

PROCEEDINGS OF SPIE

Fifth Conference on Sensors, MEMS, and Electro-Optic Systems

Monuko du Plessis

Editor

8–10 October 2018

Skukuza, South Africa

Organized by

University of Pretoria (South Africa)

Sponsored by

ECM Technologies (South Africa)

Solid State Technology (South Africa)

Horne Technologies (South Africa)

SAAB Technologies (South Africa)

HENSOLDT Optronics (Pty) Ltd. (South Africa)

Saetra (Pty) Ltd. (South Africa)

Published by

SPIE

Volume 11043

Proceedings of SPIE 0277-786X, V. 11043

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 *Fifth Conference on Sensors, MEMS, and Electro-Optic Systems*, edited by Monuko du Plessis, Proceedings of SPIE Vol. 11043 (SPIE, Bellingham, WA, 2019) Seven-digit Article CID Number.

ISSN: 0277-786X

ISSN: 1996-756X (electronic)

ISBN: 9781510627529

ISBN: 9781510627536 (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>
xi	<i>Introduction</i>

PHOTONIC SUBSYSTEMS

11043 02	Lanthanide activated phosphors for solar cell applications (Invited Paper) [11043-40]
----------	--

NANOTECHNOLOGY

11043 03	Nanoparticles and organic semiconductors for flexible electronics (Invited Paper) [11043-12]
11043 04	Structural and luminescence properties of InAs_{0.94}Sb_{0.06} alloy grown via MOVPE [11043-25]

SILICON-BASED LIGHT EMITTING DEVICES

11043 05	Figures of merit of avalanche-mode silicon LEDs [11043-34]
11043 06	Investigation of light-emission and avalanche-current mechanisms in PureB SPAD devices [11043-41]
11043 07	Light emission from Si avalanche mode LEDs as a function of E field control, impurity scattering, and carrier density balancing [11043-51]
11043 08	Realizing micro- and nano-optical bio sensors on chip [11043-70]
11043 09	Edge-emitting Si avalanche-mode LED integrated into a SiGe RF bipolar technology: optical power emission characterization with optical probe mapping technique [11043-79]

IMAGING TECHNOLOGY

11043 0A	MWIR FPA control for optimal NETD [11043-31]
----------	---

- 11043 0B **SWIR sensor design considerations** [11043-36]
11043 0C **CMOS in-pixel optical pulse frequency modulator** [11043-65]

PRINTED ELECTRONICS

- 11043 0D **Biocompatibility in inkjet-printed paper-based microelectronic biosensors** [11043-96]
11043 0E **Printed electronics MIM capacitor for a microsystem power supply** [11043-82]
11043 0F **Electronic synthesis of printed resistor layout for a thermal petri dish incubator** [11043-88]
11043 0G **Characterization of inkjet-printed dielectric on different substrates** [11043-69]
11043 0H **Development of a printed paper-based origami electrochemical sensor for the detection of heavy metals in water** [11043-5]
11043 0I **Printed, flexible wireless temperature logging system** [11043-19]
11043 0J **Colorimetric system for paper-based assays** [11043-86]
11043 0K **CMOS floating-gate transistor in a heterogeneous printed electronics sensor module** [11043-94]
11043 0L **Inductor design for inkjet-printed electronics** [11043-83]

INTEGRATED SILICON PHOTONICS

- 11043 0M **Design and simulation of optical micro-structures in silicon integrated circuitry with Si avalanche-mode light emitters, EXCEL optical ray tracing, and RSOF optical simulation** [11043-47]
11043 0N **Design and optimization of compact silicon photonic sensors** [11043-78]

PROCESSING OF DEVICES

- 11043 0O **Processing of and electrical properties of ZnO thin films and nanorods for sensor applications** [11043-75]
11043 0P **Doctor blade system for the deposition of thin semiconducting films** [11043-32]
11043 0Q **Effect of increasing etchant concentration to accelerate synthesis of 9- μ m-long TiO₂ nanotubes** [11043-10]

11043 OR **Structural, morphological, and optical studies of Rutile-phase TiO₂ rods grown on F:SnO₂-coated glass substrate by hydrothermal chemical bath deposition** [11043-24]

APPLICATIONS

11043 OS **Preparation and measurement ionizing radiation sensors with optical fibers** [11043-73]

11043 OT **Initial progress toward planar integrate, low-cost water vapour radiometers** [11043-45]

11043 OU **Earth observation of aerosols over inland water bodies in relation to calibration and validation of sentinel 2/3** [11043-71]

11043 OV **Cooking harvested power manager for natural room cooling controller** [11043-89]

11043 OW **A low cost thermal energy absorber for rural Africa applications: isolation of high pressure and low pressure through heat exchanging** [11043-49]

11043 OX **Protection against transient overvoltage in precision AC-DC transfer measurement system** [11043-26]

OPTICAL SYSTEMS

11043 OY **Digital micro-mirror devices for laser beam shaping** [11043-37]

11043 OZ **Visible light communication using a software-defined radio approach** [11043-48]

11043 10 **Silica optical fibers modify for measurement ionizing radiation** [11043-72]

NANOPARTICLES AND NANOSTRUCTURES FOR ELECTRONIC DEVICES

11043 11 **NBTI in SiGe transistors** [11043-22]

11043 12 **Inorganic p-channel thin-film transistors using CuO nanoparticles** [11043-17]

11043 13 **Self-aligned organic thin-film transistors for flexible electronics** [11043-18]

11043 14 **Improved organic thin-film transistor performance by dielectric layer patterning** [11043-14]

11043 15 **Mechanical deformation on nanoparticle-based thin-film transistors** [11043-58]

11043 16 **Oxygen detection with zinc oxide nanoparticle structures** [11043-39]

IMAGING DEVICES AND PROCESSING

- 11043 17 **Status quo and aspects to consider with ultraviolet optical versus high voltage energy relation investigations** [11043-27]
- 11043 18 **Measurement of the thermal-vacuum defocus of an objective lens for an imaging payload on a CubeSat** [11043-54]
- 11043 19 **The investigation of different image processing techniques to improve the visibility of volatile gas plumes in industry using optical gas imaging** [11043-33]

SPACE TECHNOLOGY

- 11043 1A **Flight hardware verification and validation of the K-line fire sensor payload on ZACube-2** [11043-100]
- 11043 1B **Architecture for sensing of small clock shifts in Karoo telescope time on the MeerKAT GHz radio telescope** [11043-93]

BIOSENSORS

- 11043 1C **CMOS-based impedance spectroscopy for water quality monitoring** [11043-92]