CB01

Recent Progress in Perpendicular Magnetic Recording: CoCrPt-SiO_2 Composite Media and Thermal Flying Height Control Head

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Perpendicularmagnetic recording (PMR) technology has been successfully employed to hard disk drive system to sustain the continuous growth of data storage capacity. In order to achieve good recording performance of PMR drive, PMR media should meet very stringent requirements such as small and uniform grain size, low intergranular exchange coupling, small c-axis dispersion of Co grains, narrow anisotropy distribution, and domain-free soft magnetic underlayer (SUL) [1].

In this talk, our recent work on the systematic study of structural, magnetic and recording characteristics of CoCrPt-SiO_2 based PMR media is reported. Several different approaches were made to control the exchange coupling and grain structure of recording layer, and the key recording performance parameters such as signal to noise ratio (SNR), bit error rate (BER), adjacent track erasure and thermal decay rate were correlated with the static properties of media. Different recording layer structures with single layer or multiple layers were designed and the preparation conditions of intermediate layer as well as SUL were also varied to control the recording characteristics of media.

In addition to the efforts of tailoring the structural and magnetic properties of media, another effective approach for increasing the recording density is to reduce the flying height of magnetic head during recording process. Recently, the novel method of controlling the dynamic flying height or clearance by using the thermal expansion phenomenon of magnetic head slider, so called thermal flying height control (TFC) technology [2], has been developed and we used the head with TFC capability for evaluation of media. We investigated the dependence of SNR and BER on the read/write clearances, which were controlled by TFC function, to find out the optimal fly height conditions in terms of maximum recording density achievable from the certain head/media combination. Several types of media with different granular structures were tested and the relationship between the media properties and the recording performance change with read/write clearances will be discussed.

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CB02

Comparison of Recording Performances Between Three Different Stabilizing Schemes of Soft Underlayer

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Three different types of soft underlayer (SUL) in perpendicular magnetic recording (PMR) media, namely, conventional, antiparallel-coupled (APC), and antiferromagnetically stabilized (AFM) SULs were investigated. The three PMR media had similar magnetic properties, showing a coercivity of 5kOe, a squareness of 1, and a negative nucleation field of 2kOe. A merged write/read head was used for the recording measurements, consisting of a single pole head (SPH) with a write track of 0.19 μm and a read track width of 0.12 μm.

In Fig. 1, Kerr effect images obtained by optical scanning analyzer (OSA) revealed that Type 3 (AFM) has very few domains. For Type 1 (Conventional), finger like domains were observed at the disk edges while Type 2 (APC) showed a multidomain structure.

As SpiSNR for the three media was investigated as a function of linear density (20-800 kfci), the SpiSNR was listed from low to high, Type 1<Type 3<Type 2. The media background was pre-conditioned (either DC-erased or AC-erased) prior to writing on a track for the measurements. In Figs. 2(a) and 2(b), the effects of media background on the recording performance for Type 3 (AFM) were further investigated. As shown in Fig. 2(a), fields from DC background areas as narrow as 2 μm wide (cross track) caused a significant reduction in SNR by 1.5 dB. The SNR was measured at a linear density of 425 kfci. Fig. 2(b) indicates that this effect is primarily due to a reduction in signal (not an increase in noise), implying that a significant influence on writing can be caused by fields from adjacent DC saturated tracks coupling into the write head in AFM type media [1]. It should be noted that this effect occurred to a lesser extent for Type 1 and Type 2 as investigated under the identical conditions.

Our results conclude that there was no obvious benefit of achieving single (or quasi-single) domain in terms of recording performance, using the AFM stabilized SUL. A relatively weak pinning by APC seems to be sufficient as long as the domain structure is properly controlled (no significant vortex formation), which is further manifested by a micromagnetic model calculation.

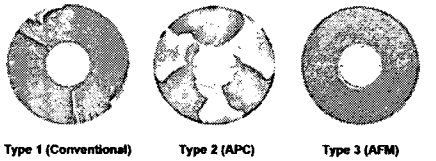

Fig. 1. Kerr images of (a) a conventional SUL, (b) an AFC SUL, and (c) a pinned AFM SUL.

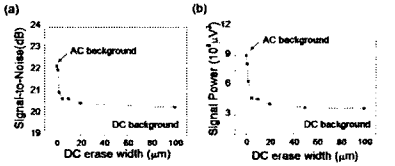

Fig. 2. (a) signal-to-noise ratio and (b) signal power as a function of DC-erased cross track width.

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