric field control and exploitation in III-N devices (Invited Paper)** [12895-19]

12895 0E **Broadband mid-infrared Fourier transform photothermal spectroscopy using a quantum cascade laser frequency comb** [12895-20]

ADVANCES IN QUANTUM SENSING/IMAGING

12895 0F **Detecting long-wave infrared in metal-silicon-metal photodiodes (Invited Paper)** [12895-26]

12895 0G **DC linearity and absorption efficiency enhancement by introducing photon-trapping microstructures into avalanche photodetectors** [12895-28]

12895 0H **Scalable photodetector design with sub-picosecond response time** [12895-29]

ADVANCES IN TERAHERTZ SPECTROSCOPY I

12895 0I **Electrical flicker-noise analysis based on trapping and de-trapping model in quantum-cascade detectors** [12895-34]

ADVANCES IN TERAHERTZ SPECTROSCOPY II

12895 0J **Modeling of short pulse generation in THz quantum cascade lasers with embedded graphene saturable absorber** [12895-37]

QUANTUM DEVICES

12895 0K **Two faces of superradiance in tandem-cavity ridge waveguide heterostructures (Invited Paper)** [12895-41]

12895 0L **Ultrafast infrared spectroscopy of InAs/GaSb and InAs/InAsSb type-II superlattices** [12895-43]

ADVANCES IN PHOTONICS: PHONONICS, AND MAGNONICS

12895 0M **Assessment of dislocation interaction processes with grain boundaries by nonlinear optical spectroscopy (Invited Paper)** [12895-47]

NANO-PHOTONICS I

12895 0N **Precision tests of the Sagnac effect with a two-axis atomic gyroscope (Invited Paper)** [12895-66]

BIO-PHOTONICS

12895 0O **Progress towards on-chip entangled photon spectroscopy and bioimaging (Invited Paper)** [12895-69]

12895 0P **High resolution bio-imaging via inverse design of metasurfaces** [12895-70]

NANO-PHOTONICS V

12895 0Q **Fast and accurate gas sensing through beat-frequency quartz-enhanced photoacoustic spectroscopy** [12895-82]

12895 0R **Frequency modulation of Rydberg states by radio frequency electromagnetic fields** [12895-84]

Conference Committee

Symposium Chairs

Ulrich T. Schwarz, Technische Universität Chemnitz (Germany)
Karin Hinzer, University of Ottawa (Canada)

Symposium Co-chairs

Sonia M. García-Blanco, Universiteit Twente (Netherlands)
Bernd Witzigmann, Friedrich-Alexander-Universität Erlangen-Nürnberg (Germany)

Program Track Chair

Ali Adibi, Georgia Institute of Technology (United States)

Conference Chairs

Manijeh Razeghi, Northwestern University (United States)
Giti A. Khodaparast, Virginia Polytechnic Institute and State University (United States)
Miriam S. Vitiello, Istituto Nanoscienze (Italy)

Conference Program Committee

Jason M. Auxier, U.S. Naval Research Laboratory (United States)
David Burghoff, The University of Texas at Austin (United States)
Sumit Kumar Gupta, St. Wilfreds PG College Jaipur (India)
Riad Haïdar, ONERA (France)
Amr S. Helmy, University of Toronto (Canada)
Sven Höfling, Julius-Maximilians-Universität Würzburg (Germany)
Jean-Pierre Huignard, Jphopto (France)
M. Saif Islam, University of California, Davis (United States)
Woo-Gwang Jung, Kookmin University (Korea, Republic of)
Pedram Khalili, Northwestern University (United States)
Giuseppe Leo, Laboratoire Matériaux et Phénomènes Quantiques (France)
Dabing Li, Changchun Institute of Optics, Fine Mechanics, and Physics (China)
Amy W. K. Liu, IQE Inc. (United States)
Quanyong Lu, Beijing Academy of Quantum Information Sciences (United States)
Tariq Manzur, Naval Undersea Warfare Center (United States)
Jerry R. Meyer, U.S. Naval Research Laboratory (United States)
Zetian Mi, University of Michigan (United States)

Jean-Luc Pelouard, Centre de Nanosciences et de Nanotechnologies (France)
Narasimha S. Prasad, NASA Langley Research Center (United States)
Edik U. Rafailov, Aston University (United Kingdom)
James P. Shaffer, Quantum Valley Ideas Laboratory (Canada)
Joseph G. Tischler, The University of Oklahoma (United States)
Cunzhu Tong, Changchun Institute of Optics, Fine Mechanics, and Physics (China)
Hui Wang, Changchun Institute of Optics, Fine Mechanics, and Physics (China)
Donghai Wu, Institute of Semiconductors (China)
Chao Zuo, Nanjing University of Science and Technology (China)