ダイヤモンドNV中心の電子スピンにおける位相緩和時間の電界依存性

Electric-field Dependence of Coherence Time of the Electron Spin in the Diamond NV Center

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Nitrogen-vacancy (NV) centers in diamonds have some remarkable properties: high fluorescence rate and spin-dependent fluorescence that enable readout of electron spin states of single NV centers, optical spin polarization, and long-lived ground state electron spin coherence. Owing to these properties, NV centers can be utilized for a range of advanced applications including high-sensitivity nano-magnetometry, electrometry [1], thermometry, quantum information science, and biological imaging.

For these applications, coherence time (T_2) of NV electron spin is important property because it affects to sensitivity of sensors and a data retention time of quantum information. T_2 of the NV electron spin is considered to be involved not only by magnetic field but also by electric filed because effects of magnetic fields and electric field on spin state influence each other [1]. In our study, therefore, we have investigated electric field dependence of T_2 in the NV center.

NV centers were created in the diamond substrate by nitrogen ion implantation and following annealing. The electrodes for applying an electric field to NV centers were formed on the diamond substrate by electron beam lithography and metal deposition. In order to measure T_2 of single NV centers we employed confocal microscope system, optically detected magnetic resonance technique and Hahn echo technique [Fig. 1]. The increase of the T_2 induced by electric field was observed [Fig. 2]. The increase of the T_2 is due to suppression of adverse impact of magnetic noise on electron spin state induced by electric field. Saturation of increasing of T2 with electric field can come from approaching motional-narrowing limit [2] also due to suppression of impact of magnetic noise on electron spin state.

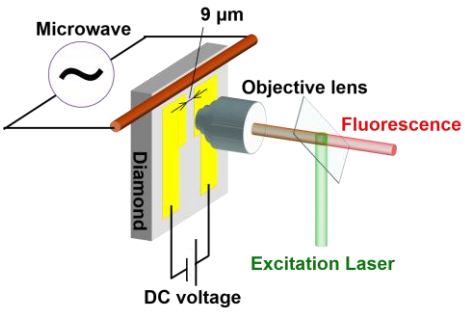

Fig. 1: Schematic image of the sample and a part of measurement set-up.

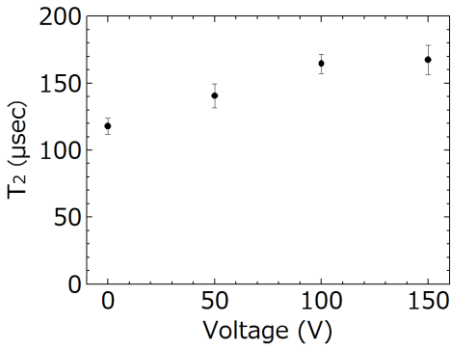

Fig. 2: Results of T_2 measurements for the single NV center under various voltage. $B_{//}$ ～0.03 mT

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[2] Zhi-Hui Wang and Susumu Takahashi, Physical Review B, 2013, 87, 115122