Designing of the Diamond-based NV Quantum Nano-Probe for the Biological Applications

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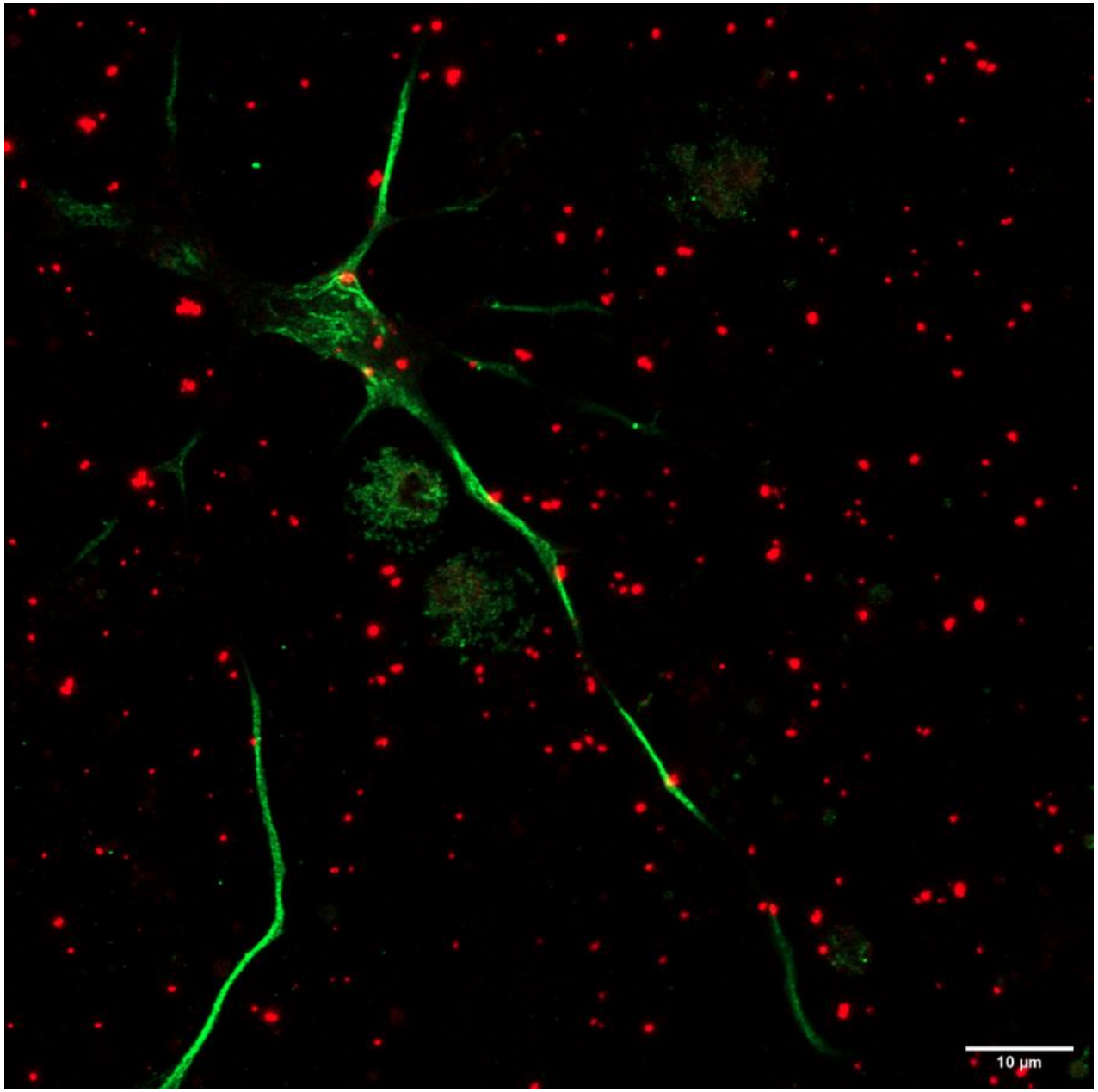
Lednice, Czech Republic

MOTIVATION

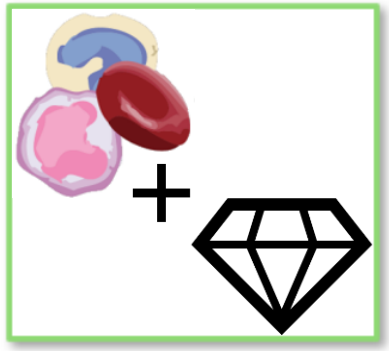
Investigate dynamics of the axon growth under inflammation

Investigate opening of the TRPV4 ion channels at axon neuron

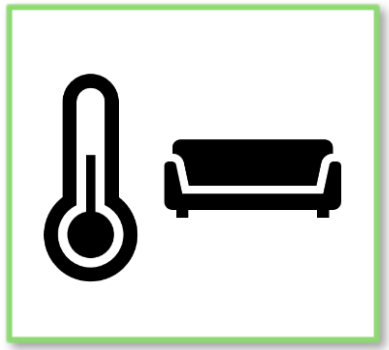
Usage of the FNDs as quantum multi sensor



