

The Influence of Different Bit Patterns Exposure on TMR Read Head

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Introduction: An increase in the areal density of the hard disk drive (HDD) has been a key to drive HDD technology development. For instance, since a magnetic bit becomes smaller; therefore, a read head dimension must be reduced and advanced fabrication technology is required. However, higher areal density may deteriorate magnetic reading performance due to magnetic interference between bits [1, 2]. For these reasons, the investigation of abnormal characteristic of read head is necessary to understand read head behavior, in order to improve the overall HDD performance. From the measurement of read head resistance during read process, we found the abnormal resistance change while the head was on the transition region.

Method: Simulation and measurement of magnetization in the Tunneling Magneto Resistance (TMR) head are performed. The simulation model is employed to demonstrate the magnetization change in the free layer (FL). The resistance changes during head moving in cross track direction (CT) and down track direction (DT) are calculated, as shown in Fig.1 (a) and (c). The experiment is conducted to measure the resistance of read head while it moves over different field patterns in CT.

Results and Discussion: Fig.1 (b) clearly shows that the resistance change of read head on difference bits in CT is a significant factor to realize, when developing the new HDD. In addition, the experimental results also show irregular resistance change when the read head moves to the negative field track in CT, as shown in Fig.2. The relations among bit patterns formation, read sensor resistance, and variation of magnetization's angle in FL are determined. These findings will be beneficial to the development of HDD in the future.

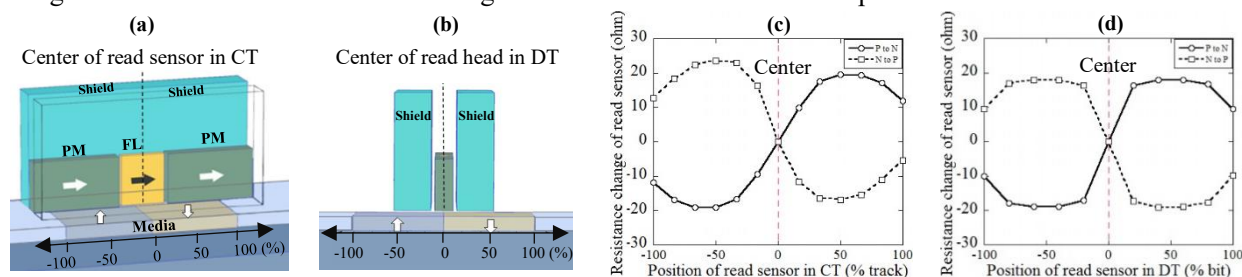


Fig.1 (a) and (b) TMR head moves over different bit patterns in CT and DT, respectively.

(c) and (d) Resistance change results of case (a) and case (b), respectively.

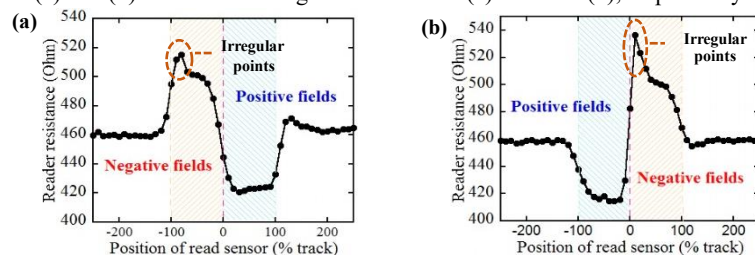


Fig.2 Resistance change in the read head when it moves from (a) negative (N) to positive (P) fields and (b) P to N fields.

- [1] S. Das, and M. Mochizuki, Magnetic head having a planar hall effect read sensor, U.S. Patent 8 760 801 B2, 2014.
- [2] D. Zeng, K. Lee, K. Chung, and S. Bae, Effects of media stray field on electromigration characteristics in current-perpendicular-to-plane giant magnetoresistance spin-valve read sensors, *J. Appl. Phys.*, 2012.