Motivation

In order to increase the GMR of CPP (Current Perpendicular to the Plane) spin valves, the electrical resistance of the auxiliary layers should be minimized. The following options for pinning are investigated:

1) Thin antiferromagnet (AFM),
2) Hard magnet (HM).

Progress in developing the deposition system used in this study

Mass flow controller with computer interface
Back-sputtering attachment for surface cleaning prior to deposition

Properties of the spin valves with AFM pinning

Magnetic properties of \( \text{Ir}_{20}\text{Mn}_{80}/\text{Co}_{90}\text{Fe}_{10}/\text{Ru}/\text{Co}_{90}\text{Fe}_{10} \) (AFM/FM)

\( \text{Ta}(4)/\text{Cu}(10)/\text{Ir}_{20}\text{Mn}_{80}/\text{Co}_{90}\text{Fe}_{10}/\text{Ru}(0.8)/\text{Co}_{90}\text{Fe}_{10}/\text{Cu}(2.5)/\text{Co}_{90}\text{Fe}_{10}/\text{Ni}_{80}\text{Fe}_{20}/\text{Ta}(5) \)

Electrical properties of \( \text{Ir}_{20}\text{Mn}_{80}/\text{Co}_{90}\text{Fe}_{10}/\text{Ru}/\text{Co}_{90}\text{Fe}_{10}/\text{Cu}/\text{Co}_{90}\text{Fe}_{10} \) spin valve (AFM/FM/SAM/AFM)

\( \text{Ta}(4)/\text{Cu}(10)/\text{Ir}_{20}\text{Mn}_{80}/\text{Co}_{90}\text{Fe}_{10}/\text{Ru}(0.8)/\text{Co}_{90}\text{Fe}_{10}/\text{Cu}(2.5)/\text{Co}_{90}\text{Fe}_{10}/\text{Ni}_{80}\text{Fe}_{20}/\text{Ta}(5) \)

Properties of the spin valves with hard magnet pinning

Magnetic properties of \( \text{Co}_{90}\text{Pt}_{20}\text{Mn}_{80} \) (HM)

\( \text{Ta}(2.5)/\text{Cr}(5)/\text{Co}_{90}\text{Pt}_{20}/\text{Cu}(2.5)/\text{Co}_{90}\text{Fe}_{10}/\text{Ni}_{80}\text{Fe}_{20}/\text{Ta}(5) \)

Magnetic and electric properties of \( \text{Co}_{90}\text{Pt}_{20}\text{Mn}_{80}/\text{Cu}/\text{CoFe} \) spin valve (HM/SAM/FM)

\( \text{Ta}(2.5)/\text{Cr}(5)/\text{Co}_{90}\text{Pt}_{20}/\text{Cu}(2.5)/\text{Co}_{90}\text{Fe}_{10}/\text{Cu}(2.5)/\text{Co}_{90}\text{Fe}_{10}/\text{Ni}_{80}\text{Fe}_{20}/\text{Ta}(5) \)

Conclusions

1) The \( \text{Ir}_{20}\text{Mn}_{80} \) (AFM) thickness can be reduced down to 3 nm without degrading the SV thermal stability in the temperature range 20-120 °C.
2) The possibility of using \( \text{Co}_{90}\text{Pt}_{20}\text{Mn}_{80} \) hard magnets as either pinned or pinning layer in an SV was demonstrated.
3) A phenomenological model was elaborated, that can explain the experimental dependence of the SV hysteresis on temperature and AFM thickness.