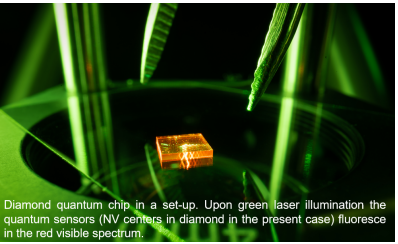
IP RIGHTS
EP application
2023

Boosting sensitivity and speed for quantum sensing

As individual defects in diamond, nitrogen vacancy (NV) centers present extraordinary opportunities for quantum sensing. We are pleased to present an innovative solution that represents a significant advancement in the field of NV-NMR measurements. The approach revolves around achieving homogeneous control over a broad area spin ensemble, allowing enhanced sensititvity and resolution.



Diamond quantum chip in a set-up. Upon green laser illumination the quantum sensors (NV centers in diamond in the present case) fluoresce in the red visible spectrum.

Simultaneous local spin manipulation

By introducing microwave radiation, the novel approach manipulates the spin ensemble, and readout occurs through laser illumination with temporal-spatial encoding of luminescence. High-precision analyses within the boundary of the solid-state matrix offering unmatched control and accuracy.

01 sensitivity increase of 300-500% compared to existing methods

02 lower-power pulse laser, allowing more efficient energy utilization

03 minimal disruption to often heat sensitive biological or chemical samples

04 10 times faster readout speed

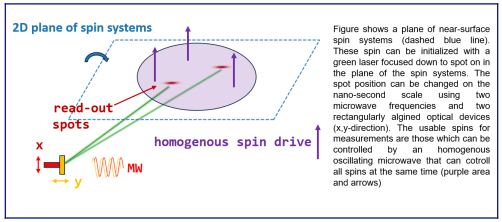


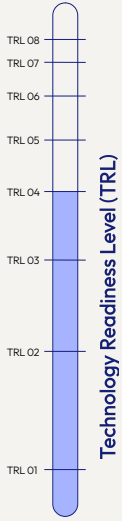
Figure shows a plane of near-surface spin systems (dashed blue line). These spin can be initialized with a green laser focused down to spot on in the plane of the spin systems. The spot position can be changed on the nano-second scale using two microwave frequencies and two rectangularly algined optical devices (x,y-direction). The usable spins for measurements are those which can be controlled by an homogenous oscillating microwave that can cotroll all spins at the same time (purple area and arrows)

CHALLENGE

The utilization of spin ensembles within solid-state matrices presents a formidable challenge due to several intricate factors. Distinguishing between spin states and the inadvertent interactions with other particles in the matrix pose significant difficulties. Furthermore, achieving accurate measurements necessitates the use of averaging to attain an adequate signal-to-noise ratio, a process that inherently limits sensitivity.

INNOVATION

The presented invention outlines an approach aimed at achieving homogeneous control over a large surface-area spin ensemble. To facilitate rapid transition between illuminated points an optical modulator is integrated into the laser pathway. Additionally, the use of a deflected and focused laser beam enables the attainment of high light power densities within the illuminated area, while maintaining laser power uniformity. The core advantage of this innovative concept lies in its ability to uniformly control the spin ensemble across a vast surface area. This, in turn, promises precision in measurement and higher levels of resolution.



01 Basic principles observed · **02** Technology concept formulated · **03** Experimental proof of concept · **04** Technology validated in lab · **05** Technology validated in relevant environment · **06** Technology demonstrated in relevant environment · **07** System prototype demonstrated in operational environment · **08** System complete and qualified

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