Scalable Electrically Read Diamond Spin Qubit Technology for Single Molecule Quantum Imagers

Q-MAGINE

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In collaboration with
NanoSpin consortium
Jens Anders
**Concept:** Electrically read NV qubit chips for molecular imaging with chemical resolution

NMR protocols are adapted to single NV qubit detection enabled by the electrical transfer between negatively charged and neutral NV centre employed for spin state detection protocol for detecting proximity nuclear spins.
Consortium partners

<table>
<thead>
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Project goals
1. Electrically (PDMR) detected NMR quantum sensor
2. Single molecular quantum sequencer
• M. Bockstedte, Ab initio description of highly correlated states in defects for realizing quantum bits, *npj Quantum Materials* 3, 31 (2018)
WP1: Management: following plan

WP2: Electrically-read diamond quantum chip

- Electrically detected single NV readout: Better spatial resolution as ODMR, limited only by the device size
- 1000 x enhanced signal detection sensitivity compared to ODMR

Precise protocols to address NV centre transition (a) (b) to enhance the readout rate (c) and to achieve single spin detection contrast > 50 %, theory design ready, in practical realization.

Building upon Qdyne sub mHz lines (Schmitt, 2017), high S/N sensing protocols are being developed and transferred to photoelectric readout.

**Randomization protocols for high S/N**

WP5 Sensor Microarchitecture and Quantum Matrix Multiplexing

Matrix addressing by STIRAP protocols - Technology ready
Fabrication and assembly of the Matrix-Chips. A) Fabrication process. B) SEM micrograph of the chip mounted on a HF circuit board, with 10 leads enabling the addressing of 25 sites on the chip. C) (left to right) schematic representation.

In preparation 2020
WP 6  NMR proteomic chip for molecular tomography

a) quantum chip design
b) integration with microfluidics

d) First tests on label-free DNA detection in microfluidic sensor

- Krecmarova et al, proc. word biomed. congress 2018
Planning 2nd term

- Transfer developed ODMR - NMR quantum protocols to electrical readout
- Enhance PDMR spin readout beyond ODMR
- Progress theory protocols to resolve nuclear spin environment in molecules (decoupling from environment, isotropic and anisotropic broadening)
- Test on single molecular system. Combined with addressing using 2 x 2 NV spin array.
Outreach

- https://www.standaard.be/cnt/dmf20190214_04176937