PROGRESS IN BIOMEDICAL OPTICS AND IMAGING
Vol. 10, No. 49

Therapeutic Laser Applications and Laser-Tissue Interactions IV

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Editors

17–18 June 2009
Munich, Germany

Sponsored and Published by
Optical Society of America (United States)
SPIE

Cooperating Organisation
German Biophotonics Research Program (Germany)

Cosponsored by
Photonics4Life—European Network of Excellence for Biophotonics
Air Force Office of Scientific Research (United States)

Volume 7373

Proceedings of SPIE, 1605-7422, v. 7373

Please use the following format to cite material from this book:
Author(s), "Title of Paper," in *Therapeutic Laser Applications and Laser-Tissue Interactions IV*, edited by Ronald Sroka, Lothar D. Lilge, Proceedings of SPIE-OSA Vol. 7373 (SPIE, Bellingham, WA, 2009) Article CID Number.

ISSN 1605-7422
ISBN 9780819476494

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
Optical Society of America
2010 Massachusetts Ave., N.W., Washington, D.C., 20036 USA
Telephone 1 202/223-8130 (Eastern Time) · Fax 1 202/223-1096
http://www.osa.org

Printed in the United States of America.

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

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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:

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Contents

NOVEL APPROACHES

POSTER SESSION

Conference Committee

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Barbara E. Krammer, Universität Salzburg (Austria)
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Ethne L. Nussbaum, University of Toronto (Canada)
Dominic J. Robinson, Erasmus Universiteit Medisch Centrum Rotterdam (Netherlands)
Ricardas Rotomskis, Vilnius University (Lithuania)
Herbert G. Stepp, Ludwig-Maximilians-Universität München (Germany)
Alfred Vogel, Universität zu Lübeck (Germany)
Georges A. Wagnieres, Ecole Polytechnique Fédérale de Lausanne (Switzerland)
Timothy C. Zhu, The University of Pennsylvania (United States)

Session Chairs

Cellular Surgery I
Lothar D. Lilge, Ontario Cancer Institute (Canada)
Alfred Vogel, Universität zu Lübeck (Germany)

Cellular Surgery II
Ralf Brinkmann, Universität zu Lübeck (Germany)
Wolfgang Baeumler, Universitätsklinikum Regensburg (Germany)

Opthalmology
Martin Frenz, Universität Bern (Switzerland)

Novel Approaches
Christoph Haisch, Technische Universität München (Germany)
Ronald Sroka, Ludwig-Maximilians-Universität München (Germany)

Photodynamic Therapy I
Barbara E. Krammer, Universität Salzburg (Austria)

Photodynamic Therapy II
Herbert G. Stepp, Ludwig-Maximilians-Universität München (Germany)
Dominic J. Robinson, Erasmus Universiteit Medisch Centrum Rotterdam (Netherlands)

Modeling
Stefan Andersson-Engels, Lunds Tekniska Högskola (Sweden)
Alfred Vogel, Universität zu Lübeck (Germany)

Clinical Laser Therapy
Raimund Hibst, Universität Ulm (Germany)

Introduction

One decade ago, the development of novel therapeutic laser and light applications in medicine focused on the investigation of light tissue interactions as function of photon (power) density and dielectric properties of the tissue. Some of this work is still ongoing and focuses more on the long term outcome. Examples thereof in these proceedings include partial porcine kidney resection (73731B) removal of atherosclerotic plaque (73731E), photodynamic therapy of skin disease (73730S) and lentotomy, the treatment of presbyopia, the loss of elasticity of the crystallize lens (73730H).

Now that lasers achieving >10^{20} Wcm^{-2} have been aimed at most common tissues and their immediate and long term responses are known, the attention of research is shifting towards exploiting this knowledge of tissue response towards maximizing the therapeutic efficacy. Maximizing efficacy in turn requires improved treatment planning, on-line treatment guidance, and biological response monitoring. A second more recent development is the exploitation of our knowledge of laser tissue interaction in biology which will become more important with recent development in molecular and cell biology as it becomes evident that single cells or small clusters of cells are driving biological and thus medically relevant processes.

Techniques to perform an intentional modification or therapies on individual cells, or small tissue volumes, require localization of the photon absorption in space and/or time such as through the use of: nanoparticles (737308), femtosecond exposure transient micro bubbles (73730D), localized x-ray sources (73730N), or micro-structuring of non-biological targets for prosthesis development (73731A). It is anticipated that this segment of "therapeutic" applications will continue to grow, as significant engineering challenges will need to be overcome which most likely will be unique for a rather large range of potential applications in medicine already apparent in the above list.

In respect to improving clinical delivery and therapeutic efficacy, modeling of therapies is becoming more prominent. Novel computing platforms such as graphic processing units (GPU), which become more easily accessible to the scientific community (see 737313, and 737315) will become more pervasive for these tasks. Modeling aspects covered here range from light penetration in skin (737316), temperature fields due to laser irradiation (73731R), to the use of corneal scattering for keratoplasty optimization (73731Y).

Also more prominent is the development of techniques which will enable monitoring of treatment progress, such as detection of tissue denaturation in real time (73730E), use of optoacoustic transients for retinal photocoagulation (73730K), and photo-bleaching of the eye's lens (73730I). Particularly within this line of research, the separation between therapeutic and diagnostic laser application becomes fluid.

The expansion of laser therapies to a whole range of different applicants is also noticeable, ranging from laser osteo-perforation in bone disease (73731T), to endovenous laser treatment (EVLT) (73731S).

Only the treatment monitoring work provides instrumentation development, see (73731M) and (73730P) hinting that laser and light sources for therapeutic applications have matured sufficiently and reached a commodity status.

The future will demonstrate if this trend will continue, away from light source development to real-time therapy monitoring technologies combined with a priority treatment monitoring.

The chairs thank the presenters for their contributions, and the audience and the authors for top information transfer and fruitful discussions. Thank you for making Therapeutic Laser Applications and Laser Tissue Interaction 2009 a scientifically interesting conference within the European Conference of Biomedical Optics 2009.

Lothar D. Lilge
Ronald Sroka