Chapter 5

Conclusion

The demands of higher capacity and speed are main trends in optical data storage. The speed is determined by the speed of motor and access time of the pickups which is limited by the mass of the pickup. In order to miniaturize pickups, the planar fiber-base optical head module, which include fiberlens, SIL and V-groove, was proposed. The module was designed and certified to realize the feasibility.

(A) Planar fiber-base optical head module

The characteristics of this module discussed below were evaluated through the simulation and experiment.

1. The detail design and the integrated analysis are discussed in Chapter 3. The target of our module are spot size < 1 μm and NA > 0.6. The relation between fiberlens length, spot size and NA was presented and the limitation of fiberlens length is 820 μm. We also found that the dimension of hemispherical SIL and SSIL have no effect in NA and spot size, so the dominant factor of dimension is absorption. Finally, we choose 700 μm fiberlens and SSIL with thickness of 25 μm to achieve the target. The fabrication errors and misalignments were also simulated. The radius of fiberlens can vary from 62.5 μm to 64.5 μm and the thickness of SSIL can vary 1 μm. The tolerance of axial misalignment is from -6 μm to 3 μm. The tolerance of lateral misalignment is 3 μm and angular misalignment is 9 degrees. Integrated planar pickups reach the performance requirements.

2. The fabrication process, the measurement system and the measurement results are shown in Chpater 4. A backside exposure process was proposed to solve the misalignment between SIL and aperture and the SIL with aperture was fabricated. The relation between fiberlens length, spot size and NA was measured and the limitation of fiberlens length is 1000 μ m. Compared with simulation result, the real radius of fiberlens is around 72.5 μ m and the trend of measurement agrees with simulation . The different between simulation and measurement may be caused by the variation of refractive index of SIL, aberration and the measurement errors. The refractive index of 30 μ m is 1.58 and the refractive index of 35 μ m is 1.69 as we assume that the measurement error is -0.1 μ m and the Seidel coefficients is 0.24. The refractive index of AZ-4620 is sensitive to the thickness variation and different thermal process.

From these results, the planar fiber-based optical head module, which includes fiberlens, SIL and V-groove, was analyzed and certified. The photoresister, AZ-4620, may not a good material for SIL, because it is sensitive to thickness variation and different thermal process.

(B)Future work

In this thesis, the basic functions of planar fiber-base optical head module have been analyzed and examined. However, the next generation optical data storage requires higher NA and smaller spot size. There are two methods below to improve this module.

(1) A sub wavelength aperture which is under SIL can decrease the spot size; although the power throughput decreases. Simultaneously, the C-shape aperture was proposed to enhance the power throughput.

(2)The blue laser has been developed. As the wavelength decreases, the NA increases

and spot size decreases. As the blue laser is used, we expect that the spot size decrease 36% and the tolerances of our module decrease so the system should be optimized for blue laser.