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Stray Field Effect in Perpendicular Magnetic Recording

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1. Introduction

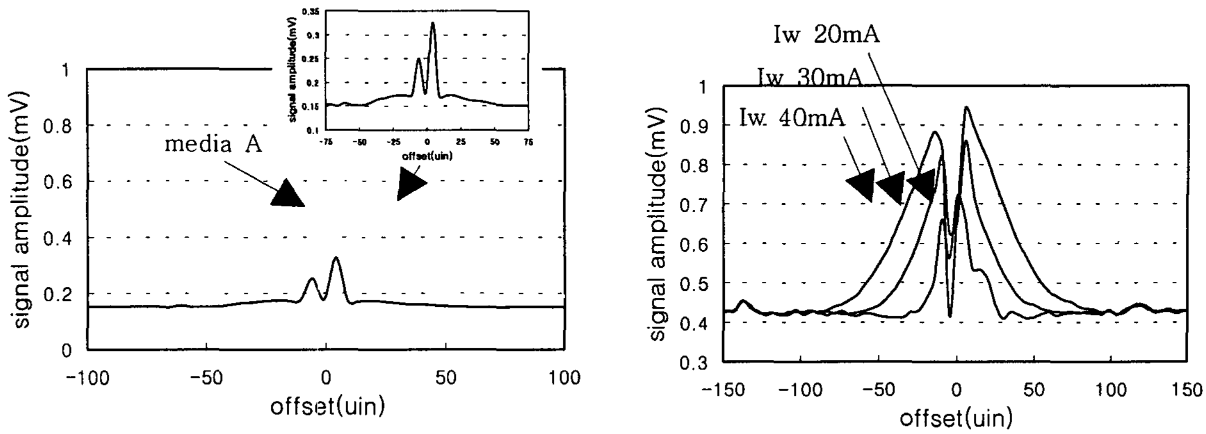
In integrating commercialized disk drive using perpendicular magnetic recording(PMR) technology, some recording properties related to SPT(single pole type) head and perpendicular media should be considered carefully[1]. PMR systems with double-layered media and SPT head are so sensitive to stray field that related adjacent track interference (ATI) could be serious. ATI is one of the major issues for disk drive integration as the track width becomes narrower. In longitudinal recording, ATI phenomena are localized around the writing pole and can be controlled relatively easily. Because of the unique shape of SPT head for perpendicular recording, however, unexpected writing/erasing are happened in wide range over neighborhood tracks. In this work, ATI phenomena of SPT head and double-layered media are examined. With background erase options, head field influence on adjacent tracks can be analyzed at each part of SPT head. The influence of the media properties on ATI is shown. Adjacent track erasing is observed with different write currents and write current optimization is suggested as a solution to prevent the ATI problems.

2. Experiments and Results

Two types of double-layered media are prepared to see the ATI effect more clearly. Media A has high nucleation field(Hn) of 1500 Oe and media B, low Hn of 100 Oe, respectively. Shielded SPT head of 0.2um wide is used. For dynamic tests, Guzik RWA 2585 and spinstand 1701A are used.

Stray fields from both of top pole and return pole can cause ATI phenomena. DC modulation method [2] is used to examine the stray fields of each part of SPT head. In DC modulation method, media is previously band-erased in one direction, positively or negatively. After band-erasing, the central track is DC-erased in either the same or the opposite direction, with respect t o the head part of interest. When the central track is erased in the opposite direction to the background, the field from the top pole, if larger than the nucleation field of the media, reverses the background magnetization and then the noise amplitude means the stray field from the top pole. For the return pole effect on ATI, the central track is erased in the same direction with the background.

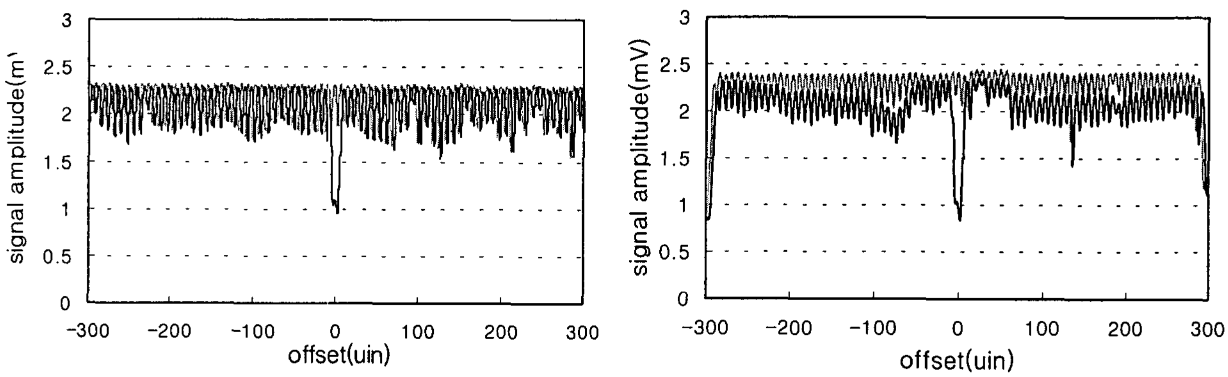
Track profile of central track is measured to see the stray field from top pole. (Fig.1) The media background is previously band-erased in positive direction and the central track is negatively erased. Fig. 1. (a) shows the stray field distributions of top pole at write current 30mA. For media B with low nucleation field, magnetic track width exceeds the mechanical track width a lot and track profile is much broader than that of media A, which can cause serious side erasing on the adjacent tracks. It means high nucleation field is required to avoid ATI phenomena but Media A also shows side-fringing field, however, much smaller than that of the low nu c leation field media. Track profiles of media B at different write currents are compared in Fig.1. (b). The erase option is same with Fig. 1. (a). Side-writing fields of low nucleation media increase steeply as write current increases and it says proper write current can be used to reduce the stray field from head.



(a) ATI of high nucleation field/low nucleation field media (b) ATI with different write currents

Fig. 1. Track profile for ATI of top pole

Adjacent track erasing(ATE) effect of data track should be considered carefully because of its influence on data stability of disk drive. To see the ATE effect of data track, multi tracks are previously written at low density (100kfci) in media back ground and then the central track is written with high density (600kfci) 50 times. Background multi tracks and the data track are recorded with the same write current. Fig. 2 shows the ATE phenomena of media A. When write current is 30mA, as seen in Fig. 2 . (b), the side erasing is definite and getting serious with repeated writing. With this profile, the stray field causing ATE can be analyzed with head shape. However, when we use write current 15mA, the ATE seems to be disappeared there is no signal deca y. It means that with proper write current, ATE can be controlled effectively. Write current optimization is very important specially in perpendicular recording system because of the wide influence of stray field from head.



(a) write current 15mA (b) write current 30mA

Fig. 2. Adjacent track erasing(ATE) effect

3. References

[1] W. Cain et al., "Challenges in the practical implementation of perpendicular magnetic recording," *IEEE Trans. Magn.*, **32**, 97−102, (1996).

[2] G. J. Tarnopolsky et al., "DC modulation noise and demagnetizing fields in thin metallic media" *IEEE Trans. Magn .*, **25**, 3160−3165, (1989).