

PROGRESS IN BIOMEDICAL OPTICS AND IMAGING

Vol. 9, No. 13

# ***Optical Interactions with Tissue and Cells XIX***

**Steven L. Jacques**

**William P. Roach**

**Robert J. Thomas**

*Editors*

**21–23 January 2008**

**San Jose, California, USA**

*Sponsored and Published by*

SPIE

**Volume 6854**

Proceedings of SPIE, 1605-7422, v. 6854

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 *Optical Interactions with Tissue and Cells XIX*, edited by Steven L. Jacques, William P. Roach, Robert J. Thomas, Proceedings of SPIE Vol. 6854 (SPIE, Bellingham, WA, 2008) Article CID Number.

ISSN 1605-7422  
ISBN 9780819470294

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 © 2008, 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](http://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 1605-7422/08/\$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

[SPIDigitalLibrary.org](http://SPIDigitalLibrary.org)

---

**Paper Numbering:** Proceedings of SPIE follow an e-First publication model, with papers published first online and then in print and on CD-ROM. Papers are published as they are submitted and meet publication criteria. A unique, consistent, permanent 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 they are published online, and connects the same identifier to all online, print, and electronic versions of the publication. SPIE uses a six-digit CID article numbering system in which:

- The first four 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. Numbers in the index correspond to the last two digits of the six-digit CID number.

# Contents

ix *Conference Committee*

---

## SESSION 1 PHOTO-THERMAL INTERACTION

---

- 6854 03 **Use of optical reporter genes to assess sublethal cellular damage following skin ablation** [6854-02]  
G. J. Wilmlink, S. R. Opalenik, Vanderbilt Univ. (USA); J. M. Davidson, Vanderbilt Univ. (USA) and Department of Veterans Affairs Medical Ctr. (USA); E. D. Jansen, Vanderbilt Univ. (USA)
- 6854 04 **Part II: Morphological analysis of embryonic development following femtosecond laser manipulation** [6854-03]  
V. Kohli, A. Y. Elezzabi, Univ. of Alberta (Canada)
- 6854 05 **NIR-laser tissue welding in an in vivo guinea pig animal model** [6854-04]  
V. Sriramaju, City College of New York (USA); H. E. Savage, New York Eye and Ear Infirmary (USA); A. Katz, R. Chakraverty, Y. Budansky, R. Podder, N. Davatgarzadeh, U. Kartazayev, City College of New York (USA); R. B. Rosen, New York Eye and Ear Infirmary (USA); R. R. Alfano, City College of New York (USA)
- 6854 06 **Porcine skin ED50 damage thresholds for 1214 nm laser irradiation** [6854-05]  
B. Chen, The Univ. of Texas at Austin (USA); J. Oliver, Air Force Research Lab. (USA); R. Vincelette, G. Pocock, R. Zaman, A. J. Welch, The Univ. of Texas at Austin (USA)
- 6854 08 **The potential application of hairless guinea pigs as a replacement for the Yucatan mini-pig in animal studies** [6854-07]  
N. M. Jindra, Air Force Research Lab. (USA); M. L. Imholte, Northrop Grumman (USA)
- 6854 09 **Air leak seal for lung dissection plane with diode laser irradiation: monitoring heat-denature with auto-fluorescence** [6854-08]  
M. Gotoh, T. Arai, Keio Univ. (Japan)

---

## SESSION 2 NEURAL STIMULATION

---

- 6854 0B **Frontiers in optical stimulation of neural tissues: past, present, and future (Invited Paper)** [6854-10]  
J. Wells, M. Bendett, J. Webb, Aculight Corp. (USA); C. Richter, A. Izzo, Northwestern Univ. (USA); E. D. Jansen, A. Mahadevan-Jansen, Vanderbilt Univ. (USA)
- 6854 0C **Laser stimulation of the auditory system at 1.94  $\mu\text{m}$  and microsecond pulse durations** [6854-11]  
A. D. Izzo, J. T. Walsh, Jr., Northwestern Univ. (USA); H. Ralph, Northstar Neuroscience (USA); J. Webb, J. Wells, M. Bendett, Aculight Corp. (USA); C.-P. Richter, Northwestern Univ. (USA)

