

PROCEEDINGS OF SPIE

[SPIDigitalLibrary.org/conference-proceedings-of-spie](https://spiedigitallibrary.org/conference-proceedings-of-spie)

Front Matter: Volume 8337

, "Front Matter: Volume 8337," Proc. SPIE 8337, Saratov Fall Meeting 2011:
Optical Technologies in Biophysics and Medicine XIII, 833701 (1 March 2012);
doi: 10.1117/12.940783

SPIE.

Event: Saratov Fall Meeting 2011, 2011, Saratov, Russian Federation

Saratov Fall Meeting 2011

Optical Technologies in Biophysics and Medicine XIII

Valery V. Tuchin
Elina A. Genina
Igor V. Meglinski
Editors

27–30 September 2011
Saratov, Russian Federation

Organized by

Saratov State University (Russian Federation) • Institute of Precision Mechanics and Control, Russian Academy of Sciences (Russian Federation) • Research-Educational Institute of Optics and Biophotonics at Saratov State University (Russian Federation) • Research-Educational Center of Nonlinear Dynamics & Biophysics of CRDF and Ministry of Education and Science of RF (REC-006) (Russian Federation) • International Research-Educational Center of Optical Technologies for Industry and Medicine "Photonics" at Saratov State University (Russian Federation) • Volga Regional Center of New Information Technologies (Russian Federation) • Saratov State Medical University (Russian Federation)

In cooperation with

Academy of Natural Sciences, Saratov Regional Division (Russian Federation) • Russian Society for Photobiology (Russian Federation) • Saratov Science Center of the Russian Academy of Sciences (Russian Federation) • Photonics4Life Consortium of EC FP7: Network of Excellence for Biophotonics • Wiley-VCH Verlag GmbH (Germany)

Sponsored by

Russian Foundation for Basic Research (Russian Federation) • Russian Academy of Sciences • U.S. Civilian Research and Development Foundation for the Independent States of the Former Soviet Union (CRDF) (United States) Saratov State University SPIE Student Chapter • Optical Society of America (OSA) • Saratov State University OSA Student Chapter • SPE "Nanostructured Glass Technology" Ltd. (Russian Federation) • SPE "Delta 21 vek," Saratov (Russian Federation)

Published by
SPIE

Volume 8337

Proceedings of SPIE, 1605-7422, v. 8337

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 *Saratov Fall Meeting 2011: Optical Technologies in Biophysics and Medicine XIII*, edited by Valery V. Tuchin, Elina A. Genina, Igor V. Meglinski, Proceedings of SPIE Vol. 8337 (SPIE, Bellingham, WA, 2012) Article CID Number.

ISSN 1605-7422

ISBN 9780819489944

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 © 2012, 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 1605-7422/12/\$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

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 as 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

vii	<i>Conference Committee</i>
xi	<i>Introduction</i>

TISSUE OPTICS

- 8337 02 **Online Monte Carlo based calculator of human skin spectra and color (Invited Paper)** [8337-04]
A. Doronin, I. Meglinski, Univ. of Otago (New Zealand)
- 8337 03 **Helicity of circular polarized light backscattered from biological tissues influenced by optical clearing** [8337-03]
E. Avci, Univ. of Otago (New Zealand) and Technische Hochschule Mittelhessen (Germany);
C. M. Macdonald, I. Meglinski, Univ. of Otago (New Zealand)
- 8337 04 **The phenomenon of cathodoluminescence in tooth hard tissues** [8337-13]
N. O. Bessudnova, M. D. Matasov, Saratov State National Research Univ. (Russian Federation)
- 8337 05 **Optical characterization of muscle** [8337-14]
L. Oliveira, Instituto Superior de Engenharia do Porto (Portugal) and Ctr. de Ciências e Tecnologias Ópticas (Portugal); A. Lage, Univ. do Porto (Portugal); M. Pais Clemente, Ctr. de Ciências e Tecnologias Ópticas (Portugal); V. V. Tuchin, Saratov State Univ. (Russian Federation)

