

## Foreword to the Special Issue on Laser and optical technologies in biomedicine and ecology

**Dear Colleagues,**

Once again, it is our pleasure to present you the Special Issue of the [Journal of Biomedical Photonics & Engineering](#) (J-BPE) with selected papers of the Biophotonics Workshop of the XVII [All-Russian Youth Conference-Contest on Optics and Laser Physics](#) (Samara, November 12-16, 2019). The conference-contest was organized by P.N. Lebedev Physical Institute (Samara Branch) and Samara National Research University and supported by Administration of Samara Region and Samara SPIE Student Chapter.

The Biophotonics Workshop gathers researchers scientific and educational institutions, and provides a platform for discussion of wide range questions including optical applications in medicine, biology, and ecology. The Biophotonics Workshop 2019 included the invited lectures of Prof. O. Baum (Federal Research Center “Crystallography and Photonics” of the Russian Academy of Sciences, Moscow, Russia) and Prof. E. Borisova (Institute of Electronics of the Bulgarian Academy of Sciences, Sofia, Bulgaria), invited reports of young scientists from FRC “Crystallography and Photonics” of RAS Yu. Alexandrovskaya and E. Kasianenko as well as contest reports of undergraduate and graduate students. Young researchers from Samara, Moscow, Kaliningrad, Nizhniy Novgorod, Orel, Saratov, Taganrog, and Irkutsk participated in the Biophotonics workshop this year.

The papers presented in the Special Issue of J-BPE cover a wide range of laser and optics modalities for biomedical and ecological purposes.

**Lubov Kokorina** *et al.* from Irkutsk State Medical University studied laser irradiation effect of nutrient media solutions on their microstructure and, as a result, a dynamics of bacterial growth in photomodified media. The authors experimentally showed that the growth rate of bacteria varies depending on the irradiation media time, that allows controlling the dynamics of bacterial cultures.

**Victoria Fedulova** *et al.* (Federal Research Center “Crystallography and Photonics” of the Russian Academy of Sciences) were engaged in studying of in essence new type of correction, which based on a modification of structure and a field of mechanical tension of a cornea. In their study, possibility of using a speckle interferometry method as a basis for the tracking system of cornea structural changes at thermal influence of a nondestructive laser radiation is considered. The authors also carried out the experiments that allowed them to proposed the polyacrylamide hydrogel composition with the temperature profile similar to the temperature profile of the cornea.

**Valery Shupletsov** *et al.* (Orel State University, Aston Institute of Photonic Technologies) describes the development of a fluorescence imaging system to define tumor surgical resection margins of abdominal organs. The authors proposed a low-cost optical tissue-mimicking phantom for quick calibration of fluorescence imaging systems depending on the target endogenous fluorophores. The capability of the developed fluorescence imaging system to register changes in

fluorescence due to carcinogenesis was shown on two series of experimental measurements. The first part included measurements of the optical phantom with riboflavin mononucleotide (imitating flavin adenine dinucleotide) and protoporphyrin IX and the second part of the study included *in vivo* measurements of liver tumors modeled in mice.

**Semen Naidenov** *et al.* from Irkutsk State Medical University and Irkutsk State University presents the results of estimating a fractal dimension of neutrophil nuclei to determine their functional state. Calculations were carried out by a specially developed algorithm. The study has shown that the fractal theory can be applied to automate medical image processing.

**Danila Tatarinov** *et al.* (Kaliningrad State Technical University) highlights a preparation method of modified chitosan films for adsorption of pyrene from solution. Solid-phase luminescence of samples was studied, degree of extraction and index of polarity of microenvironment of pyrene molecules was determined. The authors proven possible to carry out luminescent analysis of substances for pyrene content using proposed films.

**Kristina Ganichkina and Natalia Latukhina** (Samara National Research University) presented a study directed on improving methods for analyzing blood glucose levels. The authors estimated the electrical properties of porous silicon nanocomposites with various glucose solutions. In particular, the current-voltage characteristics of glucose solutions in water and tear fluid, as well as porous silicon samples of various porosities saturated with these solutions were measured. The experiments demonstrated the capability of porous silicon as a promising material for creating an electric or combined optical-electric glucose biosensor.

**Denis Kravchuk and Ksenia Voronina** (Southern Federal University) proposed models of the processes of oxygen saturation and red blood cells (RBCs) aggregation in the blood. Models of oxygenated RBCs and their distribution in the blood were constructed using the Monte Carlo technique. The acoustic signals from oxygenated and deoxygenated RBCs were simulated at various levels of oxygen saturation. The authors found that the level of spectral power density of the acoustic signal varies significantly and allows one to estimate the percentage of oxygen saturation of red blood cells in the blood with implementation of optoacoustic method.

The highlighted papers of the Special Issue demonstrate potential of optical and laser technologies in modern medical and biological applications.

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