- 6854 OE **Photostimulation of sensory neurons of the rat vagus nerve** [6854-13]  
A. Y. Rhee, Univ. of Maryland Biotechnology Institute (USA) and Univ. of Maryland, Baltimore (USA); G. Li, Univ. of Maryland Biotechnology Institute (USA) and Univ. of Maryland School of Dentistry (USA); J. Wells, Aculight Corp. (USA); J. P. Y. Kao, Univ. of Maryland Biotechnology Institute (USA), Univ. of Maryland, Baltimore (USA), and Univ. of Maryland School of Medicine (USA)
- 6854 OF **Characterization of single auditory nerve fibers in response to laser stimulation** [6854-14]  
P. Littlefield, A. D. Izzo, J. Mundi, J. T. Walsh, Jr., Northwestern Univ. (USA); E. D. Jansen, Vanderbilt Univ. (USA); M. Bendett, J. Webb, H. Ralph, Aculight Corp. (USA); C.-P. Richter, Northwestern Univ. (USA)
- 6854 OH **Prosthetic systems for therapeutic optical activation and silencing of genetically targeted neurons** [6854-16]  
J. G. Bernstein, X. Han, M. A. Henninger, E. Y. Ko, X. Qian, G. Talei Franzesi, J. P. McConnell, P. Stern, R. Desimone, E. S. Boyden, Massachusetts Institute of Technology (USA)
- 6854 OI **Optical stimulation of excised murine sciatic nerve using 1.8-um wavelength laser** [6854-17]  
R. Cargill, T. Baumann, S. L. Jacques, Oregon Health & Science Univ. (USA)

---

### SESSION 3 CELL BIOLOGY AND PHOTOCHEMISTRY

- 6854 OL **The EGFR family of receptors sensitizes cancer cells toward UV light** [6854-20]  
S. Petersen, Aalborg Univ. (Denmark) and SUNY at Buffalo (USA); M. T. Neves-Petersen, Aalborg Univ. (Denmark); B. Olsen, Univ. of Southern Denmark (Denmark)
- 6854 OM **The mechanism of PDT-induced electrical blockade: the measurement of intracellular Ca<sup>2+</sup> concentration changes in cardiac myocytes** [6854-21]  
A. Ito, S. Hosokawa, S. Hakomori, Keio Univ. (Japan); S. Miyoshi, K. Soejima, Keio Univ. School of Medicine (Japan); T. Arai, Keio Univ. (Japan)
- 6854 ON **Inactivation of viruses with a femtosecond laser via impulsive stimulated Raman scattering** [6854-22]  
K. T. Tsen, Arizona State Univ. (USA); S.-W. D. Tsen, C.-L. Chang, C.-F. Hung, T.-C. Wu, Johns Hopkins Univ. School of Medicine (USA); B. Ramakrishna, K. Mossman, Arizona State Univ. (USA); J. G. Kiang, Uniformed Services Univ. of the Health Sciences (USA)
- 6854 OO **Investigation of reactive oxygen species formation in living cells during femtosecond laser based cell surgery** [6854-23]  
J. Baumgart, Laser Zentrum Hannover e.V. (Germany); W. Bintig, A. Ngezahayo, Leibniz Univ. (Germany); W. Ertmer, Univ. of Hannover (Germany); H. Lubatschowski, A. Heisterkamp, Laser Zentrum Hannover e.V. (Germany)
- 6854 OQ **The vascular response observation by the monitoring of the photosensitizer, oxygen, and blood flow during the high intensity pulsed excitation photodynamic therapy 1h after water-soluble photosensitizer intravenous injection** [6854-25]  
S. Hakomori, H. Matsuo, T. Arai, Keio Univ. (Japan)

---

**SESSION 4 MODELING AND COMPUTATION**

---

- 6854 OT **Modeling tissue optics using Monte Carlo modeling: a tutorial (Invited Paper)** [6854-28]  
S. L. Jacques, Oregon Health & Science Univ. (USA)
- 6854 OU **Modeling the interaction of lasers and tissue: importance of accounting for time varying electric properties** [6854-29]  
D. J. Evans, M. L. Manwaring, Univ. of Idaho (USA)
- 6854 OV **Incorporation of refractive index gradients in the solution of the radiative transport equation** [6854-30]  
J. J. Zohner, Air Force Research Lab. (USA); C. D. Clark, Northrop Grumman (USA); T. Kahn, B. C. McAdoo, Clemson Univ. (USA); R. J. Thomas, Air Force Research Lab. (USA)
- 6854 OW **Spectral analysis of Pennes' bio-heat equation** [6854-31]  
L. X. Cundin, Conceptual MindWorks, Inc./Air Force Research Lab. (USA)
- 6854 OX **Modeling explosive cellular damage** [6854-33]  
D. G. Mixon, Air Force Research Lab. (USA)
- 6854 OZ **Comparing finite difference time domain and Monte Carlo modeling of human skin interaction with terahertz radiation** [6854-36]  
B. L. Ibey, J. A. Payne, D. G. Mixon, R. J. Thomas, W. P. Roach, Air Force Research Lab. (USA)

