

Abstract

Sz. Mieloch¹, Ł. Piątkowski², J. Sobkowski¹, A. Dychalska¹, G. Szawiola¹, P. Głowacki¹,
D. Stefańska¹

¹ *Institute of Materials Research and Quantum Engineering, Faculty of Materials Engineering and Technical Physics, Poznan University of Technology,*

² *Institute of Physics, Faculty of Materials Engineering and Technical Physics, Poznan University of Technology*

Title: Dependence of the ODMR signal and fluorescence spectra of NV⁻ colour centres in diamonds on the excitation wavelength

NV⁻ colour centres in diamonds exhibit long quantum coherence times even at room temperature [1], thanks to which they found numerous applications in quantum technologies. One of the common techniques used in their investigations is optically detected magnetic resonance (ODMR), which allows to study the reaction of the energy levels to the external conditions (e.g., temperature or magnetic field).

Studies presented here focus on dependence of the fluorescence spectra and the ODMR signal of the NV⁻ colour centres on the excitation wavelength in the range 490-645nm (exceeding the zero-phonon line). This is a follow-up to the studies conducted on industrial-grade samples and in a narrower excitation range. The current investigations were conducted on modified CVD diamonds with specified NV⁻ concentration of 2ppm.

There are already reports on this kind of studies in the literature [2, 3]; however, hitherto there were no investigations of the fluorescence spectra for excitation wavelengths above 520nm.

In the current studies a commercial confocal microscope was utilised, and a “white” supercontinuum laser with a tunable acoustooptic filter. For the microwave excitation an in-house developed setup was used. Fluorescence spectra were recorded with a spectrometer equipped with an EMCCD camera, and the ODMR signal – with an amplified photodetector. All measurements were made at the same spot on the sample.

Initial results indicate that the dependences of both ODMR and fluorescence intensity have a flat maxima around 540-550nm. This matches the previous studies, that exhibited a steady increase up to 540nm; this kind of dependence on the excitation wavelength seems to be characteristic to NV⁻ colour centres in diamond. Further analysis is still in progress.

This work was financed by the Ministry of Science and Higher Education within projects realised at Poznan University of Technology on the Faculty of Materials Engineering and Technical Physics: 0511/SBAD/2551, 0511/SIGR/2404 and 0511/SBAD/00/23.

Literature:

- [1] D. D. Awschalom *et. al.*, ‘Quantum technologies with optically interfaced solid-state spins’, *Nat. Photonics* **12**, 516–527 (2018)
- [2] L. M. Todenhagen *et. al.*, ‘Optical and electrical readout of diamond NV centers in dependence of the excitation wavelength’, *Appl. Phys. Lett.* **126**, 194003 (2025)
- [3] A. K. Vershovskii *et. al.*, ‘Peculiarities of absorption and luminescence spectra of nitrogen-vacancy color centers in diamond crystals’, *Opt. Spectrosc.* **116**, 384–386 (2014)