Nanostructures for the electrical measurement of the Spin Hall effect and the detection of domain walls

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Spin–orbitronics is based on the ability of spin–orbit interactions to achieve the conversion between charge currents and pure spin currents. As the precise evaluation of the conversion efficiency becomes a crucial issue, the need for straightforward ways to observe this conversion has emerged as one of the main challenges in spintronics. This thesis focused on the study of a new electrical device to characterize the spin Hall effect, and on the detection of magnetic DWs in nanowires using the direct or the inverse spin Hall effect. A new ferromagnetic/nonmagnetic nanostructure has been proposed, in which it is possible to realize the spin-charge interconversion (Fig. 1).

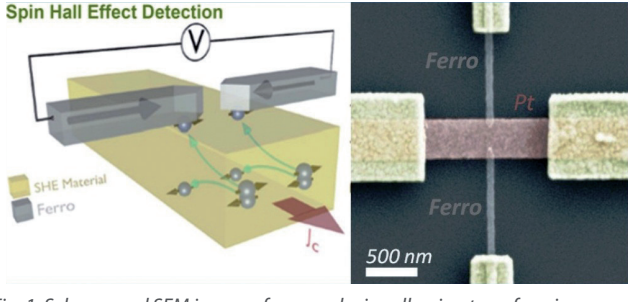

Fig. 1: Scheme and SEM image of a nanodevice allowing transforming charge currents into spin currents.

This nanostructure can be used to quantify the spin Hall angle and the spin diffusion length of Pt. The same technique can then be used to characterize the spin Hall effect in different metals and Au-based alloys. Tuong Van Pham also studied the role of the ferromagnetic/nonmagnetic interface, which is in particular found to be very important in the NiFe/Pt system. Finally, he developped a new method to detect electrically magnetic domain walls by the direct or the inverse spin Hall effect.

OUTCOMES

[1] Ferromagnetic/nonmagnetic nanostructures for the electrical measurement of the Spin Hall effect. Nano Lett. 16, 6755 (2016)

[2] Electrical detection of magnetic domain walls by inverse and direct spin Hall effect.» Appl. Phys. Lett. 109, 192401 (2016)

[3] Giant magnetoresistance in lateral metallic nanostructures for spintronic applications.» Sci. Rep. 7, 9553. (2017)

6 additionnal publications : 1 Phys. Rev. B, 1 Nanotech., 1 Appl. Phys. Lett., 1 J.M.M.M. (+2 submitted papers)
28 conference communications
Collaboration Unité Mixte CNRS/Thales.

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