Saratov State University

Research-Educational Institute of Optics & Biophotonics

Saratov Fall Meeting SFM'14

XVIII International School for Junior Scientists and Students on Optics, Laser Physics & Biophotonics

September 22 - 26, 2014
Saratov, Russia

School Chair

Valery V. Tuchin,
Saratov State University, Institute of Precise Mechanics and Control RAS, Russia; University of Oulu, Finland

School Secretaries

Elena K. Volkova & Irina Yu. Yanina
Saratov State University

Workshops:

- Modern Optics XIII (*V.P. Ryabukho*)
- English as a Communicative Tool in the Scientific Community XIII (*A.B. Pravdin, S.V. Eremina*)
- Workshop on Management of High Technologies Commercialization and Regional Innovation Systems XI (*J.S. Skibina, V.V. Tuchin*)
- History, Methodology and Philosophy of the Optical Education VII (*B.A. Medvedev, V.P. Ryabukho*)
- Telemedicine IX (*Elena V. Karchenova, Valery V. Bakutkin*)

Co-located with:

Symposium on Optics and Biophotonics -II (Saratov Fall Meeting SFM'14 – Symposium, September 23 - 26, 2014)

Special events:

Special session on student reports awarded by the Russian Foundation on Innovations U.M.N.I.K. in Optics, Laser Physics, and Biophotonics

SPIE/OSA SHORT COURSE SESSION

OSA SC:
Towards deep tissue luminescence imaging using upconverting nanoparticles
Stefan Andersson-Engels,
Lund University, Sweden

SPIE SC:
Skin spectra and colour calculator: on-line object oriented GPU accelerated Monte Carlo tool
Igor V. Meglinski,
University of Otago, New Zealand,
Saratov State University, Russia

Foundation "Dynasty" Short Course:

The spectroscopy, surface modification and bio/medical applications of nanodiamond

Chia-Liang Cheng,
National Dong Hwa University, Taiwan

Plenary speakers 2014!

Prospective Studies to Determine the Carotenoid Status in Human Skin

Jürgen Lademann,
Center of Experimental and Applied Cutaneous Physiology at the Charite Univ. Clinic, Berlin, Germany

Recent Developments on Nanodiamond for Bio/medical applications

Chia-Liang Cheng,
National Dong Hwa University, Taiwan

Optical Coherence Elastography — methods and applications

Kirill V. Larin,
University of Houston (USA), Saratov State University

Polarized light propagation in turbid media

Igor V. Meglinski,
University of Otago, New Zealand, Saratov State University

Needle Probes in Optical Coherence Tomography

David D. Sampson,
Optical + Biomedical Engineering Laboratory, School of Electrical, Electronic, and Computer Engineering, Centre for Microscopy, Characterisation and Analysis, University of Western Australia (**IEEE lecturer**)

Internet plenary speakers

Chromophore based analyses of steady-state diffuse reflectance spectroscopy: current status and perspectives for clinical adoption

Henricus J. C. M. Sterenborg,

Department of Biomedical Engineering and Physics, Academic Medical Center – Amsterdam, The Netherlands

Multiphoton tomography of human skin

Karsten König,

JenLab GmbH, Jena, Department of Biophotonics and Laser Technology, Saarland University, Saarbrücken, Germany

ED-e-TEL: Perspectives

Malina Jordanova,

MD, PhD. Solar-Terrestrial Influences Laboratory. Bulgarian Academy of Sciences, Bulgaria

Organized by

N.G. Chernyshevsky Saratov State University

Research-Educational Institute of Optics and Biophotonics at Saratov State University

Research-Educational Center of Nonlinear Dynamics & Biophysics (REC-006) of CRDF and Ministry of Education and Science of RF

International Research-Educational Center of Optical Technologies for Industry and Medicine “Photonics” at Saratov State University

Institute of Biochemistry and Physiology of Plants and Microorganisms, Russian Academy of Sciences, Saratov State University