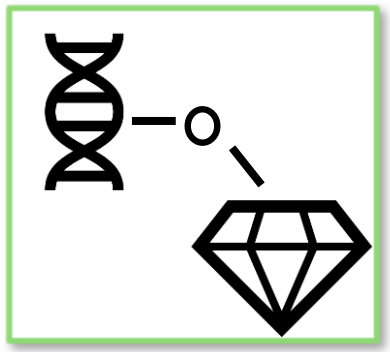
STATE OF ART



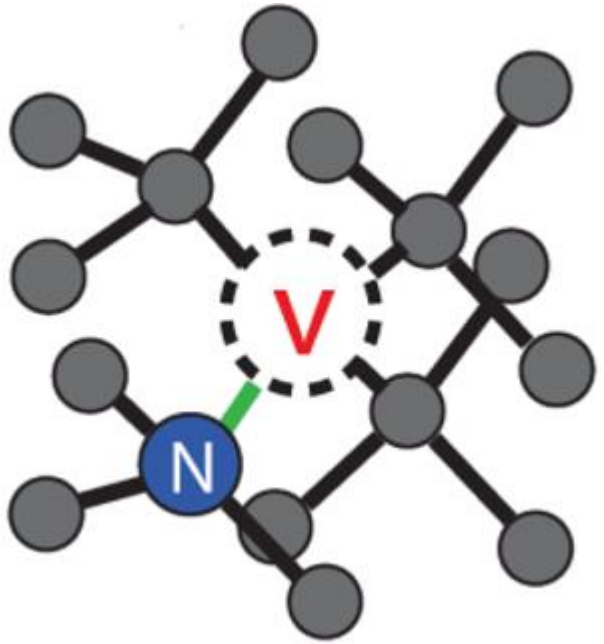
Biocompatibility



Working in room temperature

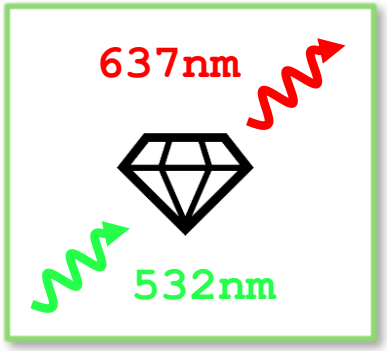


Surface modification

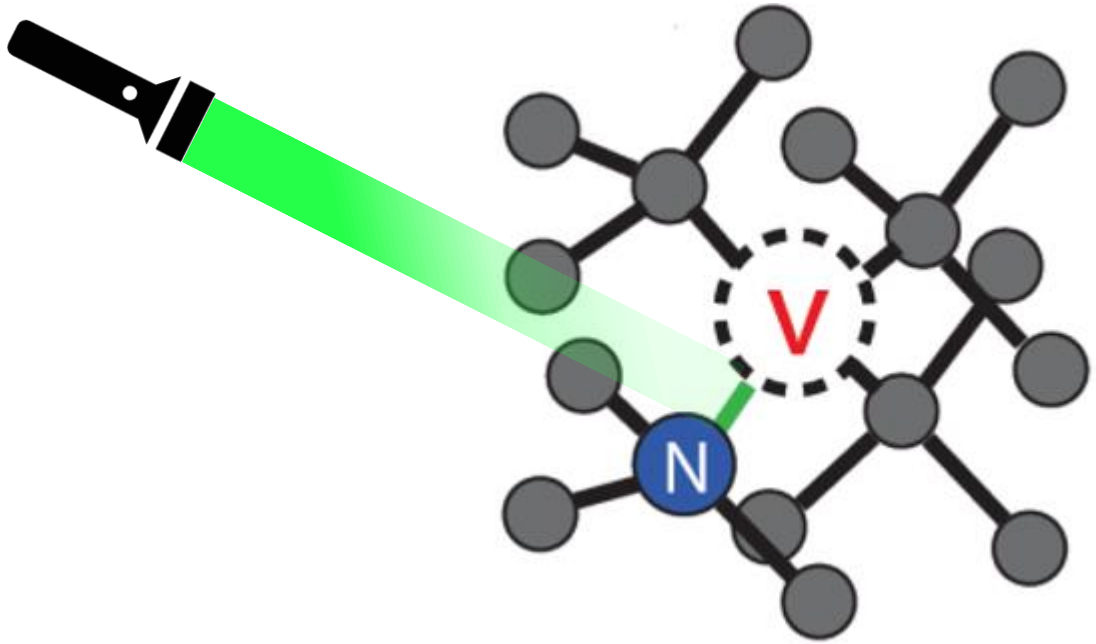


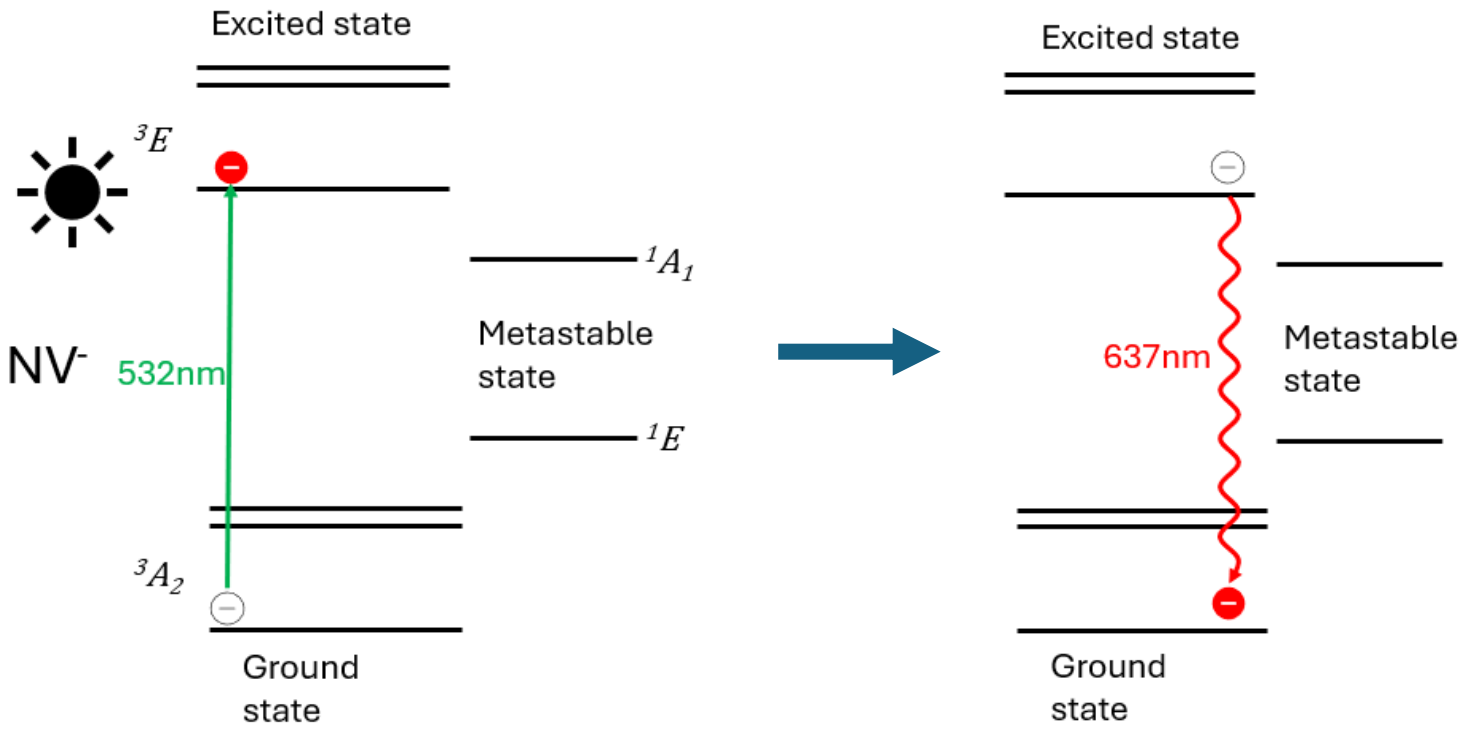
SENSING IN BIO-ENVIROMENT

STATE OF ART



Fluorescence





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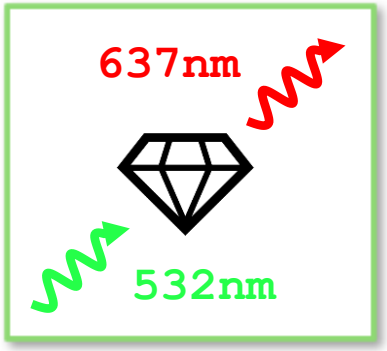
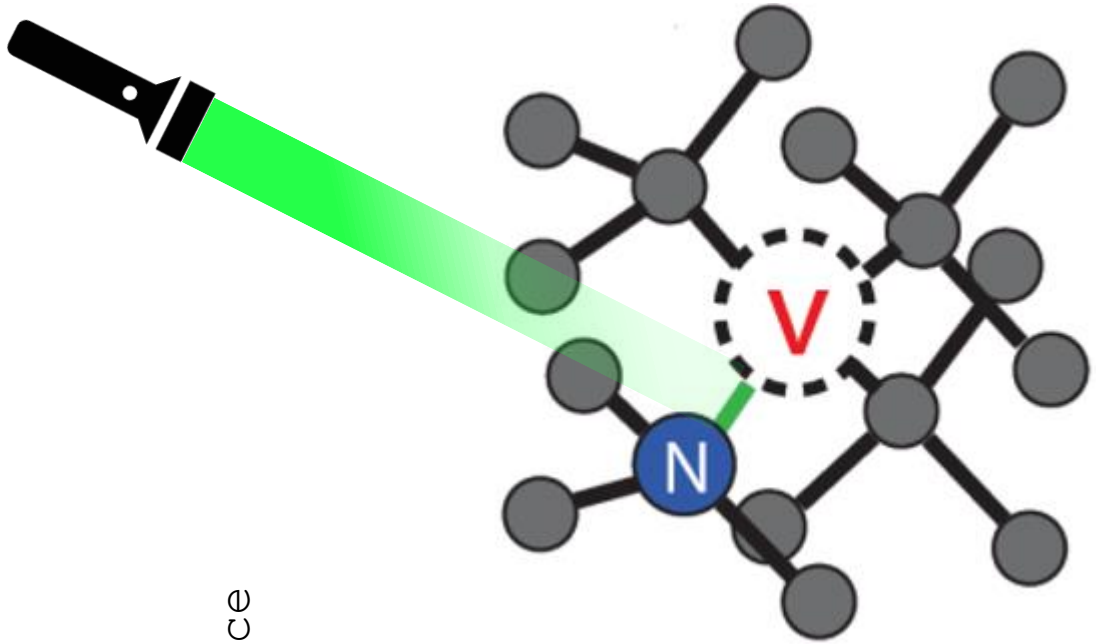
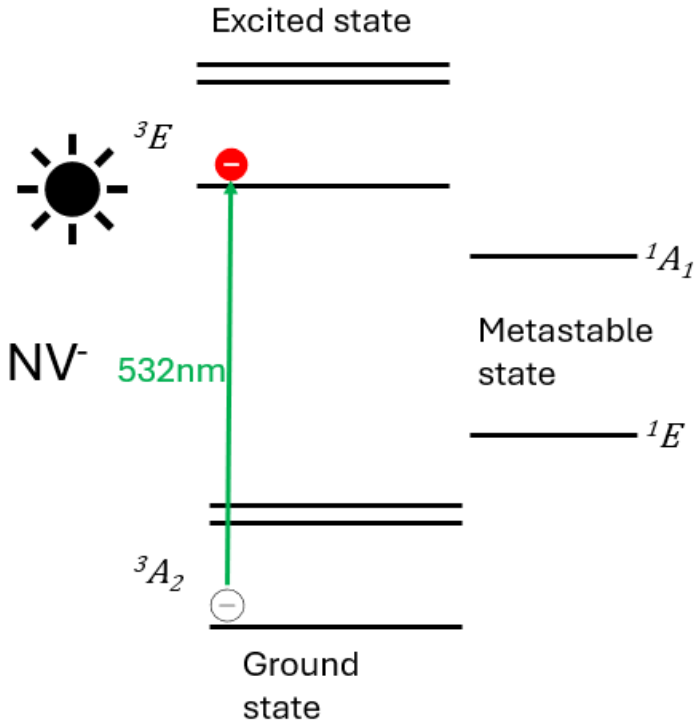
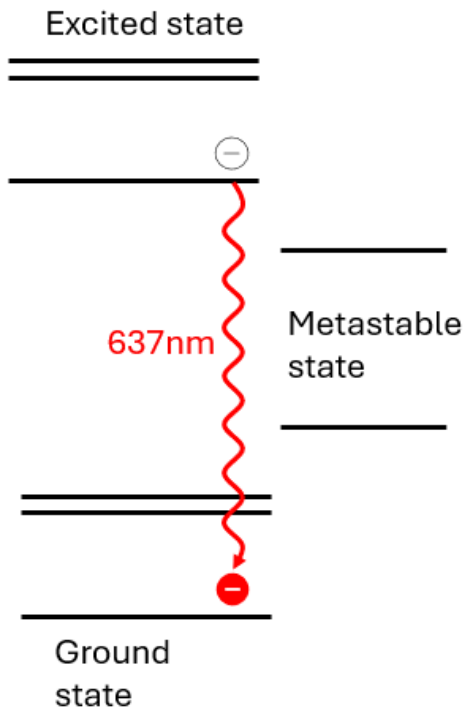
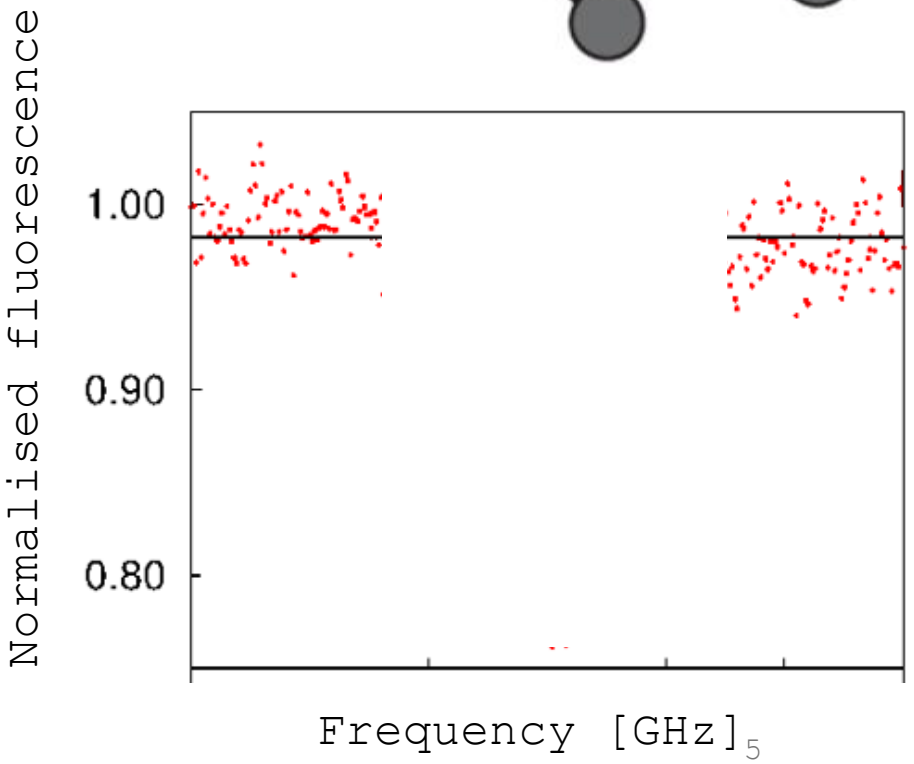