METHODS FOR DIAGNOSTICS

- 8337 06 **Application of optical coherence tomography for assessment of transcutaneous vaccine delivery** [8337-05]
T. Kamali, Univ. of Otago (New Zealand) and Technische Hochschule Mittelhessen (Germany); T. Rattanapak, S. Hook, I. Meglinski, Univ. of Otago (New Zealand)
- 8337 07 **Theoretical analysis of stratified media imaging in low-coherence interference microscopy** [8337-02]
A. A. Grebenyuk, Saratov State Univ. (Russian Federation); V. P. Ryabukho, Saratov State Univ. (Russian Federation) and Institute of Precision Mechanics and Control (Russian Federation)
- 8337 08 **Off-axis digital holography: image reconstruction in case of Nyquist frequency excess** [8337-10]
K. A. Grebenyuk, A. A. Grebenyuk, Saratov State Univ. (Russian Federation); V. P. Ryabukho, Saratov State Univ. (Russian Federation) and Institute of Precision Mechanics and Control (Russian Federation)

- 8337 09 **Application of x-ray nano-particulate markers for the visualization of intermediate layers and interfaces using scanning electron microscopy** [8337-12]
N. O. Bessudnova, D. I. Bilenko, A. M. Zakharevich, Saratov State National Research Univ. (Russian Federation)
- 8337 0A **Correlation of skin temperature and blood flow oscillations** [8337-20]
A. A. Sagaidachnyi, D. A. Usanov, A. V. Skripal, A. V. Fomin, Saratov State Univ. (Russian Federation)
- 8337 0B **Application of t-LASCA and speckle-averaging techniques for diagnostics of malignant tumors on animal models** [8337-24]
S. Ulyanov, Saratov State Univ. (Russian Federation); V. Laskavy, A. Golova, T. Polyanina, Saratov Scientific and Research Veterinary Institute (Russian Federation); O. Ulianova, Saratov State Univ. (Russian Federation), Saratov Scientific and Research Veterinary Institute (Russian Federation), and Saratov State Agrarian Univ. (Russian Federation); V. Feodorova, Saratov Scientific and Research Veterinary Institute (Russian Federation) and Saratov State Agrarian Univ. (Russian Federation); A. Ulyanov, Saratov State Univ. (Russian Federation)
- 8337 0C **Theory and calibration of speckle dynamics of phase object** [8337-19]
A. P. Vladimirov, Institute of Engineering Science (Russian Federation); A. V. Druzhinin, Institute of Metal Physics (Russian Federation); A. S. Malygin, K. N. Mikitas, Ural Federal Univ. (Russian Federation)
- 8337 0D **The most important physiological constants among the Volga region long-livers** [8337-15]
L. I. Malinova, Saratov Research Institute of Cardiology (Russian Federation); S. S. Shuvalov, T. P. Denisova, Saratov State Medical Univ. (Russian Federation)

PHOTODYNAMIC THERAPY

- 8337 0E **Thermal distribution in biological tissue at laser induced fluorescence and photodynamic therapy** [8337-06]
I. V. Krasnikov, A. Yu. Seteikin, Amur State Univ. (Russian Federation); E. Drakaki, M. Makropoulou, National Technical Univ. of Athens (Greece)
- 8337 0F **Effect of bacterial lectin on acceleration of fat cell lipolysis at in vitro diode laser treatment using encapsulated ICG** [8337-07]
I. Yu. Yanina, V. I. Kochubey, Saratov State Univ. (Russian Federation); V. V. Tuchin, Saratov State Univ. (Russian Federation), Institute of Precise Mechanics and Control (Russian Federation), and Univ of Oulu (Finland); S. A. Portnov, Y. I. Svenskaya, D. A. Gorin, Saratov State Univ. (Russian Federation); E. G. Ponomareva, V. E. Nikitina, Institute of Biochemistry and Physiology of Plants and Microorganisms (Russian Federation)
- 8337 0G **Studies of lipid peroxidation of rat blood after in vivo photodynamic treatment** [8337-08]
I. Yu. Yanina, Saratov State Univ. (Russian Federation); N. A. Navolokin, V. V. Nikitina, A. B. Bucharskaya, G. N. Maslyakova, Saratov State Medical Univ. (Russian Federation); V. V. Tuchin, Saratov State Univ. (Russian Federation), Institute of Precise Mechanics and Control (Russian Federation), and Univ. of Oulu (Finland)

LASERS AND MATERIALS FOR BIOPHOTONICS

- 8337 0H **Chiral and achiral symmetry in dynamics of vector-field lasers** [8337-01]
L. P. Svirina, Belarussian National Technical Univ. (Belarus)
- 8337 0I **Studying of dielectric properties of polymers in the terahertz frequency range** [8337-09]
E. V. Fedulova, M. M. Nazarov, A. A. Angeluts, Lomonosov Moscow State Univ. (Russian Federation); M. S. Kitai, V. I. Sokolov, Institute on Laser and Information Technologies (Russian Federation); A. P. Shkurinov, Lomonosov Moscow State Univ. (Russian Federation)
- 8337 0J **Carbon nanoparticles formed by evaporation of graphite under glass: Yb, Er laser radiation** [8337-18]
A. V. Belikov, A. V. Skrypnik, N. A. Zulina, St. Petersburg National Research Univ. of Information Technologies, Mechanics and Optics (Russian Federation)

