MAGNETIC CLAMPING FORCE ON AN M-O DISK HUB GENERATED BY MULTIPOLE MAGNETS

Y.-P CHEN and D.-R. HUANG

Opto-Electronics & Systems Lab. ITRI, Chutung, Hsinchu 310, Taiwan, Rep. of China

1. Introduction

This paper describes the magnetic force of 3.5 inch Magneto-Optical(M-O) disk hub affected by 4-pole, 6 pole, and 8-pole magnets. A sufficient magnet force for the ISO standard can be obtained as the magnetic field strength is more than 1200 Gauss. We can use this result to estimate the value of clamping force required for a 2.5 inch mini disc hub even if there is no ISO standard.

2. Experimental

In our experiments, we have improved the test method of ISO specification. The magnet is made of Nd-Fe-B, the back yoke material is Ni plate with tickness about 1 mm, the spacer is 4 pieces of thin paper sheet and its total thickness is about 0.4 mm. The dimensions of the Nd-Fe-B ring magnet has outer diameter of 15 mm, inner diameter of 6 mm and thickness of 1 mm. Nd-Fe-B magnets with $(BH)_{\max}=8$ MGOe to 36 MGOe were used to magnetize 4, 6 and 8 poles. The square wave profiles of the magnetic field distributions of the multipole magnets were obtained by designing suitable magnetizing fixtures. The maximum magnetic field strength of multi-pole magnets can be adjusted either by using Nd-Fe-B magnets with different energy products or by controlling the magnetizing current.

A so-called push-pull tester is used to measure the magnetic clamping force of a ring magnet to support the disk. The push-pull tester's center shaft is connected to a ring magnet with a nut, and the tester's bottom plate has some parrel slots to attach the test device with a T shape connector. Initially, we put the M-O disk hub below the tester's center shaft, and let the magnet adhere the disk hub. Then we reset the tester, and pulled the disk up to a height that could let the hub of the disk separate from the magnet. For each testing condition, the same push-pull action was repeated five times in order to get a average value.

3. Result and Discussion

In our experiment, the magnetic field distribution of the multipole magnets measured at a distance 0.4 mm over the surface of the magnet. The magnetization profiles of 4-pole, 6-pole and 8 pole magnets are very close to square wave with maximum magnetic field strength about 1300 Gauss.

For 4-pole and 8-pole magnets, the magnetic clamping force is linearly proportional to the magnetic field strength of the magnet as show in Fig. 1. The slope of magnetic clamping force for the 8-pole magnet is increased markedly over that of the 4-pole magnet. For these two linear curves, there is an intersection where the magnetic clamping force is about 3.2 N and the magnetic field strength is about 1400 Gauss.

The magnetic clamping force on a 3.5 inch M-O disk hub can be measured as a function of the air gap between the hub and the magnet. When the air gap is small, the 8 pole magnet shows the largest magnetic clamping force, while the 4-pole magnet shows the lowest magnetic clamping force. However, if the air gap is

increased to above 0.8 mm, the magnetic clamping force for of 4-pole magnet is greater than that of 8-pole magnet. This phenomenon can be explained by analyzing the magnetization profiles of the magnets.

In testing the magnetic clamping force on the M-0 disk hub, there is a back yoke attached to the magnet to shield the magnetic field leakage and to enhance the magnetic field strength. For an 8-pole magnet with and without back yoke, the magnetic clamping force is a function of the air gap between the hub and the magnet. The magnetic clamping force for the magnet with the back yoke is much greater than that of the magnet without the back yoke. The magnetic field strength enhancement by the back yoke can be considered to be a magnetic image effect.

In our experiments, a magnetic clamping force tester was designed to test 2.5 inch mini disc hub by using an 8-pole magnet. At a distance of 0.4 mm, the clamping force on a 2.5 inch mini disc hub is about 1.5N and the magnetic field strength is about 400 Gauss. This magnetic clamping force is available for read-write testing of 2.5 inch mini disc rotating at 1800 rpm. Compared to the 3.5 inch M-0 disk, we can obtain a linear curve for 2.5 inch mini disc which represents the relationship between the magnetic clamping force and the magnetic field strength. It is very useful for designing the clamping force requirement on a 2.5 inch mini disc hub.

4. Conclusion

For a 3.5 inch M-0 disk hub testing, we can use not only a 4-pole Sm-Co magnet, but also a 4-pole, 6-pole or 8 pole Nd-Fe-B magnet. An 8-pole magnet to clamp the M-0 disk hub has the advantage of using the same magnet as that used in the axial spindle motor for a compact design. Though there is no ISO standard for testing a 2.5 inch M-0 disk hub, we can predict a good linear curve for the clamping force as a function of magnetic field strength. It is very useful for practical applications.

References

- (1) Y. Funaki, H. Kobayashi, "The Magnetizable material and its dimensions and Annex C", 1990, p1-p12
- (2) ISO/IEC JTC 1/SC 23 90mm and 130mm REwritable/Read Optical Disk Cartridge, p93, p94

Fig. 1 The relationship between clamping force and magnetic field strength