PROCEEDINGS OF SPIE

Photonic Instrumentation Engineering IV

Yakov G. Soskind Craig Olson Editors

31 January–2 February 2017 San Francisco, California, United States

Sponsored and Published by SPIE

Volume 10110

Proceedings of SPIE 0277-786X, V. 10110

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

The papers included 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. The papers published in these proceedings 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 this book:

Author(s), "Title of Paper," in Photonic Instrumentation Engineering IV, edited by Yakov G. Soskind, Craig Olson, Proceedings of SPIE Vol. 10110 (SPIE, Bellingham, WA, 2017) Seven-digit Article CID Number.

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

ISBN: 9781510606616 ISBN: 9781510606623 (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 © 2017, 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/17/\$18.00.

Printed in the United States of America Vm7 i ffUb 5 ggc WJUhY gr & Wzi bXYf "JW bgY Zica GD-9.

Publication of record for individual papers is online in the SPIE Digital Library.



Paper Numbering: Proceedings of SPIE follow an e-First publication model, with papers published first online and then in print. Papers are published as they are submitted and meet publication criteria. A unique citation identifier (CID) number is assigned to each article at the time of the first 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, print, and electronic versions of the publication. SPIE uses a seven-digit CID article numbering system in which:

- 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. The complete citation is used on the first page, and an abbreviated version on subsequent pages.

Contents

vii Authors

- xi Conference Committee
- xiii Introduction

SESSION 1 DESIGN, DEVELOPMENT, AND FABRICATION OF PHOTONIC INSTRUMENTS I

- 10110 03 Modeling diffractive effects due to micro-lens arrays on liquid crystal panels in projectors [10110-2]
- 10110 04 Automatic correction of diffraction pattern shift in a pushbroom hyperspectral imager with a piezoelectric internal line-scanning unit [10110-3]
- 10110 05 All plastic ultra-small size imaging lens unit fabrication and evaluation for endoscope [10110-4]
- 10110 06 Design and evaluation of a freeform lens by using a method of luminous intensity mapping and a differential equation [10110-5]

SESSION 2 METROLOGY, CHARACTERIZATION, AND FABRICATION OF PHOTONIC INSTRUMENTS

- 10110 07 Optical stent inspection of surface texture and coating thickness [10110-6]
- 10110 08 Determination of the paraxial focal length using Zernike polynomials over different apertures [10110-7]
- 10110 09 Highly sensitive measurement of submicron waveguides based on Brillouin scattering [10110-8]
- 10110 0A Capabilities and challenges in transferring the wavefront-based alignment approach to small aperture multi-element optical systems (Invited Paper) [10110-9]
- 10110 0B System-level analysis and design of a compact RGB-NIR CMOS camera [10110-10]

SESSION 3 APPLICATIONS OF PHOTONIC INSTRUMENTS I

- 10110 0C **Double-sideband filter for digital holography** [10110-11]
- 10110 0D Advances in broadband-integrated optic beam combiners for mid-IR astronomical interferometers [10110-12]

- 10110 OE Locally resolved characterization of progressive addition lenses by calculation of the modulation transfer function using experimental ray tracing [10110-13]
- 10110 OF Optical coherence tomography for non-invasive examination and conservation of cultural heritage objects [10110-14]

SESSION 4 APPLICATIONS OF PHOTONIC INSTRUMENTS II

- 10110 0H Hyperspectral calibration method for CMOS-based hyperspectral sensors [10110-17]
- 10110 01 Optical frequency-domain reflectometry using multiple wavelength-swept elements of a DFB laser array [10110-18]
- 10110 0J Optical coating uniformity of 200mm (8") diameter precut wafers [10110-19]