Fluorescence









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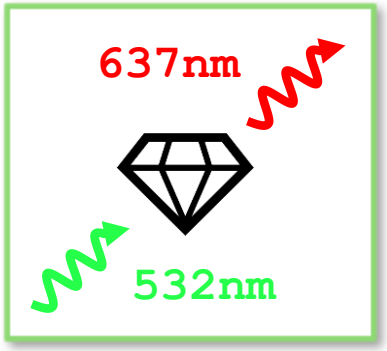
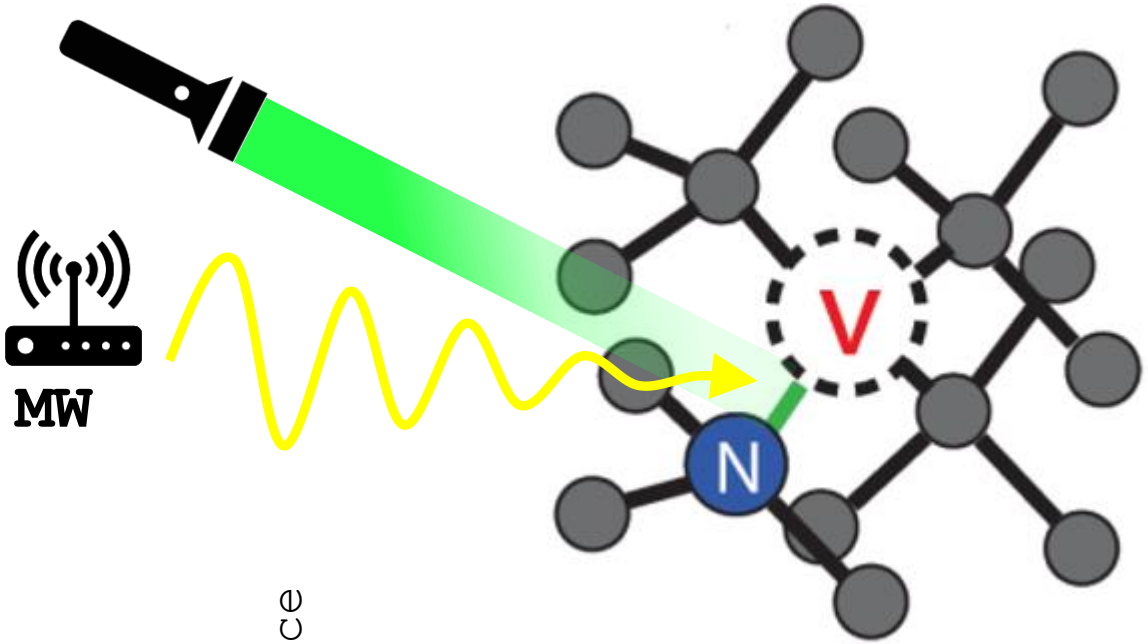
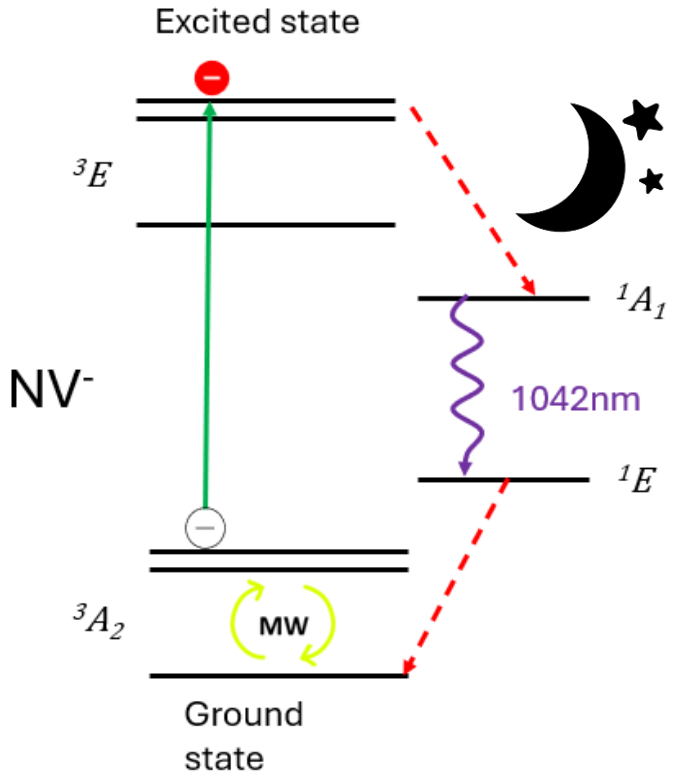
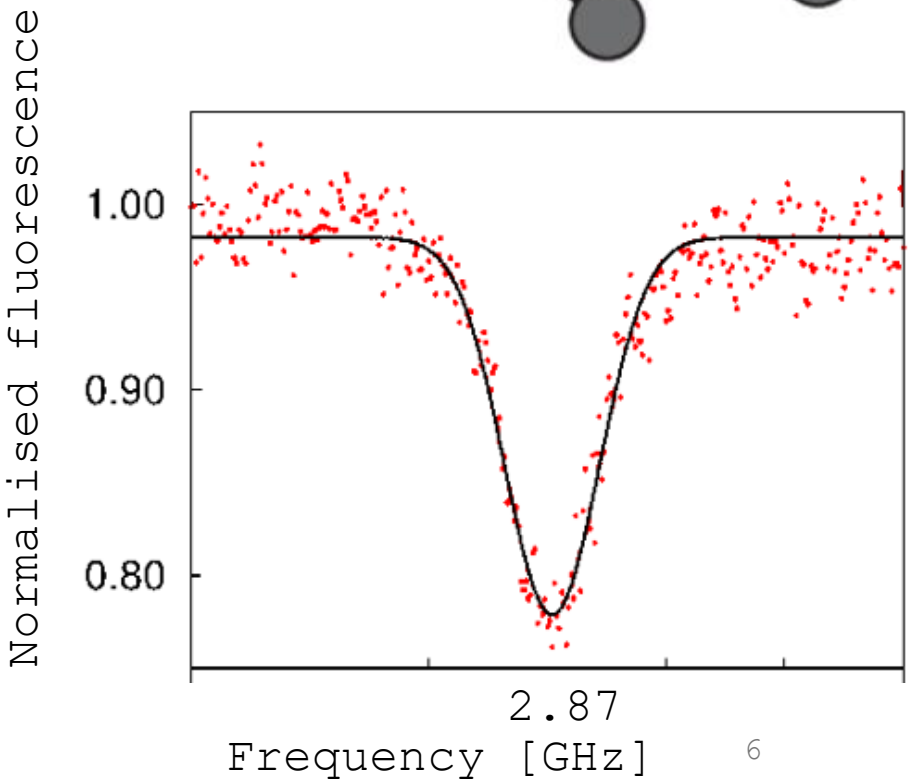
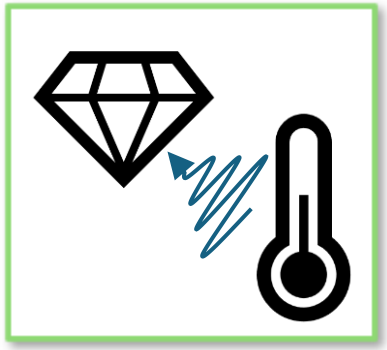


