MAGNETIZATION REVERSAL AND DOMAIN REPLICATION IN Co/Au/Co FILM WITH PERPENDICULAR ANISOTROPY

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Motivation

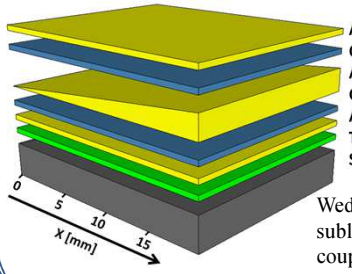
In layered structures of the pseudo-spin-valve (PSV) type the magnetization reversal is determined not only by magnetic properties of ferromagnetic sublayers but also by interactions occurring between them. For applications important is not only reversal of the whole PSV structure represented by major loop but also reversal of magnetically soft layer (minor loop). It was previously demonstrated that reversal of the soft layer depends on magnetic structure of the hard layer. In particular, for multi-domain state of the magnetically hard layer the reversal of the soft layer takes place in two steps with characteristic intermediate level corresponding to creation of **duplicated domains.**

Aim

Study of magnetization reversal accompanied by domains replication in Co/Au/Co film characterized by perpendicular anisotropy and controllable changes of interlayer coupling.

Sample - pseudo spin-valve (PSV) with perpendicular anisotropy

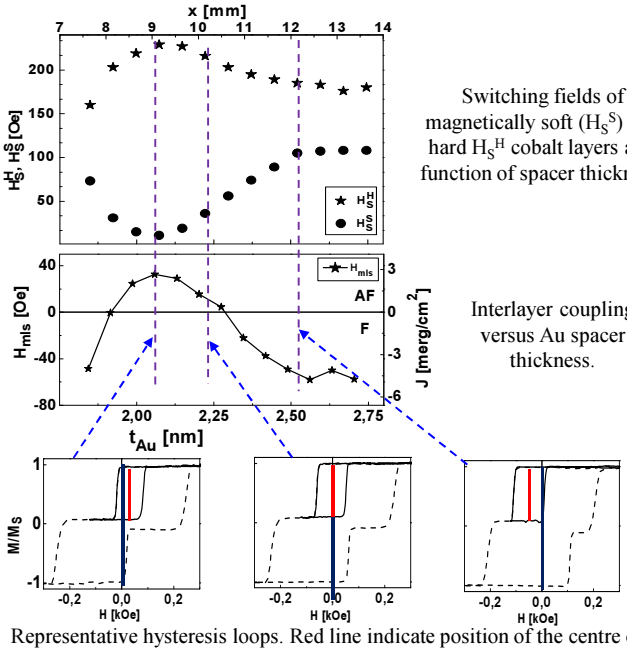
Morphology of investigated layered film – PSV structure.



Co^S and Co^H ferromagnetic sublayers characterized by perpendicular anisotropy.

Wedge shaped Au^S layer, which separates Co sublayers, allows us to determine changes of coupling as a function of the thickness of nonmagnetic spacer ($1.7 \le t_{Au}^S \le 3$ nm).

Changes of the interlayer coupling with Au spacer thickness



Switching fields of magnetically soft (H_S^S) and hard H_S^H cobalt layers as a function of spacer thickness.

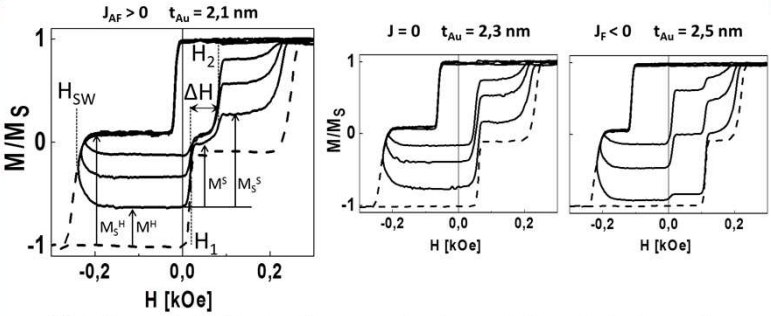
Interlayer coupling versus Au spacer thickness.

Representative hysteresis loops. Red line indicate position of the centre of minor loop H_{mls}.

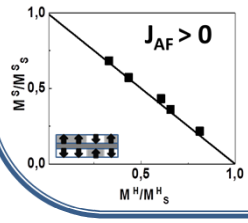
Acknowledgements

This work was partially supported by the Polish Ministry of Science and Higher Education under the Grant IP No. 2011 028371. and by the National Science Centre Poland under HARMONIA funding scheme - grant No. 2013/08/M/ST3/00960. P.K. is also supported by the Foundation for Polish Science.

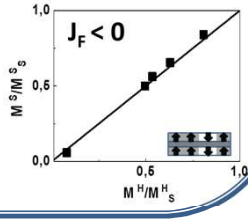
Magnetization reversal of Co^S layer recorded for partially reversed Co^H layer



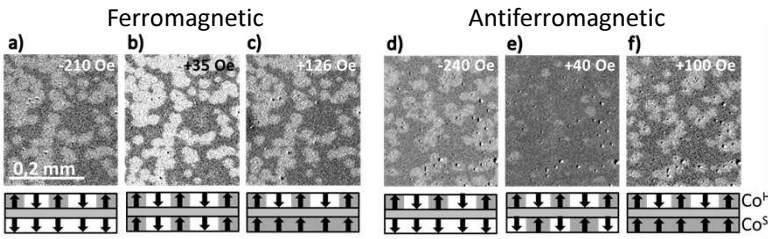
Major loops (dashed line) and representative hysteresis loops (only the part for increasing magnetic field) recorded for partially reversed magnetically hard layer. $\Delta H = H_1 - H_2$ magnetic field range in which replicated domain structure is stable.



Variation of the net magnetization of the soft layer as a function of the net magnetization of the hard layer for antiferromagnetic and ferromagnetic coupling.

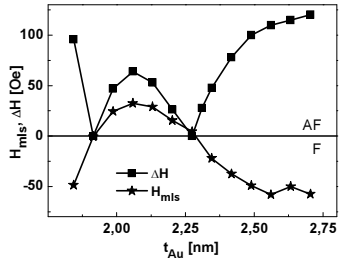


Domain replication for F and AF coupling



Panels (a, d) and (c, f) correspond to multidomain state in magnetically hard layer and monodomain state with magnetization in soft layer oriented down and up, respectively. The images b and e correspond to intermediate state with mirror domains. Cross-sectional diagram of the magnetic structure explaining the contrast recorded with magnetooptical Kerr microscope is added below each photograph.

Stability of replicated domains



The minor loop shift (H_{mls}) and the field range ΔH corresponding to the stable magnetic configuration of duplicated domains.

Conclusions

The analysis of the minor hysteresis loops (performed on one single sample), registered when magnetically harder layer was only partially reversed, allowed us to prove that the process takes place through a distinct intermediate state corresponding to the copying of the domains in AF or F configuration. The field range in which that state is preserved increases with increasing the interaction, irrespective of its sign.