Magnetic tunnel junctions with perpendicular magnetization for non-volatile memory

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PhD may follow: Yes

Summary :

Magnetic memories (MRAM) are non-volatile emerging technology with the potential to become the standard solution for high performance non-volatile memories. To move towards the 20nm technology nodes, systems with perpendicular magnetization are the ideal solution.

MRAM cells with perpendicular anisotropy should have resistance variations of >100%. In a nonvolatile memory element, the low resistance is associated to a bit '0' and the high-resistance to a '1' bit. The objective of this internship project is the development of materials for junctions with perpendicular anisotropy with an MgO barrier. The junctions are nano-fabricated to dot sizes of 50 to 200 nm in diameter. These elements will be electrically characterized to verify the current densities necessary to write the desired memory state.

This study takes place in the framework of a research collaboration between SPINTEC and the start-up Crocus Technology. It will evaluate MRAM concepts with perpendicular anisotropy patented by Spintec.

Full description :

Magnetic memories (MRAM) are non-volatile emerging technology with the potential to become the standard solution for high performance non-volatile memories. To move towards the 20nm technology nodes, systems with perpendicular magnetization are the ideal solution. Perpendicular anisotropy is already being used in mass storage hard disk type to achieve storage densities of >300Gbit/inÂ².

For MRAM cells with perpendicular anisotropy, magnetic electrodes with perpendicular anisotropy must be integrated in magnetic tunnel junctions. These junctions should have resistance variations of >100%. In a nonvolatile memory element, the low resistance is associated to a bit '0' and the high-resistance to a '1' bit. Switching between these two states can be achieved by spin transfer torque with pulses of 2-3MA/cmÂ² current density. The objective of this internship project is the development of materials for junctions with perpendicular anisotropy with an MgO barrier. Different types of electrodes will be explored using the perpendicular anisotropy of the interface with MgO barrier or Co/Pt and Co/Pd multilayers. The junctions are nano-fabricated to dot sizes of 50 to 200 nm in diameter. These elements will be electrically characterized to verify the current densities necessary to write the desired memory state. Electrical tests will be carried out using current pulses of 10-1Âµs. The combined influence of the spin-current and of heating on the switching characteristics will be investigated. This study takes place in the framework of a research collaboration between SPINTEC and the start-up Crocus Technology. It will evaluate MRAM concepts with perpendicular anisotropy patented by Spintec.

For more information on our recent results :

[1] S. Bandiera et al , Spin transfer torque switching assisted by THERMALLY induced anisotropy reorientation in perpendicular magnetic tunnel junctions , MMM Conference , App. Phys. Lett. (2011)

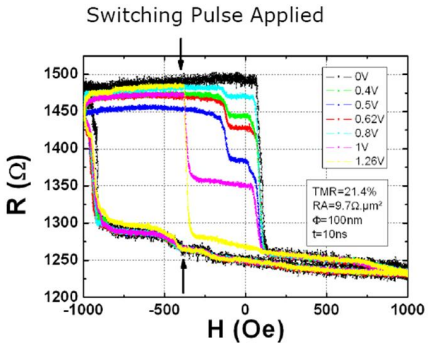

Fig. 1 : Retournement de cellule MRAM à anisotropie perpendiculaire à l'aide d'un pulse de courant de 10ns.

Requested skills :

Physics, Engineering Sciences