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I-10

CHANGES IN THE EXCITON CATHODOLUMINESCENCE SPECTRA OF DIAMOND AT ELEVATED TEMPERATURES

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The study of exciton cathodoluminescence in diamond is not only scientific but also practical importance. Ultraviolet radiation at a wavelength of 235 nm can be used for disinfection, activation of surface reactions, photochemistry, and more. Thus, diamond is a promising material for creating a cathodoluminescent source of ultraviolet radiation.

We have investigated the temperature dependences of the exciton cathodoluminescence spectra of single-crystal diamond in the temperature range from 80 to 400 K. The temperature dependences showed a characteristic increase in the intensity of exciton cathodoluminescence in the range 230–240 nm with increasing temperatures from 80 to 150–180 K. Further increase in temperature to room temperature (297 K) leads to a twofold decrease in the radiation intensity. With a further increase in temperature to 400 K, no change in the cathodoluminescence intensity was observed within the error.

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

I-11

PROTOTYPE OF A DIAMOND BASED UV SOURCE AS AN EMITTER

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The report deals with the results of a study of the exciton cathodoluminescence of diamond, as well as the creation of a prototype of a cathodoluminescent ultraviolet source based on it.

In our previous work [1], optical studies of cathodoluminescence of 5 different samples were carried out. It was found that a C12 diamond single crystal sample synthesized by the HPHT (high pressure high temperature) method has a strong radiative recombination band of free excitons at 235.2 nm. Such a sample is promising for its use as an ultraviolet emitter.

The paper presents the results of spectrometric studies of cathodoluminescence of a diamond sample in the ultraviolet region. Life tests of the emitter were carried out, and a prototype of an ultraviolet emitter was presented.

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

1. *Ripenko V., Genin D., Burachenko A., Shulepov M., Artyomov K., Eliseev A., Vins V., and Lipatov E.* Change of cathodoluminescence spectra of HTHP dimonds irradiated by electron beam in visible-UV region // 7th International Congress on Energy Fluxes and Radiation Effects (EFRE). 2020.

I-12

SOLAR WIND DETECTOR BASED ON CHERENKOV RADIATION IN DIAMOND

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To date a relevant task is the development of miniature Cherenkov detectors that could be placed on microsatellites for studying near Earth space, in particular, for observing the charged particles flows (solar wind) captured by the Earth's magnetic field. Solar activity can negatively affect the exploration of outer space, in particular, lead to the failure of the electronic equipment of spacecraft, which leads to significant financial losses. Therefore, the problem of monitoring and space weather forecasting is a very important task.

Detectors based on Cherenkov radiation (CR) are widely used to register high energy fluxes of charged particles. CR analysis allows obtaining detailed information about the registered particles (energy, particle type). However, working conditions in near-earth space impose restrictions on the materials used as radiators. The most promising is diamond, since it is a radiation resistant material with a high refractive index 2.42 and, accordingly, a low energy threshold for CR (~ 50 keV). An additional advantage of CR-based solar wind detectors is their insensitivity to the action of protons.

The report provides characteristics of a prototype solar wind detector developed at High-tech diamond devices limited (Tomsk).

The work is performed in the framework of the State task for HCEI SB RAS, Project No. FWRM-2021-0014.

I-13

PHOTOMETRIC METHOD FOR DETECTING SINGLE NV CENTERS IN NANODIAMONDS USING LOW NOISE CCD

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The color centers in diamond, unlike organic molecules, are not subject to photobleaching and are therefore ideal candidates for use as single photon sources operating at room temperature. One of the most studied and interesting of them is the NV center, consisting of nitrogen atom and a lattice vacancy. Localization of single center is possible in a bulk sample using a scanning confocal microscope. An alternative method is based on the use of nanoparticles containing a small discrete number of centers. The nanodiamonds distributed on the substrate relatively rare are similar to a star field and methods developed in astronomy to study a large number of star-like objects can be applied to them. The main tool for such studies is low noise, high sensitivity CCD, which allows measuring light fluxes and coordinates with photon accuracy. In this work we demonstrate the application of wide-field spectral and polarization photometry for the characterization and selection of the most optimal objects containing single NV centers.

I-14

HIGH-TEMPERATURE ELECTRON HOLE LIQUID IN DIAMOND WIRES

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The density functional theory is used to study the properties of the electron hole liquid (EHL) in diamond quantum wires. Take a quantum wire with a circular cross section with radius R. Electrons and holes move freely along the z-axis. To calculate the energy and equilibrium density of the EHL, the Schrцdinger equations for electrons and holes are solved numerically. Calculations have shown that the EHL is stable in diamond wires with a radius of several exciton radii. As the radius of the quantum wire decreases, the equilibrium density increases and the EHL energy decreases. So, with