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Special issue on Laser Biophotonics, dedicated to the seventieth birthday of V.V. Tuchin

Prominent Researcher and Educator, Honoured Scientist of the Russian Federation, Professor Valery V. Tuchin celebrated his seventieth birthday this year. V.V. Tuchin heads the Department of Optics and Biophotonics at N.G. Chernyshevsky Saratov State University and the Laboratory of Laser Diagnostics of Technical and Living Systems at the Institute of Precise Mechanics and Control of the Russian Academy of Sciences. He is a Vice-President of the Russian Photobiology Society. V.V. Tuchin is widely known for his achievements in optics of biological tissues, in developing methods of optical and laser measurements in biomedicine and nanobiophotonics, and in many other fields.

July and August issues of the 'Quantum Electronics' journal present the papers on laser biophotonics authored by the disciples and colleagues of V.V. Tuchin. They reflect a substantial, although not exhaustive, scope of research fields, in which Valery Tuchin actively works and which largely specify the development vector in this important area of science and technology in Russia and abroad.

In connection with the invention of high-power sources and high-sensitivity detectors of radiation of the terahertz spectral range, where biological tissues are characterised by specific resonances, the terahertz optics attracts attention of many researchers. The July issue of the journal opens with the invited paper by Angeluts et al., devoted to the response of biological and nanodimensional systems in the terahertz frequency range. Terahertz monitoring of dehydration of muscle tissue treated with hyperosmotic agents is considered in the paper by Kolesnikov et al. The mechanisms responsible for the effect of broadband pulsed terahertz radiation on neural cells are described in the paper by Duka et al.

Presently the development of new methods for imaging the structure of biological objects characterised by strong scattering is very likely to be a dominant part of all studies on biophotonics in the world. This field is represented here by the papers by Xiang Wen, Kuratov, Darvin, Kuznetsov, Konovalov and Zakharov (all with co-authors).

One of the most actively progressing methods of imaging, optical coherence tomography (OCT), is considered by Alexandrov, Shilyagin and Moiseev (with co-authors). The application of OCT and of the method, based on laser speckle contract analysis, to the investigation of blood vessels and blood flow is discussed in the papers by Choi et al. and Ogami et al. An interesting version of this method, the optical coherence flexography, is used in the paper by Liu et al. to measure Young's modulus of cartilage tissue versus the temperature.

The promising potentialities of using nanoparticles to solve a variety of research and medical problems are now apparent. The number of publications in this field is growing exponentially both in Russia and in other countries. This tendency is confirmed by a considerable number of papers in this special issue, devoted to the capabilities of using various nanoparticles for solving problems of diagnostics and therapy (teranostics). These are the papers by Zimnyakov, Matteini and Tuchina (with co-authors). In the paper by Krainov et al., the possibility of using contrasting properties of nanoparticles in optical diffusion spectroscopy is analysed.

The impact of laser radiation on biological tissues is studied in the papers by Belikov et al. and Likhachev et al. Various applications of laser scattering spectroscopy and diffractometry are discussed in the papers by Genina, Timchenko and Nikitin (with co-authors).

The knowledge of optical characteristics of biotissues is one of the key issues in developing mathematical models adequately describing the light propagation in biotissues. This is of principal importance for developing new optical methods, used in various areas of biology and medicine, including the photodynamic and photothermal destruction of cells and tissues, as well as for new approaches in optical tomography, optical biopsy, etc. The spectrophotometry using integrating spheres is one of the most often used methods for determining the optical parameters of biotissues in the visible and near infrared ranges. Two papers by Bashkatov et al. are devoted to measuring the optical parameters of the human ventricle wall and large intestine tissues in a wide range of wavelengths.

A number of papers, included in the present special issue, are written on the basis of invited talks and lectures delivered at the 1st International Symposium on Optics and Biophotonics and the 17th International School for Young Scientists and Students on Optics, Laser Physics, and Biophotonics held in Saratov, Russia, in September 2013 with Valery Tuchin as a General Chair.

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