Fluorescence

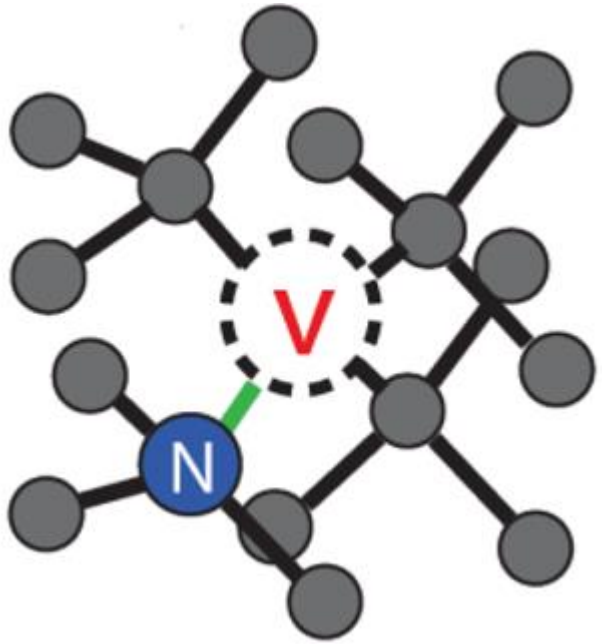






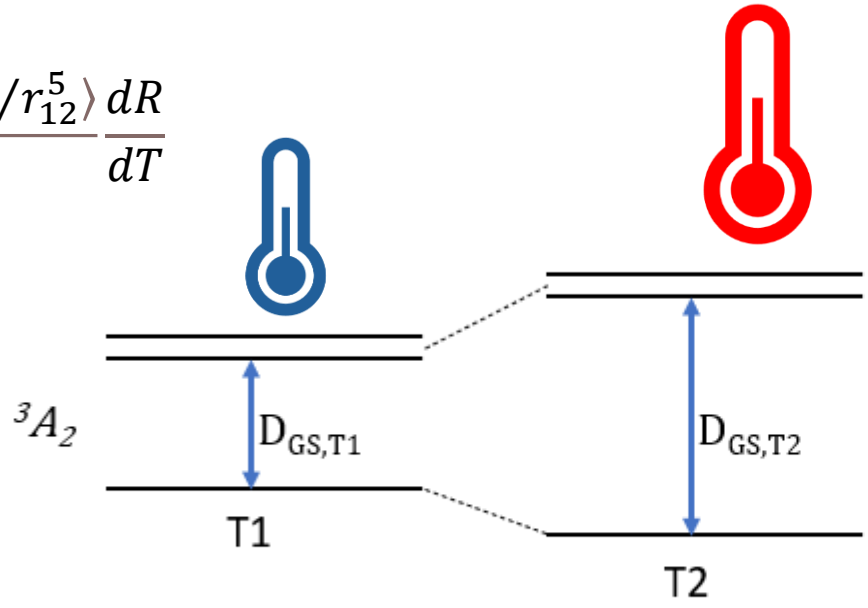


Temperature sensitivity

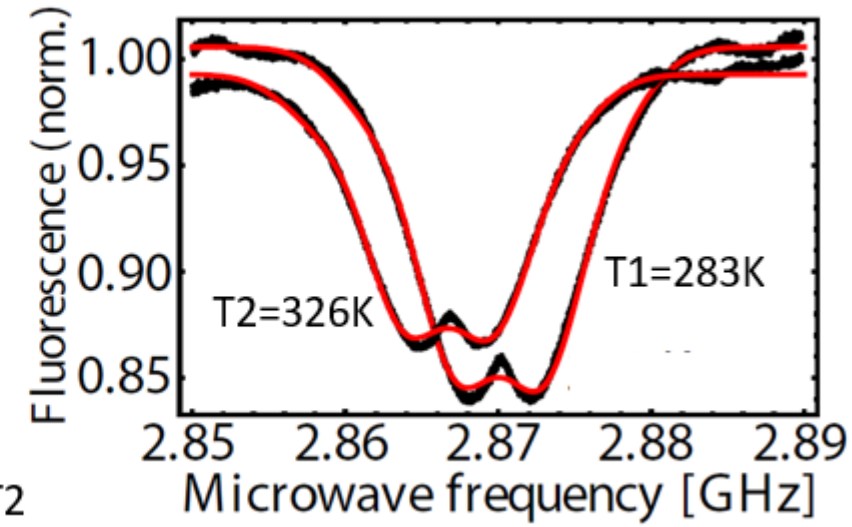


$$\frac{1}{D_{GS}}\frac{dD_{GS}}{dT} \approx \frac{1}{D_{GS}}\frac{d\langle(r_{12}^2 - 3z_{12}^2)/r_{12}^5\rangle}{dR}\frac{dR}{dT}$$

$$dD_{GS} \approx -74kHz/K$$



Ground state in case of different temperature, T1<T2



Chipset – nanodiamond particles

GOALS

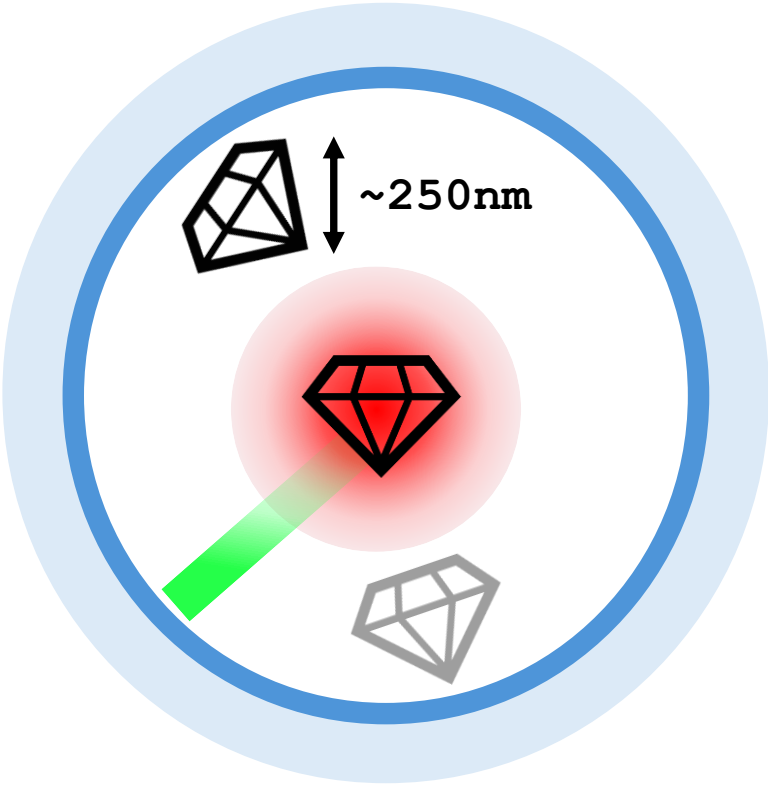
Quantum holder for nanodiamond particles
Concept of multi sensor

