Chapter 5

Conclusion

With the demand in the rapid progress of information processing, multimedia applications and various storage devices, achieving fast access time, down-sizing drives and high recording density are the main objectives for the optical data storage techniques. To enable the storage system more competitive in price and performance, developing a small-sized, high resolution and high throughput efficiency optical head is thus necessary.

Recently, MEMs technology has been discussed in many publications which cause much attention in its fabrication potential and commercial possibility. Meanwhile, a small-sized optical head to realize slim and portable devices is also a desired objective for future drive technology. Therefore, in this thesis, a near-field optical approach combining a 45^{o} mirror chip and a SIL platform was proposed by MEMs approach. The 45^{o} mirror on (100)-oriented Si wafer was fabricated by wet anisotropic etching. With this bulk micromaching, a 45^{o} (110)-mirror surface roughness can be realized to smaller than ? / 15 (red light, ? = 632.8 nm). The reflectivity of the fabricated 45^{o} mirror and influence upon the beam shape out of the fiber, were examined to prove the optical quality as a reliable component in an optical disk drive.

Because of the advantages of low weight and high flexibility when used as a light guiding media, optical fibers can overcome the tight tolerances found in high-NA optical paths and can reduce the number of components, thus, reducing the cost and weight. Therefore, an optical fiber based pickup module was proposed, from which the ultra small spot size formed by a tiny aperture can significantly increase the recording density. Besides, due to the heavyweight elements of the drive replaced by optical fiber and other micro components, the access time can be extremely reduced.

In this thesis, a fiber collimator with divergent angle of 1.16^{o} was utilized to expand the system tolerance while integration. A super solid immersion lens (SSIL) approach and an utmost thin aperture are undergoing to enable the whole pickup module. In this technology, a hemispherical microlens upon silicon substrate was formed by reflow. With an insufficient dose exposure, an equivalent SSIL structure can be realized. The preliminary flowchart is shown in Fig. 5-1.

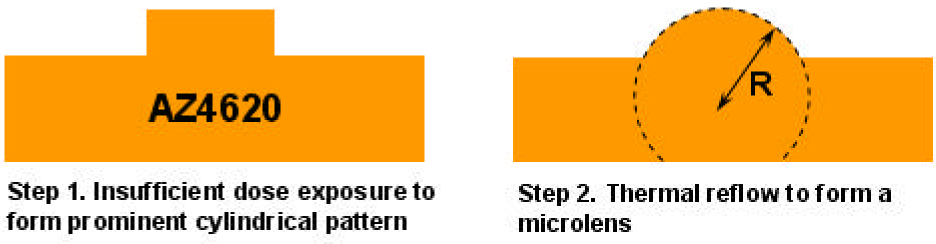

Fig. 5-1 The flowchart of equivalent SSIL structure

Until now, the new approaches of SSIL and tiny aperture have been aggressively pursued. In this thesis, the basic functions of SSIL-based optical system have been fabricated and examined. To enable the practical usage of SSIL-based approach, the improvements of the following should be preceded: (1) A smaller-size SIL is preferred to increase the tolerance to fabricated curvature and thickness errors. (2) Further reducing spot size can be accomplished by combining a SIL with an aperture system at a cost of total intensity reduction. (3) The misalignment between the aperture and the microlens has to be solved by using other suitable device or mechanism. (4) Moreover, the system tolerance has to be further evaluated to identify the performance. In order to produce the smallest possible spot with an adequately large throughput, precise relationship between transmission efficiency and the aperture shape/size should be studied.

Meanwhile, as the recording density of longitudinal magnetic storage increases at a 60-100% annual growth rate, it soon approaches the superparamagnetic limit – the operating point at which the magnetic domains are too small for stable data storage. At current rates of progress, the limit will be seen in a few years as the areal density beyond 100 $Gbit/in^2$. Superparamagnetic limit thus has motivated considerable work in the field of hybrid recording, which uses a heat source such as a focused laser spot to reduce the coercivity of the medium during the writing process. Read back can be accomplished with a magneto resistive sensor. For this optical-assisted magneto reading system to be practical, an integrated read/write head must be developed that brings the optical spot, magnetic field and the read sensor together on the same side of the media.