

Advanced SIL System with High NA and Large Tolerance

**Kitak Won, Narak Choi, Jiyeon Lee*, Yunsup Shin*, Kyungeon Lee*,
Tom D. Milster**, Jaihyung Lee, Jaisoon Kim**

School of Physics and Astronomy, Seoul National University, San 56-1 Shinrim-dong Kwanak-gu Seoul Korea

**Digital Storage Research Lab., LG Electronics, 16 Woomyon-dong, Seocho-gu, Seoul Korea*

***Optical Data Storage Center, OSC, University of Arizona, Tucson AZ 85721 USA*

jskim@phya.snu.ac.kr

To achieve high NA and large tolerance, we designed a new SIL system (Optimum SIL) which combines each advantages of the Hyper SIL and the Hemi SIL system. Also using micro-SIL system we can improve its performance. There are simulation results which support our works.

1. Introduction

To achieve high data capacity, a number of methods are suggested in optical data storage. Solid immersion lens (SIL) technology is one of the most excellent methods being suggested⁽¹⁻⁴⁾. For using with SIL technology, commonly two systems, Hemi SIL and Hyper SIL are considered. In the Hemi SIL system, a hemisphere is used as a SIL lens element, on the other hand, an aplanatic hyper hemisphere is used in the Hyper SIL system. Currently, because of the high NA gain, Hyper SIL is researched more than any other SIL system. However, due to the sensitivity of the Hyper SIL, a small position error results a large aberration, which makes it difficult to apply the Hyper SIL system in practical usage. In this paper, we suggest an idea, improving the tolerance of the optical system with a minimized NA resignation.

2. Characteristics of Optimum SIL and Micro-SIL System

Figure 1 shows the spherical aberration due to the distance from the input surface to focus point inside the SIL lens.^(5,6) There are four specific points; one is stable and aberration free(A), another is also aberration free but not stable(B), and the others are not aberration free but stable(C,D). The two prior points are used in the Hemi SIL(A) and Hyper SIL(B) system. Yet the other points C, D have not been specifically considered. In general, curve stability indicates the tolerance, and the object distance is related to the NA. Hyper SIL has a high NA gain, if the objective lens, which is conjugated to SIL position C, has some proper aberration that can compensate the SIL position-induced aberration, we can make a system which at once has a good tolerance and high NA (Optimum SIL).

Figure 2 shows general micro-SIL system. With a high refractive index GaP ($n=3.3$) the micro-sized SIL attains a much smaller spot size. Also using a spherical cap, the SIL system achieves more improved performance.