**Exchange bias dependence in gradually patterned antiferromagnet**

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Exchange bias is a phenomenon associated with the exchange interaction at the antiferromagnetic/ ferromagnetic (AF/FM) interface. The exchange coupling between dissimilar materials shifts the center of the hysteresis loops along the external field axis by an amount known as exchange bias field ($H_{EB}$). It is generally assumed that $H_{EB}$ decreases as FM thickness ($t_{FM}$) increases following a dependence of $1/t_{FM}$[1]. In this work we investigate the dependence of FM layer thickness on the exchange bias field in continuous and patterned $FeF_2$/FM (FM = Ni, FeNi) bilayers. The AF layer was gradually etched in patterned samples using a photolithography mask (Figure 1). $t_{FM}$ varies from 3 to 100 nm whilst the AF thickness under the FM layer was kept constant at 70 nm. Experimental measurements reveal that $H_{EB}$ vs $t_{FM}$ largely deviates from the dependence of $1/t_{FM}$. A theoretical model considering spring-like domain walls through the FM layer [2,3] and a finite AF anisotropy [4] is taking into account to explain the results.

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**References]**

[1] J. Nogués, Ivan K. Schuller, J. Magn. Magn. Matter. **192** (1999) 203.
[2] R. Morales,Z-P. Li, O. Petracic, X. Batlle, and Ivan K. Schuller, Appl. Phys. Lett. **89** (2006) 072504
[3] R. Morales et al., Appl. Phys. Lett. **95** (2009) 092503
[4] M. Kiwi, J. Mejia-Lopez, R. D. Portugal, and R. Ramirez, Europhys. Lett., **48** (1999) 573

**Figures**

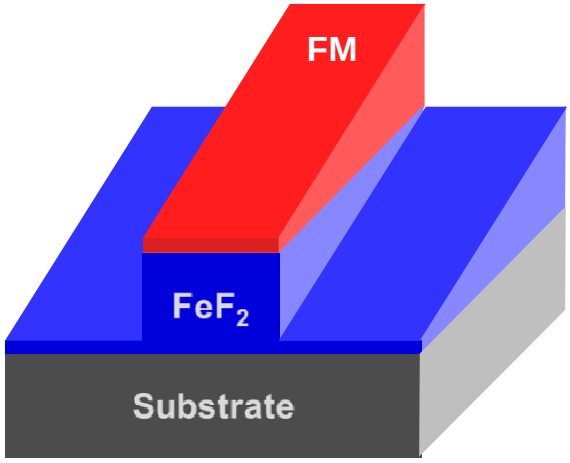


*Figure 1. A wedged $FeF_2$/FM sample patterned into stripes*