Practicals

N°12: Spintronics: Characterisation of STT in perpendicular anisotropy MRAM cells

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Magnetic memories (MRAM) are non-volatile emerging technology with the potential to become the standard solution for high performance non-volatile memories. Perpendicular Magnetic Anisotropy (PMA) tunnel junctions: i) maximize the density of memory cells on a wafer, ii) PMA energy is very larger allowing for memory retention at sub-20nm sizes. Perpendicular anisotropy materials used in magnetic tunnel junctions allow for typical magneto resistance signals > 100%. Low resistance is associated to a bit '0' and the high-resistance to a '1' bit. Switching between these two states are achieved by spin transfer torque with pulses of 2-5MA/cm² current density. The aim of this practical is to characterize electrically the current densities necessary to write the desired memory state using state phase diagrams, in DC and pulsed experiments (10-100ns). Look at methods to determine the thermal stability and write error rates on nano-fabricated magnetic tunnel junctions of 50 nm size.

The practical work is at SPINTEC in CEA Grenoble. Studies level requested to follow this practical: Master of Science in Physics, Material's Science or Nanotechnology.

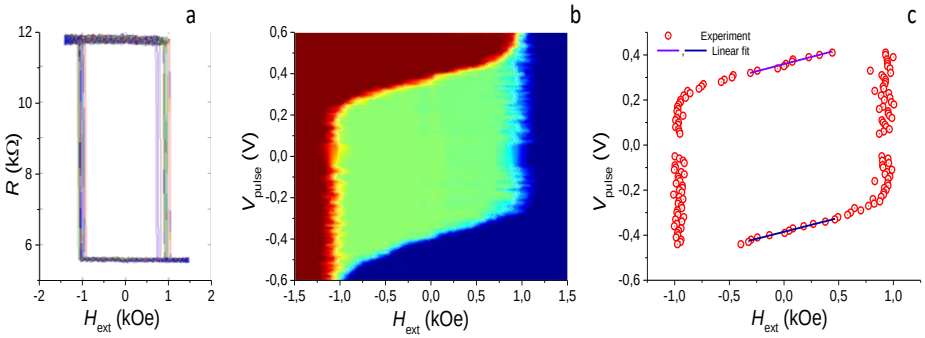

Figure 1. a) Magneto-Resistive (MR) hysteresis cycle measured on a perpendicular anisotropy tunnel junction showing the variation of the resistance. b) State phase diagram of the same junction. Switching with pulses, between low (blue) and high (red) resistance states. Bi-stable green region shows memory cell retention. c) Phase diagram boundaries to provide access to write efficiency parameters. (https://www.spintec.fr/research/mram/)