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SILICON AND CARBON ISOTOPE SHIFTS IN SIV⁰ COLOR CENTER*

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Studies of color centers, such as silicon vacancy (SiV) center in diamond are currently of high interest in view of applications in photonics, particularly, in quantum information technologies [1]. Changing the isotopes of impurities in crystals is a fruitful method of studying optically active defects. Particularly, analysis of phonon band positions in PL or absorption spectra, when isotope of diamond host lattice is changed, allows a discrimination of local vibration modes (LVM) and phonon modes. Collins et al.[2] observed isotope shifts for 12 different ZPL lines in 99% ^{13}C HPHT diamond and identified LVM for some of the defects.

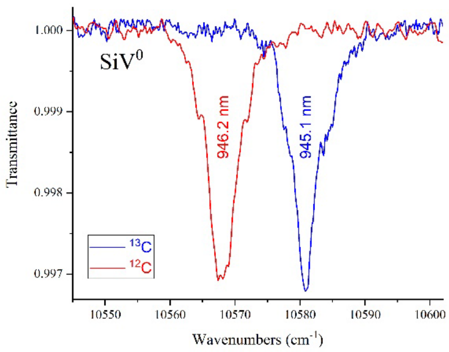

Fig.1. *Absorption spectra of SiV^0 center in diamonds enriched ^{12}C-^{13}C isotopes*

By playing with C and Si isotopes, it's possible to observe a frequency shift in SiV center, which indicates the relation between the lattice structure of SiV ceter and its PL. Such possibility is important for various applications, especially in the field of quantum technologies. Moreover, the use of isotopically pure materials makes it possible to obtain the narrowest lines of SiV color centers [3]. Previously, line shift was investigated for SiV$^-$ color centers in diamonds enriched both in ^{28}Si, ^{29}Si, and ^{30}Si isotopes [3] and in ^{12}C and ^{13}C isotopes [4].

Neutrally charged SiV^0 (946 nm) exhibits excellent spin properties, with spin-lattice relaxation times (T_1) approaching one minute and coherence times (T_2) approaching one second [5], as well as excellent optical properties, with approximately 90% of its emission into the zero-phonon line and near-transform limited optical linewidths [5]. In spite of significant activity on the study of color centers in isotopically modified diamond [6], no data on SiV^0 in ^{13}C diamond, as well enriched by different Si isotopes was reported so far. Here, we report on isotopic shift effects in SiV0 centers for both carbon and silicon atoms. The present work describes the MPCVD-growth of single-crystal diamond layers with engineered isotope compositions: (1) ^{12}C/^{13}C with natural Si content, (b) ^{28}Si/^{29}Si/^{30}Si with natural carbon content. The influence of isotope composition in these series of samples on SiV^0 peak will be reported. Specifically, a large isotopic shift for ^{12}C and ^{13}C diamonds was observed (Fig. 1), while for the change of silicon isotopes almost no significant shift was registered. Potentially, the obtained results will have an impact for the prospects of using SiV^0 centers in diamond as single-photon sources in quantum optical information technologies.

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