NEW DIRECTIONS IN SPINTRONICS

A. Fert, A. Anane, A. Barthélémy, V. Cros, J-M.George, J. Grollier,
H. Jaffrès, J-L. Maurice, F. Petroff, P. Seneor, F.Van Dau.
Unité Mixte de Physique CNRS/Thales and Université Paris Sud
E-mail: albert.fert@thalesgroup.com

While applications of GMR and TMR are already on the market, spintronics is now developing in interesting new directions. I will review some recent developments:

1. SPIN TRANSFER: The magnetic moment of a ferromagnetic element can be re-oriented WITHOUT APPLYING A MAGNETIC FIELD but only by TRANSFUSING SPINS carried by an electrical current. This is the concept of spin transfer. I will describe experiments in which the magnetization is coherently reversed by spin transfer and others in which the spin transfer is used to move back and forth a magnetic domain wall. Spin transfer is very promising for the switching of sub-micronic devices like MRAM.
2. SPINTRONICS WITH SEMICONDUCTORS: Fusion between traditional electronics and spintronics in semiconductor/ferromagnetic heterostructures is a very attractive goal (for MRAM, for example, or for re-configurable devices). I will summarize the advances in this field.
3. NANO-SPINTRONICS: Spin polarized currents can be injected into a nanoparticle to combine Coulomb and spin blockade. This probes the spin coherence time in small particles (2-3 nm), which is the relevant information to asses the potential of spin-based qubits .