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ABSTRACTS

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ELECTRON HOLE LIQUID IN DIAMONDS FORMED BY NANOSECOND LASER PULSES

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Electron-hole liquid (EHL) is a condensed state of non-equilibrium charge carriers, which can exist in some semiconductor materials at low temperature and high carrier density.

Phenomenon of EHL is a promising thing for development of diamond based electronic devices, such as opto-electronical switches. Earlier in our paper [1] we showed that the presence of EHL strongly increases the photoconductivity of diamond sample.

In the current paper we present the latest results of EHL research, carried out by our group for diamond samples. It was shown that the behavior of different charge carriers states (EHL, free excitons, electron-hole plasma) can differ in different samples, used in reserch.

The study was carried out on the state order of the Ministry of Education and Science of Russia, Project No. 0721-2020-0048.

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I-8

CARBON ELECTRONICS AND PHOTONICS

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Diamond surpasses all known semiconductors in basic parameters, second only to gallium arsenide and graphene (a quasimetallic form of carbon) in electron mobility. For a long time, the widespread use of diamond in electronics was limited by the high cost and poor quality of both natural and synthetic raw materials. Currently, the technology of synthesis and doping of diamond has reached the necessary level for the breakthrough of diamond into electronics and photonics [1, 2]. In the first place, diamond based electronic devices will ensure long term and efficient operation in high temperature conditions and high levels of ionizing radiation, in the subterahertz frequency range [3].

The future belongs to photonic integrated devices, including based on diamond [4, 5]. Photonic integrated circuits will be combined devices of quantum electronics, photonics and spintronics. Quantum computers based on photoactive centers in diamond are potentially capable of operating at room and elevated temperatures [6]. Photoactive point centers in diamond are promising candidates for single photon sources for the quantum key distribution system [7], as well as elements of the active medium of integrated laser sources [8].

The report provides an overview of the current state of the development of carbon electronics and photonics in the world, as well as the results of research in this area carried out at the Institute of High Current Electronics SB RAS and Tomsk State University.

The studies were performed in the framework of the State Task for IHCE SB RAS, Project No. FWRM-2021-0014.

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I-9

DETECTION OF HIGH ENERGY ELECTRONS BY CHERENKOV RADIATION IN DIAMOND

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Cherenkov detectors for detection of high energy particles are widely used. To obtain the necessary information about the characteristics of the particles (energy, type, etc.) can by analyze of the Cherenkov radiation (CR). Cherenkov detectors in various fields of science and technology are used. However, there are Cherenkov detectors applications, for example, in thermonuclear reactors and spacecraft, where special requirements are imposed on the radiator material. One of the promising radiator materials with high temperature and radiation resistance is diamond. In addition, the diamond has a low energy threshold for CR due to its high refractive index (2.42).

The spectral characteristics of the radiation of different specimens of type 2a synthetic diamonds under irradiation of electron beams with energies of tens to hundreds of keV was investigated. Based on the obtained data, the most suitable diamond specimens for use as a Cherenkov detector radiator were selected. CR was detected in a diamond. However, the radiation spectra also contain cathodoluminescence, which must be taken into account when creating Cherenkov detectors based on diamond.

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