Low power charge state depletion nanoscopy of the defect in diamond with a pulsed laser excitation

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Key Words: Super-resolution, quantum sensing, NV center

The nitrogen vacancy (NV) center in diamond is a potential candidate for the studies of nano photonics, quantum information processing, and sensing. Based on the manipulation and detection of spin state, the magnetic, electric, temperature and stress sensing of various solid-state materials and biological samples has been demonstrated with NV center. High spatial resolution is one of the most important advantages of NV center sensing. Recently, the charge state conversion of NV center is applied for the sub-diffraction optical imaging [1].

Here, we used pulsed laser for charge state manipulation of NV center. The charge state conversion rate was significantly enhanced by decreasing the repetition rate of laser. Subsequently, we used pulsed laser with low repetition rate for charge state depletion (CSD) super-resolution microscopy. The time-averaged power of depletion laser was reduced approximate 5 times by decreasing the repetition rate from 80 MHz to 1 MHz. Further combining with a near-infrared (NIR) laser, a resolution of 12 nm was obtained with a 1 mW depletion laser. It can reduce the optical heating, which decreases the accuracy of NV center sensing. Combining with spin manipulation, we expected our technique can be developed to a super-resolution multifunctional sensing system.

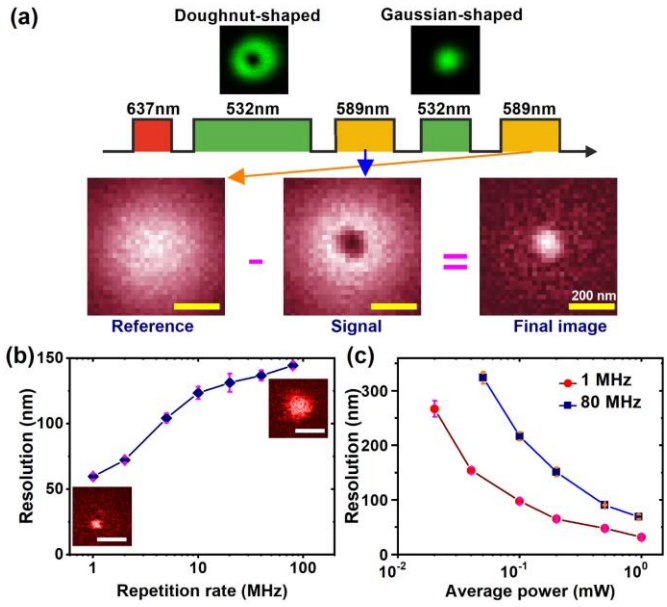

Figure 1, (a) The pulse sequence for CSD microscopy imaging. (b)The spatial resolution of CSD microscopy with various repetition rates of depletion laser. (c) The power dependent CSD microscopy resolution.

Reference:

[1] Xiang-Dong Chen, et al., Phys. Rev. Applied 12, 044039 (2019).