ECO-PHOTONICS

- 8337 0K **Eco-photonics: application of optical diagnostic modalities for non-invasive monitoring and evaluation of stress conditions of aquatic organisms (Invited Paper)** [8337-11]
A. N. Gurkov, D. V. Axenov-Gribanov, V. V. Pavlichenko, N. S. Shakhtanova, D. S. Bedulina, M. A. Timofeyev, Irkutsk State Univ. (Russian Federation); V. Kalchenko, Weizmann Institute of Science (Israel); I. Meglinski, Univ. of Otago (New Zealand)
- 8337 0L **Micro-encapsulated sensors for in vivo assessment of the oxidative stress in aquatic organisms** [8337-16]
A. Sadovoy, A*STAR Institute of Materials Research and Engineering (Singapore); C. Teh, A*STAR Institute of Molecular and Cell Biology (Singapore); M. Escobar, A*STAR Singapore Bio-imaging Consortium (Singapore); I. Meglinski, Univ. of Otago (New Zealand); V. Korzh, A*STAR Institute of Molecular and Cell Biology (Singapore)

MANAGEMENT

- 8337 0M **Photonics technology and university-driven business co-creation (Invited Paper)** [8337-22]
J. Erland Østergaard, S. Tanev, T. Bue Andersen, S. I. Bozhevolyi, Univ. of Southern Denmark (Denmark)
- 8337 0N **Re-inventing collectivism? Using innovation collectives to create and grow new technology firms (Invited Paper)** [8337-23]
D. Hudson, Carleton Univ. (Canada); S. Tanev, Univ. of Southern Denmark (Denmark)

Author Index

Conference Committee

Conference Chair

Valery V. Tuchin, Saratov State University (Russian Federation), Institute of Precision Mechanics and Control (Russian Federation), and University of Oulu (Finland)

Secretary

Elina A. Genina, Saratov State University (Russian Federation)

General Program Committee

Vadim S. Anishchenko, Saratov State University (Russian Federation)
Lev M. Babkov, Saratov State University (Russian Federation)
Alexey N. Bashkatov, Saratov State University (Russian Federation)
Valentin I. Berezin, Saratov State University (Russian Federation)
Michael V. Davidovich, Saratov State University (Russian Federation)
Vladimir L. Derbov, Saratov State University (Russian Federation)
Elina A. Genina, Saratov State University (Russian Federation)
Nikolai G. Khlebtsov, Institute of Biochemistry and Physiology of Plants and Microorganisms (Russian Federation) and Saratov State University (Russian Federation)
Vyacheslav I. Kochubey, Saratov State University (Russian Federation)
Kirill V. Larin, University of Houston (United States)
Boris A. Medvedev, Saratov State University (Russian Federation)
Igor V. Meglinski, University of Otago (New Zealand)
Leonid A. Melnikov, Saratov State Technical University (Russian Federation)
Jürgen Popp, Institute of Photonic Technology (Germany)
Alexander B. Pravdin, Saratov State University (Russian Federation)
Vladimir P. Ryabukho, Saratov State University (Russian Federation) and Institute of Precision Mechanics and Control (Russian Federation)
Alexander M. Sergeev, Institute of Applied Physics (Russian Federation)
Sergey N. Shtykov, Saratov State University (Russian Federation)
Julia S. Skibina, Saratov State University, SPE "Nanostructured Glass Technology" Ltd. (Russian Federation)
Andreas Thoss, THOSS Media GmbH (Germany)
Valery V. Tuchin, Saratov State University (Russian Federation), Institute of Precision Mechanics and Control (Russian Federation), and University of Oulu (Finland)

Dmitry A. Zimnyakov, Saratov State Technical University (Russian Federation) and Institute of Precision Mechanics and Control (Russian Federation)

