**Centre de Nanosciences et de Nanotechnologies**

# Soutenance de thèse

**Jeudi 23 mai**

15h00
**Beihang university**
**Bâtiment IRC**
**37 Rue Xueyuan**
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## Boyu ZHANG

## ”Domain wall propagation combining spin-polarized current and all-optical switching”

**Jury members :**

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**Abstract :**

Since the first observation of ultrafast demagnetization in Ni films arising from a pulsed laser excitation, there has been a strong interest in understanding the interaction between ultrashort laser pulses and magnetization. These studies have led to the discovery of all-optical switching (AOS) of magnetization in a ferrimagnetic film alloy of GdFeCo using femtosecond laser pulses. All-optical switching enables an energy-efficient magnetization reversal of the magnetic material with no external magnetic field, where the direction of the resulting magnetization is given by the right or left circular polarization of the light.
The manipulation of magnetization through laser beam has long been restricted to one material, though it turned out to be a more general phenomenon for a variety of ferromagnetic materials, including alloys, multilayers and heterostructures, as well as rare earth free synthetic ferrimagnetic heterostructures. Recently, we have observed the same phenomenon in single ferromagnetic films, thus paving the way for an integration of all-optical writing in spintronic devices.
Moreover, in similar materials, like [Co/Pt] or [Co/Ni] with high spin polarization and tunable perpendicular magnetic anisotropy (PMA), efficient current-induced domain wall (DW) motion can be observed in magnetic wires, where spin-orbit torque (SOT) or spin transfer torque (STT) provides a powerful means of manipulating domain walls, which is of great interest for several spintronic applications, such as high-density racetrack memory and magnetic domain wall logic. However, the current density required for domain wall motion is still too high to realize low power devices.
This is within this very innovative context that my Ph.D. research has focused on domain wall manipulation in magnetic wires made out of thin film with strong perpendicular magnetic anisotropy combining both spin-polarized current and all-optical switching. Different material structures have been explored, in order to investigate the combined effects of helicity-dependent optical effect and spin-orbit torque or spin transfer torque on domain wall motion in magnetic wires based on these structures. We show that domain wall can remain pinned under one laser circular helicity while depinned by the opposite circular helicity, and the threshold current density can be greatly reduced by using femtosecond laser pulses. Our findings provide novel insights towards the development of low power spintronic-photonic devices.

**Mots clés en anglais :** domain wall,spin-polarized current,femtosecond laser,racetrack memory,spintronics,magnetic multilayered wires

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