Abstract Submitted
for the MAR08 Meeting of
The American Physical Society

The role of uncompensated spins in exchange biasing HANS J. HUG, Empa, Materials Science and Technology, Switzerland and Institute of Physics, University of Basel, Switzerland, IRIS SCHMID, PETER KAPPENBERGER, SARA ROMER, Empa, Materials Science and Technology, Switzerland
— The origin of the exchange bias (EB) effect has been traced back to the existence of pinned uncompensated spins (UCS) in the antiferromagnet (AFM) or at its interface. However, the understanding of the underlying mechanism is still clouded by contradictory reports: For example, both a parallel as well as an antiparallel orientation of the UCS relative to the magnetization direction of the ferromagnet (FM) were reported for similar FM/AFM systems. Here different magnetization histories in magnetometry and high resolution magnetic force microscopy measurements are used advantageously to demonstrate the co-existence of pinned UCS that are parallel and antiparallel to the cooling field in metallic (IrMn) and oxidic (CoO) EB systems. We further conclude that the EB effect is mainly a result of pinned interfacial UCS, which are antiparallel to the FM spins [1]. In further experiments, the distribution of density of the UCS were imaged on the length scales of single grains. A surprisingly strong fluctuation of the local UCS density (UCSD) was observed. A correlation between the UCSD and the local exchange field was performed. Clearly, a high UCSD results in a high local exchange bias field. Regions with an anti-biasing effect were found. Using grain-boundary engineering, exchange-biased materials without such regions could be fabricated that showed a substantially increased exchange bias effect.
[1] Schmid et al. EPL, 81 (2008) 17001

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Date submitted: 21 Dec 2007 Electronic form version 1.4