Co/Au multilayers for possible spin transfer torque applications

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Motivation

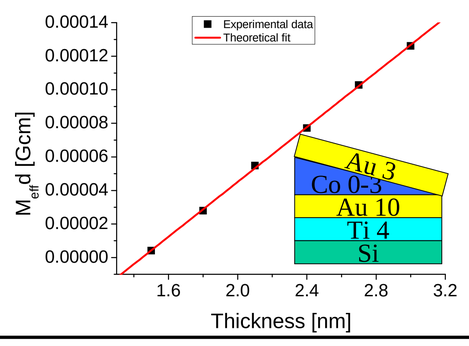
Spintronic devices [2, 3] based on spin transfer torque (STT) can be realized as double spin valves that consist of a polarizer, a free layer and a second polarizer that serves also as an analyzer. Much attention is paid to spin valves with a polarizer that has a perpendicular anisotropy. Spin valves with perpendicularly magnetized polarizer can provide sub-nanosecond switching times [1]. We have prepared Co/Au multilayers with a perpendicular anisotropy for our STT spin valves as a polarizer.

Experimental details

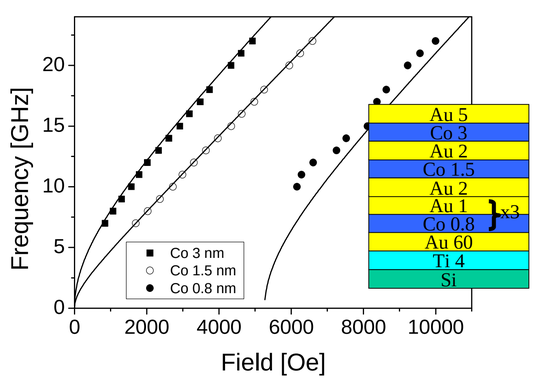
Our samples were prepared using the ultra-high vacuum sputtering system with a base pressure better than 2×10^{-7} Torr and Ar pressure 8 mTorr.
Hysteresis loops were measured by a VSM and a polar MOKE. Ferromagnetic resonance was measured using Vector Network Analyzer (VNA). This experiment was performed by sweeping field with frequency set constant.

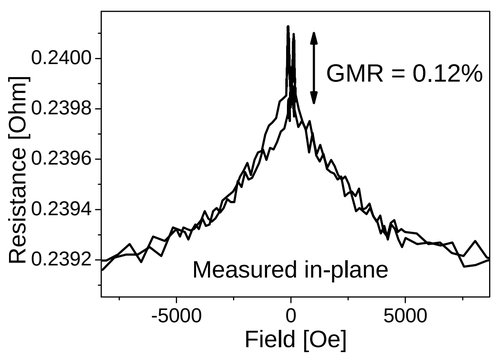
Results

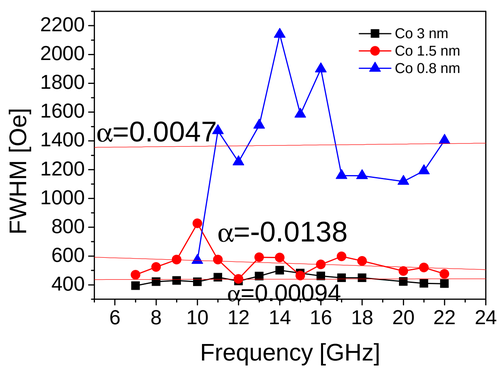
Using VNA-FMR we measured a sample with a Co wedge to obtain a surface and bulk anisotropy constants, K_S and K_V respectively. K_S =0.52 erg/cm^2 and K_V =5.1×10^6 erg/cm^3 result in transition to a perpendicular anisotropy at 1.45 nm.