SESSION 5 APPLICATIONS OF PHOTONIC INSTRUMENTS III

- 10110 0K Ultra-compact imaging plate scanner module using a MEMS mirror and specially designed MPPC [10110-20]
- 10110 0L **3D label-free super-resolution imaging** [10110-21]
- 10110 0M Round Robin test on bio-imaging transfer standard for 3D optical profilers [10110-22]
- 10110 00 Development of a high-throughput solution for crystallinity measurement using THz-Raman spectroscopy [10110-24]

SESSION 6 APPLICATIONS OF PHOTONIC INSTRUMENTS IV

- 10110 OP Multi-wavelength mid-IR light source for gas sensing [10110-25]
- 10110 0Q Stable wavelength-swept light source designed for industrial applications using KTN beamscanning technology [10110-26]
- 10110 OR Layer by layer: complex analysis with OCT technology [10110-27]
- 10110 0S Innovative polarization-holographic imaging Stokes spectropolarimeter for astronomy [10110-15]

SESSION 7 SENSORS AND RUGGEDIZED SYSTEMS I

- 10110 0U Design of a photonic integrated based optical interrogator [10110-29]
- 10110 0V Torsion sensing setup based on a Mach-Zehnder interferometer with photonics crystal fiber [10110-30]
- 10110 0X Gain-assisted broadband ring cavity enhanced spectroscopy [10110-32]

SESSION 8 SENSORS AND RUGGEDIZED SYSTEMS II

10110 OZ	A quantitative comparison of dispersion- and absorption-spectroscopic gas sensing [10110-34]
10110 11	Using quantum-dots to enable deep-UV sensitivity with standard silicon-based imaging detectors [10110-36]
SESSION 9	DESIGN, DEVELOPMENT, AND FABRICATION OF PHOTONIC INSTRUMENTS II
10110 12	Snapshot Stokes polarimeters based on a single biaxial crystal [10110-37]
10110 14	Fast and compact internal scanning CMOS-based hyperspectral camera: the Snapscan [10110-39]
10110 15	Evaluation of the thermal stability of a low-coherence interferometer for precision surface profilometry [10110-40]
10110 16	Development of an integrated sub-picometric SWIFTS-based wavelength meter [10110-41]
SESSION 10	DESIGN, DEVELOPMENT, AND FABRICATION OF PHOTONIC INSTRUMENTS III
10110 18	Quantum-cascade-laser-based heterodyne phase-sensitive dispersion spectroscopy in the mid-IR range: capabilities and limitations [10110-43]
10110 19	Miniature Raman spectroscopy utilizing stabilized diode lasers and 2D CMOS detector arrays [10110-44]
	POSTER SESSION
10110 1C	A pH sensing system using fluorescence-based fibre optical sensor capable of small volume sample measurement [10110-49]
10110 1D	Lens-free imaging-based low-cost microsensor for in-line wear debris detection in lube oils [10110-50]
10110 1F	Multimodal backside imaging of a microcontroller using confocal laser scanning and optical-beam-induced current imaging [10110-53]
10110 1G	Fiber-optic-based interferometric sensor [10110-54]
10110 1H	High-resolution fast temperature mapping of a gas turbine combustor simulator with femtosecond infrared laser written fiber Bragg gratings [10110-55]
10110 1J	Phase demodulation of Fabry-Perot interferometer-based acoustic sensor utilizing tunable filter with two quadrature wavelengths [10110-57]

10110 1K	A flexible fiber displacement sensor with tunable resolution and dynamic range based on a few-mode fiber loop [10110-58]
10110 1L	A spectroscopic method of determining color of petroleum products using CIELab color space with LED illumination [10110-60]
10110 1P	Miniature and micro spectrometers market: who is going to catch the value? [10110-64]
10110 1Q	Automatic optical inspection of regular grid patterns with an inspection camera used below the Shannon-Nyquist criterion for optical resolution [10110-65]
10110 1R	Optimization of linear-logarithmic CMOS image sensor using a photogate and a cascode MOSFET for reducing pixel response variation [10110-66]

10110 1S Extraction of depth information for 3D imaging using pixel aperture technique [10110-67]