Institute of Precise Mechanics and Control, Russian Academy of Sciences

Saratov State Medical University n.a. V.I. Razumovsky

Volga Region Center of New Information Technologies at Saratov State University

Biomedical Photonics Committee of Chinese Optical Society

University of Oulu, Finland

SPIE Student Chapter

OSA Student Chapter

Saratov/Penza IEEE Chapter

In cooperation with

Academy of Natural Sciences, Saratov Regional Division

Russian Society for Photobiology

Saratov Science Center of the Russian Academy of Sciences

Photonics4Life Consortium of EC FP7: Network of Excellence for Biophotonics

The Biophotonics4Life Worldwide Consortium (BP4L) and BiophotonicsWorld.org

Co-sponsored by

RFBR – Russian Foundation for Basic Research

RAS – Russian Academy of Sciences

SPIE – The International Society of Photo-Optical Instrumentation Engineers

OSA – Optical Society of America

IEEE - Institute of Electrical and Electronics Engineers

LLC SPE Nanostructed Glass Technology, Saratov

Russian Technology Platform "The Medicine of the Future"

Russian Technology Platform "Photonics"

Government of the Russian Federation (grant №14.Z50.31.0004 to support scientific research projects implemented under the supervision of leading scientists at Russian institutions and Russian institutions of higher education)

Program Committee

Valery V. Bakutkin, Saratov Research Institute of Hygiene, Russia

Vladimir L. Derbov, Saratov State University

Svetlana V. Eremina, Saratov State University

Elena V. Karchenova, ISfTeH and Clinic of Doctor Paramonov, Saratov, Russia

Kirill V. Larin, University of Houston (USA), Saratov State University

Martin Leahy, National University of Ireland, Galway, Ireland

Boris A. Medvedev, Saratov State University

Igor V. Meglinski, University of Otago, New Zealand, Saratov State University

Risto Myllyla, University of Oulu, Finland

Juergen Popp, Institute of Photonic Technology, Jena, Germany

Alexander B. Pravdin, Saratov State University

Alexey N. Bashkatov, Saratov State University

Julia S. Skibina, Saratov State University, SPE "Nanostructed Glass Technology" Ltd.

Valery V. Tuchin, Saratov State University, Institute of Precise Mechanics and Control RAS, Russia; University of Oulu, Finland

Martin Wolf, University Hospital Zurich, Switzerland

Organizing Committee

Chair

Vladimir P. Ryabukho, Saratov State University, Institute of Precise Mechanics and Control RAS

Members

Garif G. Akchurin

Georgy G. Akchurin

Anton A. Grebenyuk

Alexander L. Kalyanov

Natalia I. Kazadaeva

Sergey S. Klykov

Alexander S. Kolesnikov

Marina D. Kozintseva

Maxim A. Kurochkin

Nina A. Lakodina

Vladislav V. Lychagov

Olga A. Perepelitsina

Peter V. Ryabukho

Anton Yu. Sdobnov

Georgy V. Simonenko

Ilya V. Smirnov

Natalia A. Talaikova

Yana V. Tarakanchikova

Polina A. Timoshina

Natalia V. Tkachenko

Daria K. Tuchina
Anastasiya A. Zanishevskaya

Internet group

Co-chairs

Dmitry N. Agafonov,
Saratov State University

Ivan V. Fedosov,
Saratov State University

Members

Georgy V. Simonenko,
Saratov State University

Mikhail M. Stolnitz,
Saratov State University

The main goal of the School is to involve junior researches 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. The main attention will be paid to discussion of fundamentals and general approaches of description of coherent, low-coherent, polarized, spatially and temporally modulated light interactions with inhomogeneous scattering media, photonic crystals, tissue phantoms, and various types of tissues *in vitro* and *in vivo*. Such effects as static and dynamic light scattering, Doppler effect, optoacoustic and optothermal interactions, mechanical stress, photodynamic effect, etc will be 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 tissue media will be presented.

SFM-14 will be organized as the Short Courses, morning plenary sessions, afternoon lecture and oral sessions, and evening poster presentations. The original oral reports and posters will be presented by the junior scientists and students. Plenary lectures will be presented by well-recognized experts in the field.

