Quantum sensing of RF fields with 10 Hz spectral resolution using NV centers in Silicon Carbide

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Nuclear Magnetic Resonance (NMR) spectroscopy is an important analytical tool commonly used in life sciences. Its advantages come from its nature to be a non-invasive method to detect molecular structure of biological samples required for applications in diagnostics and fundamental science. However, the limited magnetic sensitivity restricts its utility to study only macroscopic sample sizes on the order of few hundred μm^3. Diamond has shown to be very promising candidate to overcome the current limitations of bulky NMR machines by using Nitrogen Vacancy (NV^-) defects that are able to reach comparable sub-Hz spectral resolution while reaching nano[1] and few micrometer[2] spatial resolution. However, diamond is an expensive material that is not compatible with standard CMOS fabrication which makes developing scalable and low-cost magnetometers difficult to achieve. On the other hand, Silicon Carbide (SiC) is a technology friendly material with large scale production of high-temperature electronics that host high quality defects useful for quantum sensing applications, like ones present in diamond.

Here we discuss our results to detect a 900 kHz radio-frequency field generated via a test coil. By utilizing the advantages of "Synchronized readout" technique[2] we were able to reach a 10 Hz spectral resolution using ensemble of NV^- centers in SiC[3] while simultaneously achieving the record room temperature coherence time of 28.1 μs. These results pave a way of using SiC defects for future practical sensing applications.

References

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[2] D. R. Glenn et. al., "High-resolution magnetic resonance spectroscopy using a solid-state spin sensor", Nature, 555, 351-354, March 2018

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Figures

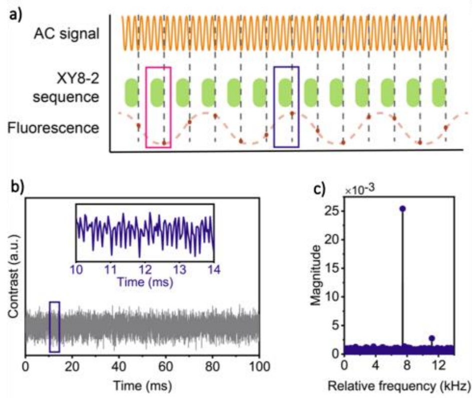

Figure 1: a) Measurement of AC signal with Synchronized readout technique. b) Recorded florescence in time domain and its c) Fourier Transform demonstrating a 900 kHz AC signal measured with 10 Hz spectral resolution