

SPECIAL ISSUE 'LASER BIOPHOTONICS'

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Laser biophotonics

This issue of *Quantum Electronics* presents the papers that reflect the state-of-the-art of laser technologies used in biomedical studies and medical practice. Among the new technologies, one can note the methods of correlation and Doppler spectroscopy, as well as THz spectroscopy, in which biologically significant molecules are characterised by specific resonances. The latter topic is considered in the paper by Nazarov et al., where the dielectric function of aqueous solutions of glucose and albumin is studied using pulsed THz spectroscopy.

The methods of correlation and Doppler spectroscopy, laser interferometry and optical coherence tomography are efficiently used for studying dynamic and structural features of normal and pathologically modified biological objects. Among the problems of optical diagnostics a special place is occupied by the development of noninvasive methods of imaging and quantitative assessment of blood and/or lymph microcirculation *in vivo*. The paper by Semyachkina-Glushkovskaya et al. is devoted to the study of brain blood circulation in rats at a level of macro- and microcirculation. The results of experimental studies using the method of laser speckle imaging to visualise the blood microcirculation variation under stress conditions are presented.

The diagnostic and therapeutic technologies using micro- and nanoparticles are intensely studied and widely used. Among numerous studies devoted to the transport of nanoparticles in cells and various biological tissues of particular importance is the problem of injecting nanoparticles into the skin. The main transcutaneous penetration routes for nanoparticles are the orifices of hair follicles and ducts of sweat and sebaceous glands. The creation of artificial channels by means of fractional laser microablation (FLMA) facilitates a deeper and better addressed delivery of nanoparticles. The paper by Genina et al. is devoted to testing different regimes of FLMA with the aim of developing methods for efficient delivery of micro- and nanoparticles into the skin dermis and monitoring the excretion of particles from the organism.

The struggle against cancer implies permanent improvement of the existing methods of cancer diagnostics and the invention of new ones. Fluorescence spectroscopy is one of the promising methods of the study that allows the high-sensitivity differentiation of healthy and pathological biotissues. The paper by Genova et al. is devoted to the development of this method for differentiating normal tissues and carcinoma in the gastrointestinal tract.

The distribution of measured diameters of red blood cells (the Price-Jones curve) is an important rheological characteristic of blood. The existing methods of measuring this distribution are hard to implement in practice. In their paper, Yurchuk et al. consider the possibility to measure the red cell distribution width in a wet blood smear using laser diffractometry.

For two decades the method of photodynamic therapy is widely used in the treatment of a number of diseases of oncological and bacterial nature. The paper by Korchenova et al. is devoted to the study of the photodynamic activity of photosensitisers based on metalloporphyrins. The sensitivity of microorganisms, sensitised by cation porphyrins and metalloporphyrins, to the photodynamic impact of light-emitting diode radiation (405 nm) is assessed, the new metalloporphyrin compounds and the quantum yield of the singlet oxygen formation are characterised.

The development of novel techniques in biomedical diagnostics gives rise to such applied problems as the approbation of methods, calibration of optical setups and control of their operation. It is often rather difficult to work with real biological tissues and, therefore, to solve the above problems use is made of different phantoms, i.e., the calibrated media having the optical properties, close to those of the biological tissues, and, thus, providing a similar character of light propagation. The paper by Loginova et al. considers the measurement of optical parameters of murine biotissues in the visible and IR ranges; optical phantoms modelling the spectral characteristics of biotissues in a wide range of wavelengths are developed.

Modern laser technologies find wider and wider application in surgery practice. In the contact laser surgery to increase the efficiency of conversion of laser radiation energy into heat, the distal end of the optical fibre, delivering the laser radiation to the biotissue, is equipped with a special converter heated to the temperature of nearly 900 °C under the impact of the laser radiation. The paper by Belikov et al. is devoted to the experimental comparison of heating efficiency of 'film' and 'bulk' converters, as well as to the study of heating dynamics of converters in the air and the determination of the diode laser (980 ± 10 nm) mean power, at which the temperature of the converter remains constant for a long time.

A number of papers, included in this issue, present the materials of invited talks and plenary lectures of the 3rd International Symposium on Optics and Biophotonics and the 19th International School for Young Scientists and Students on Optics, Laser Physics and Biophotonics (Saratov, September 2015).

We hope that the publication of these papers will be interesting for the readers of the '*Quantum Electronics*' journal and will facilitate further progress in laser biophotonics.

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