

Magnetic Shield Design Optimization in HDD Writer

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Abstract :

As increasing the recording density of the hard disk drive, the data track width is getting narrower. In such a narrow track width, there is the risk that the data in the adjacent tracks might be erased in the write operation. To avoid this erasure, the magnetic shield should be placed around the main pole to reduce the leakage flux to the adjacent tracks. However, if the magnetic shield absorbs magnetic field too much, the write field might be reduced. Therefore, the optimization of the magnetic shield design is very important.

We show the optimization of the magnetic shield design using JMAG. We find the full wrap around shield as the optimized design for the narrow track width writer. Otherwise, we use SolidWorks to simplify writer structure change including shield structure. We carry on using modeFrontier together with JMAG for automatic optimization of writer design.

Introduction

Hard disk drives record data by generating a magnetic field from the writer in the head and magnetizing the medium. However, there is also the concern that the magnetic field generated during writing operations will erase the adjacent data tracks. For these reasons, the characteristic necessary for a writer is compatibility between the intensity of the writing magnetic field and control of the magnetic field that erases the magnetic field of the adjacent tracks.

In recent years, data track widths have been getting narrower to keep up with progress in changes toward high recording density in hard disk drives, so it has become necessary to preserve the intensity of the writing magnetic field in the writer with its narrower data width. In that kind of writer, however, the concern is that the controls for the magnetic field that erases the adjacent tracks are not sufficient. In order to control the magnetic field that erases the adjacent tracks, there have been proposals for various shield designs that place a magnetic shield around the main magnetic pole. Fig. 1 shows shield configurations for a side shield, a side shield and a leading shield, and a full wrap around shield.

In order to carry out shield design development with high efficiency, it becomes essential to narrow down the design before making a sample prototype. That is why we used JMAG to carry out magnetic field analysis modeling for the writer.

Experiment

In JMAG Studio we created the writer's geometry and calculated magnetic field distribution in a recording medium with static magnetic field analysis. We evaluated the writing magnetic field intensity and the intensity of the magnetic field that erases the adjacent tracks in a track width of 80 nm.

Results

Fig. 2 shows the magnetic field evaluation results. With the writing magnetic field intensity, regardless of the fact that the shield part surrounding the main magnetic pole of the full wrap around shield is large, it is still able to secure a writing magnetic field intensity equivalent to the side shield. In the intensity of the magnetic field that erases the adjacent tracks, the full wrap around shield has a smaller erasing magnetic field than the other shield designs. Accordingly, we find that it is a design that can better control erasure of the adjacent tracks.

Conclusion

From the evaluation results for the writing magnetic field and magnetic field that erases the adjacent track in the magnetic field modeling, we come to the conclusion that the full wrap around shield design is optimal because it is compatible with both the writing magnetic field intensity and controlling the magnetic field that erases the adjacent track.

The full wrap around shield design makes the construction of the writer complicated.

By using the coupling function with SolidWorks in JMAG, it becomes easy to create the geometry. We are also making progress with the ability to automate optimization of the writer design by using modeFrontier.

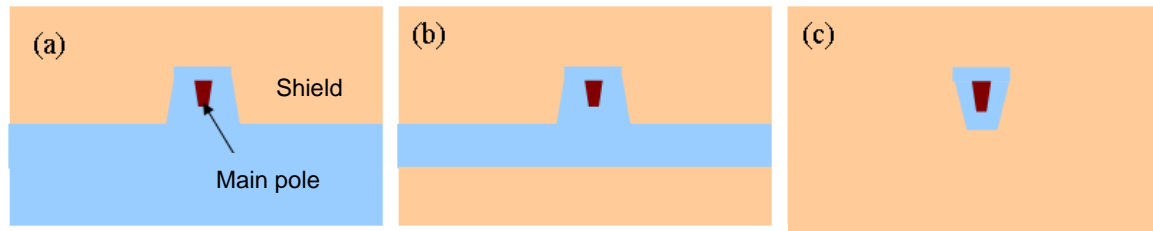


Fig. 1: The main pole and shield configuration of the writer viewed from the opposing face (ABS face) of the recording medium.

- (a) Side shield
- (b) Side shield and leading shield
- (c) Full wrap around shield

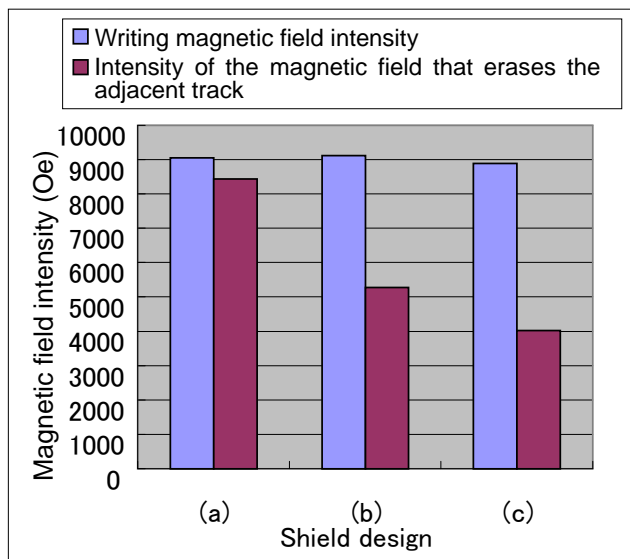


Fig. 2: A comparison of the writing magnetic field intensity and the intensity of the magnetic field that erases the adjacent tracks.

- (a) Side shield
- (b) Side shield and leading shield
- (c) Full wrap around shield