Job offer –Post-doctorate in
Spin-to-charge current interconversion in high-quality oxide films
(*For non-French scientists only*)

Research Project Short Title as Submitted to CEFIPRA: "Quantum phenomena in Ferromagnet/Oxide heavy metal heterostructures**"**
Principal Investigator contact (Name and email id): "Dr. Wilfrid Prellier, ENSICAEN - CRISMAT - UMR 6508, Paris, Wilfrid.prellier@ensicaen.fr"
Reference Number of the Job Offer: IFI_CEF_25_09

Project description

- **Keywords**: Oxides, thin films, pulsed laser deposition, spintronics, spin/charge conversion

- **Context**: Stabilizing quantum ground states in quantum materials remains one of the most compelling and complex challenges in contemporary condensed matter physics. Achieving robust control over these states holds profound implications—not only for advancing our fundamental understanding of exotic quantum phenomena such as entanglement, topological order, and emergent quasiparticles—but also for enabling transformative breakthroughs in quantum information science. The precise manipulation of quantum ground states could pave the way for quantum computing, and novel phases of matter. In parallel, the field of spintronics has gained significant momentum over recent decades, establishing itself as a cornerstone of next-generation electronic architectures. By harnessing spin currents, spintronics offers an inherently energy-efficient paradigm for information storage, transmission, and logic operations. This approach not only reduces power consumption but also opens new dimensions in device functionality, including nonvolatile memory, magnetoresistive effects, and spin-based transistors. Together, the convergence of spintronics and quantum material science signals a promising frontier for engineering controllable quantum states with both stability and scalability, crucial for the realization of future quantum technologies.

- **Abstract of the Research Project**: This project aims to investigate the mechanisms of spin-to-charge current interconversion at room temperature within high-quality complex oxide thin films. Specifically, we focus on engineered heterostructures comprising the ferromagnetic oxide $La_{0.67}Sr_{0.33}MnO_3$ (LSMO) and non-magnetic transition metal oxides such as IrO_2 and RuO_2. LSMO serves as an effective spin current source due to its high spin polarization and intrinsic half-metallic character, making it a model system for generating robust spin currents in oxide platforms. Through detailed structural, magnetic, and transport measurements, we aim to elucidate the interfacial phenomena governing spin injection, diffusion, and conversion in these oxide heterostructures. This work seeks for the development of next-generation, oxide-based spintronic devices that operate efficiently at ambient conditions. We expect that such devices could offer new opportunities in energy-efficient memory, logic, and sensor technologies with enhanced stability and scalability.

- **Scientific Objectives of the Project:**

  - Investigate substrate-induced strain through detailed structural characterization
  - Perform physical characterization using advanced techniques such as ferromagnetic resonance (FMR), superconducting -quantum interference device (SQUID) magnetometry, and Hall effect measurements
  - Evaluate the efficiency of spin-to-charge current conversion
  - Fabricate Hall bar devices for spin orbit torque (SOT) measurements

- **Methodology and Timeline of the projects :** This experimental project will be conducted at the Laboratoire CRISMAT in Caen, France, in close collaboration with the Indian Institute of Science, Bangalore, India, under the framework of a CEFIPRA/IFPCAR initiative. The first phase of the project will focus on the optimization of the synthesis processes for the targeted heterostructures, along with comprehensive structural characterization. The second phase will concentrate on investigating the underlying physical phenomena and advancing the development of prototype spintronic devices.

Candidate profile

- Candidates can be all nationalities except French. In case of double nationality (French and another one), the candidate is not eligible. In the context of CEFIPRA, Indian candidates are preferred
- No competences in French language is required
- Candidate competences: The candidate's main mission will be to prepare the films, and characterize the electronic properties of the samples using advanced structural (HRXRD) and magnetotransport experiments (Hall measurements, magnetization ..)
- Candidate know-how : Thin films, oxides, oxide-electronic, PLD, physical characterizations
- Expected starting date: 01-10-2025
- Expected duration: 24 months

How to candidate ?

Documents to be provided :

i. A cover letter (reasons for the candidature, professional project …) max 2 pages
ii. A copy of the master's degree or a proof of the program followed (and expected date of end) OR A copy of the PhD degree or a proof of the PhD program followed (and expected date of defense) max 1 page
iii. A copy of results for previous scholarship (max 3 pages)
iv. International curriculum vitae (max 2 pages)
v. Two letters of recommendation: one from any Indian institution and one from the French institution planned to host the candidate –mandatory- (max 2 pages)
vi. All should be submitted within 1 pdf file of no more than 10 pages.

Applications should be submitted to the following email address: msi@ifindia.in mentioning the reference number of the Job offer clearly.

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Candidates are requested to contact the French scientific principal investigator of the project before submission. A recommendation letter from the scientific principal investigator is mandatory.

Benefits:

- Monthly allowance of 2400 euros for Post-Doc
- Travel allowance
- University fee
- Carte de séjour fee
- Campus France management fee
- Registration to the French social security scheme

Selection process:

Selection is made by a dedicated selection committee of at least 4 persons. Decisions will be transmitted by the Embassy of France to CEFIPRA. **No consideration will be given for candidates with no recommendation letter from the French institution.**

Criteria for applicants' selection:

Academic excellence

- Excellence of the Academic background, Academic records, Honors, Letters of support, Participation to international research projects, exchange programmes and conferences.

Motivation and qualities

- Academic maturity: appropriation of the thesis project (stakes and contexts) • Quality of the presentation (oral expression, skills for synthesis, English level) • Maturity of the professional project: capacity to project her/himself within five years in terms of career development.

About CEFIPRA:
Indo-French Center for the Promotion of Advanced Research (CEFIPRA/IFCPAR) is an Indian body which promotes scientific cooperation between France and India in advanced fields of Science and Technology. It is supported by the Department of Science and Technology, Government of India and the Ministry of Europe and Foreign Affairs of the French government