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Origin of Positive and Negative Exchange Bias in Co/FeF_2. M.R. Fitzsimmons, B. Kirby, Los Alamos National Laboratory, Los Alamos, NM 87545, S. Roy, Zhi-Pan Li, Igor V. Roshchin, S.K. Sinha, Ivan K. Schuller Dept. of Physics, Univ. of California -San Diego, La Jolla, CA 92093 USA.

Exchange coupling across an antiferromagnetic-ferromagnetic interface can produce a shift of the ferromagnetic hysteresis loop about the zero of applied field; hence the phenomenon is called exchange bias. The shift can be very large; thus, in small fields, typical of applications in magnetic recording or magnetic random access memory, the magnetization of the ferromagnet is effectively pinned, providing a magnetic reference state required in these applications. Despite the technological importance of exchange bias, a detailed understanding of its origin has been elusive. A critical piece that has long been missing is quantitative information about the spatial distribution of pinned and unpinned magnetization in exchange bias systems. We have used polarized neutron beams with polarization analysis to obtain the magnetization depth profile across an exchange bias bilayer comprised of Co (the ferromagnet) and FeF_2 (the antiferromagnet). Our Co/FeF_2 system is unusual in that depending upon the magnitude of the field in which the sample was cooled (through the Néel temperature of FeF_2), the exchange bias can be either positive or negative. By comparing the magnetization depth profiles of the same sample for the two biases, we were able to identify how the distribution of pinned magnetization changes with the sign of bias, providing a unique insight into the origin of positive and negative exchange bias.

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