The NV diamond mastering: from the HFI flip-flop free cites to a fiber probe technique

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Single nitrogen-vacancy (NV) color centers in diamond are, owing to the unique and advantageous combination of their optical, spin and material properties, one of the most promising candidates for implementation of emerging quantum technologies. Initially main efforts have been directed towards the quantum information applications of the NV centers and great progress has been achieved during last decade in development of quantum registers for quantum computers on coupled electron-nuclear NV-^{13}C spin systems and, as well, in single-photon source for quantum cryptographic systems (see. e.g. [1, 2] for review). Later it was demonstrated that the NV centers offer also the unique possibilities to be employed as a nanoscale sensor for detection and imaging of weak magnetic fields with the potential $pT/\sqrt{Hz}$ to provide few sensing and nanoscale spatial resolution at ambient conditions [3] thus allowing to detect individual electron [4] and even nuclear [5] spins at distances in few nm. Moreover, nanosized diamonds hosting single NV center can be used to detect the fundamental electric charge at distance 25 nm [6] and, as well, to measure local temperature distribution within individual living cell [7]. Pressure can be measured by the same technique [1].

Here we report both on our most recent results, demonstrating for the first time the HFI characteristics for the NV-^{13}C systems having the ^{13}C atom located on the NV center symmetry axis which are of great interest due to the absence of the ^{13}C n-spin flip-flops resulting from their HFI with the e-spin of the NV center [8], and on imaging the two-dimensional profile of the magnetic field, as well as, on thermometry of single cells, using the photoluminescence spin-readout return from NV nanodiamond, sitting on a top of a fiber, captured and delivered by the optical fiber [9–11].

Acknowledgements. This research was supported in part by the Belorussian State Foundation for Basic Research, by the Russian Foundation for Basic Research and the Russian Quantum Center.

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