科目名	ナノテクノロジー特別講義Ⅲ（１単位）
担当教員	黒田眞司 教授
科目番号	※専攻によって異なります。

Nanomagnetism and spintronics

By Jean-Philippe Attané (Grenoble Alpes University, France)

Course description:

The International Technology Roadmap for Semiconductors (ITRS) recently underlined that "the dimensional scaling of CMOS will eventually approach fundamental limits", and identified the use of computational state variables other than the electron charge as a high-priority "Grand Challenge". In this context, room-temperature spin manipulation exhibits substantial potential for becoming over the next decade the basis of an alternative information processing technology. Magnetic materials and devices have indeed played a major role in science and technology for the last half century. Hard disk drives still dominate information storage, and the magnetic random access memory (MRAM) is emerging in the memory market. Nanomagnetic systems could provide unique opportunities to complement or to be the basis of a post-CMOS technology possessing new or enhanced functionalities (non-volatility, 3D stacking, resistance to irradiation, rf communication abilities based on spin precession, etc.). Beyond MRAMs, spintronics applications already include high frequency non-linear oscillators, three dimensional solid state memories, and magnetic logic operations.

The aim of this course is to introduce the basic physical concepts allowing room temperature spin manipulation. In a first step we will study the behavior of the magnetization in nanometric elements submitted to magnetic fields. In a second step, we will focus on spintronics properties, studying the relationship between magnetization and electronic transport in nanostructures.

Outline:

1) Magnetic fields and magnetization
2) Competition of magnetic energies in ferromagnets
3) Magnetization reversal in nanostructures
4) Magnetic materials and caracterization
5) Magnetoresistances
6) Spin transfer torques
7) Emerging phenomena in spintronics

Grading:

100% Final

Textbook:

No textbook required, we shall follow the Lecture Notes which will be posted on the course Web page.

Prerequisite:

Undergraduate/graduate course on electromagnetism and solid state physics.