METHODS

Numerical simulation in COMSOL
Temperature & magnetic sensing in fantom
Magnetic field sensing *in vitro*

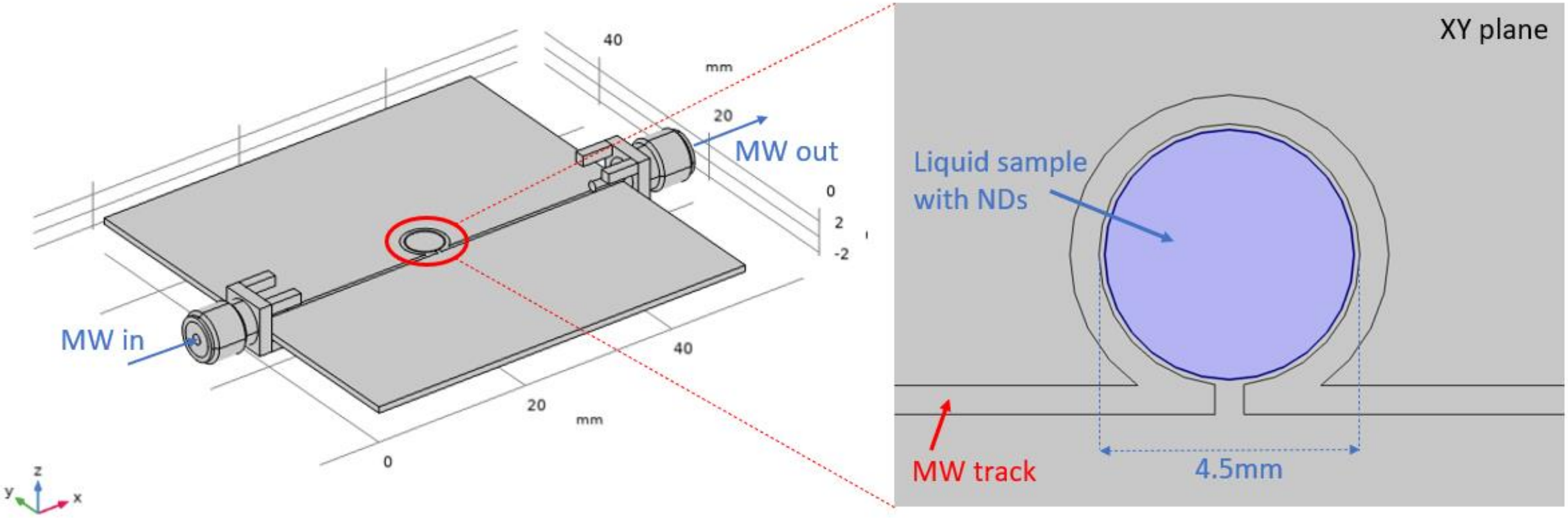
OBJECTIVE

1) Holder & Electrode
1) Simulation of the MW field
2) Minimalize microwave interferences



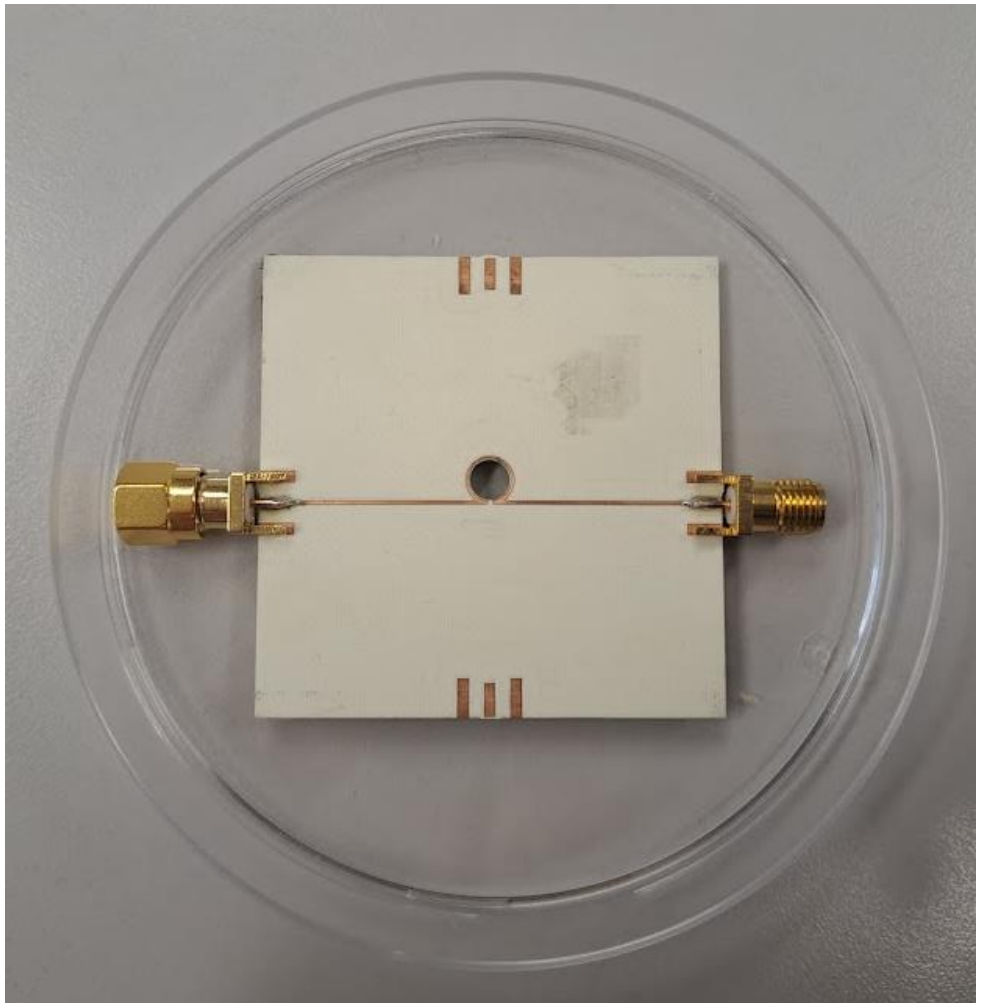
Motivation: Multi-sensor, Link local temperature with activation of TRP channels in neuron cell wall

