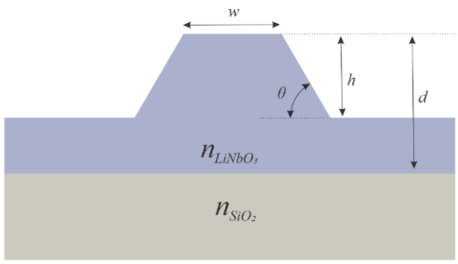
May 2025

M.Sc. student project offer:

Design and Analysis of Lithium Niobate on Insulator (LNOI) Waveguides: Mode Analysis Using COMSOL Multiphysics[1]

Project Description:

Lithium Niobate on Insulator (LNOI) is a promising platform for integrated quantum photonic circuits due to its excellent nonlinear and electro-optical properties. In addition, it can be fabricated into waveguides with diverse geometries with tailored optical properties, making this material highly suitable for efficient second-order nonlinear processes such as parametric down-conversion (PDC).



This project focuses on designing LNOI waveguides and investigating and analyzing the supported guided modes using the COMSOL Multiphysics simulation environment.

Objectives

- Developing understanding of LNOI waveguide
- Investigating the effect of waveguide geometry on refractive index and guided modes
- Learning how to perform 2D simulation in COMSOL
- Exploring new ideas in designing waveguide

Tasks

1. Literature review on LNOI material properties and waveguide design principles
2. Construction of 2D waveguide models in COMSOL Multiphysics
3. Parametric sweep over structural parameters and wavelength
4. Documentation and discussion of results

Requirements

- knowledge of fields and waves, waveguide.
- Experience with or willingness to learn COMSOL Multiphysics.
- knowledge of a programming language (MATLAB, python etc)

Supervisors

Behnood Taheri - Dr. Manfred Hammer - Prof. Dr. Jens Förstner

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[1] M. Hammer et al., "Estimation of losses caused by sidewall roughness in thin-film lithium niobate rib and strip waveguides," Opt. Express 32, 22878-22891 (2024).