Super-resolution microscopy for quantum sensing with NV center in diamond

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Quantum sensing with high sensitivity and high spatial resolution is a useful tool for physical and biological study. As one of the most promising candidates, NV centers in diamond have been demonstrated the capability for temperature, electromagnetic field and pH sensing with high spatial resolution and sensitivity [1]. The noninvasive optical far-field microscopy is widely used for the NV center locating. As the resolution of traditional optical microscopy is limited by the optical diffraction, it is necessary to develop a super-resolution microscopy for NV quantum sensing.

Here, we demonstrated the sub-diffraction resolution NV manipulation and detection based on the charge state depletion (CSD) microscopy of NV center. A doughnut-shaped 532/637 nm laser beam was used for the charge-state depletion [2]. An additional NIR laser was applied to enhance the charge-state transition and highly decrease the power of depletion-laser beam [3]. With laser intensity about 1.2 MW/cm^2, a resolution of 14 nm was obtained. Using NV ensemble in bulk diamond as local field probes, we detected the local electromagnetic field of silver nanowire with high spatial resolution. The surface plasmon resonance of nanowire was measured using sub-diffraction fluorescence lifetime microscopy. The near field microwave field transmitted through nanowire was measured using sub-diffraction spin resonance microscopy. Our method can be used for nanoscale biological and physical study.

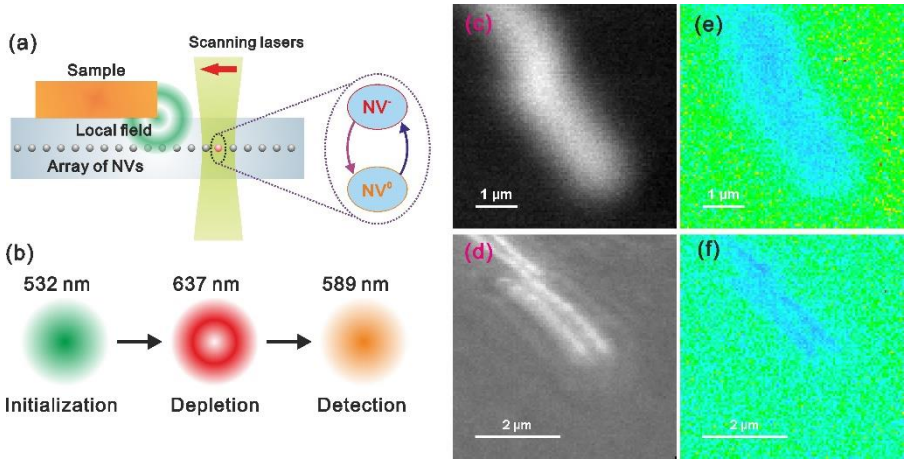

Figure 1, (a) Illustration of high resolution quantum sensing. (b) The laser beams used for super resolution microscopy. (c) (d) Ag wire enhanced fluorescence intensity imaging with confocal and CSD microscopy, respectively. (e)(f) The confocal and CSD microscopy images for Ag wire affected fluorescence lifetime imaging.

Reference:

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[3] XD Chen, S Li, et al., *Phys. Rev. Appl.* 7, 014008(2017).