Session Chairs

- 1 Plenary Session I
Valery V. Tuchin, Saratov State University (Russian Federation), Institute of Precision Mechanics and Control (Russian Federation), and University of Oulu (Finland)
- 2 Plenary Session II
Mark Neil, Blackett Laboratory, Imperial College London (United Kingdom)
- 3 Plenary Session III
Ilya Yaroslavsky, Palomar Medical Technologies, Inc. (United States)
- 4 Plenary Session Internet Biophotonics
Valery V. Tuchin, Saratov State University (Russian Federation), Institute of Precision Mechanics and Control (Russian Federation), and University of Oulu (Finland)
- 5 Russian-Chinese Seminar
Qingming Luo, Huazhong University of Science and Technology (China)
Valery V. Tuchin, Saratov State University (Russian Federation), Institute of Precision Mechanics and Control (Russian Federation), and University of Oulu (Finland)
- 6 Special Session Dedicated to Memory of Britton Chance
Qingming Luo, Huazhong University of Science and Technology (China)
Igor V. Meglinski, University of Otago (New Zealand)
Valery V. Tuchin, Saratov State University (Russian Federation), Institute of Precision Mechanics and Control (Russian Federation), and University of Oulu (Finland)
- 7 Biophysics I
Kirill Larin, University of Houston (United States)
- 8 Biophysics II
Igor V. Meglinski, University of Otago (New Zealand)
- 9 Biophysics III
Ivan V. Fedosov, Saratov State University (Russian Federation)

- 10 Photonics
Vladimir L. Derbov, Saratov State University (Russian Federation)
- 11 Spectroscopy
Valentin I. Berezin, Saratov State University (Russian Federation)
Lev M. Babkov, Saratov State University, (Russian Federation)
- 12 Nonlinear Dynamics/Microscopy
Kirill Larin, University of Houston (United States)
- 13 Management
Valery V. Tuchin, Saratov State University (Russian Federation), Institute of Precision Mechanics and Control (Russian Federation), and University of Oulu (Finland)
Julia S. Skibina, Saratov State University, SPE "Nanostructured Glass Technology" Ltd. (Russian Federation)
- 14 Nanobiophotonics
Nikolai G. Khlebtsov, Institute of Biochemistry and Physiology of Plants and Microorganisms (Russian Federation) and Saratov State University (Russian Federation)
- 15 Modern Optics
Vladimir P. Pyabukho, Saratov State University (Russian Federation) and Institute of Precision Mechanics and Control (Russian Federation)
- 16 English
Svetlana V. Eremina, Saratov State University (Russian Federation)
- 17 Education
Boris A. Medvedev, Saratov State University (Russian Federation)
Vladimir P. Pyabukho, Saratov State University (Russian Federation) and Institute of Precision Mechanics and Control (Russian Federation)
- 18 Low-Dimensional Structures
Olga E. Glukhova, Saratov State University (Russian Federation)
- 19 Telemedicine
Elena V. Karchenova, ISfTeH and Saratov DNA-Centre (Russian Federation)
Valery V. Bakutkin, Saratov Research Institute of Hygiene (Russian Federation)
- 20 Joint Poster Session and Internet Discussion
Ivan V. Fedosov, Saratov State University (Russian Federation)

Introduction

The Annual International Multidisciplinary School for Young Scientists and Students on Optics, Laser Physics and Biophotonics (Saratov Fall Meeting (SFM-11)) was held 27–30 September 2011 in Saratov, Russia, with about 500 participants from Russia, USA, Europe, and Asia. The meeting covered a wide range of modern problems of fundamental and applied optics, laser physics, photonics, and biomedical optics. SFM-11 also contained 13 international workshops:

- Special Session Dedicated to Memory of Britton Chance
Qingming Luo, Igor V. Meglinski, Valery V. Tuchin, Chairs
- Optical Technologies in Biophysics & Medicine XIII
Valery V. Tuchin, Chair
- Laser Physics and Photonics XIII
Vladimir L. Derbov, Chair
- Spectroscopy and Molecular Modeling XII
Valentin I. Berezin and Lev M. Babkov, Chairs
- Modern Optics X
Vladimir P. Ryabukho, Chair
- English as a Communicative Tool in the Scientific Community X
Alexander B. Pravdin and Svetlana V. Eremina, Chairs
- Management of High Technologies Commercialization and Regional
Innovation Systems VIII
Valery V. Tuchin and Julia S. Skibina, Chairs
- Nanobiophotonics VII
Nikolai G. Khlebtsov, Chair
- Microscopic and Low-Coherence Methods in Biomedical and Non-
Biomedical Applications IV
Kirill V. Larin, Chair
- History, Methodology and Philosophy of the Optical Education IV
Vladimir P. Ryabukho and Boris A. Medvedev, Chairs
- Internet Biophotonics IV
Valery V. Tuchin, Chair
- Nonlinear Dynamics II
Vadim S. Anishchenko, Chair
- Low-Dimensional Structures
Olga E. Glukhova

A special event during the Meeting was the Russian-Chinese Seminar, with Qingming Luo and Valery V. Tuchin serving as chairs.

