N4-O-009501

SYNTHETIC DIAMOND COLOR CENTERS IN QUANTUM INFORMATION TECHNOLOGIES*

E.I. LIPATOV[1,2]

[1]*Institute of High Current Electronics, Tomsk, Russian Federation*
[2]*Tomsk State University, Tomsk, Russian Federation*

Synthetic diamond is beginning to use in quantum technologies: sensing, computing and cryptography. The characteristics of diamond are such that they will allow diamond-based devices to operate at room and elevated temperatures, at high levels of radiation and in chemically aggressive environments. In addition to quantum technologies, diamond will get applications in radiation-resistant, high-temperature and power electronics and photonics.

Optically active centers in diamond containing a vacancy and impurity atoms (N, N_2, Si, Ge, etc.) are characterized by high photostability, absorption and luminescence spectra in the visible range, and characteristic luminescence times on the scale of tens of nanoseconds [1–3]. Most of the centers mentioned are relatively easy to create in a diamond sample in the process of diamond synthesis or during its post-growth radiation-thermal treatment.

The recent demonstration of laser radiation at NV centers under optical pumping [4] opens up wide opportunities for creating injection diamond lasers and then integrated diamond lasers based on photoactive color centers. This, in turn, will make it possible to create compact integrated quantum magnetic field sensors, quantum processors based on the spin states of NV centers in diamond, etc.

The report presents the results of studies of optical absorption, luminescence, excitation of spin states of photoactive centers, discusses the existing and possible applications of impurity-defect centers in diamond, photoactive in the green and red regions of the visible range, for problems of integrated optics, quantum communications and quantum computing.

REFERENCES

[1] I. A. Dobrinets, V. G. Vins, A. M. Zaitsev, “HPHT-Treated Diamonds,” Springer Series in Materials Science, vol. 181, pp.1-270, 2013.

[2] M. A. Lobaev, D. B. Radishev, S. A. Bogdanov, A. L. Vikharev, A. M. Gorbachev, V. A. Isaev, S. A. Kraev, A. I. Okhapkin, E. A. Arhipova, M. N. Drozdov, V. I. Shashkin, “Diamond p-i-n diode with nitrogen containing intrinsic region for the study of nitrogen-vacancy center electroluminescence,” Physica Status Solidi, vol. 14, no. 11, 2000347, 2020.

[3] S. Pezzagna, J. Meijer, “Quantum computer based on color centers in diamond,” Applied Physics Reviews, vol. 8, 011308, 2021.

[4] A. Savvin, A. Dormidonov, E. Smetanina, V. Mitrokhin, E. Lipatov, D. Genin, S. Potanin, A. Yelisseyev, V. Vins, “NV^- diamond laser,” Nature communications, vol. 12, 7118, 2021.

* The work was supported by the Ministry of Education and Science of Russian Federation (the state order, project No 0721-2020-0048).