

Post-doc position

Spin photodiodes for the detection of circularly polarized light

Context of subject:

Solid-state detectors capable of directly sensing light helicity are essential components for polarization-encoded optical communication and circular-polarimetric imaging. Spin photodiodes (spin PDs) based on ferromagnet/tunnel-barrier/semiconductor heterostructures offer a promising approach for direct helicity detection. A spin PD can be regarded as the reverse operation of a spin-light emitting diode (spin-LED): circularly polarized light generates spin-polarized carriers in the semiconductor, which are electrically detected through spin-dependent tunneling.

Although major advances have been achieved in recent years by our group in the development of spin-LEDs, including circular polarization degrees of approximately 40% at room temperature and electrical switching of magnetization, and consequently of the polarization of light [1], relatively little research has focused on the development of spin photodiodes. We have recently demonstrated that a Ge-based spin photodiode can operate without an externally applied magnetic field at wavelengths relevant to optical telecommunications [2]. However, the spin-dependent photocurrent asymmetry still less than 1%. The goal of the post-doc is to develop spin-photodiode based on different semiconductors (GaAs, Ge) to enhance the polarization detection efficiency.

References:

- [1] P. A. Dainone et al., "Controlling the helicity of light by electrical magnetization switching", **Nature** 627, 783 (2024)
- [2] A. Djeflal et al., "CoFeB/MgO/Ge spin photodiode operating at telecommunication wavelength with zero applied magnetic field", **Phys. Rev. Appl.** 10, 044049 (2018)

Environment of work

The post-doc candidate will work in the "Nanomaterial for optoelectronics" team at Institut Jean Lamour (Nancy, France, <https://ijl.univ-lorraine.fr/equipes/equipe-nanomateriaux-pour-loptoelectronique>), where is internationally recognized for its expertise in semiconductor spintronics. The group has abundant experience in electron spin injection and detection in semiconductors. The study will also benefit from the multi-UHV chamber interconnected platform TUBE in IJL, where allows to fabricate divers structure and make in-situ characterization without breaking the vacuum.

Tasks of candidate:

1. Develop and deposit spin-detector layers on various semiconductor photodiode structures using magnetron sputtering.
2. Fabricate spin-photodiode devices using UV photolithography and microfabrication techniques.

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3. Perform spin-dependent photocurrent measurements and characterize the performance of spin-photodiode devices.

Candidate profile:

Since the post-doc will be in charge of spin-detector growth, device fabrication as well as the photocurrent characterization, knowledge of thin film growth, e-beam lithography process as well as transport measurement are necessary. A solid training in semiconductor and spintronics physics is also necessary. Creativity, rigor, and taste for teamwork are qualities that will be highly appreciated. Good communication skills (English or French) are also required.

Application deadline: 3 January, 2027 (the position may be filled before deadline)

Salary and duration of contract:

Net monthly salary: €2,200

Gross monthly salary: €2,700

Contract duration: One-year contract, renewable for an additional year.

Documents required: CV with publication list, 2 recommendation letters from previous supervisors.

Information supplementary: Once the candidate is chosen, we need to submit all information of the candidate (CV, passport, research subject) for French security control procedure. Depending on the delay time of the procedure, the post-doc could start the work in IJL **from January 4, 2027.**

Contact:

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Please find the activity of research in Dr. Lu 's group with the link below:

<https://scholar.google.fr/citations?user=UxHJNIAAAAAJ&hl=fr>