Last year plenary lectures:

Imaging Deep Tissue in Three Dimensions by Near Infrared Imaging,
Martin Wolf,
University Hospital Zurich, Switzerland

Assessing Corneal and Soft Tissue Biomechanical Properties using Optical Coherence Elastography,
Kirill V. Larin,
University of Houston, USA

Optical Biopsy with Complex Structured Light,
Igor Meglinski,
University of Otago, New Zealand

Silicon Nanoparticles for Sensitive Fluorescence Analysis in Living Cells and Drug Delivery Carried out by Multi Departmental and Institutional Collaborations,
Munir H. Nayfeh,
Department of Physics, University of Illinois at Urbana-Champaign, USA

Analytical and Theranostic Applications of Plasmonic Nanoparticles and Multifunctional Nanocomposites,
Nikolai G. Khlebtsov,
Institute of Biochemistry and Physiology of Plants and Microorganisms, Russian Academy of Sciences, Saratov State University, Russia

Terahertz Fingerprints in Biology and Technology,
Alexander Shkurinov,
M.V. Lomonosov Moscow State University, Russia

From Organic Chromophores to Plasmonic Nanoparticles for Photothermal Therapies and Laser-activated Drug Release,
Roberto Pini,
National Reserch Council of Italy and

University of Florence, Italy

Green, Compact Diode Laser-based Systems for Biophotonics Application,
Peter E. Andersen,
Technical University of Denmark, Denmark

Collapsing Field Domains in Electron-Hole Plasma of GaAs, and Examples of the Phenomenon Application from Superfast Voltage Switch to sub-THz Imaging,
Sergey N. Vainshtein,
University of Oulu, Finland

Last year Internet plenary lectures

Shaped Light for Biophotonics,
Kishan Dholakia,
University of St. Andrews, UK

Origin of Optical Pulse and Non-Invasive Measurement of Hemoglobin,
Ilya Fine,
Elfi Tech Ltd., Science Park, Israel

Participants from Australia, Bulgaria, Belarus, Belgium, Canada, China, Denmark, Finland, Germany, India, Iran, Ireland, Italy, New Zealand, Latvia, Russia, Slovakia, Portugal, Singapore, Switzerland, Turkey, UK, USA, Uzbekistan have located their papers at the meeting website: http://sfm.eventry.org/2013/internet.

Among invited Internet lecturers were well recognized experts in the fields of biomedical optics and light scattering.

Official languages of the School and the Workshops are English and Russian, translation will be provided.

The Conference fee

For foreign participants the conference fee is $ 200 (includes Program, two short-courses, Welcome Party, Barbecue, Volga-river voyage, and light refreshments), may be paid during the Meeting or transferred to the account number for request.

For Russian participants the Conference fee will depend on financial support from the Russian Foundation of Basic Research and other sponsors.

Lodging

Hotel "Slovakia" ashore the Volga river

http://slovakia.all-hotels.ru/

Hotel "Volga" in the downtown

Western style mini-hotel Bohemia in the downtown

http://www.bohemiahotel.ru

mail@bohemiahotel.ru

Student hostel "Volna" ashore the Volga river

Student hostel of SSU

Culture program

Visits to Conservatoire, Theaters, and Museums, 4-hour Volga-tour.

Registration

Electronic registration before **August 15, 2014**, at http://sfm.eventry.org/symposium2014/ is required.

Submission of Abstracts

Each author is requested to submit a one-page abstract. Abstract must be uploaded to the Conference website http://sfm.eventry.org/symposium2014/ before **August 15, 2014**.

Proceedings

Conference papers will be published as SPIE Proceedings (CD, SPIE Digital Library), Conference Proceedings (in Russian and English) under the title "Optical Physics and Biophotonics" and in Russian and International peer-reviewed journals: *J. of Innovative Optical Health Sciences (English), Quantum Electronics (Russian/English), Applied Nonlinear Dynamics (Russian/English), and Optics and Spectroscopy (Russian/English)*.

All papers will be subjected to the normal refereeing process for the journals. Manuscripts of papers should be submitted not later than **October 15, 2014**.

Visa application support

To apply for visa to Russian Consulate you need an official invitation letter. Procedure for letter preparation takes two months; the following information about you and accompany persons is needed:

1. Passport (valid up to six months after September 27, 2014) number:_____ dates of issue:___ and of expiry:_____ (copy of passport page with photo)

2. Date of birth:___, place of birth:_____

3. Living address:_____

4. Working position:_____

5. Working address:_____

Please, send this information to general secretary of the SFM-14

Elina A. Genina: eagenina@yandex.ru

Important deadlines

Visa application support – information for official invitation letter, before May 31, 2014

Submission of Abstracts – before August 15, 2014

Registration – before August 15, 2014

Hotel reservation – before August 15, 2014

Conference fee – before September 22, 2014

Manuscripts submission – before October 15, 2014

SFM-14 webpage: http://sfm.eventry.org/school2014/

On behalf of the Organizing Committee of SFM'14-School I have a pleasure in inviting you to attend this Meeting

