Abstract Submitted
for the MAR10 Meeting of
The American Physical Society

Self-assembly of an exchange-spring composite via magnetic phase separation in $\mathbf{Pr_{1-x}Ca_xCoO_3}$ S. EL-KHATIB, National Institute of Standards and Technology, S. BOSE, C. HE, J. KUPLIC, University of Minnesota, Q. HUANG, National Institute of Standards and Technology, J.W. LYNN, J. BORCHERS, National Institute of Standards and Technology, J.F. MITCHELL, Argonne National Lab, C. LEIGHTON, University of Minnesota — We report structural and magnetic properties in bulk polycrystalline $Pr_{1-x}Ca_xCoO_3$ ($0.00\leq x \leq 0.30$) from neutron diffraction, thermogravimetic analysis, magnetometry, and small-angle neutron scattering (SANS). Upon cooling, the $Pr_{0.70}Ca_{0.30}CoO_3$ composition (deep in the FM phase) first undergoes a transition around 250 K where short-range FM clusters emerge with a size of order 1-2 unit cells. The magnetization and SANS intensity slowly increase on cooling to 70 K, where the system undergoes a transition to a long-range ordered FM state, but with low magnetization, indicative of a small FM volume fraction. Magnetometry and SANS data indicate coexistence of the short-range clusters within a network of long-range FM. The coercivities H_C of the short-range and long-range FM regions are very different, and a non-monotonic T dependence of the H_C reveals clear evidence of FM exchange coupling between the phase-separated regions. In essence the phase separation leads to natural formation of a hard/soft composite, which displays classic exchange spring behavior. Work at UMN supported by DoE.

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Date submitted: 08 Dec 2009 Electronic form version 1.4