Nanopositioning of single NV spins

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ABSTRACT
Precise control over the position of a single quantum object is important for many experiments in quantum science and nanotechnology. We report on a technique for high-accuracy positioning of individual diamond nanocrystals [1]. The positioning is done with a home-built nanomanipulator under real-time scanning electron imaging, yielding an accuracy of a few nanometers. This technique is applied to pick up, move and position a single NV defect center contained in a diamond nanocrystal. We verify that the unique optical and spin properties of the NV center are conserved by the positioning process.

INTRODUCTION
Diamond has recently emerged as a unique material for quantum information processing [2]. In particular, Nitrogen-Vacancy centers (NV centers) in diamond exhibit quantum behaviour up to room temperature. NV centers naturally emit photons one at a time and can be used as a reliable single-photon source. Moreover, the electronic and nuclear spin states associated with the NV center have extremely long coherence times that allow coherent control of single spins at room temperature with very high fidelity that is unmatched in the solid state.
We have developed a technique to control the positioning of single NV centers embedded in ~50nm diamond nanocrystals. .We aim to use this new technique to study and exploit coupling of single NV centers to photonic cavities and plasmonic structures: experiments, where precise positioning of the NV center is essential.

RESULTS AND DISCUSSION
Identification and optical characterization of single NV centers contained in ~50 nm diamond nanocrystals is done in a home-built confocal microscope. We are able to pick up, move and position these nanocrystals with nanometer precision (Fig. 1) with sharp probe inside a scanning electron microscope. Measurements of the effects of positioning on the optical and spin properties of the NV center will be presented.

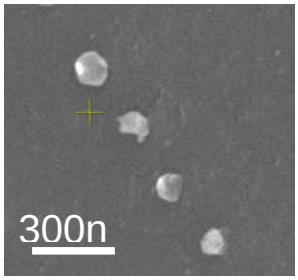

Fig 1. Four diamond nanocrystals that were subsequently picked up, moved, and positioned with nanometer precision

REFERENCES
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