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Characterization of isotopic composition and purity of 13C enriched cvd diamond layers by raman and PL spectroscopy

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The NV-13C hybrid quantum system, which consists of a negatively charged NV-center [1] located at a distance of several angstroms from the isotopic 13C atom [2], has great prospects for application in quantum devices for processing and transmitting information [3]. However, the practical application of NV-13C complexes in diamond requires the development of a technology for the formation of these systems, which ensures control of their localization in the bulk of diamond with a sufficiently high accuracy (up to several microns). At present, two approaches to the formation of NV-13C complexes have been proposed. The first is the formation of single NV centers in diamond containing the natural amount of 13C isotope and the search for 13C atoms located near them. The main disadvantage is the low natural concentration of the 13C isotope in diamond (1.1%), so the search for single NVs and nearby 13C is a very laborious and time-consuming task. The second approach is to create a thin homoepitaxial layer consisting of 13C isotopes and NV-centers using local doping during diamond growth by chemical vapor deposition (CVD). This method will make it possible to localize single NV surrounded by 13C isotope atoms in a thin layer of diamond without disturbing the crystal structure [4] and without deteriorating the optical and spin properties. A fast and non-destructive technique is needed here for estimating the concentration of NV centers in the homoepitaxial diamond layers and determining the isotopic composition of the samples under investigation. In this paper we represent an original method that combines luminescence and Raman spectroscopy to estimate the concentration of NV-centers and isotopic composition with high spatial resolution.

Biography

Nikolay I. Kargin, Honoured Science Worker of the Russian Federation. Skills and expertise: wide-gap semiconductors, epitaxy, silicon carbide, III-group nitrides, graphene, diamond. Position: Director of the Microvawe Photonics and Microwave Technology Center at NRNU MEPhI. The main activities of the Center: microvawe electronics, photonics, semiconductor physics, quantum physics and quantum sensors. Prof. N. Kargin has published more than 200 scientific articles.