SPECIAL ISSUE 'TOPICAL PROBLEMS OF BIOPHOTONICS'

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Biophotonics emerged at the interface of most innovative scientific disciplines of the last century, i.e. photonics and bio- and nanotechnology. This area of scientific research and development unites physicists, biologists, chemists, pharmacists and physicians of various specialisations; the latter are the so called 'end users'.

To emphasise the importance of the area and successful interaction of researchers in the field of biophotonics, note that the 2014 Nobel Prizes were awarded to Isamu Akasaki, Hiroshi Amano and Shuji Nakamura for 'the efficient blue LEDs that enabled the use of bright and energy-efficient white light sources', as well as to Eric Betzig, William Mörner, and Stefan Hell for fluorescence microscopy with super-resolution. In 2018, Arthur Ashkin received the award for optical tweezers and their use in biological systems, together with Gerard Mourou and Donna Strickland who received it for the generation of high-intensity ultrashort optical pulses. All these innovative developments are closely related to biophotonics, were in particular initiated by its requirements, and serve its further development.

In recent years, biophotonics in combination with quantum electronics technologies is gaining more and more significance in biology and medicine due to unique features of the related techniques and devices, including simple configuration, high spatial and temporal resolution, potentially low costs, and ability for easy data management and collection, as well as the rapid development of the global photonics market, which in 2018 was estimated at \$556.4 bln and is expected to grow to \$780.4 bln by 2023 [1]. In accordance with current estimations, the market of biophotonics itself will reach \$91.31 bln by 2024. [2]. A wide range of products and technologies is presented on the biophotonics market varying from components to ready-to-use medical diagnostics and therapy devices, as well as numerous non-medical techniques, including biometric devices and biosensors [3].

Biophotonics has a broad development potential, since optical and especially laser technology allow one to acquire images and affect human tissues and organs in real time with micron resolution avoiding the use of ionising radiation [4]. Only for a particular market segment, optical coherence tomography (OCT) systems, the growth of the total annual global sales amounted to about 45%. In 2015, the evaluation of the OCT systems amounted to ~\$750 mln per year, and the total income for the last 25 years exceeded ~\$5 bln [5]. Undoubtedly, the fast market growth will continue, since biophotonics technologies become more common and are actively introduced into clinical practice.

On the other hand, modern photonics developments, including laser and LED sources, as well as innovative techniques for probe delivery and radiation detection, are widely employed in biophotonics. They can significantly expand the capabilities of optical imaging and improve the quality of treatment. An additional advantage consists in the possibility of combining optical methods with other imaging and treatment techniques.

This special issue of Quantum Electronics presents the results of scientific investigations, characterising the main directions of development and recent advances in the area of laser biophotonics. Selected papers were discussed at two prominent international symposia held in Russia, which attract world leading experts in the field of biophotonics. This first event is the International Symposium 'Topical Problems of Biophotonics-2019' (TPB-2019, 27–31 July 2019) [6], which was organised by the Institute of Applied Physics, RAS, and Privolzhsky Research Medical University as a continuation of previous biennial TPB symposia (held from 2007 to 2017). The second event is the 23rd International Conference on Optics, Laser Physics and Biophotonics 'Saratov Fall Meeting (SFM-19)' that took place in Saratov from 23 September to 27 September 2019 [7] organised by Saratov State University together with other universities and institutions of the Russian Academy of Sciences. Over 500 people from 20 countries attended SFM-19.

This and the following issues contain papers related to topical problems of biophotonics that represent the following fundamental and applied areas: optical techniques of bioimaging and high resolution microscopy with high spatial resolution and deep probing (H. Schneckenburger et al., D. Lighter et al., Y. Feng et al., E.V. Potapova et al.); optical and THz properties of biological tissues (B.P. Yakimov et al., A.A. Selifonov et al., S.N. Savenkov et al., E. Kekkonen et al.); nanobiophotonics (E.A. Sagaidachnaya et al., S.V. Zabotnov et al., V.A. Oleschenko et al.) and laser photomodification of biological tissues (O.L. Zakharkina et al., A.P. Sviridov et al., O.I. Baum et al., A.V. Belikov et al.).

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