

## PhD proposal 2017-2020

### *Mid-IR integrated photonic spectrometer*

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Research group: <http://silicon-photonics.ief.u-psud.fr/>

Mid-infrared (mid-IR) spectroscopy is a nearly universal way to identify chemical and biological substances, as most of the molecules have their vibrational and rotational resonances in the mid-IR wavelength range. Commercially available mid-IR systems are based on bulky and expensive equipment, while lots of efforts are now devoted to the reduction of their size down to chip-scale dimensions. The demonstration of mid-IR photonic circuits on silicon chips would benefit from reliable and high-volume fabrication to offer high performance, low cost, compact, low weight and power consumption photonic circuits, which is particularly interesting for mid-IR spectroscopic sensing systems that need to be portable and low cost.

In this context, we develop a new route towards key advances in the development of chip-scale integrated circuits on silicon for the mid-IR wavelength range. The original idea is to use nonlinear optical properties in Ge-rich materials (Ge/SiGe quantum well (QW), graded SiGe layers, ...) for the active devices (source, detector) combined with sensing parts on the chip. Beside the demonstration of active devices and sensing parts, a **complete platform needs the development of photonic integrated spectrometer in the mid-IR wavelength range** in order to analyze the evolution of the optical signal as a function of the frequency.

Several structures will be studied including AWG (Arrayed Waveguide Grating), array of Mach-Zehnder interferometers, ring resonators, echelle grating structures,... in order to perform parallel sensing in different wavelength. The PhD student will compare these different structures, mainly in terms of the bandwidth, resolution and sensitivity. **He(she) will be in charge of the different steps for the realization of efficient and compact spectrometers: design, fabrication and characterization of the different structures on a dedicated experimental set-up.**

The work will be done in the framework of the ERC INSPIRE project, in a strong collaboration with Giovanni Isella's group (L-Ness lab (Politecnico di Milano)).

#### **Applicant skills:**

- Basic knowledge of photonic integrated devices.
- Willingness to study and learn modelling/design/fabrication and characterization of photonics devices.

**Funding of the thesis:** Under the ERC contract

**How to apply ?** Send an e-mail to [delphine.morini@u-psud.fr](mailto:delphine.morini@u-psud.fr)