Stage N° : 13

Contact
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Title

Manipulation of spin currents and magnetic state at the nanoscale using the spin orbit coupling

Keywords
Spintronics, nanoelectronic and devices, nanomagnetism

Summary
Very recently, a collection of Spin Orbit based spin- to-charge interconversion mechanisms (Spin Hall effects, Rashba and Topological Insulators) were observed experimentally. It appears in the set of non-magnetic metals, semiconductors or oxydes, and sorts the carriers according to their spin state. It allows injecting and detecting spins without necessarily using magnetic materials or a magnetic field, which is both conceptually and technologically very interesting. In this framework, we wish to create lateral nanostructures taking advantage of pure spin current generated by harnessing the Spin Orbit coupling for both spin to charge interconversion mechanisms and the manipulation of magnetization state of nano-object (dot or magnetic domain wall) by absorption of this current and spin transfer torque.

Full description of the subject

The development of spin electronics, or spintronics, allows to imagine many devices taking advantage of an electronics no longer based solely on the electrical charge of the carriers but also on their spin. This new degree of freedom offers additional means of conveying information, and introduces new ways to manipulating it.

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In this framework, we wish to create lateral nanostructures taking advantage of pure spin current generated by harnessing the Spin Orbit coupling for both spin to charge interconversion mechanisms and the manipulation of magnetization state of nano-object (dot or magnetic domain wall) by absorption of this current and spin transfer torque. Material of interest will be metals, oxydes and topological insulators to generate or detect spin currents, and will be applied to the manipulation of the magnetic state of a nanoelement, an example of a recent realization being given on the figure.

If subjects related to the spin transfer by absorption of a pure spin current are very competitive, they are scientifically rich, and currently booming. This area of research is still largely open to exploration, and we are benefiting from our recent development of efficient injection and detection devices.

The proposed topic lies in basic research but with a clear opening towards applied research. The trainee will benefit from the technical and scientific environment of the laboratory, and the collaborations put in place with the major actors of the field at the international level. This project is supported by funding from the ANR.

Requested skills
Master in Condensed Matter and Physics. Experimental physics, measurement of electronic spin transport properties, nanofabrication, modelisation

Possibility to follow with a PhD (Yes/No)
Yes

Figure