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Magnetic Reversal Behaviors of Perpendicular Exchange-Coupled Fe/FePt Bilayer Films

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$L1_0$ FePt film with (001) orientation is regarded as a potential candidate for advanced magnetic media with ultrahigh recording density due to its high magnetocrystalline anisotropy energy (K_u ~108 erg/cm^3). Although high K_u sustains the thermal stability of magnetic grains when the mean grain size is reduced to few nanometers, meanwhile, enhancement in coercivity (H_c) causes serious problems in magnetization and reversal. High current is required for a writing head to generate sufficient magnetic field to reverse the moment direction of a storage bit, causing the serious writing issue. Exchange coupled composite (ECC) media have been proposed to solve this problem. Through the interaction between soft and hard magnetic phases, H_c can be reduced to one tenth with improved thermal stability[1,2]. Although the switching behaviors in individual soft and hard layers were well understood from simulated studies, the experimental characterization results are still lacking.

In this paper, the switching behavior and exchange interaction of films consisting of a soft Fe layer with 0 to 20 *nm* in thickness (t_{Fe}) deposited on 20 nm-thick hard FePt(001) were reported. Large reversible magnetization (M_{rev}) from dc-demagnetization analysis indicates that the strongest exchange coupling is present in the film with t_{Fe} = 5 nm, leading to a maximum reduction of H_c by 65% from 2,600 Oe for the pure FePt(001) film to 900 Oe. When t_{Fe} exceeds 8 nm, M_{rev} decreases and H_c increases again. Both angular dependence magnetization and MFM observation reveal that the magnetic anisotropy tilts away from normal direction. This indicates that the critical coupling length, the maximum thickness within that the moment of Fe layer can be fully aligned in the direction of magnetization of FePt layer, is between 5 and 8 nm. Dynamic magnetic switching was investigated using a vector vibrating-sample magnetometer (VVSM). The results manifest two facts different from the NiFe/FePt film[3]: (1) The reversal of magnetic moments in Fe layer occurs non-cooperatively and (2) the stepwise reversal is more significant than that in the NiFe/FePt case. Our experimental results support the feasibility of applying the composite soft Fe/hard FePt to low the switching field.

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Recording Front-end Read and Write System Analysis

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As data rates continue to increase, front-end analysis design techniques must evolve in order to manage the transmission line effects and the parasitic effects of the transducer and electronics. Here, front-end system analysis focuses on the read/write IC, the suspension interconnect, and the read/write transducer [1]. The suspension interconnect connects the read/write IC to the read/write transducer. The suspension interconnect includes the short flex cable, and an integrated lead suspension (ILS) interconnect section.

Data signal fidelity is maintained by proper termination at the read/write IC, and appropriate design of the read/write transducer. Past interconnect designs have shown that signal losses can be reduced by proper layout of the stainless steel openings [2], and relatively lower-impedance interconnects can be utilized to enhance the write current process by proper termination at the write driver's source [3]. Recent write driver experiments have shown that writing can be improved with write current signal emphasis from the transmission line effects [4]. For writing, transmission line termination techniques are utilized to induce the required overshoot at transitions in the write current waveform. Figure 1 shows an error-rate plot of achieving acceptable error-rates without the typically required source emphasis during the write current transitions.

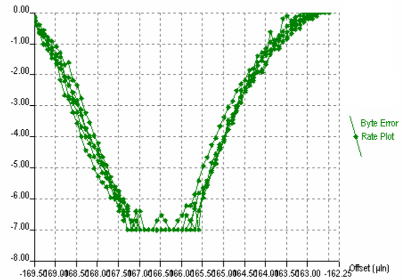

Fig. 1 Error-rate without source emphasis during current signal transitions.

For reading, the key aspects are the parasitic components at the read transducer and the read amplifier's input. The parasitics affect the bandwidth and the SNR of the front-end system. The Noise Figure (NF, SNR) of the front-end system can be modeled to include the parasitic effects along with the transmission losses of the interconnect. Figure 2 shows the NF plot of the front-end system and the capacitance effects on the SNR as a function of the frequency [1].

This presentation will give a review and a discussion of the above material. Specifically, the presentation will expound on the theory and the design analysis of electrical interconnect termination effects, writing with over-terminated interconnects, and parasitic effects on the SNR for reading.

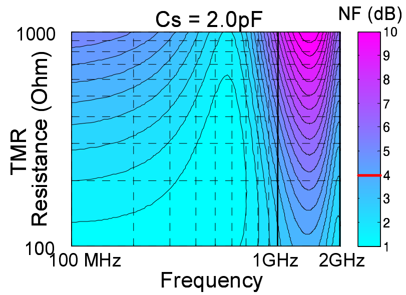

Fig. 2. Noise Figure (NF/SNR) with read sensor having parasitic capacitance of 2pF.

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