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III-V/Si heterostructures: from optoelectronic properties to spin-polarised photodiodes.

A 36-month PhD programme is available at the Institut FOTON to study the optoelectronic properties of III-V/Si heterostructures.

Start of thesis: between 1 September 2026 and 1 November 2026
Thesis supervisor: C. Cornet (Pr. Hab), J. Courtin (Ass. Prof.)
Funding: CDO
Team: Optoelectronics, Heteroepitaxy and Materials research department, hosted at INSA–Rennes.
Keywords: electronic properties, optoelectronics, spintronics, III-V/Si heterostructures
Subject: The scientific community's interest in studying opto-spintronic components has recently grown considerably. These devices, aiming at controlling and coupling fundamental properties of light and electronic transport, are expected to represent a major technological breakthrough, as compared to today's components. The areas affected are also very broad, ranging from information technology [1] to bioimaging [2]. Regarding photodetection systems, the devices studied with Ge [3] or GaAs [4] suffer from major defects. Due to its indirect band gap, Ge has limited absorption efficiency. GaAs structures, on the other hand, have been produced on expensive III-V substrates, which is prohibitive for their large-scale deployment. This thesis project aims at proposing new opto-spintronic III-V/Si devices architectures that combine efficiency and low production costs.

The OHM department at the Institut FOTON is renowned for its expertise in the growth and characterisation of III-V materials and optoelectronic devices on silicon substrates. The aim of this work will be to study the electronic, optoelectronic and spintronic properties of Metal/GaAs/Si and Metal/Insulator/GaAs/Si stacks. To this end, the work will range from sample production (photolithography, etching, bonding, PVD deposition) to the study of optoelectronic properties (current-voltage measurements, capacitive measurements, C-AFM, external quantum efficiency). The ultimate goal will be to produce a photosensitive device capable of injecting and extracting a spin current.

The expected results include a detailed understanding of charge and spin transport mechanisms. The effect of defects inherent to III-V/Si growth and the possibility of exploiting these defects will be investigated.

Candidate profile

Candidates must have a master's degree, preferably with a background in semiconductor physics. Basic knowledge of electronics and Python programming would be appreciated. Applicants must have a keen interest in experimentation.
Fluency in English is required (both written and spoken).

Institut FOTON (CNRS, UMR6082)

Institut FOTON is a joint research unit bringing together the CNRS, the University of Rennes, and INSA Rennes. Institut FOTON's unique feature is that it brings together three departments and three platforms covering targeted areas of photonics and energy around joint programmes: the physical layer of telecommunications, technologies related to industrial and defense applications (optical sensors, lasers, instrumentation for photonics), photovoltaics and hydrogen production. Research themes are rooted in those of the key enabling technology (KET) of photonics, a priority for Europe and the Brittany region. The doctoral student will work mainly within the OHM department (approximately 50 permanent and non-permanent staff), in close collaboration with the SP and DOP departments of the FOTON institute.

Further information - Contact

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OHM department : https://www.institut-foton.eu/en/dpts/ohm/
3D visit of the OHM facilities: https://my.mpskin.com/fr/tour/xcbef28rc5
NanoRennes technological platform : https://nanorennes.cnrs.fr/

Application

All applications may include the following documents:

- Cover letter
- Detailed CV
- Copy of master's degree or equivalent
- Transcripts
- List of publications, if applicable
- Two letters of recommendation (if possible)

Bibliography

[1] M. Lindemann *et al.*, Ultrafast spin-lasers, Nature **568**, 212 (2019).
[2] N. Nishizawa *et al.*, Angular optimization for cancer identification with circularly polarized light, Journal of Biophotonics **14**, e202000380 (2021).
[3] F. Bottegoni *et al.*, Spin-charge interconversion in heterostructures based on group-IV semiconductors, La Rivista Del Nuovo Cimento **43**, 45 (2020).
[4] V. I. Safarov *et al.*, Recombination Time Mismatch and Spin Dependent Photocurrent at a Ferromagnetic-Metal–Semiconductor Tunnel Junction, Phys. Rev. Lett. **128**, 057701 (2022).