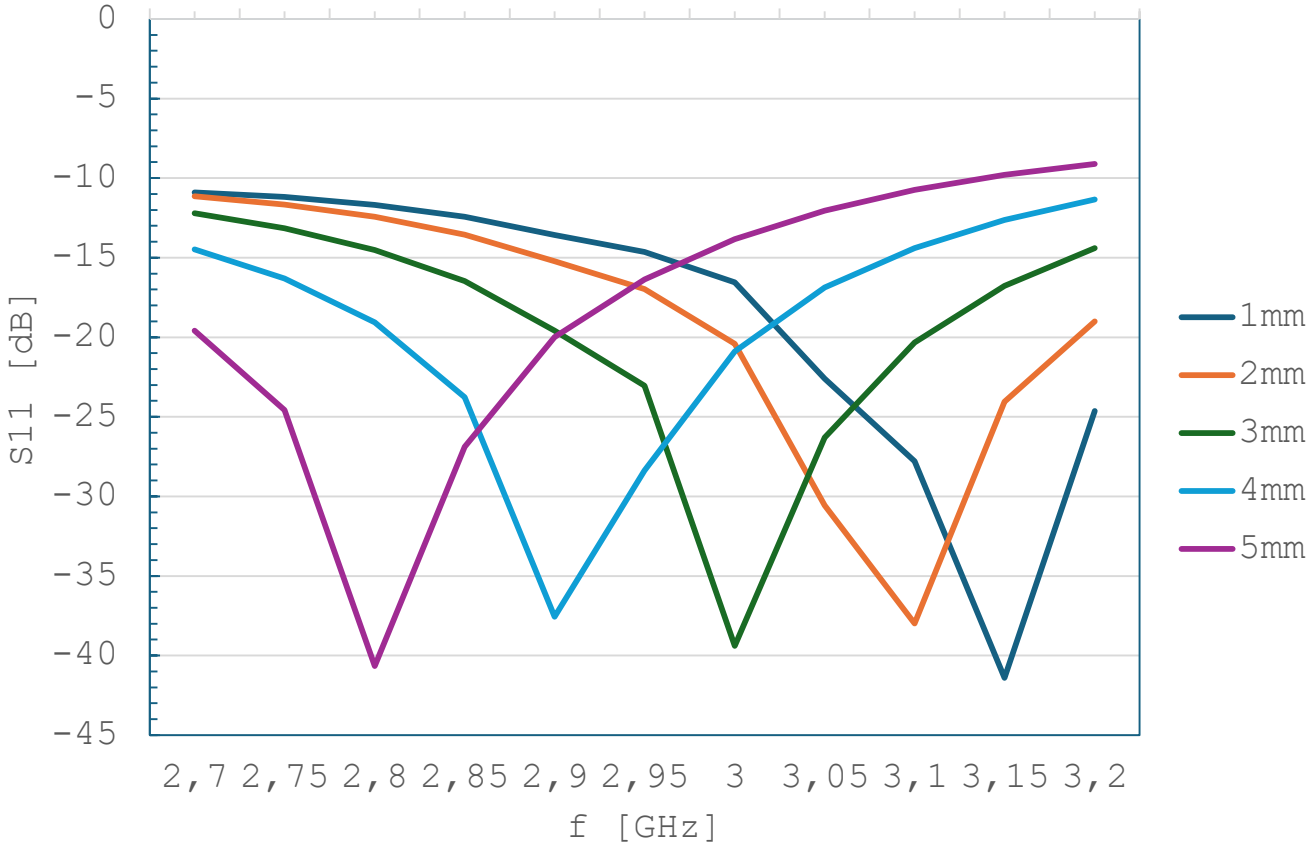
Chipset – nanodiamond particles



Model of the omega antenna

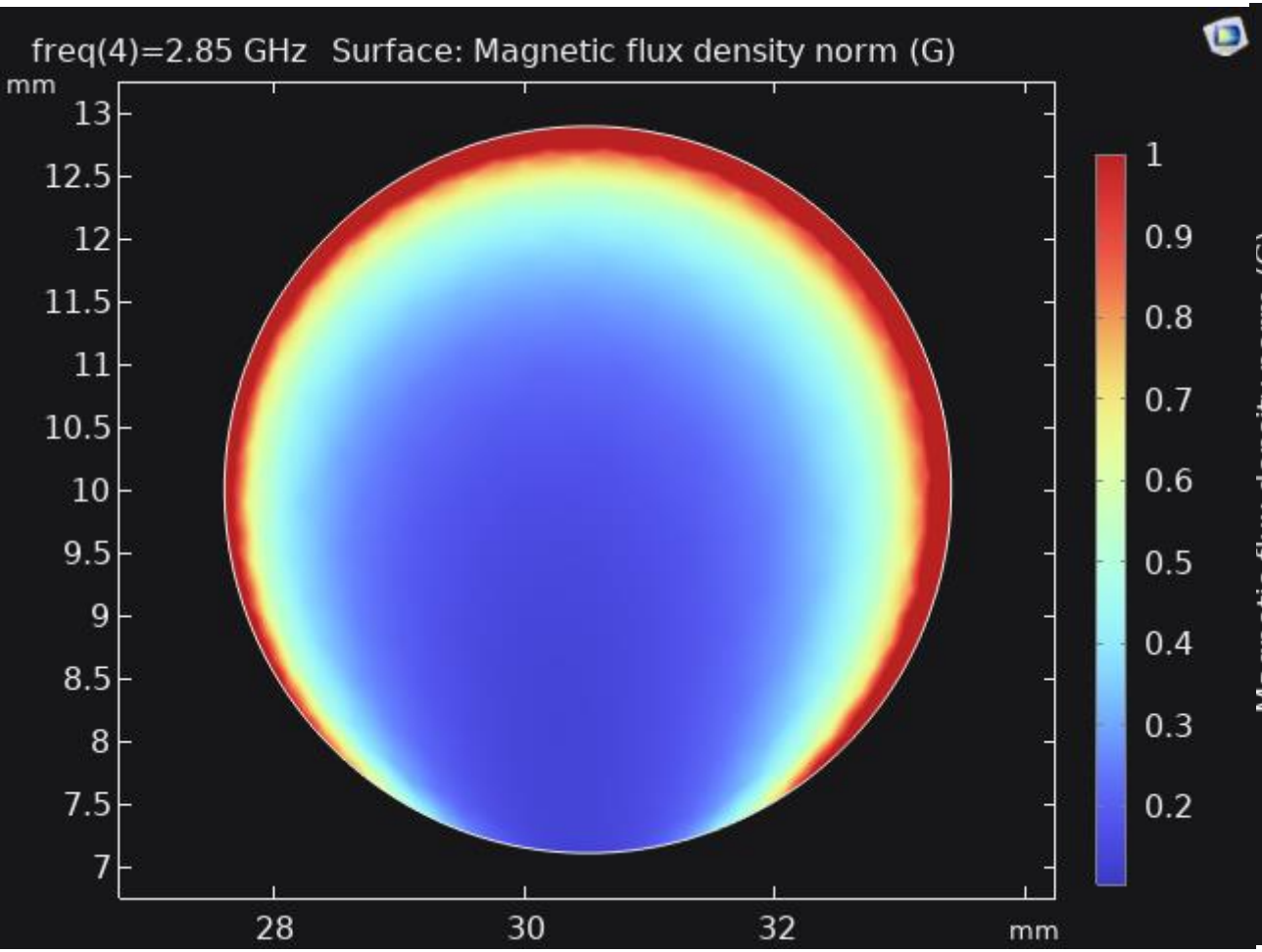
Chipset design

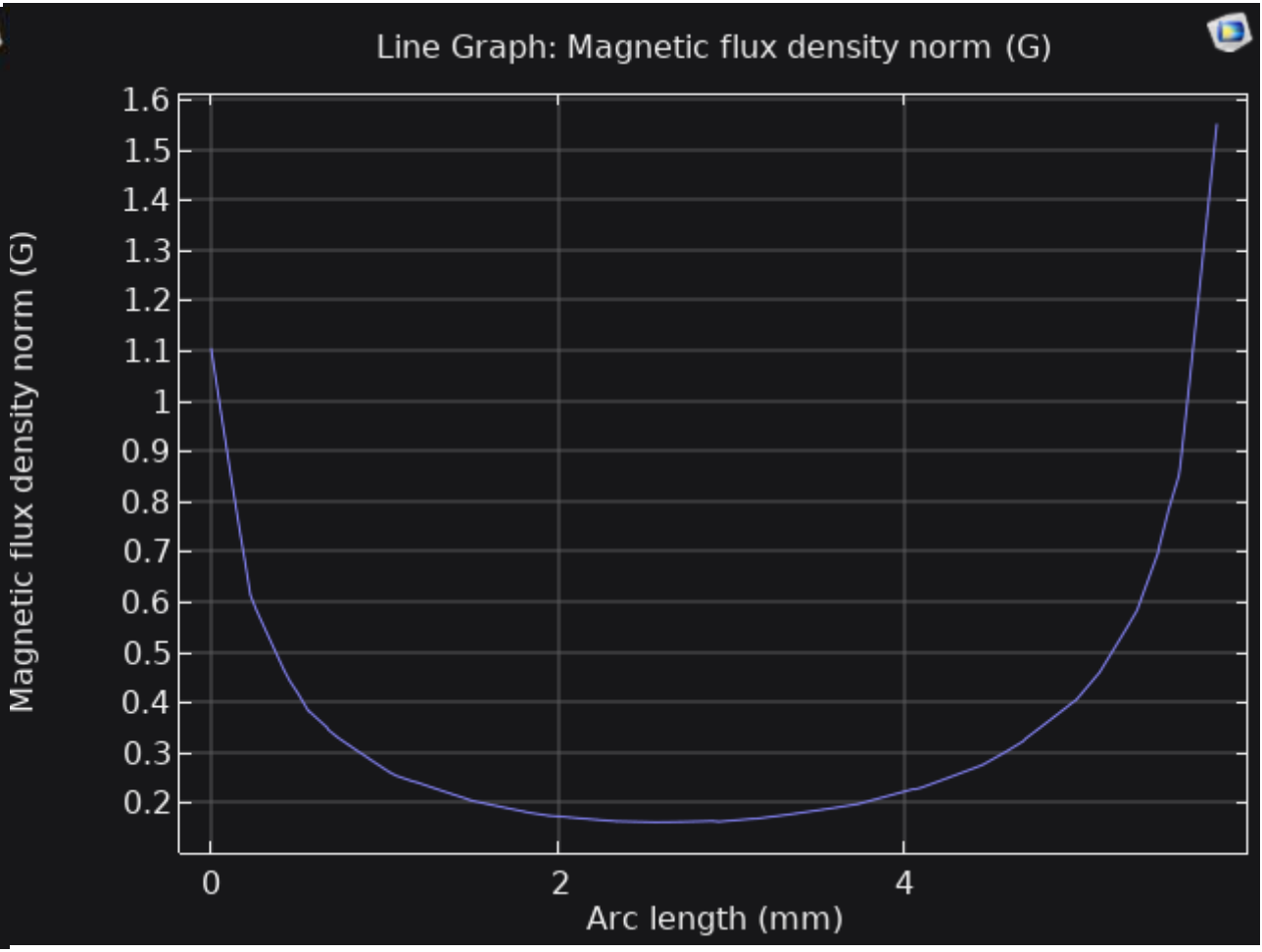




Omega structure with resonance ~2.87GHz, inner diameter 4.5mm

Chipset – nanodiamond particles





