Evaluation of a dressed photon-phonon etching of a diamond substrate using a confocal microscopy

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The newly discovered Nitrogen-Vacancy (NV) center inside diamond has the potential to revolutionize our current standpoint in Material- as well as Medical Engineering [1]. NV centers are optically active point defects and occur naturally inside diamond crystals. Due to their nanoscale size, ultra-high resolution, magneto sensitivity, long coherence time and their ability to work under ambient temperatures [2], NV centers can be brought to close proximity to the target samples and allow for nanoscale magnetic sensing. Reports have shown that NV centers are even capable of detecting single nuclear spins [3].

Nevertheless, paramagnetic impurities on the surface of diamonds have shown to exhibit a negative impact on the coherence time of NV centers. Also, photon collection efficiency suffers through surface inhomogenities of the diamond. Therefore, our near-field etching could reduce the amount of surface protrusions as well as the amount of paramagnetic impurities on our diamond surface.

In my experiments, I worked with 2x2mm diamond substrates containing implanted NV centers. Through confocal microscopy, the typical fluorescence of NV (637 nm zero-phonon line) can be examined. Hereby the differences in the fluorescence intensities between the original diamond substrate and the flattened diamond substrate (through dressed-photon phonon (DPP) etching [4]) are of our utmost interest. Logically, the DPP etching assisted diamond substrate should exhibit a superior fluorescence intensity compared to the ordinary diamond substrate.

Fig.1 illustrates how the DPP etching can influence the fluorescence intensity. By flattening the surface of the diamond substrate, we remove non-luminescent impurities and also decrease the scattering. The DPP etching has been realized using a He-Cd Laser with a wavelength of 325 nm. Our samples were immersed into O_2 ambient gas. Etching times were ranging between 0-3 h. We will discuss DPP etching effect of NV emission through the confocal microscopy.

Acknowledgment: This work was partially supported by a Grant-in-Aid for Scientific Research (B) (No. 26286022), the Exploratory Research program (No. 26630122), Scientific Research on Innovative Areas “Artificial photosynthesis (AnApple)” (No. 15H00866), Nanotechnology Platform (No.12024046) of MEXT, the Research Foundation for Opto-Science and Technology, bilateral collaboration project of JSPS-CNR, and Core-to-Core Program of JSPS (A. Advanced Research Networks).

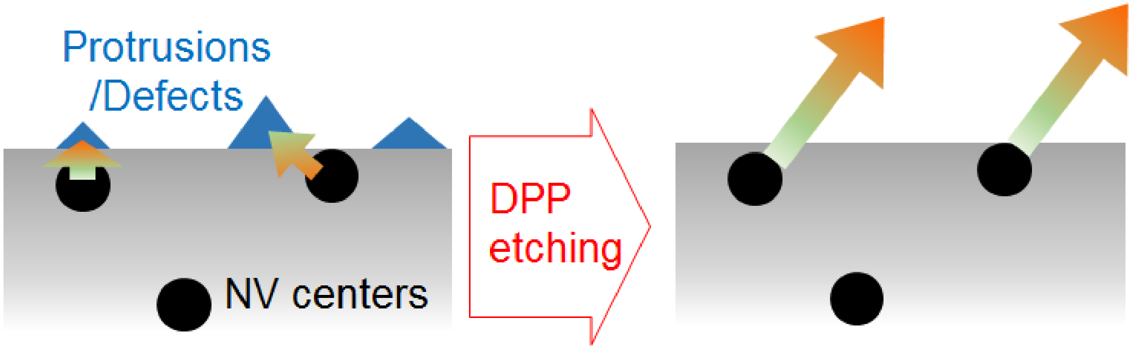

Fig. 1. Increasing emission intensity using DPP etching

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