PHOTON-INDUCED EFFECTS ON CONDUCTIVE AND COLOR CENTERS OF DIAMONDS*

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Diamond is a material with many unique properties suitable for the different applications from power electronics to quantum computing. It has an ultra-wide band gap (5.47 eV), high electron and hole mobility, high thermal conductivity, high reflectivity, transparency from RF to UV radiation, and has compelling potential advantages over the most known semiconductors, such as the narrow-bandgap silicon (Si), in radiation-resistant, high-power, and high-frequency electronics, as well as in deep-UV optoelectronics, synchrotron optics, quantum information, quantum sensing and extreme-environment applications [1].

It was previously shown that diamonds under the influence of optical radiation [2,3], X-ray radiation [4,5], radio frequency radiation [6,7] are capable of changing their properties. This fact can be used for various practical applications, such as the creation of optical and X-ray detectors, quantum sensors, optoelectronic devices, etc. In addition, in [8], an NV color center laser was demonstrated, and it was shown that the additional effect of optical radiation changes the lasing properties [9].

In this work, we studied the effect of optical and X-ray radiation on the concentrations of various conductive and color centers in diamonds (related with phosphorus, nitgoren, boron, germanium, silicon and others). It has been shown that optical radiation significantly affects the charge states of color centers, and these effects are observed not only when exposed to high-energy photons (deep UV, X-rays), but also when exposed to relatively low-energy ones (IR and visible light). Moreover, many effects demonstrate a significant memory effect, even at room temperature - up to several days. To restore charge states, the crystal must be annealed. We envision this could be used in applications such as optical recording memory, optical and quantum sensors, and X-ray and deep-UV imagers.

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* The work was supported by the Ministry of Science and Higher Education of Russian Federation, Youth laboratory under the leadership of Boldyrev K.N.