Magnetization Rotation in Exchange Biased Ni/FeF_2

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Abstract

Exchange biased Ni/epitaxial-FeF_2 films have been investigated using vector magnetometry. Films of Ni-wedge/Co/Ni-wedge/epitaxial-FeF_2 are being studied with the Octupole Magnetometer on Beamline 4.0.2 using MOKE and XMCD. The double wedge profile of Ni enables the embedded Co layer to serve as a magnetic probe inside the Ni layers while keeping the total FM layer thickness constant. The Co layer may reveal the existence of domain structures in the Ni layers as a function of layer thickness. Hysteresis loops of films with a thicker layer of Ni have been studied using a vibrating sample magnetometer with a vector coil attachment by varying the cooling field H_{FC} applied along the FeF_2 easy axis. At low H_{FC} a single longitudinal hysteresis loop is observed, negatively shifted with a large exchange field. With increasing H_{FC}, the loop divides into two sub-loops shifted oppositely from zero field by the same amount. The positively shifted sub-loop grows in size with H_{FC} until only a single positively shifted loop is found. Throughout this process, the negative/positive (sub)loop shift has maintained the same *discrete* value. This is in sharp contrast to films with twinned FeF_2 where the exchange field *gradually* changes from negative to positive values with

increasing H_{FC}. The transverse magnetization shows clear correlations with the longitudinal sub-loops. Interestingly, over 90% of the Ni reverses its magnetization by rotation, either in one step or through two successive rotations. These results are attributed to the single crystal nature of the antiferromagnetic FeF_2, which allows two opposite regions of large domains to couple to the Ni with a larger average effect than the small domains in the twinned FeF_2.