Magnetic Imaging of Biquadratic Coupling in Ferromagnetic Bilayers*

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Physical properties of thin magnetic nanostructures are dominated by exchange interactions between the layers. These interactions in most cases induce collinear coupling of spins. The much smaller noncollinear coupling of spins is also allowed through the biquadratic term in the exchange Hamiltonian. Recently, Vlasko-Vlasov et al. [1] observed unusual coupling of two ferromagnetic layers in contact. They studied junctions of SmCo and Fe layers and deduced noncollinear magnetic configurations based on magneto-optical imaging of the top Fe layer. To simultaneously probe the magnetization in the surface Fe layer and in the buried SmCo layer, we used circularly polarized synchrotron radiation. Element-specific hysteresis loops were performed by tuning the energy of the synchrotron radiation to the absorption edges of Fe (7.110 keV) and Sm (6.710 keV). In addition, fluorescence imaging of magnetic domains was performed by using focused circularly polarized x-rays (1 μm by 1 μm). Hysteresis and imaging data unequivocally demonstrated that the Sm and Fe magnetizations were perpendicularly coupled. *This work is supported by the U.S. DOE, Office of Science under Contract No. W-31-109-ENG-38.

[1] Vlasov V.K., Welp U., Jiang J.S., et al., *Phys.Rev.Lett*., 2001,**86**, 4386.

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