

SPECIAL ISSUE DEVOTED TO LASER BIOPHOTONICS

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Laser biophotonics

This issue of Quantum Electronics contains papers reflecting the current state of the field of knowledge and technology, currently called "biophotonics". Since in most studies the source of electromagnetic radiation is a laser, the papers of this issue are joined under the title "laser biophotonics". This concept defines a wide area of research at the intersection of physics, materials sciences, biology, medicine, mathematical modelling and other disciplines, the rapid development of which is currently due to many factors. They include new results of fundamental research in the field of biotissue optics and the interaction of laser radiation with biotissues and cells, a significant progress in the development of means for generating, delivering, detecting and visualising optical radiation, and the use of new computer and nanotechnologies. All of the above factors provide the possibility of obtaining new, previously inaccessible information about living objects and offer a more effective and directed impact of electromagnetic radiation on individual biological structures, thereby opening up new possibilities for early efficient diagnostics, as well as the treatment of socially significant diseases.

An important basis of biophotonics is the field of biotissue optics. The paper by M. Osis et al. discusses the method of spectral time-of-flight reflectometry, in which a broadband picosecond laser and a set of narrow-band filters were used for time-of-flight characterisation of photons diffusely scattered from different skin layers *in vivo* at different distances between the source and the radiation receiver. It is shown that such measurements may be useful for non-invasive determination of the composition of the skin in future studies. In the study reported by J. Schleusener et al., images of skin areas containing hair follicles obtained using confocal microscopy with high spatial resolution were analysed. The purpose of the study was to evaluate the contribution to the image from various components of the skin without any staining of different structures. The results of the developed method can be used, e.g., to analyse the paths of penetration of various drugs and cosmetic preparations into the skin, in particular, through hair follicles. In the paper by I. Carneiro et al. spectral measurements of the liver optical properties were carried out in a wide (400–1000 nm) wavelength range.

A number of papers, in particular, those by C. Wu et al., A.G. Orlova et al., D.B. Kolker et al., and A. Schwarz et al., present the results of studies of biological tissues using such dynamically developing methods of laser biophotonics, as optical coherence tomography (OCT), OCT-angiography (OCT-A), optical coherence elastography (OCE), and optoacoustic microscopy (OAM). In particular, it is shown that the OCE allows the measurement of the elastic properties of the lens without its extraction from the eyeball and has a significant potential for clinical use. The combined approach using OAM and OCT-A can be applied in experimental and clinical medicine to study the functional changes of microcirculation in the diagnosis of vascular pathologies of the superficial tissues and to evaluate the efficiency of the microvascular response to treatment. It is shown that elastographic characteristics that carry diagnostic information can be determined by extracting vibrations from different depths of the skin using interferometric and tomographic processing of the speckle signal, which is remotely recorded by means of a video camera.

In the paper by M.Yu. Kirillin et al., the possibilities of a complementary bimodal approach combining fluorescence imaging and OAM to monitoring photodynamic therapy of gliomas with the use of nanoconstructs were studied using a numerical simulation method. A.V. Belikov et al. report experimental modelling of the physical process of laser tattoo removal. I.Yu. Yanina et al. investigated the impact of biological tissue heating on the accuracy of thermometry using the luminescence of up-conversion nanoparticles.

The possibility of using dual-wavelength fluorescence imaging for localisation of photosensitisers in tissues and terahertz imaging for the contactless diagnostics of human psychoemotional conditions is discussed in the papers by A.V. Khilov et al. and E.E. Berlovskaya et al, recpectively.

The problem of the ambiguity of solving the inverse problem of polarimetry for a certain type of anisotropic media is considered in the theoretical paper by M.N. Savenkova et al.

A non-standard application of theoretical laser physics in medicine is discussed in the paper by V.G. Volostnikov et al., devoted to the possibilities of applying the mathematical formalism developed for describing spiral beams of light to the analysis and classification of electrocardiograms.

Most of the research presented in this special issue have been discussed at the annual International Symposium on Optics and Biophotonics, held in Saratov on 24–28 September 2018, in which more than 400 scientists from 30 countries of the world took part. The editors of this issue are deeply grateful to all the authors and hope that the papers of the issue will be of interest to a wide community of the journal readers.

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