INFLUENCE OF DOMAIN REPLICATION ON MAGNETORESISTANCE OF Co/Au/Co FILM WITH PERPENDICULAR ANISOTROPY AND ANTIFERROMAGNETIC COUPLING

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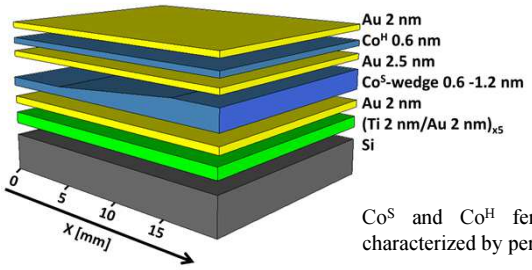
Introduction

Spin valve structures composed of soft and hard ferromagnetic layers (FM^S and FM^H, respectively) are promising for applications. Therefore, precise characterization of magnetization reversal and magnetoresistance, and their correlation with magnetic structure is very important. Both processes are determined by the magnetic properties of FM layers (M, K, H_C) and by effective coupling between them (J). Other parameter which can strongly modify the reversal process is related to inhomogeneous stray fields originating from the domain structure.

The aim of this work is to investigate the magnetoresistance effect for Au/Co/Au/Co/Au layered system characterized by PMA and weak AF coupling. The R(H) dependences corresponding to reversal of FM^S layer (minor loop) were measured for partially reversed FM^H layer. The characteristic feature of this reversal process is an intermediate state related to domain replication from FM^H to FM^S layer. The interpretation of R(H) dependence is confirmed by domain observation performed with magnetooptical Kerr microscope.

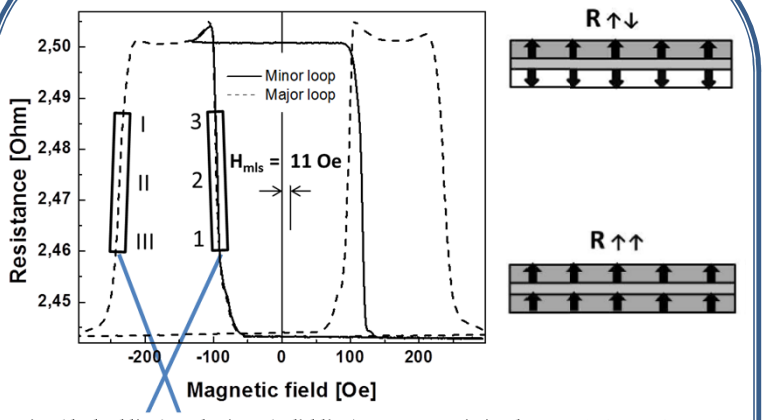
Sample - pseudo spin-valve (PSV) type system with perpendicular anisotropy

Morphology of investigated layered film – PSV structure.



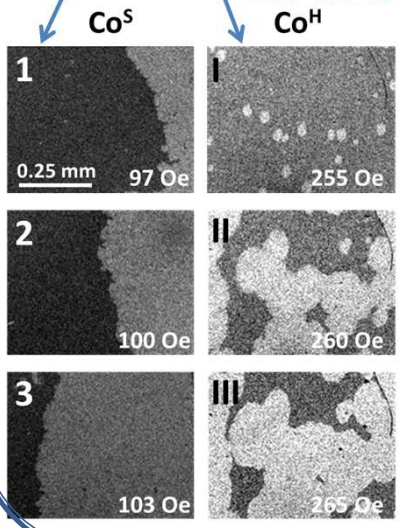
Co^S and Co^H ferromagnetic sublayers characterized by perpendicular anisotropy.

Major and minor magnetoresistive hysteresis loops

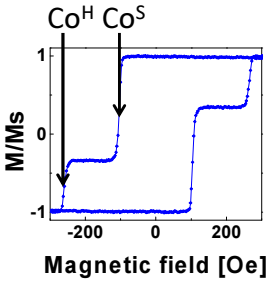


Major (dashed line) and minor (solid line) magnetoresistive hysteresis loops determined for Si/(Ti-2nm/Au-2nm)5/Au-2nm/Co-1.2nm/Au-2.5nm/Co- 0.6nm/Au-2nm spin valve structure. H_{mls} - magnetic field corresponding to the center of minor loop.

Domain structure and magnetisation reversal of Co^S and Co^H layers

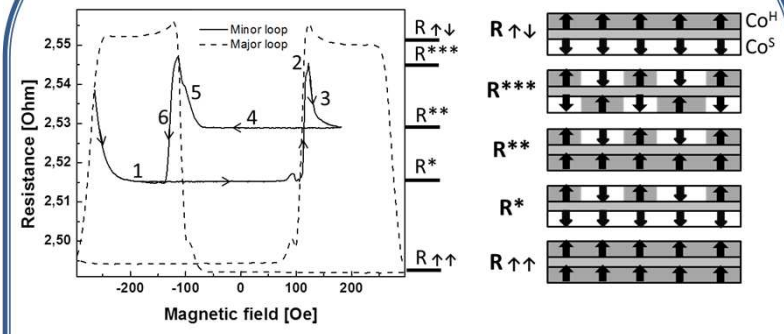


Domain structure recorded using magneto-optical Kerr microscope with polar configuration (P-MOKE) for reversal of soft and hard magnetic layer.



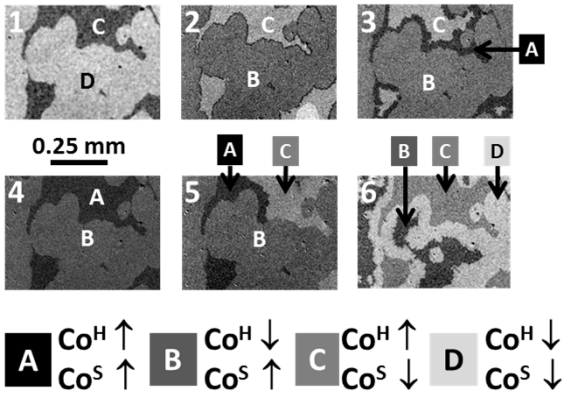
Representative hysteresis loop of the whole PSV structure

Domain replication for F and AF coupling



Major and minor magnetoresistive hysteresis loops. The minor loop is recorded for partially reversed Co^H layer. The numbers 1-6 correspond to magnetic structure presented in bottom panel.

Replication of domains



Domain structure recorded with P-MOKE microscope. The numbers 1-6 correspond to positions indicated on the R(H) dependence.

Conclusions

We have demonstrated that in Co^S/Au/Co^H spin valve structures magnetoresistive minor loop recorded for partially reversed magnetically hard layer (Co^H) shows three resistance levels. Two of them correspond to the single domain state of magnetically soft layer and the third to duplicated domains with antiparallel magnetization configuration for antiferromagnetic coupling. The first stage of reversal process from single domain state to the multidomen state is controlled by nucleation of domains, and the second stage is mainly controlled by domain walls propagation.

Acknowledgements

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