

Near-Field Solid Immersion Lens (SIL) Microscope

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Abstract: A near-field solid immersion lens (SIL) microscope is developed for a standard microscope. With white-light incoherent illumination, the resolution of this system for observing DVDs pits is around 200nm with an effective NA of 1.5.

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1. Introduction

Recently, the Solid Immersion Lens (SIL) is being investigated for application in biomedical microscopy, optical data storage, lithography and other fields.[1,2] The SIL microscope is attractive, because it can achieve spatial resolution higher than conventional optical systems, and it exhibits high transmission efficiency. In this paper, we report on a Solid Immersion Lens (SIL) microscope mounted into a conventional optical microscope with advanced compact mechanical design.

2. Experimental Setup

The mechanical design of the SIL microscope is based on an inverted Olympus IX70 microscope. The design includes an easy-to-use stage, swing arm, bimorph control, and flexure holder. The SIL is designed to swing away from the sample, so that immediate comparison between far-field and near-field imaging is possible. The stage design includes an integrated two-axis tip/tilt mechanism that makes the sample surface parallel with respect to the flat surface of the SIL. The sample is held with a vacuum chuck. In the inverted microscope, the objective lens is mounted below the sample. Instead, the gap between the flat surface of the SIL and the sample is air. The gap is controlled by sensing the induced polarization from a focused frustrated total internal reflection.

3. Measurement results and conclusion

In the experiment, a LaSFN9 SIL was fabricated and used. Figure 1a) shows an image of a DVD pit pattern through the SIL and a 100X 0.8 NA objective lens, which exhibits an effective NA of 1.5. Based on the SIL image, the resolution is determined by measuring the drop length of the DVD pit edge between the bright and dark portion.[3] With this method, the average slope length between the bright and dark part is around 200nm in the 10%-90% slope region. The same sample is also investigated with AFM (Atomic Force Microscopy), as shown in Fig 1 b).

These images show that with white-light incoherent wavelength illumination and a differential interference contrast (DIC) prism, the resolution of this system is around 200 nm. The imaging compares well with an AFM image of the same area. The SIL microscope provides non-destructive, cost-effective and high resolution optical images of sample, and the image is much easier to obtain than with an AFM. This system can be widely used to measure biomedical samples.

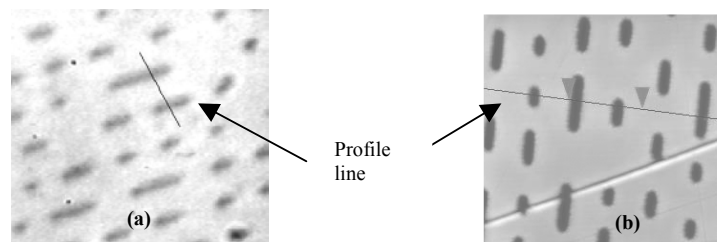


Fig. 1 a) DVD pit pattern image taken with SIL in the near-field configuration. b) image taken with AFM. ($5\mu\text{m}\times 5\mu\text{m}$)

4. Reference

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