Fabrication and Characterization of Diamond Photonic Cavities for absorption-based quantum sensing

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Project Type: *Master thesis or Internship* *Section:* *MT, PH*
Official Start Date: *Anytime*
Submission of Final Report or Group Meeting Presentation at the end of the project

Project overview: Color centers in diamond are being considered as a promising platform for achieving scalable quantum technologies and as ambient condition quantum sensors. Diamond integrated photonics additionally offers sensing approaches that can outperform bulk implementations with more compact design, higher sensitivity per unit volume and enables the possibility of massive parallel detection schemes. Our fabrication technology enables the creation of suspended optical cavities from single-crystal bulk diamond and **the goal of this project** is to establish a robust high yield fabrication protocol and optimize the measurement procedure to achieve a near-unity readout fidelity based on IR absorption via resonantly enhanced spin-optic coupling.

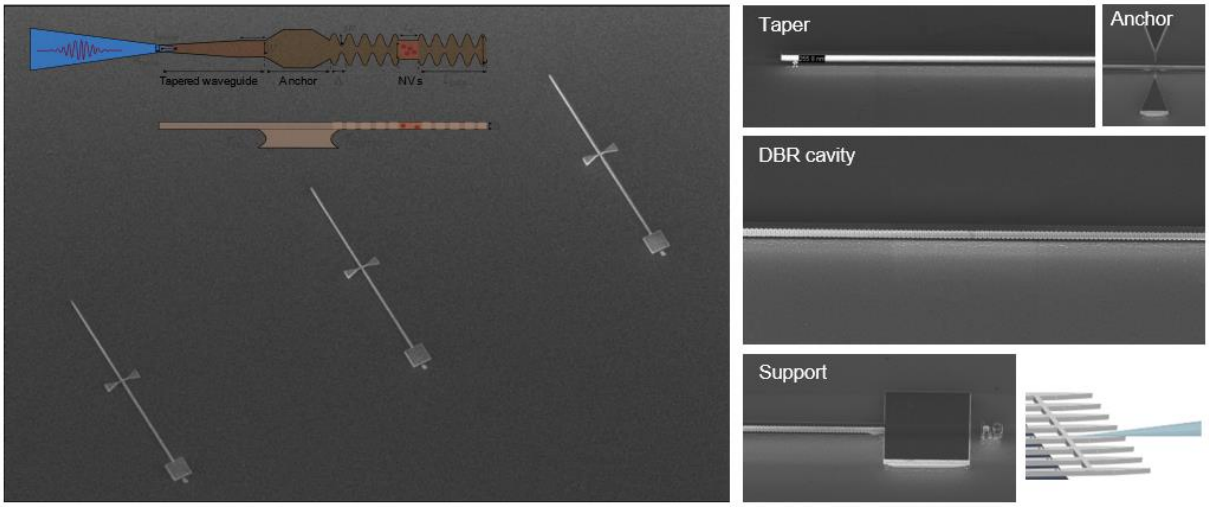

Figure 1. *Fabricated fully integrated suspended fiber-coupled diamond waveguide with a phase-shifted Bragg cavity for absorption-based quantum sensing applications and its corresponding zoom view.*

The candidate should be enthusiastic about experimental work ranging from optical characterization to device testing and knowledge in the following areas will be especially valued:

- Nanofabrication techniques including clean-room experience, metal deposition, characterization by SEM, as well as etching.
- Control and automation electronics, including lock-in techniques and LabView programming.

What the student will do: the student will be able to participate in the process of fabrication, measurement and characterization components. The main tasks include:

- Assisting nano-fabrication and further inspection under SEM.
- Implementation of lock-in technique on the current setup.
- Improve the coupling efficiency using an etch fiber to waveguide structure and characterize the Q factor of the device.
- Explore the interplay between NV density, Q factor, and input laser power.