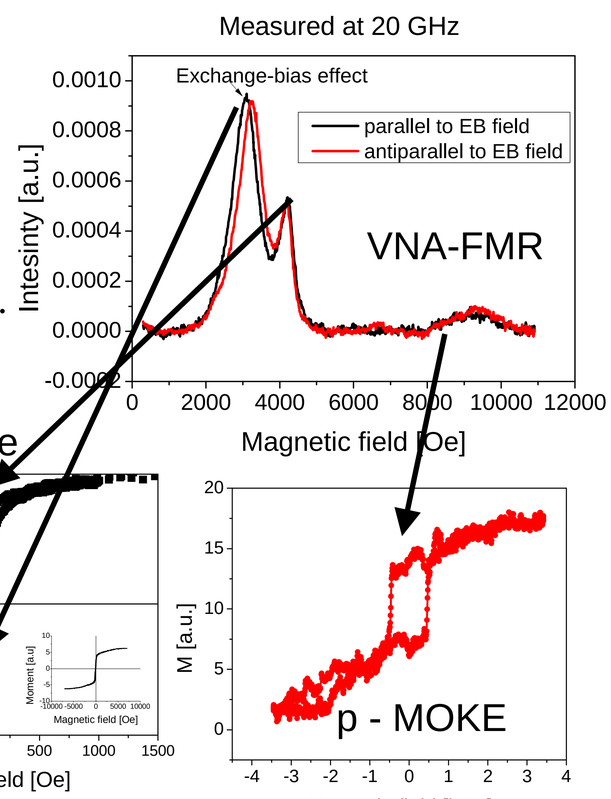
The first structure consist only of Co layers with different thickness, so we have 2 layers with in-plane and one with a perpendicular anisotropy, confirmed by VNA-FMR and p – MOKE measurements. GMR current in-plane measurements give 0.12% for in-plane layers. FWHM is almost independent of frequency, which results in **very small α≈0**.



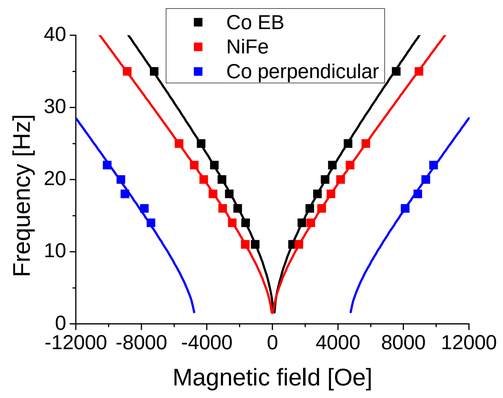


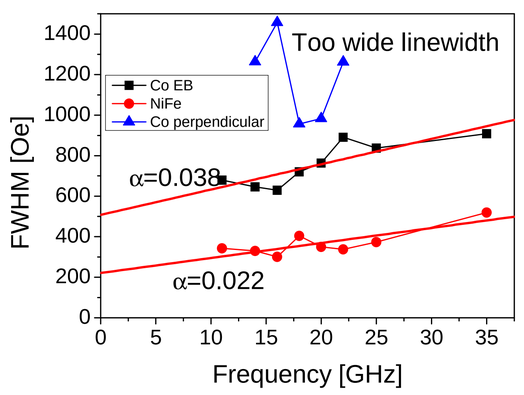


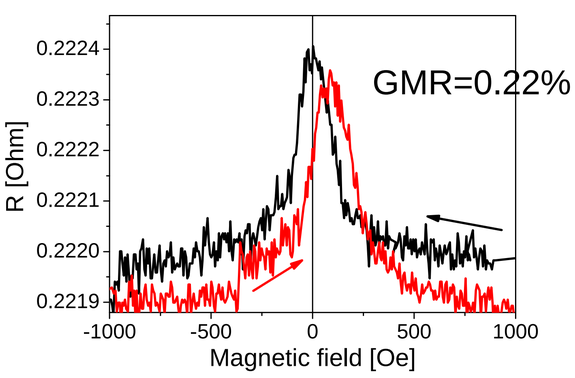
The second structure consist of similar polarizer as first, but the free layer is permalloy (Py) and the analyzer is Co pinned by IrMn. It was characterized magnetically by VNA-FMR, p – MOKE and VSM measurements. Exchange bias of the pinned layer is of 100 Oe.



GMR CIP is larger (0.22%) than in the first structure probably because of usage copper (Cu) spacer. The linewidth dependence on frequency of Py layer and Co layer pinned by IrMn results in α much larger than Co/Au multilayers, but values of FWHM are similar. The linewidth of permalloy free layer is the lowest.







Summary

We prepared several samples with the perpendicularly magnetized polarizer. The structure with the copper spacer and the permalloy free layer has larger GMR value. The linewidth dependence on frequency is different for Co/Au multilayers and for magnetic layers in vicinity of copper. Co/Au multilayers dependence is almost frequency independent.

References

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Acknowledgments

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