ANALYSIS OF SIDE WRITING ASYMMETRY

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Introduction

Magnetic recording heads may present asymmetric write characteristics across the track width, depending on their construction or/and the system operation. As pointed out in [1], side writing becomes asymmetric and edge erase bands worsen in hard disk drives when bits are written with a skew angle. In guardband-less helical scan tape systems, recording is performed with an azimuth angle that can be as large as 25°. In such cases, the gap edges of the recording heads are not symmetrical with respect to the head running direction and present asymmetric field gradients, leading to asymmetric side writing.

In this paper, we investigate the side writing asymmetry of Helical Scan Silicon (HSS) heads and introduce a profiling method for studying the write process across the track width. The method is suited for analyzing the fringing field at each edge of the head as function of the write current and wavelength. Typical of current HSS heads produced by Alditech is the perfect alignment of the magnetic poles. In early stage prototypes, however, the pole alignment is good at one gap side while it is poorer at the opposite side. We analyze here an early stage prototype with 3.3 µm pole width and 0.11 µm gap length, particularly misaligned at one side (Fig. 1).

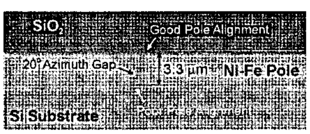

Fig. 1. Magnetic poles of the HSS prototype.

Methodology and Results

The method we present involves writing a track deeply embedded into the recording medium by means of a high current combined with a long wavelength. The embedded track is then overwritten using a shorter recording wavelength. The overwriting track and the residue of the embedded track are profiled together in one scan to avoid introducing offsets between their output profiles by two consecutive passes. The resulting profiles contain enhanced information about write and erase performances of the head in cross-track direction. Overwrite profiles measured with MP tape (δ= 300 nm) and very thin ME tape (δ= 50 nm) are shown in Fig. 2. The tapes have the same coercivity H_c = 135 kA/m. The embedded track is written at 2.73 µm wavelength with an 80 mA_{pp} current. The wavelength of the overwriting track is 0.5 µm.

An offset between the profiles of the overwriting track and of the residual track is visible at low overwrite current (I_{owr} = 10 mA_{pp}), which could be explained by asymmetric side writing of the recording head. This hypothesis is supported by the MFM image in Fig. 3. At higher overwrite current (I_{owr} = 30 mA_{pp}), the profile of the residual track becomes distorted showing that one edge of the embedded track is better erased than the other. In the case of MP tape, residual signal is left deeply embedded into the medium across the complete track width but also close to the surface at one edge, which is just weakly erased. With the much thinner ME tape, the embedded track is efficiently erased in depth and width except the hard-to-erase edge, as also shown by the MFM image in Fig. 3. Analysis of the MFM image by FFT processing indicates that the residual information is concentrated in the hard-to-erase edge. The overwrite current has to be higher than double for symmetrically erasing both edges of the embedded track.

The hard-to-erase edge corresponds to the side of the head with a poor pole alignment. If the pole alignment is poor, write fields are not well confined in the gap region and side writing is strong. The side written information in the corresponding edge of the embedded track is difficult to be erased at moderate currents. Nevertheless, at the other edge, the erasure is almost as efficient as in the track center. This proofs that the good pole alignment reduces side writing in this edge of the embedded track, due to much localized side fringing field. The well localized side field is suited to minimize edge effects such as side erasure.

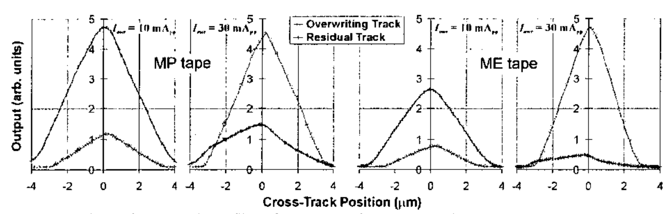

Fig. 2. Cross-track profiles of two overwrite sequences in MP and ME tapes.

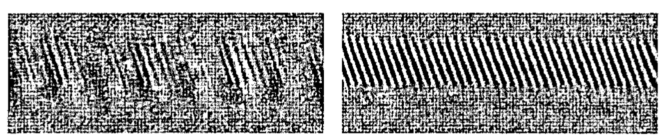
Fig. 3. MFM images (7.5 µm x 20 µm) corresponding to the overwrite sequences with ME tape from Fig. 2 (left image: I_{owr} = 10 mA_{pp}; right image: I_{owr} = 30 mA_{pp}).

References

[1] T. T. Lam, J. G. Zhu, and H. C. Tong, *IEEE Trans. Magn.* 33, 2719 (1997).

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