

# Optical magnetic field sensor with diamond

In the joint project DiaQuantFab, a very compact magnetic field sensor was developed, the heart of which is a diamond with magnetic field-sensitive defects. If these defects (NV centers) are excited with green LED light, they emit red fluorescent light. The intensity of the detected fluorescent light indicates the strength of an external magnetic field.

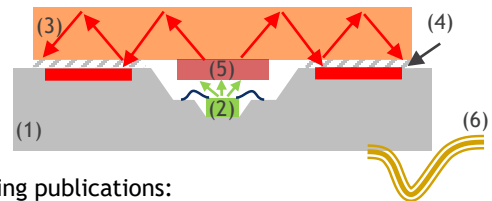
The sensor was designed as a hybrid emitter-receiver platform with an integrated LED light source, separation of the excitation and fluorescence signal by a glass long-pass filter and monolithic photodetectors for analyzing the fluorescence signal. A special feature is that this sensor is also suitable for zero-field measurements.

## PROPERTIES

- LED energization: 520 nm
- Dimension: 10 x 10 x 0.8 mm<sup>3</sup>
- AC sensitivity: 4.8 pA/μT [120 Hz]
- DC sensitivity: 49 nA/mT [5-50 mT]
- Output signals as photodiode currents or pre-amplified photo voltages

## Structure

1. 3D-structured silicon chip with cavity and photodiodes
2. LED (λ ~ 500 nm ... 530 nm)
3. Glass filter (Long pass OG 590, Schott), thickness: 2 mm
4. Underfill
5. Diamant with NV defects [ppm], approx. 500 x 500 x 100 μm<sup>3</sup>
6. Electrical connection



Pending publications:

- Bähr et al. "Compact All-Optical Quantum Sensor Device Based on Nitrogen Vacancy Centers in Diamond." *Physica Status Solidi (a)*, Special Issue: Recent Advances in Diamond Science and Technology, 220, no. 4 (2023): 2200338. <https://doi.org/10.1002/pssa.202200338>.
- Bähr et al. "Making Use of Low-Cost High-Pressure-High-Temperature-Diamond Materials for Industry-Type Quantum Sensor Device Applications." *Physica Status Solidi (a)* n/a, no. n/a (2024): 2400457. <https://doi.org/10.1002/pssa.202400457>.



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