

Ph.D. Position



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MAGNETALLIEN

Job offer title

Optimizing spin-orbitronics torque in multilayers

General information

Workplace: Nancy, FRANCE

Type of contract: PhD Student contract / Thesis offer

Contract period: 36 months

Expected date of employment : 2025

Proportion of work: Full time

Remuneration: 2 200 € gross/monthly.

Desired level of education: Master in Physics, Materials Science, Spintronics or similar.

Experience required: Master.

European research program: Yes

Context

The rapid evolution of information technologies, including in particular the increasing use of artificial intelligence, requires the development of new approaches for electronic devices to face the related energy consumption. By way of example, data centers alone could consume 5-10% of the world global energy production. In this context, spintronics and its new subbranch orbitronics could provide disruptive solutions.

In this project, we aim to build on our new results [1,2] to engineer multilayer structure, playing between bulk and interfacial effects in magnetic materials, to optimized the electrical manipulation of their magnetization. To achieve this goal, the PhD student will perform structural and magnetic characterization on amorphous or textured polycrystalline multilayers grow by sputtering. The selected systems at the end of these characterizations will be micro-structured by the student in the IJL clean-room, in order to functionalize them and subsequently measure their electronic transport properties. The Phd student will evaluate the net efficiency of different source of spin and/or orbital currents on the different systems through angular momentum torques measurements. The ultimate goal is to optimized current-induced magnetization dynamics and switching.

[1] D. Céspedes et al. *Advanced Materials* 33, 2007047 (2021)

[2] A. Anadon et al. arXiv <https://arxiv.org/abs/2406.04110>

The PhD student will develop skills in structural characterization through the use of X-ray diffraction and Transmission Electronic Microscopy coupled with chemical analysis (EDS and EELS). She/He will learn different microfabrication technics in cleanroom. She/he will acquire strong knowledge in magnetotransport measurements including low frequency (DC) and high frequency (RF) techniques such as second harmonic or spin-torque ferromagnetic resonance. All this investigation will be carried out on state of the art equipment's at Institut Jean Lamour (IJL), located at Nancy, France

As part of the European project [ERC CoG MAGETALLIEN](#) project (ID grant 101086807), the PhD student will have a unique opportunity to contribute to scientific and technological advances in the field of spin-orbitronics. In this context we are seeking for a young, motivated student to take up these challenges.

Expected Skills

- Candidates must hold a Master degree in physics, materials or nanoscience, and have the following knowledges:
 - Strong theoretical background in physics and more precisely in solid-state physics and in magnetism. Knowledge in spintronics and magnetization dynamic is a plus
 - Background in material sciences including thin film deposition and crystallography.
- General skills: Programming in Python, Mathematica and/or LabVIEW will be considered as a plus. Good communication skills, scientific curiosity and a taste for experimental work will be highly considerate !
- Fluent English or French is mandatory

Work context

The successful candidate will work in the SPIN team, <https://spin.ijl.cnrs.fr>, Institut Jean Lamour, under the supervision of Dr. J. Carlos Rojas-Sánchez, Dr. Sébastien Petit-Watelot and Prof. Michel Hehn.

[The Institut Jean Lamour \(IJL\)](#) is a joint research unit of the CNRS and the University of Lorraine. The IJL has about 500 members including researchers, teacher-researchers, engineering, technical and administrative staff, doctoral students and post-doctoral fellows, and hosts about 80 internships per year. It collaborates with more than 150 industrial partners and its academic collaborations are deployed in some 30 countries. Its exceptional instrumental park is spread over 4 sites, the main one being a new building located on the Artem campus in Nancy.

The SPIN research group's subjects range from the development of innovative materials for implementation in spin electronics devices, to the development of magnetic sensors and the fundamental study of physical phenomena related to magnetism.

Nancy is a beautiful French city, with quick access to metropolises such as Paris, France.

Constraints and risks

No major risk. The selected candidate will have to work in cleanroom environments.

Application

Interested candidates should apply through CNRS website

[Portail Emploi CNRS - Job offer - Optimizing spin-orbitronics torque in multilayers \(M/F\)](#)

Pre-selected candidates will be contacted for an interview.

Further information:

- J. Carlos Rojas-Sánchez (CNRS Researcher) : juan-carlos.rojas-sanchez@univ-lorraine.fr
- Sébastien Petit-Watelot (Lorraine University Assistant Professor) : sebastien.petit@univ-lorraine.fr
- Michel Hehn (Lorraine University Professor) : michel.hehn@univ-lorraine.fr



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