Abstract Submitted
for the MAR12 Meeting of
The American Physical Society

Large exchange anisotropy in nanostructured $Cu_{30}Mn_{70}$ ribbons[1]

J. MARION, F. JIMÉNEZ-VILLACORTA, L.H. LEWIS, Northeastern University Department of Chemical Engineering — Exchange bias (H_{ex}), arising from coupling between antiferromagnetic (AFM) and ferromagnetic (FM) materials, is a diagnostic metric of magnetic interactions in inhomogeneous systems. An extremely large H_{ex} of 10 kOe is found in the rapidly-solidified alloy $Cu_{30}Mn_{70}$ at 10 K [1-2], but disappears at temperatures above the system blocking temperature of 123 K. X-ray diffraction reveals the presence of two well-crystallized FCC γ-phases with cubic a-parameters 3.744 and 3.750 Å, unit cell volumes of 52.5 and 52.7 $Å^3$, respectively, and a crystallite size of $\sim$30 nm. We hypothesize that the γ-phase with larger a-parameter is Mn-rich while the other is Mn-poor. The observed magnetic behavior is attributed to exchange interactions between Mn-rich regions where AFM coupling between nearest-neighbor Mn atoms dominates, and Mn-poor regions where FM coupling between next-nearest-neighbors dominates [1]. Compositional fluctuations result in an additional cluster-glass-like freezing behavior due to magnetically frustrated interactions between Mn atoms [2].

[1] Kouvel, J.S., J. Appl. Phys. S31 (1961) 5, S142-147.
[2] Mydosh, J. A. (1995), Spin Glasses, Taylor & Francis.

[1]This research was conducted under ONR grant # N000141010533. The author would also like to acknowledge Drs. Matthew Willard and Maria Daniil at NRL.

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Date submitted: 18 Nov 2011 Electronic form version 1.4