Valery V. Tuchin

Workshop:
Modern Optics XIII

Lectures on Optics for University Students, Postgraduate Students and High School Students

Chair

Vladimir P. Ryabukho, Saratov State University and Institute of Precision Mechanics and Control RAS (Russia)

Secretaries

Ol'ga A. Perepelitsina, Vladislav V. Lychagov, Alexander Kal'yanov, Il'ya Smirnov Saratov State University (Russia)

Program Committee:

Vladimir L. Derbov, *Saratov State University (Russia)*

Boris B. Gorbatenko, *Saratov State Technical University (Russia)*

Boris A. Medvedev, *Saratov State University (Russia*)

Leonid A. Melnikov, *Saratov State Technical University (Russia)*

Alexander B. Pravdin, *Saratov State University (Russia)*

Lyudmila V. Pravdina, *Saratov Physics and Technical Lyceum (Russia)*

Alexander V. Priezzhev, *Moscow State University (Russia)*

Vladimir P. Ryabukho, *Saratov State University (Russia*)

Mikhail A. Starshov, *Saratov State University (Russia*)

Valery V. Tuchin, *Saratov State University (Russia*)

The main goal of the Workshop is promotion of school and high school youth achievements in optics - a thriving direction in physics.

One of the leading scientific schools of optics in Russia, which is a recognized authority in other countries formed in Saratov to date. Conferences, seminars and scientific schools are one of the effective ways to attract talented young people to scientific work, particularly in the area of optical research. Widening the circle of young people, the inclusion of students in high schools and colleges, including the physical, technical and other natural sciences field are one of the main tasks of scientific-methodical workshop on "Modern Optics".

Organized by

- N.G. Chernyshevsky Saratov State University
- Research-Educational Institute of Optics and Biophotonics at Saratov State University
- Research-Educational Center of Nonlinear Dynamics & Biophysics (REC-006) of CRDF
- Institute of Precise Mechanics and Control, Russian Academy of Sciences
- Saratov Physics and Technical Lyceum
- Regional Center of additional education "Search"

Workshop program

The program of the seminar "Modern Optics" consists of lectures and demonstration parts and seminars on selected topics. Four lecture days with thematic sections supposed to hold the afternoon. Section sessions supposed to hold for 3-4 favorites, the most interesting topics for teachers, which posts students and pupils on the results of independent work is supposed to hear and discuss also.

Workshop

English as a Communicative Tool in the Scientific Community XIII

Chairs:

Alexander B. Pravdin, **Svetlana V. Eremina,** Saratov State University (Russia)

Secretary:

Natalia I. Kazadaeva, Saratov State University (Russia)

International Program Committee

Vladimir L. Derbov, Saratov State University (Russia)

Igor V. Meglinski, University of Otago (New Zealand)

Alexander V. Priezzhev, Moscow State University (Russia)

Valery V. Tuchin, Saratov State University (Russia)

Dmitry A. Zimnyakov, Saratov State Technical University (Russia)

The main goal of the Workshop is to introduce young researches and students to the international community of scientists dealing with development and application of laser and optical technologies in medicine and biology. Joining this fast-developing field of research is impossible without active English, the language that has become an international communicative tool of modern science. The communicative problem that most of the beginner scientists face is well expressed in the maxim "If you want your voice to be heard in the present-day world, it should sound in English"

Most of the modern publications necessary for the work of a graduate student, postgraduate or young scientists is in English. Therefore, the skill of scanning large amounts of English text with selecting informationally valuable fragments will be one of the leading topics of the sessions and round-table discussions. The level of discussions will be intended for graduate students.

The main attention will be paid to training the active English as an international communicative tool without which it is impossible to present one's own research results to the scientific community. Traditionally in Russia the language education of specialists in natural sciences was oriented at passive English. We believe that introducing the students and young researchers to the technology of scientific presentations and Internet sites, to the style and grammar peculiarities of a scientific article, etc., will stimulate the progress in their language education and help to overcome the psychological barrier impeding the active use of English.

The Workshop will include lecture sessions with oral presentations. The subjects touched upon during these sessions will be extended and developed in round-table discussions.

We expect active participation of the leading English instructors of Saratov State University, including those working within the framework of REC006 Project, the School professors that have considerable experience in English scientific presentations, the members of Editorial Boards and referees of international journals. At least 3-4 foreign scientists including those from English-speaking countries are supposed to take part in the Workshop.

