Optical Biopsy XVIII: Toward Real-Time Spectroscopic Imaging and Diagnosis

Robert R. Alfano Stavros G. Demos Angela B. Seddon Editors

2–5 February 2020 San Francisco, California, United States

Sponsored by SPIE

Cosponsored by
Hamamatsu Corporation (United States)
Thorlabs (United States)
Spectra-Physics (United States)
NKT Photonics A/S (Denmark)
Pavilion Integration Corporation (United States)
Corning Incorporated (United States)
Intuitive Surgical (United States)
Coherent, Inc. (United States)

Published by SPIE

Volume 11234

Proceedings of SPIE, 1605-7422, V. 11234

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

Optical Biopsy XVIII: Toward Real-Time Spectroscopic Imaging and Diagnosis, edited by Robert R. Alfano, Stavros G. Demos, Angela B. Seddon, Proc. of SPIE Vol. 11234, 1123401 · © 2020 SPIE · CCC code: 1605-7422/20/\$21 · doi: 10.1117/12.2569509

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 Biopsy XVIII: Toward Real-Time Spectroscopic Imaging and Diagnosis*, edited by Robert R. Alfano, Stavros G. Demos, Angela B. Seddon, Proceedings of SPIE Vol. 11234 (SPIE, Bellingham, WA, 2020) Seven-digit Article CID Number.

ISSN: 1605-7422

ISSN: 2410-9045 (electronic)

ISBN: 9781510632318

ISBN: 9781510632325 (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

Copyright © 2020, 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 \$21.00 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 1605-7422/20/\$21.00.

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.



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 ix	Authors Conference Committee
	SUPERCONTINUUM IN BIOMEDICAL SCIENCE: INTRODUCTION
11234 06	Wavelength dependence of ultrahigh resolution optical coherence tomography using supercontinuum [11234-5]
	CUTTING EDGE SUPERCONTINUUM AND BIOMEDICAL SCIENCE
11234 07	Brain metabolism monitoring through CCO measurements using all-fiber-integrated super-continuum source [11234-64]
	SPECTRAL IMAGING
11234 0G	Molecular oxygen mapping in biological samples by time-correlated single photon counting technique and Ir(III)-based complexes [11234-24]
	NOVEL TECHNIQUES
11234 OL	Generalized special functions are Majorana-like photons [11234-18]
11234 OM	The use of Stokes-Mueller polarimetry for assessment of amyloid- β progression in a mouse model of Alzheimer's disease [11234-19]
	SPECTROSCOPIC METHODS I
11234 OP	A time-resolved near-infrared spectroscopy based on CMOS image sensor [11234-23]
	SPECTROSCOPIC METHODS II
11234 OR	Fast and label-free optical detection of dysplastic and tumour brain tissues [11234-25]

11234 OV	Scattering spectra from trace particles actively illuminated by a mid-infrared supercontinuum FTIR sensor [11234-29]
11234 OW	Stand-off non-destructive determination of protein level in wheat flour with a super-continuum laser [11234-30]
11234 OY	S ₂ state optical property enhancement of indocyanine green due to optical exposure [11234-31]
	OPTICAL HISTOLOGY I
11234 OZ	Optical virtual skin biopsy using two-color ultrafast fiber laser (Invited Paper) [11234-32]
	OPTICAL HISTOLOGY III
	OFFICAL HISTOLOGY III
11234 1A	Optical access to the brain through a transparent cranial implant (Invited Paper) [11234-44]
	OPTICAL BIOASSAY PLATFORMS
11234 1D	Correlation of metabolites in saliva and in vivo tissue of oral cancer patients based on fluorescence spectral deconvolution [11234-47]
11234 1E	Brain metabolism changes in cases of impaired breathing or blood circulation in rodents evaluated by optical spectroscopy methods [11234-6]
	POSTER SESSION
11234 1H	SWIR windows as an adjunctive to biopsy for distinguishing and monitoring benign and malignant tissues [11234-50]
11234 11	In vivo detection of glioblastoma through multimodal fibre-probe spectroscopy [11234-52]
11234 1J	Improving temporal resolution of fNIRS-DOT by the guidance of data-reduced pre-OT [11234-53]
11234 1K	A multi-channel diffuse correlation spectroscopy system for dynamic topography of blood flow index in deep tissues [11234-54]
11234 1L	A lock-in photon-counting based single pixel imaging toward real-time multi-wavelength SFD-DOT [11234-55]

Abnormal tryptophan metabolism in Alzheimer's disease (ALZ): label-free spectroscopy suggests an alternative theory of ALZ causation [11234-59]

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.

