ELABORATION AND CHEMICAL CHARACTERIZATION OF Co/Al_2O_3/Co MULTILAYERS

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Magnetoresistance of magnetic tunnel junctions (MTJ: ferromagnetic/insulator/ferromagnetic) has potential applications in magnetic sensors and non volatile memory devices. Magnetoresistance of 40% has already been obtained by S.S.P. Parkin and al.[1]. The magnetoresistance strongly depends on the exact composition of the layers and the interface properties. Therefore, the different layers must be appropriately deposited. The development of an efficiently optimized oxidation process of the insulator barrier is required, because the MTJ device strongly depends not only on intrinsic ferromagnetic electrodes, but also on the insulating barrier [2] [3].

We are currently studying Co/Al_2O_3/Co sandwiches deposited on a (111) silicon substrate by Ar^+ ionic beam sputtering using two different targets (Co, Al), under ultra high vacuum (UHV). In order to form alumina, oxygen is introduced into the chamber while the aluminum target is sputtered. On one hand, this technique allows us to obtain a low rate of deposition (down to 0.4 Å/min) therefore to accurately control the thickness. On the other hand, the UHV considerably reduces the pollution of the layers (contrary to cathodic sputtering in which the film growing is exposed to direct ion plasma).
The oxidation state of alumina is controlled by Auger Electron Spectroscopy (AES).

So, aluminum oxide is formed and no contamination of carbon (272 eV) is observed. Conditions of Al_2O_3 deposition are determined by the evolution of Al/O ratio. The aluminum oxide spectrum is compared to a spectrum obtained on an alumina wafer. We obtain a ratio of 0.31, which corresponds to the stoechiometric Al_2O_3, when using an oxygen pressure of 4.10^{-7} mbar (Fig 1).

The composition of the cobalt layer is also controlled by AES, and no carbon or oxygen contamination is observed.
Moreover, a mechanical profilometer is used to calibrate the Co and Al_2O_3 deposition rate (v_{Co} = 3 Å/min, v_{Al2O3} = 0.5 Å/min), after a lithography process. The elaboration and the chemical characterization by Rutherford Backscattering Spectroscopy of Co/Al_2O_3/Co multilayers are still in progress.

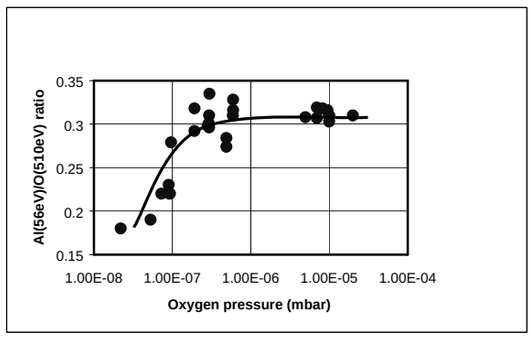

Fig. 1.. *Al(56eV)/O(510eV) Auger ratio as a function of the oxygen pressure during deposition.*

References

[1] S.S.P. Parkin and al., J. Appl. Phys., 85(8), 5828, (1999).
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