PROGRESS IN BIOMEDICAL OPTICS AND IMAGING
Vol. 19 No. 35

Optical Diagnostics and Sensing XVIII: Toward Point-of-Care Diagnostics

Gerard L. Coté
Editor

29–30 January 2018
San Francisco, California, United States

Sponsored and Published by
SPIE

Volume 10501

Proceedings of SPIE, 1605-7422, V. 10501

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

Optical Diagnostics and Sensing XVIII: Toward Point-of-Care Diagnostics, edited by Gerard L. Coté,
Proc. of SPIE Vol. 10501, 1050101 · © 2018 SPIE · CCC code:
1605-7422/18/$18 · doi: 10.1117/12.2323027

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 *Optical Diagnostics and Sensing XVIII: Toward Point-of-Care Diagnostics*, edited by Gerard L. Coté, Proceedings of SPIE Vol. 10501 (SPIE, Bellingham, WA, 2018) Seven-digit Article CID Number.

ISSN: 1605-7422
ISSN: 2410-9045 (electronic)

ISBN: 9781510614871
ISBN: 9781510614888 (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 © 2018, 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 1605-7422/18/$18.00.

Printed in the United States of America.

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

SPIE. DIGITAL LIBRARY
SPIEDigitalLibrary.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 *Authors*
ix *Conference Committee*

SESSION 1 SURFACE ENHANCED RAMAN SPECTROSCOPY AND NANOPARTICLES

10501 02 **Development of an optical fiber SERS microprobe for minimally invasive sensing applications** [10501-1]

10501 03 **Nanoengineered capsules for selective SERS analysis of biological samples** [10501-2]

10501 04 **Development of a free-solution SERS-based assay for point-of-care oral cancer biomarker detection using DNA-conjugated gold nanoparticles** [10501-3]

10501 05 **Development of a paper-based vertical flow SERS assay for citrulline detection using aptamer-conjugated gold nanoparticles** [10501-4]

SESSION 2 OPTICAL MONITORING OF GLUCOSE AND OTHER BIOMARKERS

10501 07 **A portable measuring system for a competitive binding glucose biosensor** [10501-6]

10501 08 **Computational circular dichroism estimation for point-of-care diagnostics via vortex half-wave retarders** [10501-7]

10501 0A **Evaluation and benchmarking of an EC-QCL-based mid-infrared spectrometer for monitoring metabolic blood parameters in critical care units** [10501-9]

SESSION 3 POINT OF CARE BIOSENSING APPROACHES

10501 0C **Phase sensitive diffraction sensor for high sensitivity refractive index measurement** [10501-11]

10501 0E **Optimized computational imaging methods for small-target sensing in lens-free holographic microscopy** [10501-13]

10501 0F **Toward noninvasive detection and monitoring of malaria with broadband diffuse optical spectroscopy** [10501-14]

SESSION 4 OPTICAL IMAGING FOR POINT OF CARE AND FIELD APPLICATIONS

10501 0G **Image-based non-contact monitoring of skin texture changed by piloerection for emotion estimation** [10501-15]

10501 0H **Measuring the arterial-induced skin vibration by geometrical moiré fringe** [10501-16]

10501 0J **Differential color space analysis for investigating nutrient content in a puréed food dilution-flavor matrix: a step toward objective malnutrition risk assessment** [10501-18]

SESSION 5 NEAR INFRARED SENSING AND MONITORING IN VIVO

10501 0K **Development of chair-side evaluation system of swallowing discomfort of denture wearers** [10501-19]

10501 0L **Optical monitoring of spinal cord subcellular damage after acute spinal cord injury** [10501-20]

10501 0M **In vivo near infrared (NIRS) sensor attachment using fibrin bioadhesive** [10501-21]

10501 0N **Noninvasive optical diagnosis of low back pain with the aid of Chinese cupping procedure** [10501-22]

10501 0P **In-vivo quantitative measurement of tissue oxygen saturation of human webbing using a transmission type continuous-wave near-infrared spectroscopy** [10501-24]

SESSION 6 IMAGING PHOTOPLETHYSMOGRAPHY AND REMOTE PHYSIOLOGICAL SENSING I

10501 0Q **A fast non-contact imaging photoplethysmography method using a tissue-like model** [10501-25]

