Titre de la thèse/Thesis title : Flexible photonic Integrated $\chi^{(2)}$ platform for Broadband Frequency Conversion

Laboratoire d'accueil / Host Laboratory : FEMTO-ST, Dept Optique

Spécialité du doctorat préparé/Speciality : Sciences pour l'Ingénieur

Mots-clefs / Keywords : Integrated Photonics, nonlinear effects

Context : Integrated photonics on lithium niobate is experiencing considerable growth, driven by the exceptional electro-optical and nonlinear properties of this material. Frequency conversion via the χ(2) effect — in particular second harmonic generation (SHG), difference frequency generation (DFG) and optical parametric conversion (OPO) — is at the heart of many strategic applications.

Current challenges lie in broadening the conversion bandwidth, improving conversion efficiencies and integrating these functions into compact and reproducible photonic circuits. Advanced fabrication techniques (ion slicing for obtaining thin $LiNbO_3$ films, thermal poling for periodic domain inversion, and precision cleaving) are paving the way for a new generation of integrated nonlinear components.

This project is part of this momentum, combining design through numerical simulation (COMSOL, Lumerical) and fabrication in a cleanroom environment within the MIMENTO platform, recognised at both national and European levels for its expertise in photonic micro-nanotechnologies.

Descriptif détaillé de la thèse / Job description

This PhD project focuses on the development of flexible χ(2) photonic systems based on lithium niobate ($LiNbO_3$) platforms for broadband optical frequency conversion. By exploiting the second-order nonlinear susceptibility χ(2), the work aims to design and implement high-performance frequency converters that bridge the gap between conventional waveguide technologies and advanced fabrication methods such as ion slicing, thermal poling, and optical-grade dicing. Leveraging the state-of-the-art equipment and expertise of the MIMENTO technology center, the thesis seeks to establish new generic integration building blocks with direct applications in artificial intelligence, biomedical diagnostics, free-space telecommunications, and quantum systems.

Références bibliographiques / Bibliography

[1] Aiman Zinaoui, Martin Khouri, Jean-David Fayssaud, Arthur De Sousa Lopes Moreira, Miguel Angel Suarez, Samuel Queste, Laurent Robert, Ludovic Gauthier-Manuel, Mathieu Chauvet, Nadège Courjal, *A $LiNbO_3$ Platform with Tailored Thickness Bridging Bulk and Thin Film: Application to Broadband Frequency Conversion,* **ACS Photonics** *12(10),* 5614-5622 (2025). DOI : 10.1021/acsphotonics.5c01334

[2] A. Zinaoui, L. Grosjean, A. De Sousa Lopes Moreira, M. Suarez, S. Queste, L. Robert, M. Chauvet, **N. Courjal**, "*Broadband and widely tunable second harmonic generation in suspended thin-film LiNbO3 rib waveguides*," **APL Photonics**, *9*(10) (2024). DOI : 10.1063/5.0230481

Profil demandé / Applicant profile

The project is open to candidates with a Master 2 or engineering degree, with the following skills and interests:

- Strong background in physics (optics, electromagnetism, materials physics)
- Knowledge of guided photonics and/or nonlinear optics
- Proficiency in numerical simulation tools (COMSOL, Lumerical, or equivalent)
- Interest in micro-nanofabrication and cleanroom techniques
- Ability to write and communicate scientifically in both French and English

Preferred selection criteria:
- Academmic excellency
- Strong background in experimental integrated photonics

- Personal characteristics:
- Experimental rigor and a passion for laboratory work
- Autonomy, intellectual curiosity and initiative
- Ability to work in a team and in an interdisciplinary environment
- Openness to mobility (conferences, national and European collaborations)

Financement : MESRI Etablissement

Dossier à envoyer pour le **20/05/2026**
Début du contrat : 1er Octobre 2026
Salaire mensuel brut : 2300€

Direction de la thèse:/ **Thesis Supervisor Nadege Courjal**
NOM et PRENOM / e-mail **nadege.courjal@femto-st.fr**

Encadrement de la thèse : **co-directeur(s) et co-encadrant(s)**
NOMS et PRENOMS / Qualité durant la thèse (co-directeur, co-encadrant)

Applicants are invited to submit their application to the PhD supervisors.
Application must contain the following documents:
- CV
- Cover letter
- At least 1 reference letter