Heat assisted magnetic recording using exchange bias.

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In a conventional Heat Assisted Magnetic Recording (HAMR) system a FePt granular layer is used to provide both a temperature dependent magnetocrystalline anisotropy and to give the required signal for the retrieval of the information. Hence a single material is used with two functions. With bi-functionality of this type it is difficult to optimise each function and generally a compromise for both functions is required. In the case of FePt there are also serious issues associated with achieving the necessary phase transformation to create the high anisotropy required.

We have recently proposed a new approach which enables the separation of the two functions so that the temperature dependent anisotropy is generated separately from the ferromagnetic signal required for read back [1]. This approach makes use of a phenomenon known as exchange bias. This is where a ferromagnetic (F) layer is grown in contact with an antiferromagnetic (AF) one. The interaction across the F/AF interface results in a unidirectional anisotropy being induced in the F layer. As a result, the hysteresis loop for the F layer is shifted along the field axis so that both coercivities can lie in negative fields. A typical hysteresis loop for an in-plane oriented IrMn(AF)/CoFe(F) exchange bias system is shown in Figure 1. The most important feature of this system is that it cannot be demagnetised by the application of a large negative field.

We have shown that an IrMn AF layer couples to a conventional CoCrPt-SiO_2 F layer [2]. In such exchange bias system the information is stored in the AF when it is field cooled. This has the advantage that the data cannot be field erased and can only be erased by the use of thermal energy. We have identified a suitable seed layer structure to orient the IrMn in the perpendicular direction and have optimised the thickness of the AF layer (6nm). This optimisation resulted in a shifted hysteresis loop with segregated grains as required for a low noise medium. However for HAMR applications thermal stability is crucial. In this paper we present recent results on the stability of these structures.

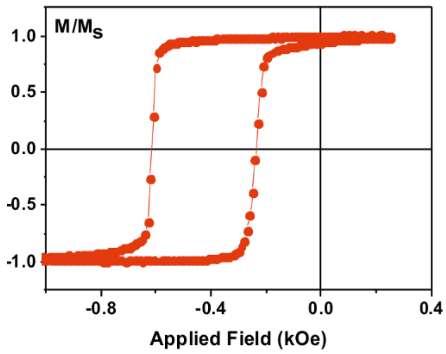

Figure 1. Typical hysteresis loop for an exchange biased system.

[1] K. O'Grady and G. Vallejo-Fernandez, "Magnetic storage disc based on exchange bias," U.S. patent 14/938,139 (2015).

[2] K. Elphick et al., "HAMR Media Based on Exchange Bias", Appl. Phys. Lett. 109 052402 (2016).