Aguilar, Guillermo, 1A Alam, Hasan, 07

Alekseyev, Aleksander G., 1E Alfano, Robert R., OL, 1H, 1P

Anand, Suresh, OR Aruna, Prakasarao, 1D Baria, Enrico, OR, 11 Beard, Daniel, 07 Binder, Devin K., 1A Bishnoi, Suman, OY Borovkova, Mariia, 0M Broglio, Steven, 07 Buccoliero, Anna Maria, OR

Bykov, Alexander, 0M Cano-Velázquez, Mildred S., 1A

Chang, Guoqing, 0Z Chung, Hsiang-Yu, 0Z Cicchi, Riccardo, OR, 11

Dan, Mai, 1L Davoodzadeh, Nami, 1A Demory, Brandon, OW Dremin, Viktor V., 1E Dudenkova, Varvara V., 0G Dunaev, Andrey V., 1E Dutta, Surjendu B., OY Fukushi, Yasuko, OP Ganesan, Singaravelu, 1D Gao, Feng, 1J, 1K, 1L Giordano, Flavio, OR

Gnanatheepam, Einstein, 1D Goverdhan, Amit, 0Y Greinert, Rüdiger, 0Z Guo, Kaiwen, 07, 0V, 0W Gupta, Sharad, 0Y Hakamata, Masashi, OP Halaney, David, 1A He, Xianadona, 1K

Hernández-Cordero, Juan, 1A

Hou, Xi, 1L Hu, Xiaosu, 07

Ifarraguerri, Agustin I., 0V Islam, Mohammed N., 07, 0V, 0W

Jaiswal, Saumya, OY Jonak, Carrie R., 1A Kagawa, Keiichiro, OP Kandurova, Ksenia Yu., 1E Kärtner, Franz X., 0Z Kawabe, Tsutomu, 06 Kawagoe, Hiroyuki, 06

Kawahito, Shoji, OP Kharey, Prashant, 0Y Kim, Jessica, 07 Kovelman, Ioulia, 07 Kozlov, Igor O., 1E Kritchenkov, Ilva S., 0G Kumari, Anshu, 0Y

Kuznetsov, Sergey L., 1E

Li, Tongxin, 1L Lioe, De Xing, OP Liu, Dongyuan, 1J Liu, Yang, 1J Lukina, Maria M., 0G Mamani-Reyes, Sandra, OL Manoharan, Yuvaraj, 1D

Martinez, Ramon A., 07, 0V, 0W Matsushima, Miyoko, 06 Maynard, Robert, OW Meah, Cynthia N., 07 Meah, Shawn, OW Meglinski, Igor V., 0M, 1E Memmini, Allyssa K., 07 Mori, Kensaku, 06 Nishizawa, Norihiko, 06 Niwayama, Masatsugu, OP

Nolan, Daniel A., 0L Novikova, Tatiana, 0M Pahnke, Jens, 0M Pan, Tiantian, 1J Pappu, Raja, 1D

Pavone, Francesco Saverio, OR, 11 Piavchenko, Gennadii A., 1E Pierangelo, Angelo, 0M Pillai, Vinoshene, 11 Popov, Alexey, 0M Pracucci, Enrico, 11 Qin, Zhuanping, 1K

Ramamoorthy, Sangeetha, 1D Ratto, Gian Michele, 11 Russo, Rachel, 07

Sadaksharam, Jayachandran, 1D Seryogina, Evgeniya S., 1E Shcheslavskiy, Vladislav I., 0G

Shi, Lingyan, OL, 1H Shirmanova, Marina V., 0G Shupletsov, Valery V., 1E Solomatina, Anastasia I., 0G Sordillo, Diana C., 1H Sordillo, Laura A., 1H, 1P

