

PhD open position at Institut Foton

Hybride photonic integrated circuit based on Porous Silicon and Polymers materials for sensing applications « HYSIPOP ».

A 36-month duration PhD will start at Foton Institut on the study of hybrid integrated photonic circuits based on porous silicon and polymers for biosensor applications.

PhD starting: between the 1st of october and the 1st of november 2018

PhD director: Mohammed Guendouz **Co-PhD director:** Nathalie Lorrain & Monique Thual.

Funding: Co-funding ARED (Région Bretagne) & Lannion Trégor Communauté (LTC).

Team: Systèmes Photoniques in « Optique Guidée & Capteurs », group located in ENSSAT - Lannion.

Keywords: Materials, photonic, integrated optic, technologic fabrication, optical characterizations, modeling.

Subject

The HYSIPOP thesis main goal is to develop a prototype of an ultra-sensitive integrated optical biosensor for specific low-level biological molecules detection. These molecules are involved in diseases such as cancer or Alzheimer's disease. The detection of biomarkers at early stages of these diseases may allow the rapid introduction of treatments to prevent the spread of these diseases.

The integrated optical sensor consists of waveguides and micro-resonators components. A micro-resonator is an interferometer in which light propagates and lets pass only certain colors that constitute a comb of specific wavelengths that will resonate. The presence of the molecules in contact with the micro-resonator results in a shift in the wavelength response which is larger as the concentration of molecules increases. The longer this wavelength shift for a given concentration, the more sensitive the sensor will be.

To further enhance the sensitivity and lift the technological locks, the architecture of the sensor will consist of two micro-resonators cascaded which will take advantage of an effect called "Vernier effect" between two wavelength combs. Moreover, the structure will be qualified of hybrid because it will be made of different materials: polymers whose propagation losses are low and porous silicon whose large surface of contact and grafting allows a great interaction with the species to be detected. Thus one of the two interferometers which serves as a reference and the access waveguides will be made of polymers while the second micro-resonator will be made of porous silicon, and will constitute the sensitive part of the sensor.

This thesis will take advantages of all the skills and equipment of the Foton institute in integrated optics and fibers in the continuity of the APOGEE thesis which has already given rise to 10 papers (3 posters, 3 oral presentations and 4 publications), including one with the companies IDIL and Souriau of Photonics Bretagne. It will then further improve the characteristics of the integrated optical sensor and will also offer the opportunity to expand collaborations with companies in particular Lannion such as IDIL for component integration, Kerdry for technological aspects and Souriau also Member of Photonics Bretagne with whom we already have collaborations in particular on the aspects of connectivity and fiber sensors.

PhD candidate profile

The candidate should have a master or engineer degree in the field of photonics, justifying advanced knowledge in physics, in materials (polymers and semiconductors), in guided optics, in optical

characterizations and in modeling (Matlab, Labview,...). She/He will directly be involved in the modeling, fabrication and optical characterizations of photonic circuits.

The PhD candidate should have an interest in the modeling work, the experimental work (in the clean rooms of the technological platform, the CCLO of Foton institute) and also for the team work. The mastery of English is required.

Foton Institute (CNRS, UMR 6082)

The Foton Institute is a joint research unit of about 150 people associating the CNRS, the University of Rennes 1 (the Enssat and the IUT of Lannion) and the INSA of Rennes. The unit is structured into six thematic areas and three teams, spread over two sites: two teams in Rennes, Opto-electronics, Hetero-epitaxy and Materials (OHM, INSA-Rennes) and Dynamique des lasers, Optique et Polarimétrie (DOP, UR1) and a Photonic Systems team at Lannion (Enssat-Lannion). In this latest team, the Guided Optics & Sensors Group is involved in the study of different optical materials and components for optical sensor applications and/or Telecoms. The specificity of Foton is to gather three teams and three platforms around common programs covering specific areas of photonics: telecommunications, technologies related to industrial and defense applications (optical sensors, lasers, instrumentation for photonics) and photovoltaics. Foton's themes are anchored in those of the Key Photonics technology (KET: Key Enabling Technology), an European priority and in the Brittany region.

The doctoral student will work in the "Guided Optics & Sensors" group of about 25 people. This group has extensive experience in photonic integrated circuits and benefits of all the equipment of the CCLO technology platform (200 m² clean rooms, PECVD, sub-micron photolithography, dry etching ICP-RIE, Scanning Electron Microscope,...) and optical benches adapted to integrated optics. On site, the PhD student will thus benefit from the skills and resources for technological realization, but also for modeling aspects, for the assembly and characterization of optical integrated circuits and optical fibers.

Complementary information - Contact

More information can be obtained by contacting:

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Candidature

All candidates have to send by email the following documents:

- Cover letter describing the candidate motivations for the position
- Detailed *curriculum vitae* (CV)
- Educational grades and marks (of the last 2 years)
- Copy of the master's degree or equivalent
- List of publications if applicable
- Recommendation letters (x2)

Application deadline is 01/06/2018. Following the deadline, candidates will be rapidly informed of their status. Retained candidates will be invited for an interview, on site (Lannion) or by web seminar depending of their location.

