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3-D FEM Analysis of SPT Head
Dimension on Recording Characteristics

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The cross-track interference in the write process becomes a serious problem for high density magnetic recording. The discrete track media may be attractive to reduce the cross-track interference. The deviation of head from the centerline of track will affect the cross-track interference. In this paper, the effect of the width of write head on behavior of flux and magnetization in the case of continuous track media and discrete track media is investigated using 3-D read/write simulation system[1]. The effect of width of read head on the output is also examined.

Fig.1 shows a 1/2 region of the SPT head model analyzed. The saturation flux density B_s of main pole and soft underlayer is 2.4T, and that of return yoke is 1.4T. The spacing between main pole and media is 10nm. The thicknesses of media, intermediate layer and soft underlayer are 10nm, 5nm, and 75nm respectively. H_c of media is 637kA/m, H_k is 796kA/m and M_s is 0.565T. The ampere-turns are 0.2AT. The number of the 1st order hexahedral elements is 213,400. Only one step is calculated and CPU time is 1~5h.

Figure 1: Schematic diagram of the proposed antenna structure. The figure includes a top view and a cross-sectional view. The top view shows a rectangular antenna with dimensions 500 nm by 1500 nm. The cross-sectional view shows the antenna's profile with dimensions 1000 nm by 70 nm. A legend identifies the layers: head (white), media (black), soft (light gray), underlayer (dark gray), shield (hatched), and coil (dotted). A 3D inset shows the antenna's position relative to a medium, with dimensions 70 nm, 35 nm, and 15 nm.

Fig.2. A tip of SPT head.

Fig.3 shows the distribution of flux density at $W_w = 52.5\text{nm}$. The flux density is a little concentrated to the recording track of discrete track media compared with the continuous track media. Figs.4 and 5 show the magnetization M_y along the down track (x) direction and the cross track (z) direction. The magnetization of the discrete track media under the recording head is larger than that of the continuous track media. Fig.6 shows a read head. Fig.7 shows the effect of width W_w of write head on the output of read head. The width W_w of write head which the cross talk is negligible is about 35nm for continuous track media and

(a) discrete track

(b) continuous track

Fig.3 Distribution of flux density direction ($W_w = 52.5\text{nm}$).

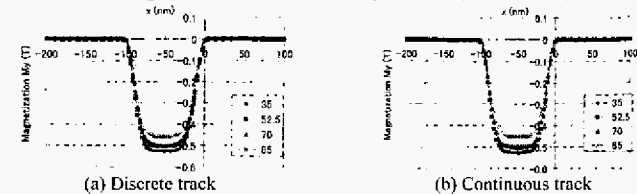


Fig.4 Magnetization M_r along down track direction.

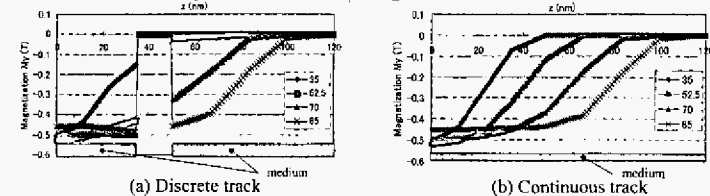


Fig.5 Magnetization M_y along cross track direction.

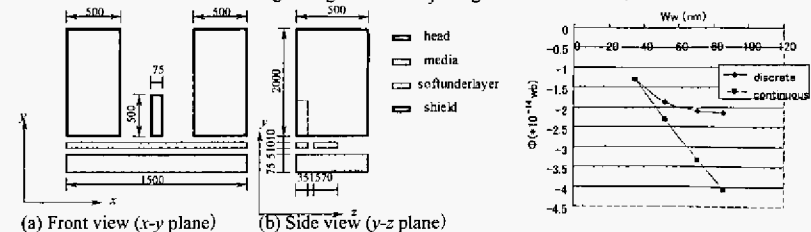


Fig.6 Read head.

Fig.7 Effect of width W_w on output of read head.

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[1] M.Ohtake, N.Takanashi and K.Sinagawa, "Analysis of writing characteristics of CF-SPT head using 3-D read/write simulation system", *IEEE Trans. Magn.*, 40, pp.2613-2615, 2004.