Interplay between spin currents and Domain Walls in lateral nanostructures

Principal investigators

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VanTuong Pham's PhD project aims at engineering the interplay between pure spin currents and domain walls, with the objectives of demonstrating the new advantages offered by pure spin currents for domain wall manipulation, of studying spin-orbit torques, and of developing an expertise in spintronics metrology. Also, some fabricated devices will perform elementary memory or logic operations, with the long-term aim of engendering a multi-input multi-output reprogrammable analogic gate.

Description

On one hand, the discovery of current-induced magnetic domain wall motion allows foreseeing several memory and logic applications. On the other hand, it has been recently discovered that pure spin currents could be manipulated. Such currents correspond to the case where up and down spins diffuses along opposite directions, whereas there is no overall charge current.

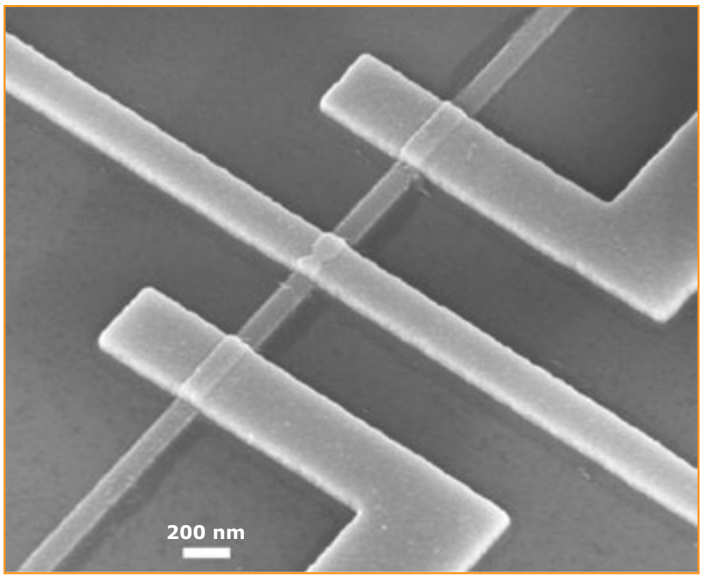
Tuong van Pham's PhD project aims at engineering the interplay between pure spin currents and domain walls: an ingenious use of pure spin currents in replacement of spin-polarized currents could allow developing a purely spin-based information technology.

The research strategy is based on three different elements able to create/detect pure spin currents: Ferromagnet / Normal metal interfaces, Spin-Orbit effects, and Domain Walls

The central idea consists in optimizing these three elementary building blocks, and in combining them in lateral nanostructures. The methodical exploration of these combinations will lead to a very large spectrum of exciting functionalities and scientific outputs.

In particular, although the use of wide wires made out of ferromagnetic/nonmagnetic multilayers is the mainstream way to probe spin-orbit torques, it is confronted to several obstacles.

We propose to get around these obstacles by separating spatially the ferromagnet and the spin-orbit material. In particular, we will realise non-local measurements, using a normal metal to convey the pure spin current. Thus, the spin transfer torque will occur at the interface between the normal metal and the ferromagnet, which allows distinguishing the rashba interfacial effects from the bulk spin Hall effect.



Scanning electron microscopy image of a nanostructure made of a NiFe nanowire and of Cu contacts, and used to study the interplay between domain walls and pure spin currents

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