

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

**Dear Colleagues,**

For the sixth time, 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 XVIII [All-Russian Youth Conference-Contest on Optics and Laser Physics](#) (Samara, November 10-14, 2020). 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 2020 was held online, and its program included competitive oral and poster reports of young scientists from technical and medical universities and academician scientific organizations of Moscow, Nizhny Novgorod, Saratov, Orel, Irkutsk, Kaliningrad, St. Petersburg, Samara and Astrakhan, invited reports and brilliant lectures by leading scientists. A wide range of questions including optical applications in medicine, biology, and ecology was discussed at the Workshop. The lectures of Academician of the RAS **Yu. N. Kulchin** (Institute of Automation and Control Processes FEB of RAS, Vladivostok), **Prof. E.A. Genina** (Saratov State University), **Prof. I. N. Zvestovskaya** (National Research Nuclear University MEPhI, Moscow) and **Prof. V. E. Pozhar** (Scientific and Technological Center of Unique Instrumentation of RAS, Moscow) aroused great interest.

The winner of the Biophotonics section in the Oral Presentations nomination became **A. Sovetsky** (Institute of Applied Physics of RAS, Nizhny Novgorod) whom paper with co-authors **A. Zykov** et al. is presented in the Special Issue of J-BPE. Their study as other papers presented in the Special Issue cover a wide range of laser and optics modalities for biomedical and ecological applications.

**Alexey Zykov** *et al.* (Institute of Applied Physics of RAS, Nizhny Novgorod) proposed a computationally efficient and fairly realistic model of OCT-scan formation in spectral-domain optical coherence tomography. The model is based on the approximation of discrete scatterers and ballistic character of scattering. An important feature of the model is its ability to easily account for arbitrary scatterer motions and computationally efficiently generate large sequences of OCT scans for gradually varying configurations of scatterers. This makes the proposed simulation platform very convenient for studies related to the development of angiographic processing of OCT scans for visualization of microcirculation of blood, as well as for studies of decorrelation of speckle patterns in OCT scans due to random motions of scatterers. Examples demonstrating utilization of the proposed model for generation OCT scans imitating perfused vessels in biological tissues, as well as evolution of speckles in OCT scans due to random translational and rotational motions of localized scatterers are demonstrated.

**Alida Alykova** *et al.* from National Research Nuclear University MEPhI (Moscow Engineering Physics Institute) demonstrated the temperature measurements of silicon nanoparticles. The temperature was determined under laser photo-induced heating from the ratio of the intensities of the Stokes and anti-Stokes components of the Raman scattering. The obtained results of the dependence of nanoparticles temperature on the laser radiation intensity and the temperature dependence of the Raman line position may be used to determine the optimal regimes of photo-hyperthermia enhanced by silicon nanoparticles for cancer therapy.

**Anastasia Kosheleva** *et al.* from National Research Nuclear University “Moscow Engineering Physics Institute” shows the results of nanoparticles selectively heated by external action as agents for hyperthermia of some types of tumors. In their study the selective heating of suspensions of silicon nanoparticles using a device for electromagnetic high-frequency therapy is performed.

**Anna Neupokoeva** *et al.* (Irkutsk State Medical University) describes the studying the impact of laser irradiation ( $\lambda = 532$  nm) on human blood plasma. The structural changes in plasma were controlled by the crystallographic method with the mean crystallogram segment size as a numerical evaluation. In addition, the structural changes were explored by processing the speckle patterns obtained during laser radiation passes through plasma. Exposure to laser radiation for 20 min resulted in the 30% reduction of the crystallogram characteristic size with the dynamics of the structural changes coinciding with the dynamics discovered by speckle patterns processing. The crystallographic method revealed that laser induced structural changes in plasma remain for 24–36 h after exposure.

**Natalia Rodenko** *et al.* from Samara National Research University studied the Fourier spectra of the antibiotic exposed to a high-intensity pulsed magnetic field. The action was carried out at a frequency  $f = 40$  kHz, with a number of pulses  $n = 1$ , at intensities of the pulsed magnetic field  $H = 0.09 * 10^6$  A/m,  $H = 0.50 * 10^6$  A/m,  $H = 0.82 * 10^6$  A/m. It was assumed that under the conditions of the pulsed magnetic field there may be a change in the structure of the drug molecule. The authors noted that an increase in the pulsed magnetic field power leads first to a decrease in the intensity of the band in the Fourier spectrum, and then – to its increase.

**Danila Tatarinov** *et al.* (Kaliningrad State Technical University) highlights a chitosan-TiO<sub>2</sub> nanocomposites (NCs CS-TiO<sub>2</sub>) were development for the photocatalytic degradation of representatives of polycyclic aromatic hydrocarbons (PAHs). TiO<sub>2</sub> nanoparticles were synthesized by laser ablation method and their sizes were determined by dynamic laser light scattering. Anthracene and pyrene in micellar solution were used as representatives of PAHs. The effect of TiO<sub>2</sub> in the composition of prepared nanocomposites on the photodegradation of PAHs in model environments under UV irradiation was studied. The method of solid-phase luminescence was used to estimate the decrease in PAHs concentrations. The efficiency of using the nanocomposites for the photocatalytic degradation of anthracene and pyrene was demonstrated.

The papers collected in the Special Issue highlights the potential of optical and laser technologies in modern medical, biological and ecological applications.

Special Issue Editors:

**Ivan A. Bratchenko**

Samara National Research University

E-mail: [iabratchenko@gmail.com](mailto:iabratchenko@gmail.com)

**Aleksandra M. Mayorova**

Samara Branch of P.N. Lebedev Physical Institute of Russian Academy of Sciences

E-mail: [mayorovaal@gmail.com](mailto:mayorovaal@gmail.com)