In the framework of the Workshop an Internet session will be organized in which the participants will be introduced to the facilities of remote language

acquisition and consult with instructors.

Topics

The education program will include but is not restricted to the following topic areas:

- The style of a modern scientific publication
- Cursory reading as a means to extract maximal information basing on minimal vocabulary
- Submitting a paper to an International Journal: language requirements
- Russian-English terminology system in biomedical optics

Workshop:
Management of High Technologies Commercialization and Regional Innovation Systems XI

Chairs

Julia S. Skibina,
Saratov State University, LLC SPE Nanostructed Glass Technology

Valery V. Tuchin,
Saratov State University, Institute of Precision Mechanics and Control RAS, Russia; University of Oulu, Finland

Secretary

Anastasiya A. Zanishevskaya,

Saratov State University, SPE "Nanostructed Glass Technology" Ltd.

International Program Committee

Gregory B. Altshuler,
Cynosure/ Palomar Medical Technologies Inc., USA

Robert Breault,
Breault Research Organization, Arizona Optics Industry Association, USA

Leonid E. Dolotov, Saratov State University

Yury V. Kistenev, Russian Technology Platform "The Medicine of the Future"

Boris Reznik, BioRASI, Inc., USA

Natalya V. Romanova,
Saratov State University

Sergey N. Sokolov,
INJECT Enterprise, Saratov, Russia

Stoyan Tanev,
University of Southern Denmark, Denmark

Andreas Thoss, THOSS Media GmbH, Berlin, Germany

The workshop program will include the following **topics**:

- High technology commercialization, innovation management, high technologies and business, technologies of opening of the innovative companies, innovative business, transfer of technologies, financing of innovative activity, management of innovation risks, venture financing, education in the field of management in biophotonics and biotechnologies
- Development and monitoring of branch "road maps" as the basis for planning of regional branch clusters and innovation zones
- Actual priorities of the regional innovation policy
- Experience of IP commercialization and actual problems of Academy of Sciences, high schools, chambers of commerce and regional industrial company interaction
- Special sessions on student presentations of new projects to be awarded and reports awarded by the Russian Foundation on Innovations U.M.N.I.K. in Optics, Laser Physics, and Biophotonics

Workshop:
History, methodology and philosophy of the optical education VII

Chairs:

Vladimir P. Ryabukho, Boris A. Medvedev, Saratov State University (Russia)

Secretary:

Alexander A. Skaptsov Saratov State University (Russia)

International Program Committee

Vladimir L. Derbov, Saratov State University (Russia)

Alexander V. Priezzhev, M.V. Lomonosov Moscow State University (Russia)

Alexander V. Gorokhov, Samara State University (Russia)

Valery V. Tuchin, Saratov State University (Russia)

Alex Vitkin, University of Toronto (Canada)

The goals of the Workshop are the development of the optical education, the actualization of the interdisciplinary investigation using optical conceptions and tools, the expansion of European educational field of optical physics and biophysics and the increase of creative resources and potential of bachelor, master's degree, post-graduate training in Optics and Biophotonics.

Topics

There are three main discussing topics.

History of discoveries in optics:

- Founders of optical physics
- History of optical scientific schools
- Optical discoveries on chronicles of the world culture
- Historical aspects of optical investigations for life science

Methodology problems of the optical education:

- Lecture demonstrations of optics
- University optical training
- Methodology of teaching optics in the general course of physics at a natural-science department
- Principles of optical mathematical simulation

Teaching optics in the light of the interdisciplinary education and scientific knowledge integration:

- Problems of teaching optics at medical colleges and universities
- Optical physics in the course "The modern natural scientific conception" at humanitarian departments
- Minimum program of biology, biophysics, biochemistry, and biomedicine for student specialized in optics

Workshop:

Telemedicine: Opportunities, Applications, Prospects IX

Chairs:

Elena V. Karchenova, ISfTeH and Clinic of Doctor Paramonov, Saratov, Russia

Valery V. Bakutkin, Saratov Research Institute of Hygiene, Russia

International Program Committee

Frank Lievens, ISfTeH (Belgium)

Malina Jordanova, MD, PhD. Solar-Terrestrial Influences Laboratory. Bulgarian Academy of Sciences (Bulgaria)

Anton V. Vladzimirsky, President of AfUTeHD (Ukraine)

Oleg V. Kasimov, Saratov Railway Clinic (Russia)

Valery V. Tuchin Saratov State University (Russia)

Development of Telemedicine and e-Health for high-quality of medicine, medical education, medical researches. This Seminar will put emphasis on all aspects of Telemedicine and e-Health.

