# Mechanisms of Photobiomodulation Therapy XV

Michael R. Hamblin James D. Carroll Praveen Arany Editors

1 February 2020 San Francisco, California, United States

Sponsored and Published by SPIE

**Volume 11221** 

Proceedings of SPIE, 1605-7422, V. 11221

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 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 *Mechanisms of Photobiomodulation Therapy XV*, edited by Michael R. Hamblin, James D. Carroll, Praveen Arany, Proceedings of SPIE Vol. 11221 (SPIE, Bellingham, WA, 2020) Seven-digit Article CID Number.

ISSN: 1605-7422

ISSN: 2410-9045 (electronic)

ISBN: 9781510632059

ISBN: 9781510632066 (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 © 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**

∨ ∨ii	Authors Conference Committee
SESSION 1	CELLULAR MECHANISMS OF PBM
11221 03	Photobiomodulation promotes cell survival in diabetic wounded fibroblast cells [11221-2]
SESSION 2	MODELING PBM DOSIMETRY
11221 09	Review on clinical trial results of red and near infrared LED photobiomodulation [11221-8]
11221 0A	Fluorescent light energy in wound healing: when is a photon something more? [11221-9]
SESSION 3	MOLECULAR MECHANISMS OF PBM
11221 0D	Femtosecond transient absorption spectroscopy to study the effects of low irradiance light on cytochrome c and cytochrome c reductase [11221-12]
11221 OE	Low irradiance light exposure alters the activity of key enzymes in the mitochondrial electron transport chain [11221-13]
11221 OF	Effects of specific inhibitors and low irradiance visible light on the redox cycling of cytochrome c in isolated mitochondria using resonance Raman spectroscopy [11221-14]
SESSION 4	PBM CLINICAL APPLICATIONS
11221 OL	<b>40</b> Hz invisible spectral flicker and its potential use in Alzheimer's light therapy treatment [11221-20]
	POSTER SESSION
11221 00	Effect of LED phototherapy on pain control after insertion of elastomeric separators in orthodontics patients: clinical trial [11221-23]

11221 OP	Nanoconcentrations of 1,9-dimethylmethylene blue (DMMB) associated to laser, LED or polarized light are highly effective on AmPDT carried out in aerobes and aerotolerant anaerobes Gram-positive bacteria [11221-24]
11221 0Q	Evaluation of optical redox ratio in Candida albicans cells exposed to photobiomodulation [11221-25]
11221 OR	LED-bed therapy of cardiovascular disorders: a volunteer study [11221-27]

### **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.

Abrahamse, H., 03 Adjimann, Tamara S., 0Q Alves, Fernanda, 0Q Bezerra, Maria Carolina S. M., 00 Briljonoks, Dz., OR Broena, Jes, OL Campbell, Shannon E., 0A Carstensen, Marcus S., OL Corell, Dennis Dan, 0A, 0L Corrêa, Thaila Quatrini, 0Q Crugeira, Pedro Jorge L., 0P de A. Santos, Darcy, OP de Almeida, Paulo Fernando, OP de Oliveira, Susana C. P. S., OP Dehghani, Mehrnoush, 0A Denton, Michael L., OD, OE, OF Edge, Dierdre, 0A Fagnani, Sandra R. C. A., OP Feijóo Carrillo, Gustavo M., 0L Habib, Fernando A. L., 00 Hamblin, Michael R., 0A Hansen, Henrik E., OL Hansen, Luna S., OL Hebert, Lise, 0A Houreld, N. N., 03 Jaworska, Joanna, 0A Jere, S. W., 03 Kriegsfeld, Lance J., OL Kronberga, H., OR Lalonde, Josh W., OF Lim, Sungkyoo, 09 Lindén, Johannes, OL Marcinkevics, Z., OR Mellergaard, Maiken, 0A Monteiro, Juliana S. C., OP Nguyen, N. Mai, OL Nielsen, Michael R., 0A Noojin, Gary D., 0D, 0F Nunes, lago P. F., OP O'Connor, Sean P., 0D Petersen, Paul Michael, OL Pinheiro, Antônio Luiz B., 0O, 0P Pope, Nathaniel J., OD, OE, OF Powell, Samantha M., OD, OF Pratavieira, Sebastião, OQ Rickman, John M., 0D Sampaio, Fernando J. P., OP Scully, Marlan O., 0D

Skov, Søren, OA

Soares, Luiz Guilherme P., 0O, 0P Spigulis, J., 0R Yakovlev, Vladislav V., 0D, 0F Zago, Michela, 0A

## **Conference Committee**

#### Symposium Chairs

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

#### **Program Track Chairs**

 Brian Jet-Fei Wang, Beckman Laser Institute and Medical Clinic, University of California, Irvine (United States)
 Eva Sevick, The University of Texas Health Science Center at Houston (United States)

#### Conference Chairs

Michael R. Hamblin, Wellman Center for Photomedicine (United States)

James D. Carroll, THOR Photomedicine Ltd. (United Kingdom)

Praveen Arany, University at Buffalo (United States)

#### Conference Program Committee

Heidi Abrahamse, University of Johannesburg (South Africa)
Michael L. Denton, Air Force Research Laboratory (United States)
Tomas Hode, Immunophotonics, Inc. (United States)
Clark E. Tedford, LumiThera (United States)
Mei X. Wu, Harvard Medical School (United States) and Wellman Center for Photomedicine (United States)

#### Session Chairs

- 1 Cellular Mechanisms of PBM Praveen Arany, University at Buffalo (United States) James D. Carroll, THOR Photomedicine Ltd. (United Kingdom)
- 2 Modeling PBM Dosimetry James D. Carroll, THOR Photomedicine Ltd. (United Kingdom)
- Molecular Mechanisms of PBM
  Mei X. Wu, Harvard Medical School (United States) and Wellman Center for Photomedicine (United States)

4 PBM Clinical Applications
Praveen Arany, University at Buffalo (United States)