

Ph.D. Position

Development of integrated optical sensors in the Mid - InfraRed

The Institut FOTON is offering a 36-month Ph.D. scholarship on the development of spectroscopic sensors integrated in the Mid-InfraRed.

Starting date:

Supervisor: Joël CHARRIER, Nathalie LORRAIN and Joël CHARRIER

Research team: Photonic Systems (group), at ENSSAT-Lannion

Keywords: Photonic Integrated Circuits, Mid-InfraRed, Spectroscopic sensing

Project description

Many molecules display absorption features in the Mid-Infrared (Mid-IR), a spectral region invisible to the human eye ranging from 2 to 20 μm . A standard optical analysis based on light absorption in this wavelength range gives a real fingerprint of these molecules, allowing their identification and quantification. Many application areas such as environmental monitoring, early disease detection or defense can benefit from such measures. Thus, the development of portable and compact sensors is fundamental for in situ studies related to the detection of emerging molecules. However, the conversion of bulky laboratory systems into on-field devices requires the development of integrated micro-components enabling precise, sensitive and high resolution measurements in harsh environments.

The sensors based on the development of optical waveguides fabricated from chalcogenides and porous materials transmitting in the Mid-IR, can be considered as an innovative and efficient solution to ensure the conversion of a laboratory systems to compact and portable devices for on-site analysis. The latter components are based on technologies developed for micro-photonics, micro-fluidics and micro-electronics. Integrated within miniaturized platforms, they are commonly called "sensor-on-a-chip" or "lab-on-a-chip" and can possibly perform different functions on the same substrate.

In this context, the objective of this thesis is thus to design a microsensor allowing the implementation of on-chip infrared spectroscopy using original integrated optical structures (ridge waveguides, sub-wavelength waveguides, slot waveguide, Vernier effect, microresonator...) and by combining light sources in this wavelength range. The thesis work will be based on previous doctoral works on the development of integrated optical platforms based on chalcogenide glasses and porous materials for Mid-IR sensing applications. The doctoral student will also benefit from the Foton Institute expertise in the field of Mid-IR optical characterizations as well as on the CCLO clean room processing facilities (materials deposition (sputtering, e-beam evaporation), sub-micron photolithography, dry etching ICP-RIE, Scanning Electron Microscope...). This work in the Mid-IR field will also benefit from numerous interactions with local industrial and academic partners in the photonic field (team « Verres et Céramiques » of ISCR, Photonics Bretagne, SelenOptics, Le Verre Fluoré).

The doctoral student will work in the “Guided Optics & Sensors” group of about 25 people and located in Lannion. This group has extensive experience in photonic integrated circuits and benefits from CCLO clean room processing facilities (materials deposition (sputtering, e-beam evaporation), sub-micron photolithography, dry etching ICP-RIE, Scanning Electron Microscope...) and optical benches adapted to integrated optics characterizations. On site, the PhD student will thus benefit from the skills and resources related to technological fabrication,

modeling aspects but also for the assembly and characterization of optical integrated circuits and optical fibers.

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Qualifications

The thesis subject will implement multidisciplinary skills in guided optics, integrated optics, in physics of materials and in the field of sensors. Master 2 level training (or engineering school) addressing a significant part of these areas is necessary to address this thesis subject. Skills in electromagnetic simulation, guided optics, technological realization and / or optical characterizations will be highly appreciated. The candidate should also have a taste for technology in integrated optics, in experimental characterizations and good skills for team work.

Partnership

Team « Verres et Céramiques » of ISCR

About the Institut FOTON (CNRS, UMR6082)

The Institut FOTON is a research unit of the French National Centre for Scientific Research (CNRS) associated to University of Rennes 1 and the National Institute for Applied Sciences (INSA) of Rennes. FOTON is composed of three research teams: the “Optoelectronics, Heteroepitaxy and Materials” team, the “laser Dynamics, microwave photonics, Polarimetry, terahertz, imaging” team located in Rennes, and the “Photonic Systems” team located in Lannion. The two cities are located approximately 170 km apart, in the province of Brittany, Western France. Photonic Systems team is involved in research on laser physics, and in particular on the experimental demonstration of new functionalities that could potentially contribute to overcoming the challenges

related to sensors sensitivity, telecom capacity. The group has an established reputation in the area of laser physics.

The successful candidate will carry out research in Lannion.

More information about FOTON can be found at: <http://foton.cnrs.fr>.

Further information-Contact

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Application procedure

Please submit your application at your earliest convenience by e-mail to:

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Your application should include:

- Cover letter
- Detailed CV
- Copy of M.Sc. degree or equivalent
- Grade transcripts
- List of publications, if applicable
- Contact details of two references

All qualified candidates are invited to apply.