Topics

The workshop program will include but is not restricted to the following topics:

- consulting services
- diagnostic/monitoring systems and devices
- electronic health cards
- electronic medical records
- home monitoring services and equipment
- hospital information systems
- imaging/PACS
- internet/intranet services
- satellite communication
- secure data transmission
- surgical systems
- systems integration
- telecommunication services
- telemedicine equipment
- videoconferencing
- vital signs monitoring
- wireless data communication

In a professional and business-minded environment, Telemedicine III brings manufacturers and suppliers together with a qualified and international audience of healthcare service providers and other key contacts such as:

- consultants
- distributors and agents
- educators and researchers
- government representatives
- homecare service
- hospital buyers, administrators and department heads
- insurers
- international organizations and association executives
- physicians and nurses
- for the purpose of establishing new trade contacts and developing existing relationships

The event also features many educational opportunities through its extensive program of presentations, panel discussions and satellite conferences on topics such as:

- bio-informatics
- broadband and wireless networks
- business models
- cost-benefit studies
- current ehealth realizations and projects
- developing countries and ehealth
- distance education
- ehealth integration into routine medical practice
- electronic medical records
- home monitoring and homecare applications
- legal and ethical aspects
- reimbursement issues
- satellites and ehealth

- standardization and interconnectivity
- telemedicine applications and projects

SPIE Short Course:

Skin spectra and colour calculator: on-line object oriented GPU accelerated Monte Carlo tool

***Igor Meglinski**, University of Otago, Dunedin, New Zealand*

This course aims at introducing the basics of light-tissue interaction, and the influence of tissue optical properties on the signal formation in major optical modalities used in skin diagnosis. The basics of tissue optical properties will be reviewed in order to appreciate the parameters used for the modelling and its physical origin. The theoretical framework is based on the radiative transfer principles and the known exact analytic solution of wave propagation in random media. The choice of phase function will be discussed. Comparison to numerical simulations of human skin spectra and skin colour with the experimental data will be presented. A range of probing conditions for screening the complex composite structure of skin and detection the optical signal affected by structural or physiological changes will be considered. Finally, the online Monte Carlo tool, specially developed for imitation of optical radiation propagation within complex multi-layered tissue-like media will be introduced. The current version provides access to simulation of detector depth sensitivity (sampling volume) for a range of probes typically used in reflectance-based measurements, reflectance spectra of human skin and/or multi-layered scattering structures, and skin-colour modelling. The tool allows users to customize the parameters of the medium, probe, and observation area. In addition the particular applications of the computational tool, including fluence rate distribution, OCT images, laser pulse propagation, and coherent polarized light, will be considered.

LEARNING OBJECTIVES

This course will enable you to:

- understand the basic principle of light-tissue interaction and become familiar with the state-of-the-art in the computational modelling of light propagation in complex tissue-like turbid media;
- be introduced to the basics of skin tissue optical properties, their origin, and skin colour formation
- understand and explain the basics of light propagation in biological tissues in relation to the major optical diagnostic modalities used in non-invasive skin tissue diagnosis/imaging, and to discuss the potential of these techniques for particular biomedical applications;
- major optical diagnostic/imaging modalities will be discussed, including presentation of the on-line computational model and its details description for practical use in particular applications.

INTENDED AUDIENCE

Physicists, engineers, and scientists who are interested in optical and laser diagnostics, light-tissue interaction, and computer modelling of radiative transfer in complex tissue-like turbid medium will benefit from this course.

COURSE LEVEL

Intermediate

COURSE LENGTH

Half-day

INSTRUCTOR

Igor V. Meglinski, PhD, Fellow of SPIE and Institute of Physics (UK) is a Professor at the Department of Physics, University of Otago (New Zealand). His research interests activities lie at the interface between physics, biomedical engineering, medicine and biological sciences, focusing on the development of new non-invasive optical diagnostic and imaging techniques and their applications in medicine & biology, material sciences, combustion, pharmacy, environmental monitoring, agricultural, food processing and health care industries. He is author or co-author of more than 190 papers in peer-reviewed scientific journals, proceedings of international conferences, book chapters and patents. Over 300 presentations at the major international conferences, symposia and workshops, including over 140 invited lectures and plenary talks.