Sordillo, Peter P., 1H, 1P Stavtsev, Dmitry D., 1E Stelmashchuk, Olga A., 1E Terry, Fred L., 0V, 0W Tunik, Sergey P., 0G Van Den Bergh, Francoise, 07 Wang, Bingyuan, 1J Weissman, Daniel, 07 Xie, Jinbin, 1K Yamamoto, Seiji, 0P Yamanaka, Masahito, 06 Yasutomi, Keita, 0P Zhai, Tianqu, 07, 0V, 0W Zhang, Yao, 1J Zherebtsov, Evgeny A., 1E

Conference Committee

Symposium Chairs

Jennifer K. Barton, The University of Arizona (United States) **Wolfgang Drexler**, Medizinische Universität Wien (Austria)

Program Track Chairs

Tuan Vo-Dinh, Fitzpatrick Institute for Photonics, Duke University (United States)

Anita Mahadevan-Jansen, Vanderbilt University (United States)

Conference Chairs

Robert R. Alfano, The City College of New York (United States)Stavros G. Demos, University of Rochester Laboratory for Laser Energetics (United States)

Angela B. Seddon, The University of Nottingham (United Kingdom)

Conference Program Committee

Nicole J. Crane, Naval Medical Research Center (United States)

Amir Gandjbakhche, National Institutes of Health (United States)

Israel Gannot, Johns Hopkins University (United States) and Tel Aviv
University (Israel)

Michael G Giacomelli, University of Rochester (United States)

Zhiwei Huang, National University of Singapore (Singapore)

Nicusor V. Iftimia, Physical Sciences Inc. (United States)

Richard M. Levenson, University of California, Davis (United States)

Igor V. Meglinski, University of Oulu (Finland)

Yang Pu, MicroPhotoAcoustics, Inc. (United States)

Milind Rajadhyaksha, Memorial Sloan-Kettering Cancer Center (United States)

Lingyan Shi, University of California, San Diego (United States)

Gennady B. Shvets, Cornell University (United States)

Ganesan Singaravelu, Anna University, Chennai (India)

Min Xu, Hunter College (United States)

Session Chairs

1 Supercontinuum 50th Birthday

Angela B. Seddon, The University of Nottingham (United Kingdom)

- Supercontinuum Field: Introduction
 Angela B. Seddon, The University of Nottingham (United Kingdom)
- 3 Supercontinuum in Biomedical Science: Introduction Angela B. Seddon, The University of Nottingham (United Kingdom)
- 4 Cutting Edge Supercontinuum and Biomedical Science

 Angela B. Seddon, The University of Nottingham (United Kingdom)
- 5 Fiber Mid-Infrared Supercontinuum: Introduction **Angela B. Seddon**, The University of Nottingham (United Kingdom)
- 6 Fiber Mid-Infrared Supercontinuum and Biomedical Science Angela B. Seddon, The University of Nottingham (United Kingdom)
- Industrial Supercontinuum Fiber LasersAngela B. Seddon, The University of Nottingham (United Kingdom)
- Spectral Imaging Angela B. Seddon, The University of Nottingham (United Kingdom) Stavros G. Demos, Laboratory for Laser Energetics (United States)
- Novel Techniques

 Laura A. Sordillo, The City College of New York (United States)

 Lingyan Shi, University of California, San Diego (United States)
- Spectroscopic Methods I Israel Gannot, Tel Aviv University (Israel) Enrique J. Galvez, Colgate University (United States) Ganesan Singaravelu, Anna University, Chennai (India)
- 11 Spectroscopic Methods II
 Binlin Wu, Southern Connecticut State University (United States)
 Min Xu, Hunter College (United States)
- 12 Optical Histology I Yang Pu, MicroPhotoAcoustics, Inc. (United States) Lingyan Shi, University of California, San Diego (United States)
- 13 Optical Histology II Yang Pu, MicroPhotoAcoustics, Inc. (United States) Yasuaki Kumamoto, Osaka University (Japan)
- Optical Histology III
 Anna N. Yaroslavsky, University of Massachusetts Lowell (United States)
 Angela B. Seddon, The University of Nottingham (United Kingdom)

15 Optical Bioassay Platforms

Stavros G. Demos, Laboratory for Laser Energetics (United States) **Nicusor V. Iftimia**, Physical Sciences Inc. (United States)