---

**SESSION 5 PHOTO-THERMAL ABLATION**

---

- 6854 10 **Pressure (mechanical) effects in infrared tissue ablation (Invited Paper)** [6854-37]  
G. Edwards, W. Wagner, A. Sokolow, Duke Univ. (USA); R. Pearlstein, Duke Univ. Medical Ctr. (USA)
- 6854 11 **Viability evaluation of culture cells patterned by femtosecond laser-induced impulsive force** [6854-38]  
N. Takizawa, Hamano Life Science Research Foundation (Japan); K. Okano, Hamano Life Science Research Foundation (Japan) and Osaka Univ. (Japan); T. Uwada, Hamano Life Science Research Foundation (Japan); Y. Hosokawa, H. Masuhara, Hamano Life Science Research Foundation (Japan), Osaka Univ. (Japan), and CREST, Japan Science and Technology Agency (Japan)
- 6854 12 **Threshold parameters of the mechanisms of selective nanophotothermolysis with gold nanoparticles** [6854-39]  
V. Pustovalov, Belarusian Institute of System Analysis (Belarus); V. Zharov, Univ. of Arkansas for Medical Sciences (USA)
- 6854 13 **Part I. Embryonic surgery using femtosecond laser pulses for the delivery of exogenous materials and the analysis of gene expression** [6854-40]  
V. Kohli, A. Y. Elezzabi, Univ. of Alberta (Canada)

- 6854 14 **Smart bombing a single targeted cell with femtogram order reagents using laser-induced shockwave technique** [6854-41]  
K. Okano, Hamano Life Science Research Foundation (Japan) and Osaka Univ. (Japan); N. Takizawa, T. Uwada, Hamano Life Science Research Foundation (Japan); Y. Hosokawa, H. Masuhara, Hamano Life Science Research Foundation (Japan), Osaka Univ. (Japan), and CREST, Japan Science and Technology Agency (Japan)
- 6854 15 **An in vitro corneal model with a laser damage threshold at 2  $\mu\text{m}$  that is similar to that in the rabbit** [6854-42]  
M. S. Foltz, M. L. Denton, K. J. Schuster, Northrop Grumman (USA); L. E. Estlack, Conceptual Mindworks, Inc. (USA); S. S. Kumru, Air Force Research Lab. (USA)
- 6854 16 **Ultra-short pulsed laser tissue ablation using focused laser beam** [6854-44]  
M. K. Jaunich, S. Raje, K. Mitra, M. S. Grace, Florida Institute of Technology (USA); M. Fahey, G. Spooner, Raydiance, Inc. (USA)
- 6854 17 **Laser ablation of otic capsule tissue** [6854-45]  
R. G. McCaughey, B. J. F. Wong, Beckman Laser Institute (USA); J. Tafoya, Y. Sun, Infralase Inc. (USA); R. Jain, Univ. of New Mexico (USA)
- 6854 18 **Selective removal of cholesterol ester in atherosclerotic plaque using nanosecond pulsed laser at 5.75  $\mu\text{m}$**  [6854-46]  
K. Ishii, H. Tsukimoto, H. Hazama, K. Awazu, Osaka Univ. (Japan)

---

**SESSION 6 SPECTROSCOPY, OPTICS, AND SCATTERING**

- 6854 19 **Optimizing the use of laser alignment thermal sensitive paper for a 1.54 micron Er-glass laser** [6854-47]  
K. J. Walter, T. E. Eurell, T. E. Johnson, Colorado State Univ. (USA)
- 6854 1A **Coherent backscattering of polarized light for tissue diagnostics: an electric field Monte Carlo study** [6854-48]  
M. Xu, Fairfield Univ. (USA)
- 6854 1C **Optical properties of human tendons characterized by PSOCT and their relation to tendinopathy: a clinical study** [6854-51]  
P. O. Bagnaninchi, Keele Univ. (United Kingdom); D. Churmakov, M. Bonesi, Cranfield Health, Cranfield Univ. (United Kingdom); Y. Yang, Keele Univ. (United Kingdom); C. Phelan, Univ. Hospital of North Staffordshire (United Kingdom); N. Maffulli, Keele Univ. (United Kingdom); I. Meglinski, Cranfield Health, Cranfield Univ. (United Kingdom); A. El Haj, Keele Univ. (United Kingdom)
- 6854 1D **Optical imaging of structures within highly scattering material using a lens and aperture to form a spatiofrequency filter** [6854-52]  
N. Pfeiffer, P. Chan, G. H. Chapman, F. Vasefi, B. Kaminska, Simon Fraser Univ. (Canada)
- 6854 1E **Enhanced angular domain optical imaging by background scattered light subtraction from a deviated laser source** [6854-53]  
F. Vasefi, G. H. Chapman, P. Chan, B. Kaminska, N. Pfeiffer, Simon Fraser Univ. (Canada)