10501 0R **Localised photoplethysmography imaging for heart rate estimation of pre-term infants in the clinic** [10501-26]

10501 0S **CameraHRV: robust measurement of heart rate variability using a camera** [10501-27]

SESSION 7 IMAGING PHOTOPLETHYSMOGRAPHY AND REMOTE PHYSIOLOGICAL SENSING II

10501 0W **Simultaneous estimation of arterial and venous oxygen saturation using a camera** [10501-31]

10501 0X **Spatio-temporal analysis of blood perfusion by imaging photoplethysmography** [10501-32]

10501 0Z **Remote spectral measurements of the blood volume pulse with applications for imaging photoplethysmography** [10501-41]

SESSION 8 IMAGING PHOTOPLETHYSMOGRAPHY AND REMOTE PHYSIOLOGICAL SENSING III

10501 10 **Noncontact sphygmomanometer based on pulse-wave transit time between the face and hand** [10501-34]

10501 11 **Evaluation of arterial oxygen saturation using RGB camera-based remote photoplethysmography** [10501-35]

10501 12 **Data fusion for improved camera-based detection of respiration in neonates** [10501-36]

10501 13 **Non-contact assessment of obstructive sleep apnea cardiovascular biomarkers using photoplethysmography imaging** [10501-37]

10501 14 **Near-continuous non-contact cardiac pulse monitoring in a neonatal intensive care unit in near darkness** [10501-38]

POSTER SESSION

10501 15 **A multiplexed electronic architecture for opto-electronic patch sensor to effectively monitor heart rate and oxygen saturation** [10501-39]

10501 16 **Simultaneous estimation of transcutaneous bilirubin, hemoglobin, and melanin based on diffuse reflectance spectroscopy** [10501-40]

10501 17 **Challenges in automated estimation of capillary refill time in dogs** [10501-42]

10501 19 **Proximal design for a multimodality endoscope with multiphoton microscopy, optical coherence microscopy and visual modalities** [10501-44]

10501 1B **Development of real-time and quantitative monitoring of thrombus formation in an extracorporeal centrifugal blood pump** [10501-46]

10501 1C **Interconnecting wearable devices with nano-biosensing implants through optical wireless communications** [10501-47]

10501 1D **Ultrasensitive spectroscopy based on photonic waveguides on Al_2O_3/SiO_2 platform** [10501-48]

10501 1E **Photodynamic diagnostics of stress-induced gastrointestinal neoplasia in laboratory animals using 5-aminolevulinic acid and Al-phthalocyanine** [10501-49]

10501 1G **Label-free detection of HIV-1 infected cells via integration of optical tweezers and photoluminescence spectroscopy** [10501-52]

10501 1I **Evaluation of the polymerization shrinkage of experimental flowable composite resins through optical coherence tomography** [10501-54]

10501 1K **Diffraction-based BioCD biosensor for point-of-care diagnostics** [10501-56]

10501 1L **Developing upconversion nanoparticle-based smart substrates for remote temperature sensing** [10501-58]

10501 1M **Efficacy of hidden markov model over support vector machine on multiclass classification of healthy and cancerous cervical tissues** [10501-57]

Authors

Numbers in the index correspond to the last two digits of the seven-digit citation identifier (CID) article numbering system used in Proceedings of SPIE. The first five digits reflect the volume number. Base 36 numbering is employed for the last two digits and indicates the order of articles within the volume. Numbers start with 00, 01, 02, 03, 04, 05, 06, 07, 08, 09, 0A, 0B...0Z, followed by 10-1Z, 20-2Z, etc.