Chipset – nanodiamond particles

Heating properties

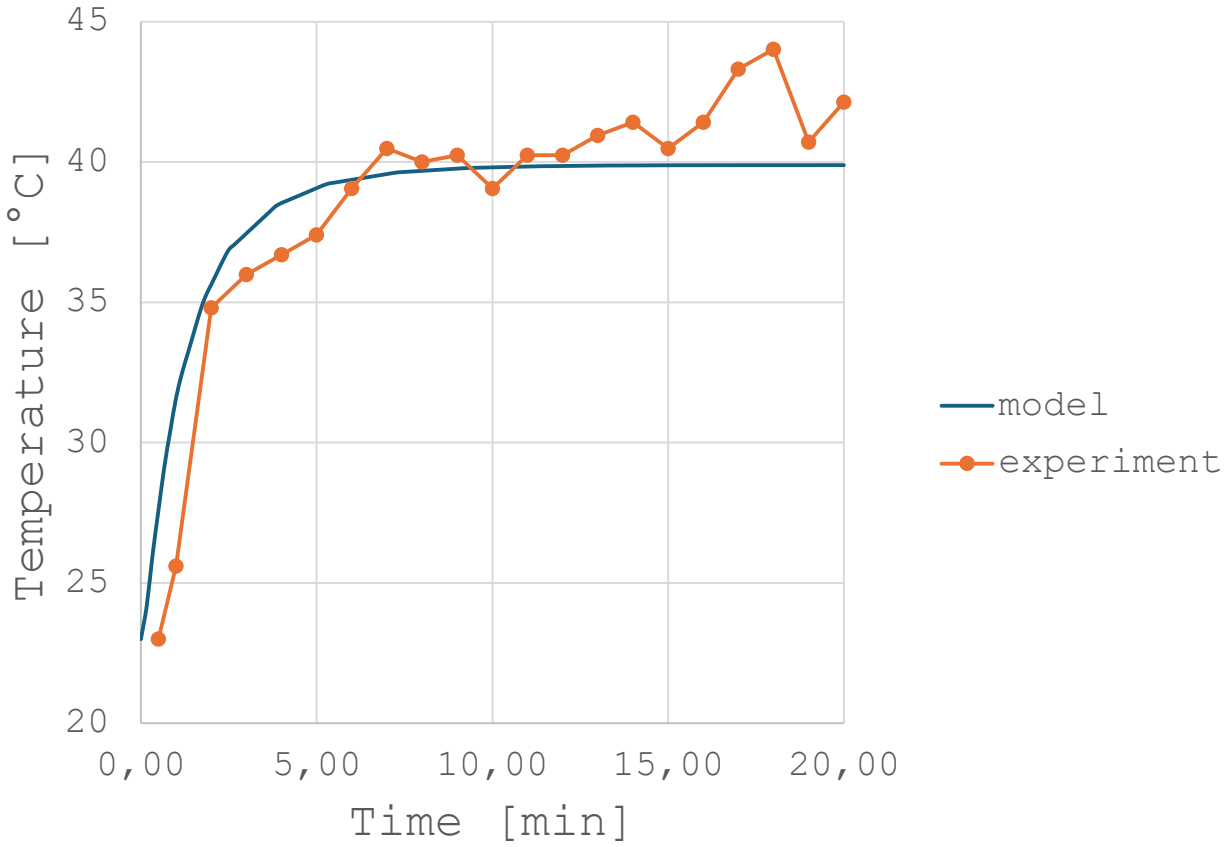
Numerical simulation

MW heating module COMSOL

Experiment

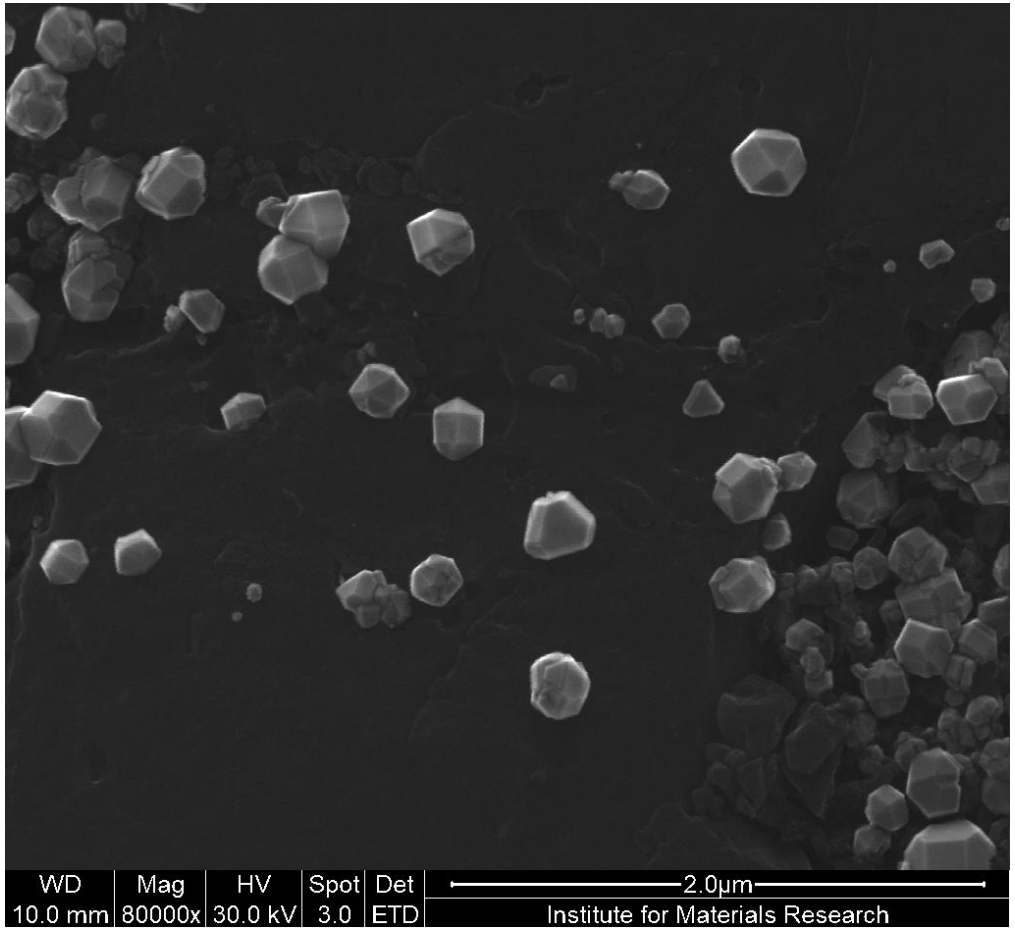
Sensing of temperature via NDs

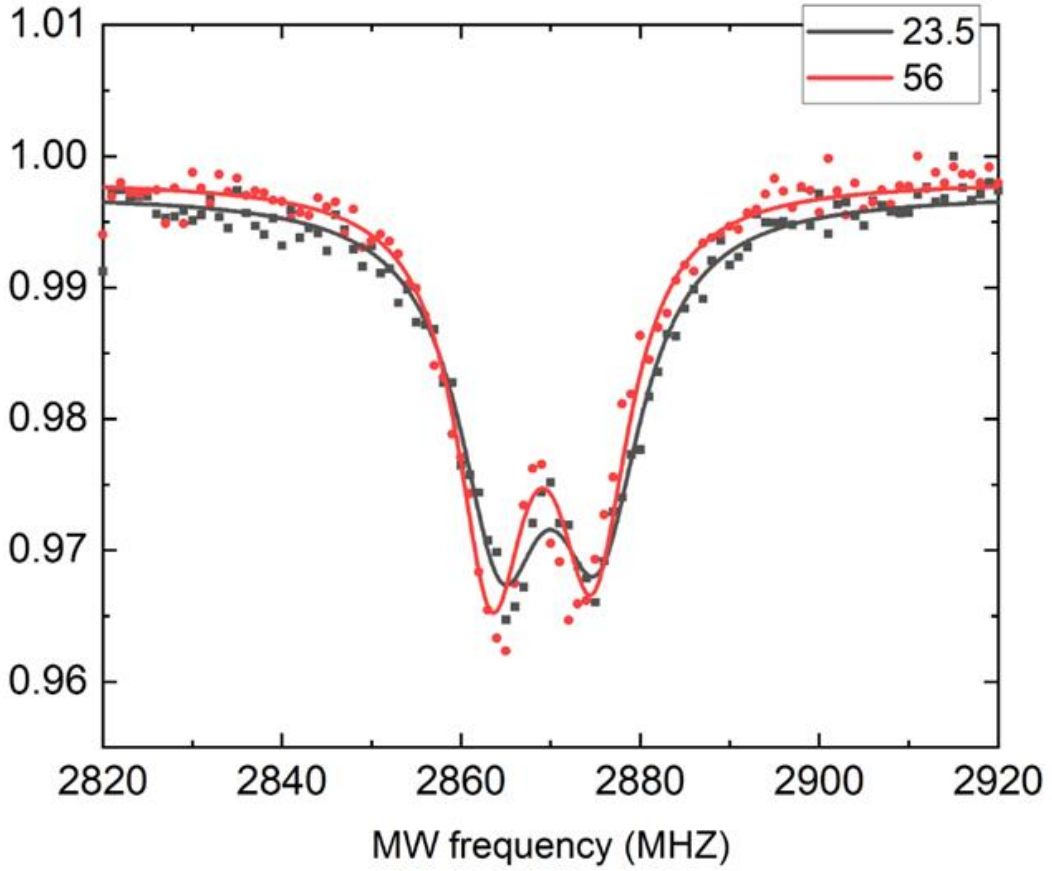
Liquid media, HEPES – biological phantom