OSA Short Course: Towards deep tissue luminescence imaging using upconverting nanoparticles

Stefan Andersson-Engels,
Lund University, Sweden

This course aims at introducing the basics of fluorescence techniques for biomedical imaging, and how the signal is influenced by the tissue optical properties. Fluorescence is a very sensitive technique used in many disciplines. It provides a unique potential for biomedical diagnostics, and is today well explored. Here we will focus on two major challenges that remain for fluorescence imaging in biomedical applications: to achieve good sensitivity and specificity to regions located deeply into tissue, and to image those with as high spatial resolution as possible. Light scattering is making the light diffuse, limiting the spatial resolution of measured images. Light absorption in tissue is providing the basis for generating the fluorescence signal, while it restricts the penetration of light limiting the probe volume. Reabsorption of emitted fluorescence often also alters the spectroscopic signature of the fluorescence signal. This makes it challenging to extract the intrinsic fluorescence properties, directly related to the fluorophore concentration; and to obtain sensitivity at depths. In the course we will address techniques to extract the intrinsic fluorescence signal and also methods to provide better depth sensitivity at slightly better spatial resolution. Two issues are in particular important in order to provide good sensitivity at depth: to use excitation and emission wavelengths penetrating deep into tissue, and to be able to efficiently suppress any unspecific background light generated in other regions of the tissue. Especially fluorescence generated superficially in the tissue, being much less attenuated due to the shorter light paths through the tissue, constitute a severely disturbing source of background limiting the sensitivity for deep imaging. Upconverting nanoparticles (UCNPs) provide unique abilities to obtain images of deep tissue locations. They can be engineered so that both the excitation and emission wavelengths are in the tissue optical window (at wavelengths where tissue is attenuating the light as little as possible). They also provide a signal that is shifted towards shorter wavelengths than the excitation, providing very powerful possibilities to completely filter out any tissue autofluorescence, and thus provide a background-free signal. In addition they yield an improved spatial resolution. This is because they require several photons to be sequentially absorbed, altering the sensitivity profiles of the excitation process. Much effort is today devoted to develop this new class of optical contrast agent for bioimaging, and some of the current research directions will be outlined in this course.

LEARNING OBJECTIVES

This course will enable you to:

- understand the basic principle of fluorescence spectroscopic techniques for tissue diagnostics. You will also learn how the optical properties becomes important for the signal you will measure from

tissues;

- better grasp some basic biomedical needs for fluorescence diagnostics in biomedicine. Examples in particular pre-clinical and clinical specialities will be provided;
- know some endogenous and exogenous fluorophores used in fluorescence diagnostics today. You will also get a feeling for pros and cons with various fluorescence modalities.
- know how upconverting nanoparticles can be used to further improve the potential of deep tissue luminescence imaging, and also understand some of the unique properties of upconverting nanoparticles of importance for bioimaging.

INTENDED AUDIENCE

Physicists, engineers, and biomedical scientists who are interested in fluorescence techniques and deep optical imaging in tissue will benefit from this course.

COURSE LEVEL

Intermediate

COURSE LENGTH

Half-day

INSTRUCTOR

Stefan Andersson-Engels received the M.Sc. degree in engineering physics and the Ph.D. degree in physics from Lund University, Lund, Sweden, in 1985 and 1990, respectively.

He was involved in developing methods for tissue diagnostics based on optical spectroscopic techniques. He was at McMaster University, Hamilton, ON, Canada, for one year, and was involved in tissue optics as well as confocal and two-photon microscopy. In 1993, he joined Lund University as an Assistant Professor, and became an Associate Professor in 1994 and a Full Professor in 1999. He is the author or coauthor of more than 160 articles published in peer reviewed journals. His current research interests include optical spectroscopy for biomedical and pharmaceutical applications as well as interstitial photodynamic therapy of malignant tumors.

Prof. Andersson-Engels has been a Co-Organizer of several international conferences including the Gordon Conference on Lasers in Biology and Medicine in 2000, the European Conference on Biomedical Optics in 2003, and a series of biannual international summer schools in biophotonics at the Island Ven in Sweden.

