Design and simulation of passive diamond nanophotonic components

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Official Start Date:	*Spring Semester*		
Submission of Final Report:	*End of Semester*		
Group Meeting Presentation:	*Project midpoint*		

Context: Diamond-based photonic integrated circuits (PICs) are a new and exciting field of photonics technology that utilize diamond to fabricate integrated circuits for photonic applications. Diamond can host colour centres, impurities introduced in the crystal lattice, that create additional electronic states in the wide band gap of diamond, giving rise to transitions that absorb and emit light in the visible spectrum. This makes diamond ideal for applications in **quantum sensing, imaging and computing**. The wide bandgap of diamond crystals also makes diamond an ideal material for photonic applications in a wide range of wavelengths, from the UV to the infrared. The development of diamond-based PICs is an ongoing research area, and new advances in materials, fabrication methods, and device designs are expected to further enhance their performance and versatility.

Project overview: At LQNO, we are focused on the fabrication of low-loss diamond PICs, for quantum technologies, enabled by the design and fabrication of passive photonic components, such as waveguides, couplers, resonators, etc. They play a crucial role in controlling, directing, and manipulating light, but their performance and efficiency can be affected by various design factors. **The goal of this project is to optimize the design of passive photonic components to improve their performance and efficiency.**

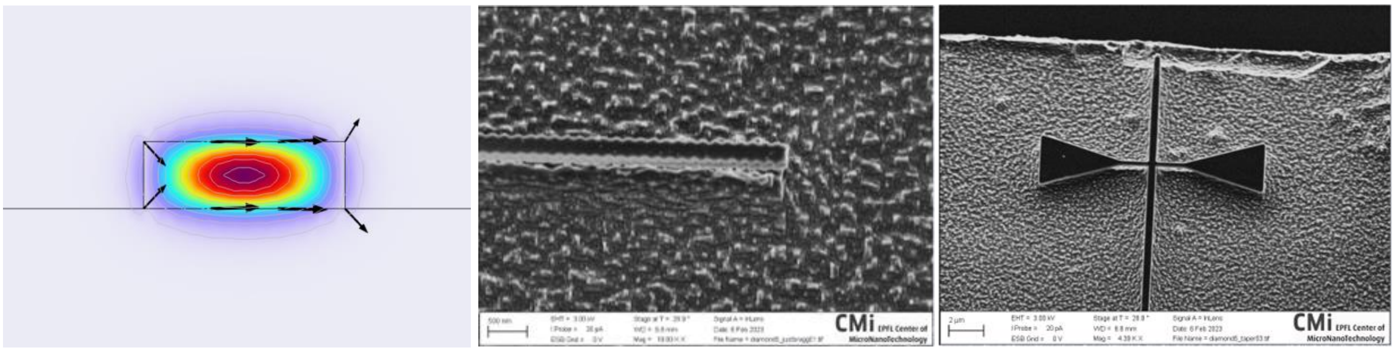

Figure 1. *Left COMSOL simulation of a waveguide. Center: Suspension Structure. Right: Distributed Bragg reflector.*

What the student will do: The student will take part in the design work of photonic structures, by **designing, simulating, and analyzing the performance** of different components, subject to the needs of the project as it advances and while understanding the needs and limitations of the fabrication process of the structures:

- Structures: suspended waveguides, suspension structures, distributed Bragg reflectors, photonic crystals... (dimensioning, simulation and optimization).
- Learning outcomes: Comprehensive use of **ANSYS Lumerical & COMSOL** as simulation platforms. Mask layout and design of photonic test structures using **Python**. Gaining an understanding of photonic components and microfabrication techniques.

If time allows: the student will be able to participate in the process of fabrication, measurement and characterization components that they will have designed in our laboratory.

Student gain: Through this project, the student will gain a vast experience in the use of industry-standard simulation software, photonic design software, and learn the basic skills required to be a **photonic design engineer**. If time allows, the student will gain hands-on experience with fabrication, and optical characterization equipment and tools.