Chipset – nanodiamond particles

Biological sensing - fantom

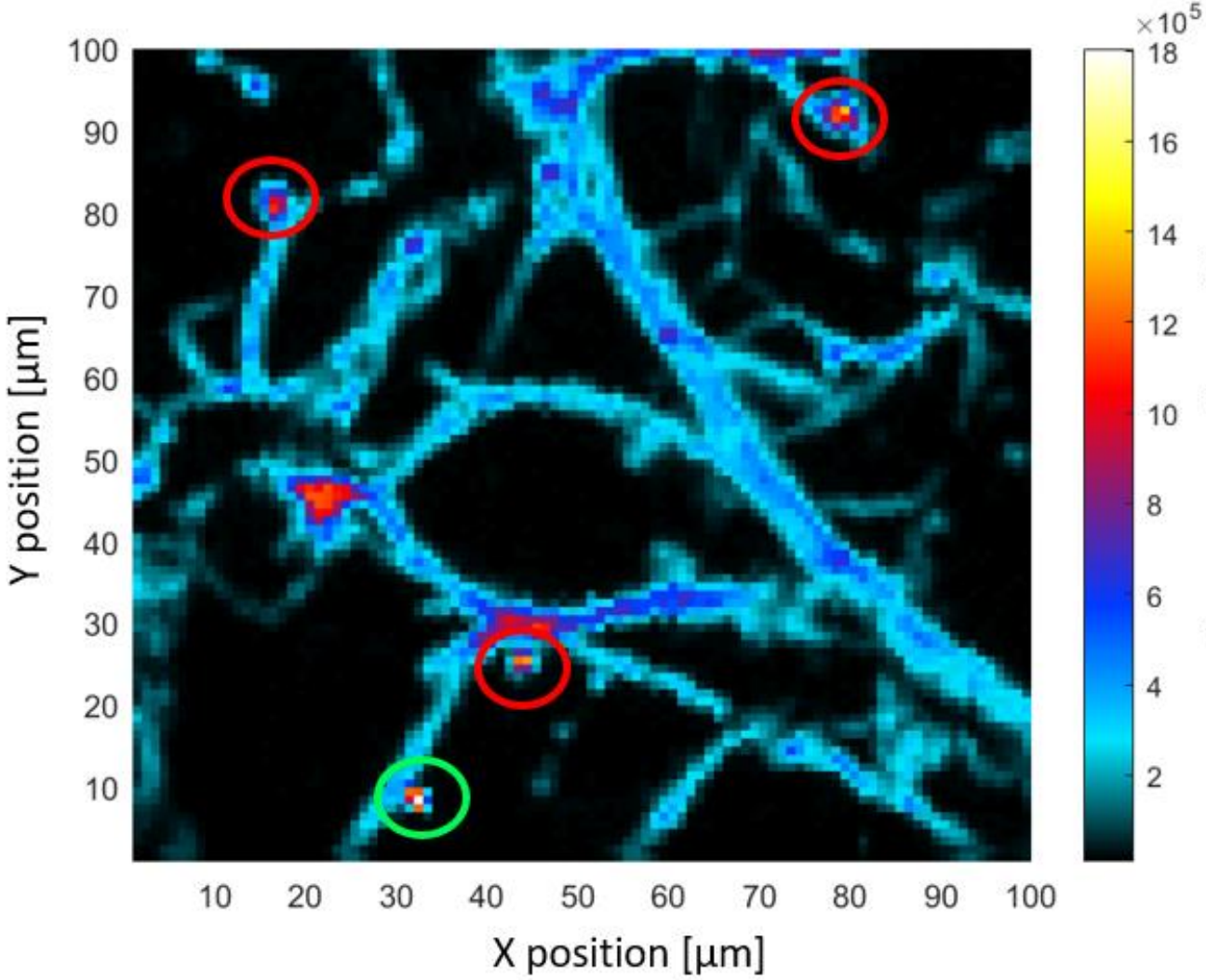


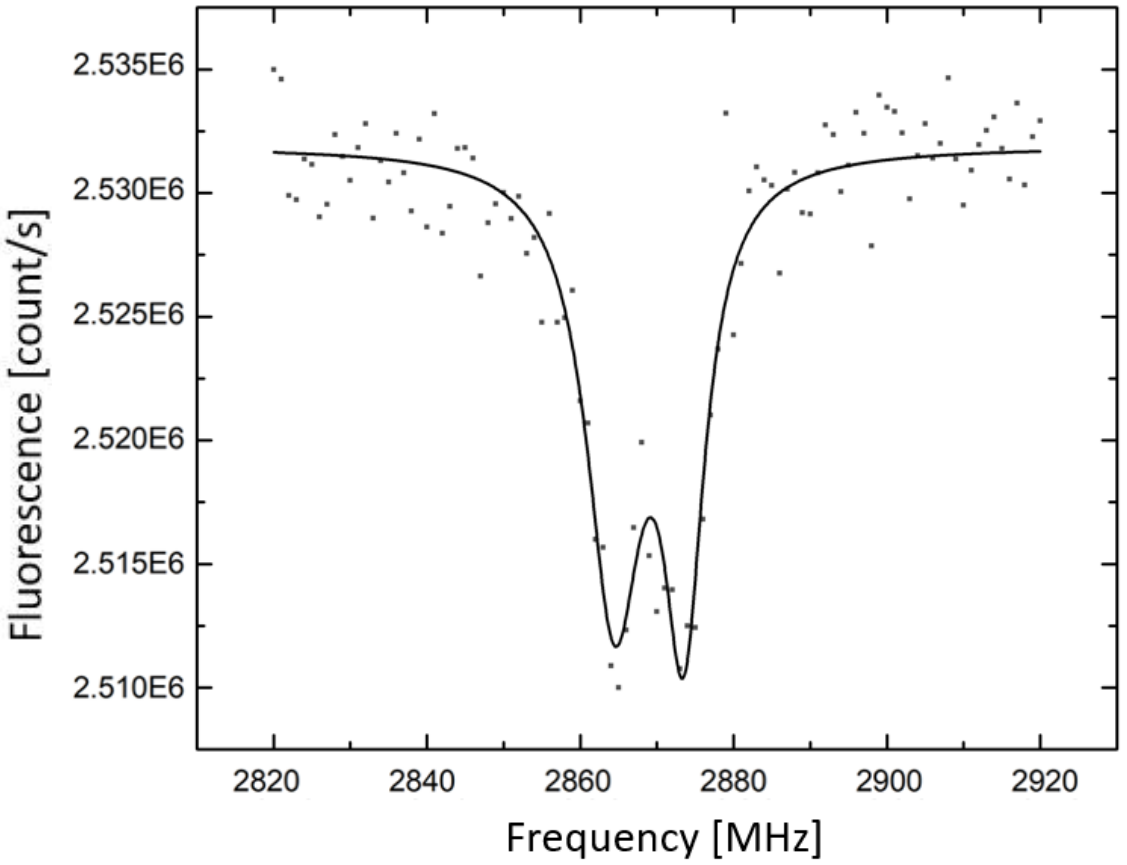


ODMR spectra from NDs for two different te
1mW 532nm laser, 2W of microwave power

Chipset – nanodiamond particles

Biological sensing – *in vitro*





ODMR spectra from NDs in green ellip
1mW 532nm laser, 2W of microwave pow

Thanks for the attention