Abdul, Wares MD., 16
Abdurashitov, Arkady, 1E
Adachi, Makoto, 0P
Agranovich, Ilana, 1E
Aizimu, Tuerxun, 0P
Aizu, Yoshihisa, 11
Akaho, Rina, 0G
Alharbi, Samah, 15
Alkahtani, Masfer, 1L
Amelard, Robert, 0J, 13
Angelov, Ivan, 1E
Arteta, Carlos, 0R
Avramov, Latchezar, 1E
Balmaekers, Benoît, 14
Bambang Oetomo, Sidarto, 14
Barman, Ritwik, 1M
Barton, Jennifer K., 19
Blackford, Ethan B., 0Q, 0Z
Blanos, Panagiotis, 15
Bodrova, Anastasiya, 1E
Borisova, Ekaterina, 1E
Busch, H., 0A
Cajazeira, Marlus R. R., 1I
Campbell, Chris, 0F
Carneiro, Vanda S. M., 1I
Chaichulee, Sitthichok, 0R, 12
Chang, C., 1K
Chen, Ray T., 1D
Cheng, Yi-Shing Lisa, 04
Chiu, Shih-Yung, 0H
Choi, H., 1K
Clausi, David A., 13
Coker, Zachary, 1L
Colvin, Lydia E., 07
Coté, Gerard L., 03, 04, 05, 07
Cugmas, Blaž, 17
Dalir, Hamed, 1D
de Haan, Gerard, 0W
Delbeck, S., 0A
Deutz, Nicolaas, 05
Dumont, Guy, 0M
Engle, Isaiah, 0E
Ernst, Hannes, 0X
Estepp, Justin R., 0Q, 0Z
Fedosov, Ivan, 1E
Fong, Allan, 0L
Förster, Michael, 0X
Fujiwara, Tatsuki, 1B
Garan, Jacob, 0E
Gerbi, Marleny E. M. M., 1I
Ghosh, Nirmalya, 1M
Gomes, Anderson S. L., 1I
Grafen, M., 0A
Green, Gabrielle, 0R
Grunlan, Melissa A., 07
Haider, Shahid A., 08
Han, Sungyub, 04
Haneishi, Hideaki, 0P, 10, 11, 16
Heidari, Elham, 1D
Heise, H. M., 0A
Hemmer, Philip, 1L
Hsu, Yu-Hsiang, 0H
Hu, Sijung, 15
Ikuta, Ryuhei, 0K
Jagani, Shubh, 13
Johari, Pedram, 1C
Jorge, João, 0R, 12
Jornet, Josep M., 1C
Juodkazis, Saulius, 02
Kataoka, Kanako, 0K
Khorovodov, Alexander, 1E
Kiekens, Kelli C., 19
Kosaka, Ryo, 1B
Kumar, Sunil, 0C
Kumawat, Nityanand, 0C
Kurmi, Indrajit, 1M
Kuwana, Katsuyuki, 1B
Kwon, Brian K., 0L, 0M
Lee, Chih-Kung, 0H
Lee, Shu-Sheng, 0H
Li, Nanxi, 0N
Li, Ting, 0N
Liang, Hangbing, 0W
Locke, Andrea K., 03, 04, 05
Lugongolo, Masixole Yvonne, 1G
Maaza, Malik, 1G
Macnab, Andrew, 0L, 0M
Mahadevan-Jansen, Anita, 02
Malberg, Hagen, 0X
Mamun, Md Abdullah Al, 02
Manouchehri, Neda, 0L
Mantareva, Vanya, 1E
Marble, Kassie, 1L
Maruyama, Osamu, 1B
Matsumoto, Keisuke, 0K
McCormick, Kenny, 0R, 12
McDuff, Daniel J., 0Q, 0Z, 11
McLeod, Euan, 0E

