Chapter 5

Summary

5.1 Discussion

The following, there are several issues will be discussed:

1. Here, the SIL and sub-micro aperture are aligned precisely by backside exposure step for self-alignment process. The α- Si pedestal layer is taken as the mask pattern for backside exposure step, and the sub-micro aperture is made into the α- Si pedestal layer. If the thickness of the α- Si pedestal layer is smaller, a better optical performance in sub-micro aperture will be obtained, but the backside exposure step can fail due to the thickness of the α- Si pedestal layer is too small. Conversely, if the thickness of the α- Si pedestal layer is larger, the backside exposure step can be realized, but it will cause a worse performance in sub-micro aperture.

2. In this research, we adjust a lot of parameters of physical sputtering in shrinkage aperture step, and the thermal coater is also employed to shrink aperture. But the fabrication results are all failure. We don't know why we fail in shrinkage aperture step. But we think that the physical sputtering method is a feasible process for shrinkage aperture. Furthermore, we bring up two techniques including the electroplating process and electro-beam writer can also fabricate the sub-micro aperture.

3. In SIL fabricating, we found that a lost dimension in the diameter of columnar AZ-4620 patter compared with the designed parameters of SIL diameter, this lost dimension occurred in backside exposure step. Because of the diffraction always exists in UV light exposure step, so a lost dimension in the diameter of columnar

AZ-4620 pattern will produce in backside exposure step due to diffraction effect.

4. The fabrication results and designed parameter of SIL in radius dimension have larger deviation as shown in Tab.3-5. Because the designed parameter of SIL is a perfect hemisphere, but fabrication results of SIL in fabrication process is not a perfect hemisphere. Hence the deviation in radius of SIL is larger.

5. The simulation and measurement results of spot size in fiberlens combining SIL component have larger deviation as shown in Tab.4-5. Because the surface profile of SIL in simulation condition is assumed a perfect hemisphere, but the actual surface profile of SIL in fabrication process results is not a perfect hemisphere. For this reason, it will cause a larger deviation in spot size of fiberlens with SIL component due to the discordant surface profile of SIL.

5.2 Conclusion

A NFR pick-up head combining aperture, SIL, and microcoil is achieved by surface micromachining technology and electroplating process. The self-alignment technique is adopted to overcome the misalignment between the SIL and aperture component. By combining SIL and aperture together, a better performance and resolution can be obtained. This fabrication process is a batch process without bonding or assembling step.

The aperture of diameter 2.88 μm is made easily by lift-off process, but the shrinkage aperture step is fail. The shrinkage aperture is still trying. The SIL is fabricated by thermal reflowing. The deviation in sag height of SIL is less than 2%, this is a good results. But owing to the surface profile of SIL component is not a perfect hemisphere after thermal reflowing process, so we will obtain a larger deviation in radius size of SIL. The UV-LIGA process is applied to fabricate the

microcoil and contact pad. The microcoil and contact pad structure with large thickness can be made with low stress by controlling the electroplating recipes.

The self-alignment verification and spot size calibration are measured far-field experiment setup. The measurement result verifies the feasibility of the proposed self-alignment technique. Hence the SIL and aperture can be aligned precisely. The simulation and measuring results of spot size in only fiberlens component is very match. But owing to the surface profile of SIL component is not a perfect hemisphere after thermal reflowing process, so the deviation of spot size in fiberlens combining SIL component is larger. The measurement results of spot size in fiberlens with φ60 SIL and φ70 SIL component have 30.1% and 29.1% shrinkage efficiency, respectively. The SIL with sag 30 μm has about 50% transmission efficiency. Furthermore, the spot size calibration before and after laser destruction is almost conformably, and the surface of SIL is not damaged completely.