

PROCEEDINGS OF SPIE

Quantum Sensing and Nano Electronics and Photonics XVI

Manijeh Razeghi
Jay S. Lewis
Eric Tournié
Giti A. Khodaparast
Editors

3–7 February 2019
San Francisco, California, United States

Sponsored and Published by
SPIE

Volume 10926

Proceedings of SPIE 0277-786X, V. 10926

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 *Quantum Sensing and Nano Electronics and Photonics XVI*, edited by Manijeh Razeghi, Jay S. Lewis, Eric Tournié, Giti A. Khodaparast, Proceedings of SPIE Vol. 10926 (SPIE, Bellingham, WA, 2019) Seven-digit Article CID Number.

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

ISBN: 9781510624948
ISBN: 9781510624955 (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 \$18.00 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/\$18.00.

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**

SPIDigitalLibrary.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 Committee</i>

BIOSENSING

10926 06	Non-invasive blood glucose measurement using quantum cascade lasers (Invited Paper) [10926-6]
----------	---

GAS SENSING

10926 0C	Quartz-enhanced photoacoustic sensors for detection of multiple hydrocarbon and methane isotopes [10926-11]
10926 0D	New generation of tuning forks for quartz-enhanced photoacoustic spectroscopy [10926-12]

SWIR TO LWIR PHOTODETECTORS

10926 0E	High-performance extended SWIR photodetectors using strain compensated InGaAs/GaAsSb type-II quantum wells (Invited Paper) [10926-13]
10926 0G	A comprehensive set of simulation tools to model and design high-performance type-II InAs/GaSb superlattice infrared detectors [10926-15]

NEAR-FIELD OPTICS

10926 0L	Near-field scanning thermoreflectance imaging (NeSTRI) as a nano-optical technique for contactlessly mapping the thermal conductivity of 2D materials at the nanoscale [10926-20]
----------	--

QUANTUM SYSTEMS

10926 0N	A new perspective on causality, locality, and duality in entangled quantum nano systems (Keynote Paper) [10926-22]
----------	---

- 10926 0O **Self-field, radiated energy, and radiated linear momentum of an accelerated point charge: part 2 (Invited Paper)** [10926-23]
- 10926 0R **GaN laser diodes for quantum technologies** [10926-26]

ADVANCES IN DETECTORS AND IMAGING

- 10926 0W **Measurement concept for direct time-of-flight sensors at high ambient light** [10926-31]

ADVANCES IN LASERS I

- 10926 11 **New design strategies for multifunctional and inexpensive quantum cascade lasers (Invited Paper)** [10926-34]
- 10926 13 **Advances of MOEMS-based external cavity QCLs** [10926-36]
- 10926 14 **Dynamical and anisotropic properties of spin-VCSELs (Invited Paper)** [10926-37]

ADVANCES IN LASERS II

- 10926 17 **Free-space optical communications with quantum cascade lasers (Invited Paper)** [10926-40]

ADVANCES IN MATERIAL GROWTH

- 10926 1C **Heteroepitaxial growth of silicon on GaAs via low-temperature plasma-enhanced chemical vapor deposition (Invited Paper)** [10926-45]
- 10926 1D **GaN substrate development through the near equilibrium ammonothermal (NEAT) method and its application to higher performance GaN-based devices (Invited Paper)** [10926-46]

THZ SOURCES

- 10926 1E **Upscaling the output power of a photo-mixing THz source driven by a dual-frequency laser operating on two transverse modes (Invited Paper)** [10926-47]

METASURFACES

- 10926 1Q **3D-printed infrared metamaterials (Invited Paper)** [10926-59]

PHOTONIC INTEGRATED CIRCUITS

- 10926 1U **Ge-rich graded-index Si_{1-x}Ge_x racetrack resonators operating at deep mid-IR wavelengths** [10926-63]
- 10926 1V **Monolithic integration of quantum cascade laser, quantum cascade detector, and subwavelength waveguides for mid-infrared integrated gas sensing** [10926-64]

NEW APPROACHES TO MICRO-/NANOFABRICATION

- 10926 1X **Hybrid dynamic structures for optical quality surfaces shape control: live-mirror (Invited Paper)** [10926-66]
- 10926 1Y **Dynamic optical laser fabrication for engineering of quantum photonic devices (Invited Paper)** [10926-67]

PLASMONICS FOR SENSING

- 10926 27 **Enhancement of quantum efficiency in nBn detectors with thin absorbers using plasmonic gratings (Invited Paper)** [10926-76]
- 10926 28 **Surface plasmon resonance transducers with membrane structure toward gas-sensing applications** [10926-77]
- 10926 29 **Plasmonic optical systems for gas detection** [10926-78]

ADVANCES IN MATERIAL CHARACTERIZATION

- 10926 2A **Transient extreme ultraviolet measurement of element-specific charge transfer dynamics in multiple-material junctions (Invited Paper)** [10926-79]
- 10926 2C **Organic charge-transfer compounds: complex interactions at the nanoscale (Invited Paper)** [10926-81]

FREQUENCY COMBS

- 10926 2F **Exploratory research on the light quantum future technical basis (Invited Paper)** [10926-84]
- 10926 2G **Numerical studies of superlattice multipliers performance (Invited Paper)** [10926-85]
- 10926 2I **Stable and efficient mid-infrared III-V semiconductor frequency combs with two-color pumping** [10926-88]

POSTER SESSION

- 10926 2K **Octupole electrode pattern for tuning forks vibrating at the first overtone mode in quartz-enhanced photoacoustic spectroscopy** [10926-90]
- 10926 2L **Simultaneous dual gas QEPAS sensing of water and methane/nitrous oxide** [10926-91]
- 10926 2M **Vertical silicon nanowire-based optical waveguide for DNA hybridization biosensor** [10926-92]
- 10926 2O **Mid-infrared gas sensing using uncooled quantum cascade laser with low power consumption** [10926-94]
- 10926 2P **Extending the linear concentration range of a multi-gas-analyzer** [10926-95]
- 10926 2Q **Indirect mid-infrared optical feedback cavity-enhanced spectroscopy in a Brewster window cavity** [10926-96]
- 10926 2R **Tuning the gain-bandwidth product of electron injector photodetectors** [10926-97]
- 10926 2S **Plasmonic switches based on arrays of plasmonic nanostructures surrounded by VO₂ thin films** [10926-98]