Abstract Submitted
for the MAR05 Meeting of
The American Physical Society

Extraordinary Hall Effect in (Ni80Fe20)x(SiO2)1-x Thin Films[1]

HUI LIU[2], FUK KAY LEE, RONG KUN ZHENG, X.X. ZHANG, OPHELIA K.C. TSUI, Department of Physics and Institute of Nano Science and Technology, Hong Kong University of Science and Technology — The extraordinary Hall effect (EHE) in ferromagnetic samples is generally attributed to scatterings of iterant electrons in the presence of spin-orbit interactions. In this work, study on the thickness dependence of the EHE in the $(Ni_{80}Fe_{20})_x(SiO_2)_{1-x}$ system showed the spontaneous Hall resistivity, ρ_{sy}^S, to be a constant while the Hall coefficient, $R_S(\equiv \rho_{sy}^S/M_S$ where M_S is the saturated magnetization) increased monotonically owing to a depression in M_S. We propose the constancy of ρ_{sy}^S with reducing thickness to arise from the sample morphological structure becoming two-dimensional with decreasing film thickness, expected from classical percolation theory. We also find in this system with varying x that $\rho_{sy}^S \propto \rho_{xx}^\gamma$, with $\gamma = 0.53$ to 1 in disagreement with the value 2 frequently attributed to the side jump effect, but explainable in terms of the more general form $\rho_{sy}^S = \rho_{xx}\Delta y_e/\Lambda_{SO}$, where Δy_e is the side jump displacement and Λ_{SO} the spin-orbit mean-free-path.

[1]We acknowledge Prof. Ping Sheng for many useful discussions as well as encouragements. This work is supported by the Research Grant Council of Hong Kong through the project HKUST6150/01P.
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Date submitted: 20 Mar 2013 Electronic form version 1.4