- 6854 1F **Enhancement of light in tissue using hyper-osmotic agents** [6854-54]  
R. T. Zaman, B. Chen, A. B. Parthasarathy, A. D. Estrada, Jr., A. Ponticorvo, H. G. Rylander III, A. K. Dunn, A. J. Welch, The Univ. of Texas at Austin (USA)
- 6854 1H **Characterization of neutral density filters for use in near infrared lasers** [6854-56]  
E. Rickers, K. J. Walter, T. E. Johnson, Colorado State Univ. (USA)

---

#### POSTER SESSION

---

- 6854 1J **Morphometric effects of different energy densities of diode laser on adipose tissue in rats** [6854-59]  
H. C. Senhorinho, G. L. Bichinho, P. Nohama, M. A. Gariba, Pontifical Catholic Univ. of Paraná (Brazil)
- 6854 1K **Femtosecond laser manipulation techniques for individual patterning of biological micro-object** [6854-60]  
Y. Hosokawa, Hamano Life Science Research Foundation (Japan), Osaka Univ. (Japan), and CREST, Japan Science and Technology Agency (Japan); Y. Jiang, Hamano Life Science Research Foundation (Japan) and Handai Nano Photonics Institute (Japan); I. Oh, Handai Nano Photonics Institute (Japan) and Osaka Univ. (Japan); N. Takizawa, T. Uwada, Hamano Life Science Research Foundation (Japan); K. Okano, Hamano Life Science Research Foundation (Japan) and Osaka Univ. (Japan); H. Masuhara, Hamano Life Science Research Foundation (Japan), Handai Nano Photonics Institute (Japan), Osaka Univ. (Japan), and CREST, Japan Science and Technology Agency (Japan)
- 6854 1L **Femtosecond cellular transfection using a non-diffracting beam** [6854-61]  
X. Tsampoula, V. Garcés-Chávez, M. Comrie, D. J. Stevenson, B. Agate, C. T. A. Brown, F. Gunn-Moore, K. Dholakia, Univ. of St. Andrews (United Kingdom)
- 6854 1M **Full path Monte Carlo simulation of fluorescence in non-voxelized complex heterogeneous mouse model** [6854-62]  
J.-F. Delorme, G. Ma, Advanced Research Technologies (Canada); F. Lesage, Ecole Polytechnique de Montreal (Canada); F. Leblond, A. Benyamin-Seyar, Advanced Research Technologies (Canada)

*Author Index*





# Conference Committee

## *Symposium Chairs*

**James Fujimoto**, Massachusetts Institute of Technology (USA)  
**R. Rox Anderson**, Wellman Center for Photomedicine, Massachusetts General Hospital (USA), and Harvard School of Medicine (USA)

## *Program Track Chairs*

**Steven L. Jacques**, Oregon Health and Science University (USA)  
**William P. Roach**, Air Force Research Laboratory (USA)

## *Conference Chairs*

**Steven L. Jacques**, Oregon Health & Science University (USA)  
**William P. Roach**, Air Force Research Laboratory (USA)  
**Robert J. Thomas**, Air Force Research Laboratory (USA)

## *Program Committee*

**Randolph D. Glickman**, The University of Texas Health Science Center at San Antonio (USA)  
**E. Duco Jansen**, Vanderbilt University (USA)  
**Anita Mahadevan-Jansen**, Vanderbilt University (USA)  
**Jill McQuade**, Air Force Research Laboratory (USA)  
**Jessica C. Ramella-Roman**, The Catholic University of America (USA)  
**Alfred Vogel**, Universität zu Lübeck (Germany)  
**Lihong V. Wang**, Washington University in St. Louis (USA)

## *Session Chairs*

- 1 Photo-Thermal Interaction  
**E. Duco Jansen**, Vanderbilt University (USA)
- 2 Neural Stimulation  
**Anita Mahadevan-Jansen**, Vanderbilt University (USA)
- 3 Cell Biology and Photochemistry  
**Randolph D. Glickman**, The University of Texas Health Science Center at San Antonio (USA)
- 4 Modeling and Computation  
**Robert J. Thomas**, Air Force Research Laboratory (USA)

- 5 Photo-Thermal Ablation  
**Robert J. Thomas**, Air Force Research Laboratory (USA)
  - 6 Spectroscopy, Optics, and Scattering  
**Lihong V. Wang**, Washington University in St. Louis (USA)  
**Jessica C. Ramella-Roman**, The Catholic University of America (USA)
- Poster Session  
**Robert J. Thomas**, Air Force Research Laboratory (USA)