Phase resolved X-ray Ferromagnetic Resonance (XFMR) measurements of a ferromagnetic bilayer with a rare earth cap.

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The precessional magnetization dynamics of ferromagnetic thin films are exploited in the operation of high frequency magnetic devices such as hard disk drive sensors, non-reciprocal microwave devices and spin transfer torque oscillators. Time resolved X-ray Magnetic Circular Dichroism (XMCD) promises to provide new insight into the nature and origin of the damping in such systems. Measurements are performed in a pump-probe configuration, with the x-ray probe pulses phase locked to a microwave source that stimulates magnetization precession within the sample. By sweeping an external static field, x-ray ferromagnetic resonance (XFMR) may be observed. The line width of the resonance provides a direct measure of the damping while the phase-resolved XMCD measurement allows the role of different chemical species and atomic sites to be explored.

Previous XFMR studies have either used fluorescence to observe the shortening of the longitudinal magnetization component [1], or transmission to perform phase resolved measurements of the transverse magnetization components [2]. We introduce a further XFMR measurement technique in which phase-resolved fluorescence measurements are used to detect the transverse magnetization components. In particular we report on phase-resolved measurements of a $Co_{50}Fe_{50}$(0.7nm)/$Ni_{81}Fe_{19}$(5 nm) bilayer with a Dy(1 nm) cap. The Dy cap is reported to reduce spin-transfer-torque noise in spin valve structures, while maintaining the magneto-resistance response [3]. Comparison with a $Co_{50}Fe_{50}$ (0.7 nm)/$Ni_{81}Fe_{19}$ (5 nm) film without a Dy cap revealed enhanced damping of the magnetization at both the Ni and Fe sites for the Dy capped sample. The Dy cap was found to be weakly polarized by the underlying ferromagnetic layer.

References

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