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Write head design for high density longitudinal magnetic recording

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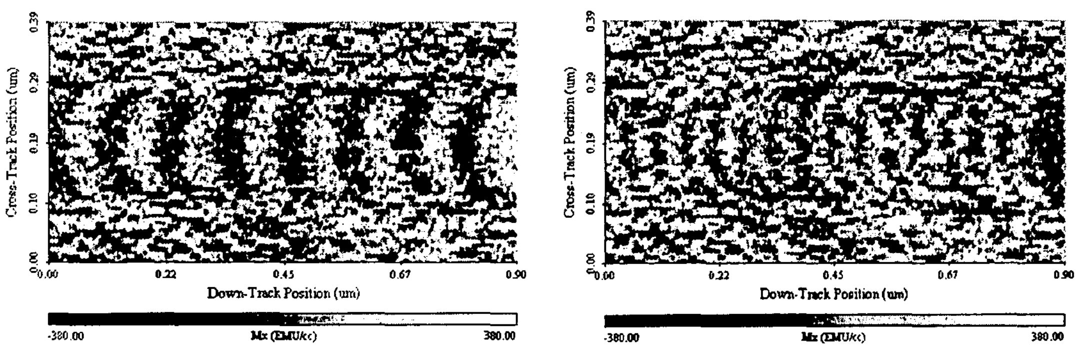
The density of magnetic recording has been increasing at a very fast rate for the last several decades. Recently, a very high recording density of 56 Gb/in^2 was achieved [1], and it is expected to reach 100 Gb/in^2 within a year or so.

However, there are many obstacles left to achieve the high density of magnetic recording. One of them is the proper design of write head to obtain higher write fields. Higher write fields are required to record form a bit pattern on high coercivity media; for example, a H_c of 4000 Oe or greater is required for a high density 100 Gb/in^2. Most of all, the greatest obstacle for achieving high-density magnetic recording is a media noise. Decreasing of media noise is achieved by reduction of the grain sizes and of the media thickness [2,3]. But this method will cause thermal instability and recorded bit pattern decay in a very short period of time. The use of a high magnetocrystalline anisotropy energy media is good for improving thermal stability. This approach, however, suffers from the limitation imposed by low values of the write field, which can be generated by conventional heads.

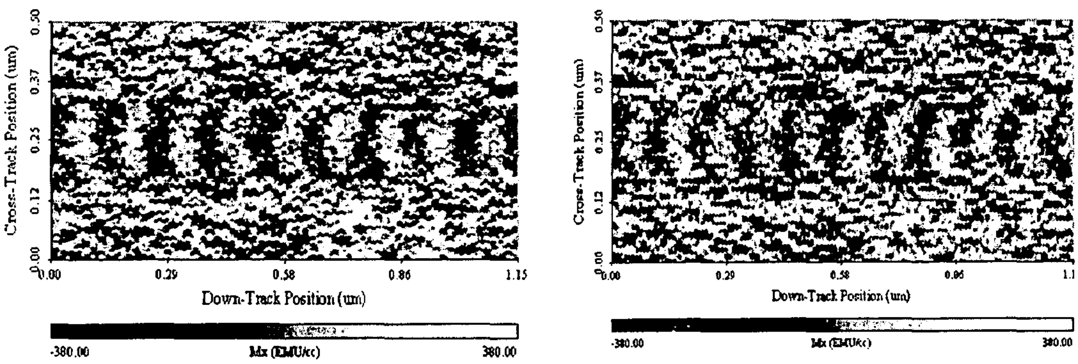
In this study, we tried to find out the condition of thermally stable high density magnetic recording using a properly designed ring head and various grain sizes (D) of the media and linear density. Some important head parameters used in this study are: the gap length of 0.05 μm, the track width of 0.08 μm and the flying height is 10 nm. The maximum head field is 7600 Oe. A two-dimensional array of hexagons was used to simulate the longitudinal media. The anisotropy field is H_k = 8500 Oe, the saturation magnetization is M_s = 380 emu/cc. The grain size of media is varied from 7 nm to 10 nm, and the thickness is fixed at 13 nm. The linear density is varied from 397 kfci to 907 kfci.

Calculated results are shown in Fig.1, at D=7nm. A reasonable good bit pattern with a linear density of 454 kfci is generated shown in Fig.1 (a). But, as the increase of linear density, at 907 kfci, the bit pattern becomes not clear shown in Fig 1 (b). Also, in a small grain size, such as 7 nm, the thermal stability problem becomes more serious because of a small volume. In D=9nm, we can obtain a reasonable good bit pattern with a linear density of 397, 454 kfci shown in Fig 2.



(a) 454 kfci (b) 907 kfci

Fig.1 Recorded bit pattern at D=7nm



(a) 397 kfci (b) 454 kfci

Fig.2 Recorded bit pattern at D=9nm

Reference

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