

# Ferromagnetic to antiferromagnetic net exchange coupling transition in sputtered Co/CoO bilayers.

A. N. Dobrynin<sup>1,2</sup>, P. Warin<sup>3</sup>, A. Vorobiev<sup>4</sup>, D. Givord<sup>1</sup>

<sup>1</sup>*Institut Neel, CNRS, Grenoble, France*

<sup>2</sup>*Diamond Light Source, Didcot, United Kingdom*

<sup>3</sup>*INAC, CEA, Grenoble, France*

<sup>4</sup>*ESRF, Grenoble, France.*

We demonstrate a negative-to-positive exchange bias transition in proximity of the exchange bias blocking temperature of sputtered Co/CoO bilayers. We compare the samples prepared by magnetron sputtering and by high-rate triode sputtering. The sample roughness (varied from 0.5 nm to 2.5 nm), and thickness (10 nm for Co, 2 to 4 nm for CoO) were characterised by X-ray reflectivity and AFM. The exchange bias blocking temperature was varied from 80 K for samples with smaller roughness and smaller thickness of CoO, to 130 K for samples with larger roughness and thickness of the oxide layer. For all samples the transition from positive to negative exchange bias was observed in proximity to the blocking temperature, as shown in Fig. 1.

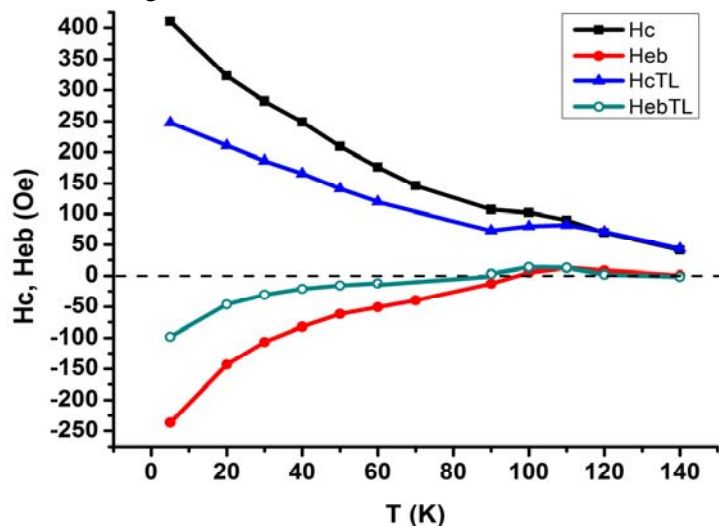


Fig.1: Temperature dependence of coercivity and exchange bias for first and training hysteresis loops for sample Co 10 nm / CoO 4nm (roughness 2.5 nm). Hc (filled squares) – coercivity of the first loop, Heb (filled circles) – exchange bias of the first loop, HcTL (filled triangles) – coercivity of the training loop, HebTL (open circles) – exchange bias of the training loop. All the measurements were taken after field cooling at 1 T from 300 K.

Similar results have been reported in several recent works [1-3], but no unambiguous interpretation has been provided. Here we exploit the recently developed technique to measure the exchange bias inducing temperature [4,5] in order to get supplementary information about exchange interactions at the Co/CoO interface. The coercivity enhancement, accompanying the positive exchange bias, indicates a different exchange coupling mechanism as compared to that in the negative bias case. A modified Malozemoff random field model of exchange bias [6] is employed for explanation of the observed behaviour. Establishing of the interfacial antiferromagnetic structure causes the transition between antiferromagnetic to ferromagnetic net exchange coupling at the rough interface. Furthermore, we discuss the synchrotron based experiments which may allow to clarify the arrangement of the magnetic moments at the interface at different temperatures.

## References

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Email corresponding author: alexey.dobrynin@diamond.ac.uk

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