Promising materials of optoelectronics, laser physics, and photonics

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The Special Section „Advanced Materials of Optoelectronics, Laser Physics and Photonics" journal „Optics and Spectroscopy" includes 14 articles based on scientific papers presented at the annual international conference „Saratov Fall Meeting 2024" (SFM'24, N.G.Chernyshevsky SSU, 23−September 27, 2024, Saratov, Russia, URL: https://sfmconference.org /). The conference was held in a part-time format and was dedicated to the 115th anniversary of Saratov State University and the 75th anniversary of diplomatic relations between Russia and China.

The following events were successfully held as part of SFM'24: XII International Symposium on Optics and Biophotonics, XXVIII International Scientific School for Students and Young Scientists on Optics, Laser Physics and Biophotonics, and International Scientific School for Students and Young Scientists on Fluorescent Dyes and Proteins and Instrumentation for Life Science Research. In total, more than 400 participants from 20 countries took part in 19 thematic conferences, seminars and round tables, and more than 250 reports and papers were presented, including the reports of the Internet section, 7 plenary and 25 invited papers. Students, young scientists and schoolchildren had an opportunity to listen to lectures devoted to topical problems of biophotonics and application of optical and laser technologies in biology and medicine, including precise mechanics and control of properties of biological tissues and cells, coherent optics of random and ordered media, materials and environmental science, nonlinear dynamics of laser systems, laser physics, spectroscopy and molecular modeling, terahertz photonics, nanophotonics and nanobiophotonics.

The plenary speakers were world leaders in the field of biophotonics: Alexei M. Yaschenok from Skolkovo Institute of Science and Technology (Russia), Xunbin Wei from Peking University (China), Honggen Liao from Shanghai Jiaotong University (China), Yu Cheng from Fujian Normal University (China), Igor V. Meglinsky from Aston University (UK) and Sechenov University (Russia), Tianong Dai from Harvard Medical School Photomedical Center (USA), Andrey Yu Abramov from University College London (UK).

The articles presented in the special section of the journal are aimed at studying promising semiconductor materials (InGaAs, ZnTe, Fe:β-Ga_2O_3 etc.), as well as the creation and development of modern methods and approaches required for solving fundamental and applied problems in the field of radiophotonics, optics and terahertz (THz) spectroscopy.

Some of the papers are devoted to the creation of efficient optoelectronic sources, beam converters and detectors of electromagnetic radiation. S.S. Pushkarev et al. proposed in their paper elastically strained heterostructures based on multiperiod InGaAs/InAlAs superlattices grown by molecular beam epitaxy (MBE) on InP substrates as broadband sources of THz pulse generation.

The paper by A.A. Grekova et al. is devoted to the study of the direct-gap semiconductor ZnTe grown on GaAs substrates by the MBE method. ZnTe-based structures are needed for IR detectors for modulators and thermal imaging cameras. The effect of deviation from stoichiometry by Zn and Te on the spectral characteristics of ZnTe crystal in the range of $0.4-1.2\,\mu$m has been studied by ellipsometry in the paper.

The paper by V.A. Kisilevsky et al. is devoted to the optimization of the technology of waveguide structures formation by electron beam nanolithography due to the use of specialized positive resist. The article by A.A. Tatarintsev et. al. discusses a promising material Ga_2O_3 for medium and high power electronics. An operational criterion for assessing the quality of luminescent center profiling is proposed in the paper employing the influence of the internal charging effect of the sample, in which the underlying semi-isolating layer of iron-doped β-Ga_2O_3 captures electrons to deep acceptor levels of iron.

The paper by A.V. Radivon et al. presents the results of work on the creation and study of spiral zone plates designed for the formation of THz vortex beams. A peculiar feature of the study is the use of a comparative new THz material — carbon nanotubes deposited on a stretchable polymer substrate as the basis for the optical element. The work of V.V. Likhov is also devoted to the generation of optical vortex beams. The article describes the development of a spiral-shell waveguide with a reduced refractive index.

The section on spectroscopy and the development of methods for the identification of various substances is represented by two papers. The results of spectroscopic studies of single crystal langasite $La_3Ga_5SiO_{14}$ in the THz range are reported in the paper by A.M. Kuzmenko et al. and the influence of local distortions of the crystal field on the response function is analyzed. The application of improved Raman methods for the identification of various organic and inorganic compounds is discussed in the paper by R.A. Gylka et al.

Two papers study new materials for nonlinear light conversion. Yu.A. Kochukov and co-authors studied the parameters of simulated Raman scattering of light in the

crystal of cationic solid solution Sr0.9Ba0.1MoO4 under the action of laser pulses with energy $20\,\mu$J and duration 0.25−6.00 ps. P.D. Kharitonova and co-authors studied the laser-induced damage threshold of $LiGaSe_2$ with and without antireflection microstructures under the action of a nanosecond YAG:Nd^{3+}-laser with intracavity parametric light generation at $2.1\,\mu$m. The potential of $LiGaSe_2$ with antireflection microstructures as a nonlinear medium for parametric conversion of laser radiation in the mid-IR range has been theoretically and experimentally studied.

Several papers are devoted to the study of spectral-luminescent properties of materials. The paper by K.D. Shmelkov et al. presents the results of a study of the temperature dependence of the spectral-luminescent characteristics of four terbium complexes based on 2,2′-bipyridyldicarboxanilide, differing in the substituents in the phenyl ring. The quantum yield and integral luminescence intensity of the complexes were found to decrease with the increase of the temperature, and the temperature sensitivity coefficients of these characteristics were calculated. A new phase of $Na_2BaY_4F_{16}$ compound (monoclinic syngony, spatial group C2/m, $Z = 2$, lattice parameters $a = 12.1948(3)$ Å, $b = 8.2486(2)$ Å, $c = 7.0894(2)$ Å, $\beta = 119.893(3)$) was obtained in the study of A.A. Volchek et al. The first up-conversion luminescence studies have been performed for $Na_2BaY_4F_{16}$:Yb^{3+}, Er^{3+} under excitation at 980 nm.

D.S. Chunaev et al. study two-photon absorption and simulated Raman scattering in $Na_2Mo_2O_7$ crystal under irradiation by picosecond laser pulses with a duration of 25 ps. The maximum two-photon absorption coefficient at a wavelength of 523.5 nm was 7.8 cm/GW.

The effect of gold nanoparticles on the electro-optical parameters of nematic liquid crystal ZhK-1289 was studied in the paper by I.S. Chekulaev et al. The results demonstrate the prospects for the application of nanoparticles to improve the performance of liquid crystal devices in the fields of display technologies, antennas, and biosensor systems.

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