Foundation "Dynasty" Short Course:

The spectroscopy, surface modification and bio/medical applications of nanodiamond

***Chia-Liang Cheng**, National Dong Hwa University, Taiwan*

In this short course, we intend to introduce a newly emerged versatile nanomaterial, nanodiamond, and its promising bio and medical applications. The advantage of using nanodiamond as a nano-bio-probe compared to other nanoparticles (gold and quantum dots, etc.) will be the focus. First, we will start with a general introduction on nanoparticles used in life science applications, and an introduction on various instrumentation and methods of applications in biological systems. Then, we will cover the basic knowledge on the material, spectroscopic methods (Infrared, Raman spectroscopy and fluorescence measurements), the characterization and applications of nanodiamond. Finally, some implementations of nanodiamond in bio imaging will be demonstrated to show the promising bio and medical applications of nanodiamond. The whole short course is divided into three parts as the following

Lecture 1: Nanoparticles and spectroscopic techniques used in life science applications. This section starts with an introduction on various nanoparticles, instrumentation and methods of applications used in bio imaging. Infrared, Raman and fluorescence techniques are illustrated with examples to explain how these techniques are implemented in life science measurements. Then, the advantage of using nanodiamond in bio and medical applications compared to other nanoparticles are demonstrated.

Lecture 2: Surface functionalization, characterization of nanodiamond prepared for bio and medical applications. The basic properties of nanodiamond as well as other carbon related materials such as diamond like carbon, carbon nanotubes and carbon nanostructures will be discussed. The surface functionalization/characterization and spectroscopic properties of various techniques will be covered. For bio and medical applications, the surfaces of nanodiamond are functionalized for further conjugation of biologically interested molecules such as proteins or drug. The nanodiamond serves as a biocompatible nano-label or transport vehicles of bio molecules into biological systems. The cytotoxicity of the nanodiamonds and the surface functionalization and characterization methods will be discussed in this section.

Lecure 3: Bio and medical applications of nanodiamond. In this section, we will demonstrate the bio application of nanodiamond. Nanodiamond conjugated with interested biomolecules to form nanodiamond-biomolecules complexes; the interaction of biomolecules with cells or bacteria is demonstrated using nanodiamond as a biocompatible labeling marker. The methods of using spectroscopic properties of nanodiamond such as Raman and fluorescence signals as a bio labeling marker for visualizing the bio interaction will be illustrated.

LEARNING OBJECTIVES

This course will enable you to:

- understand and become familiar with the basic spectroscopic properties of Nanoparticles and spectroscopic techniques used in life science applications,
- be introduced to the basics of fluorescence and spectroscopic imaging using nanodiamond in biological systems, and the Surface functionalization, characterization of nanodiamond prepared for bio and medical applications
- be introduced the latest Bio and medical applications of nanodiamond, such as in bio imaging and in drug delivery.

INTENDED AUDIENCE

Engineers, scientists, and physicians who are interested in nanobiotechnology and nanomaterial application for medical science and clinics will benefit from this course.

COURSE LEVEL

Intermediate

COURSE LENGTH

Half-day

INSTRUCTOR

Chia-Liang Cheng is a professor in the Physics Department, and Vice President of National Dong Hwa University (NDHU), Hualien Taiwan. He received his Ph. D. degree from the Physics Department of the University of Oregon, USA in 1993. After obtaining his Ph.D. degree, he was a post-doc with Prof Y.T. Lee (Nobel Laureate in Chemistry, 1986) at the Chemistry Department in the University of California, Berkeley and Institute of Atomic and Molecular Sciences, Academia Sinica, Taipei from 1994-1997. He was an assistant professor at Physics Department of the National Taiwan Normal University for one year, and then he joined NDHU in 1998. In 2005, he was promoted full professor. He is specialized in spectroscopy, and optical imaging. Currently, he is the Vice President of NDHU.

His research interests are in Bio/medical applications of nanodiamond; spectroscopic studies on nanomaterial; visible-light-activated TiO_2 nanoparticles; Infrared, Raman spectroscopy, etc. His interests go beyond the boundary of physics, chemistry, biology and medicine. His group is one of the pioneering groups in the world to successfully use nanodiamond as a biological marker to observe bio molecules interaction with cells or bacteria. They have recently delivered anticancer drug using nanodiamond as a delivery vehicle into lung cancer tumors in the animal model. He has been giving invited lectures in almost all the important diamond research conferences.