Planar domain walls in Co/NiO and their role in exchange bias.

M. Liberati[1, 2]; *A. Scholl*[2]; *E. Arenholz*[2]; *H. Ohldag*[3]; *Y. Tang*[4]; *A. Berkowitz*[4]; *J. Stohr*[3]

1. Department of Physics, Montana State University, Bozeman, MT, USA.
2. Lawrence Berkeley National Laboratory, Berkeley, CA, USA.
3. Stanford Synchrotron Radiation Laboratory, Stanford, CA, USA.
4. Center for Magnetic Recording Research, University of California, San Diego, CA, USA.

The exchange bias effect established at the interface between antiferromagnetic and ferromagnetic materials holds a key role in today ' s magneto-electronic devices. It was shown that the creation of a planar domain wall at the ferromagnet/antiferromagnet (AFM/FM) interface, limits the strength of exchange bias, assuming large interface exchange [1]. Although proposed 20 years ago, such a domain wall had never been observed. Using X-ray Magnetic Linear Dichroism we confirm the presence of a planar domain wall at the interface of Co/NiO(001), Fig. 1. The ferromagnet via interface coupling creates an antiferromagnetic exchange spring. From the rotation angle of the antiferrmagnetic surface and the field we deduced the interface coupling and the anisotropy of the NiO crystal.

While a planar wall is present in supposedly all AFM/FM systems, the actually reached bias is usually much smaller than the limit set by the creation of a wall. We show that a much reduced wall rotation occurs in polycrystalline NiO, a good exchange bias material, because of the higher anisotropy or " magnetic hardness " of the film compared to the NiO single crystal. In systems containing hard antiferromagnets the strength of the interface coupling via pinned, uncompensated spins ultimately limits the bias.

This work was supported by the U.S. Department of Energy under Contract No. DE-AC03-76SF00098 at Lawrence Berkeley National Laboratory.

[1] D. Mauri, H.C. Siegmann, P.S. Bagus, E. Key, J. Appl. Phys. 62, 3047 (1997).
[2] A. Scholl, M. Liberati, E. Arenholz, H. Ohldag, J. Stohr, Phys. Rev. Lett. 92, 247201 (2004).

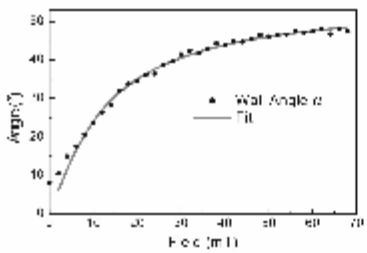

Fig. 1: Rotation angle of planar wall in a NiO (001) single crystal.