McShane, Mike, 03
Means, A. Kristen, 07
Melzer, Jeffrey E., 0E
Mokhtari-Koushyar, Farzad, 1D
Mota, Cláudia C. B. O., 1I
Mthunzi-Kufa, Patience, 1G
Mukherjee, Sukanya, 1M
Mukhopadhyay, Sabyasachi, 1M
Nakada, Taka-aki, 0P
Nakaguchi, Toshiya, 0P
Nakano, Kazuya, 0P, 10, 11, 16
Namykin, Anton, 1E
Navolokin, Nikita, 1E
Niizeki, Kyuichi, 11
Nishidate, Izumi, 0Q, 10, 11, 16
Nolte, D., 1K
Noto, Luyanda Lunga, 1G
Oaks, Luke A., 04
Oda, Shigeto, 0P
Ogawa, Keiko, 0G
Ohnishi, Takashi, 0P, 10
Ohtsu, Mizuki, 16
Ohuchi, Katsuhiro, 1B
Ombinda-Lemboumba, Saturnin, 1G
Ono, Yumie, 0K
Ostendorf, A., 0A
O'Sullivan, Thomas D., 0F
Pagano, Roberto, 0M
Pai, Amruta, 0S
Pandey, Honey, 1C
Panigrahi, Prasanta K., 1M
Pfisterer, Kaylen J., 0J, 13
Pratiher, Sawon, 1M
Sabharwal, Ashutosh, 0S
Sakota, Daisuke, 1B
Savran, C., 1K
Schechinger, Monika, 03
Semyachkina-Glushkovskaya, Oxana, 1E
Shadgan, Babak, 0L, 0M
Shortt, Katelyn, 0L
Shushunova, Natalia, 1E
So, Kitty, 0L
Souza, Alex F., 1I
Spigulis, Janis, 17
Stoddart, Paul R., 02
Streijger, Femke, 0L
Stuijk, Sander, 0W
Takahashi, Nozomi, 0P
Talarico, Olivia, 19
Tamaki, Katsushi, 0K
Tang, Naimei, 1D
Tarassenko, Lionel, 0R, 12
Tran, Megan Y., 08
Tromberg, Bruce J., 0F
Trumpp, Alexander, 0X
Tsumura, Norimichi, 0G
Uchida, Mihiro, 0G
van Gastel, Mark, 0W, 14
Varma, Manoj, 0C
Veeraraghavan, Ashok, 0S
Verkruysse, Wim, 14
Villarroel, Mauricio, 0R, 12
Wang, Chun-Hsiung, 0H
Wong, Alexander, 08, 0J, 13
Wu, Wen-Jong, 0H
Xiong, Zhen, 0E
Xu, Xiaochuan, 1D
Yakovlev, Vladislav V., 1L
Yamazaki, Hiroyuki, 1B
Yan, Liangwen, 15
You, Yil-Hwan, 03
Zaunseder, Sebastian, 0X
Zisserman, Andrew, 0R

Conference Committee

Symposium Chairs

James G. Fujimoto, Massachusetts Institute of Technology (United States)
R. Rox Anderson, Wellman Center for Photomedicine, Massachusetts General Hospital (United States) and Harvard Medical School (United States)

Program Track Chairs

Ammasi Periasamy, University of Virginia (United States)
Daniel L. Farkas, University of Southern California (United States) and SMI (United States)

Conference Chair

Gerard L. Coté, Texas A&M University (United States)

Conference Program Committee

Zane A. Arp, GlaxoSmithKline (United States)
Brent D. Cameron, The University of Toledo (United States)
Werner Gellermann, The University of Utah (United States)
H. Michael Heise, Fachhochschule Südwestfalen, Iserlohn (Germany)
Jürgen M. Lademann, Charité Universitätsmedizin Berlin (Germany)
Kristen C. Maitland, Texas A&M University (United States)
Michael J. McShane, Texas A&M University (United States)
Kenith E. Meissner, Swansea University (United Kingdom)
Timothy J. Muldoon, University of Arkansas (United States)
Aydogan Ozcan, University of California, Los Angeles (United States)
Babak Shadgan, The University of British Columbia (Canada)
Kexin Xu, Tianjin University (China)
Shaoqun Zeng, Britton Chance Center for Biomedical Photonics (China)

Session Chairs

1 Surface Enhanced Raman Spectroscopy and Nanoparticles
Michael J. McShane, Texas A&M University (United States)

2 Optical Monitoring of Glucose and Other Biomarkers
Brent D. Cameron, The University of Toledo (United States)

3 Point of Care Biosensing Approaches
Gerard L. Coté, Texas A&M University (United States)

4 Optical Imaging for Point of Care and Field Applications
Kristen C. Maitland, Texas A&M University (United States)

5 Near Infrared Sensing and Monitoring In Vivo
Babak Shadgan, The University of British Columbia (Canada)

6 Imaging Photoplethysmography and Remote Physiological Sensing I
Ethan B. Blackford, Ball Aerospace & Technologies Corporation (United States)
Daniel J. McDuff, Microsoft (United States)

7 Imaging Photoplethysmography and Remote Physiological Sensing II
Ethan B. Blackford, Ball Aerospace & Technologies Corporation (United States)
Daniel J. McDuff, Microsoft (United States)

8 Imaging Photoplethysmography and Remote Physiological Sensing III
Ethan B. Blackford, Ball Aerospace & Technologies Corporation (United States)
Daniel J. McDuff, Microsoft (United States)