

# On-chip hybrid Mid-infrared supercontinuum source

Ecole Centrale de Lyon



**NICOLAS BAUDIN**  
INTERNSHIPS IN FRANCE INITIATIVE

Name of the hosting institution in France	Ecole Centrale de Lyon
Name of the host laboratory / research team	Nanotechnology Institute of Lyon / Photonics
Address	Institut des Nanotechnologies de Lyon INL - UMR 5270 Ecole Centrale de Lyon - 36 av Guy de Collongue 69134 Ecully Cedex, France
Web site	<a href="https://eclausion.ec-lyon.fr/">https://eclausion.ec-lyon.fr/</a>
Name of the supervisor	Christian GRILLET
Function	CNRS
Email	christian.grillet@ec-lyon.fr

## Internship offer

Topic of the internship (title)	On-chip hybrid Mid-infrared supercontinuum source
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Proposed dates of the internship *	Start: 2020-09-01	End: 2021-01-29
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\* The supervisors have indicated the dates proposed are flexible and are able to be postponed subject to COVID-19 border closures.

### Scientific and academic objectives of the internship (detailed description of the internship content, work expected from the intern and expected outcomes):

Despite its recognized potential, Mid-IR technologies are still limited in their range of applications, largely because of the size of the Mid-IR devices (optical components operating in this wavelength range have long been restricted to discrete components operating in free space, and to simple passive guides, generally based on multimode chalcogenide fibres) and the prohibitive costs of the instruments used due to the lack of compact Mid-IR optical devices. Our strategy is therefore based on the development of an integrated hybrid Mid-IR platform, involving the miniaturization of optical components and their integration on a planar substrate made of materials with remarkable optical properties (particularly in terms of transparency and non-linearities) at MIR wavelengths like SiGe alloys and LiNbO<sub>3</sub>. Heterogeneous integration with material platform transparent in the visible and near-infrared (like SiTiO<sub>2</sub> and innovative oxides developed by our collaborator - 3D oxides), will also be pursued in order to access the full spectral range from visible to mid-IR. The student's project will focus on one of the fundamental issues of integrated Mid-IR, namely efficient and broadband MIR sources and their integration into an optical circuit. The student will be involved at all stages of the project from the design of the devices using commercial or in-house developed electromagnetic modelling tools such as FEMSIM, FDTD, Schrodinger non-linear equations, the manufacture of the devices by clean room processes via the NANOLYON nanotechnology platform and the Micro Nano Research Facility - MNRF at RMIT (nanolithography, etching) and their optical characterizations. The student will be working with the Nanophotonics, Mid-IR team at the INL ECL. The student will benefit from INL's resources and expertise in integrated photonics and non-linear optics both in terms of device design and on technology and clean room manufacturing aspects for the production of the first basic demonstrators. The student will work closely with our industrial partner 3D oxides on the oxide platforms in particular to optimise these new material platforms (SiTiO<sub>2</sub>, transition metal oxides ect...) in the context of integrated photonics (losses, high nonlinearity ect...), and the deposition process.

Name of industrial partner	3D oxides
Role of the industrial partner in the internship project	Development of the oxide platform for visible to mid-IR application. Deposition process, material loss measurement, material nonlinearity measurement
Main contact at the French industrial partner	Giacomo Benvenuti
Email of contact at French industrial partner	giacomo.benvenuti@3d-oxides.com
Name of the Australian partner institution	RMIT
Name of lab/department/team involved in the collaboration at the Australian partner institution	Micro Nano Research Facility (MNRF)/Integrated Photonics and Applications Centre (InPAC)
Main contact in the Australian partner institution	Arnan Mitchell
Function	Professor, Director
Email address	arnan.mitchell@rmit.edu.au

Outside of this ongoing collaboration, will applications coming from students of other eligible Australian universities be considered by the hosting institution in France?	Yes
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## Expected profile of applicant

Level of study	S/he should work towards his/her Masters/honours
Discipline	Physics; Optics; Solid-state physics
Required qualities, knowledge and skills	We seek a talented and ambitious researcher with a good knowledge and a solid background in the field of solid-state physics, optics, and semiconductor devices. An experience in photonics, nonlinear optics, clean-room fabrication, material deposition or optical modelling and characterization will be strongly appreciated.