SFM-11 also featured a seminar on Telemedicine: Opportunities, Applications, Prospects VI (Elena V. Karchenova and Valery V. Bakutkin, chairs) and a Special Internet Session of European Network of Excellence for Biophotonics WP 5:

Software for Modeling and Data Analysis in Biophotonics (Valery V. Tuchin and Mark Neil, chairs).

The main goal of the School, Workshops, and Seminars is to involve young researchers and students in the field of recent developments and applications of laser and optical technologies in medicine and biology, coherent optics of random and ordered media, material and environmental sciences, nonlinear dynamics of laser systems, laser spectroscopy and molecular modeling. Primary attention was paid to discussion of fundamentals and general approaches of description of coherent, low-coherent, polarized, spatially and temporally modulated light interactions with inhomogeneous absorbing media, photonic crystals, tissue phantoms, and various types of tissues *in vitro* and *in vivo*. Such effects as static and dynamic light scattering, Doppler, optoacoustic and optothermal interactions, mechanical stress, photodynamic effect, etc., were considered. On this basis the variety of laser and optical technologies for medical diagnostics, therapy, surgery, and light dosimetry, as well as for spectroscopy of random and ordered media were presented.

SFM-11 was organized as morning plenary sessions, afternoon lecture and oral sessions, and evening poster presentations and Internet discussion. The original oral reports and posters were presented by the junior scientists and students. Plenary lectures were listened with a great interest and discussed by the audience.

Plenary and Invited lectures, oral and poster presentations covered a wide area of tissue optics, spectroscopy and imaging, controlling of optical properties of tissues, as well as biophysical and photo-chemical aspects of photo and laser therapy. Besides this SPIE volume, a few special issues and sections of well-recognized peer-reviewed journals, such as *Optics and Spectroscopy* and *Quantum Electronics* will be published.

The SPIE/OSA short courses for students, engineers, scientists, and clinicians "Nonlinear morphofunctional imaging of tissues," by Prof. Francesco Pavone, European Laboratory for Nonlinear Spectroscopy and Department of Physics Sesto Fiorentino (Italy) and "Optical coherence tomography: imaging and sensing of tissues and cells," by Dr. Kirill V. Larin, University of Houston (USA), accompanied the conference. There were more than 50 attendees of each, mostly students, and were organized by Saratov University SPIE and OSA Student Chapters and supported by SPIE, OSA, and Saratov State University.

A unique feature of the Saratov Fall Meetings is the Internet Workshop and one-day on-line discussion. In 2011, this session has included the following plenary lectures: "Photoacoustic tomography: from cells to organs," by Prof. Lihong V. Wang, Washington University in St. Louis (USA); "In vivo 3D imaging of kidney microcirculation using Doppler OCT," by Prof. Yu Chen, Fischell Department of Bioengineering, University of Maryland (USA); and "Clinical application of near-

infrared spectroscopy and imaging in neonates," by Prof. Martin Wolf, University Hospital Zurich (Switzerland).

Participants from USA, Canada, Russia, Germany, Austria, Switzerland, Spain, Finland, Ireland, UK, Italy, Bulgaria, Poland, Ukraine, Belarus, China, Japan, Singapore, New Zealand and other countries have located their papers on the meeting website: <http://sfm.eventry.org/2011/internet>, which was available during the meeting and will be available for a whole year up to the next meeting.

A great number of presented materials are the result of collaboration between research groups from different countries supported by international scientific programs such as CRDF, PHOTONICS4LIFE, and others.

This volume includes papers presented on the Workshop on Optical Technologies in Biophysics and Medicine XIII. It is a great pleasure and privilege for the editors to thank all of the authors for their contributions to SFM-11, especially to the Internet lecturers for their exciting presentations.

The organizers of SFM-11 are grateful to all of the sponsoring organizations and programs that supported this meeting very effectively, especially to: SPIE, Optical Society of America; Russian Foundation for Basic Research; U.S. Civilian Research & Development Foundation for the Independent States of the Former Soviet Union (CRDF), grant REC-006; PHOTONICS4LIFE of FP7-ICT-2007-2 (№ 224014, 2008-2013); and Volga Region Center of New Information Technologies.

Valery V. Tuchin
Elina A. Genina
Igor V. Meglinski

