課題番号　　:F-13-IT-0001
利用形態　　:技術代行
利用課題名（日本語）　　:ピンホールアレイの作製
Program Title (English)　　:Calibration of wavefront sensor with pinhole array extended source
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1. 概要（Summary）

In this program, a high numerical aperture (NA) wavefront sensor with pinhole array extended source is studied. In the sensor calibration process, Cr pinhole array with diameter of 130 nm is used to generate quasi-spherical waves. Nanotechnology platform in Tokyo Institute of Technology fabricated the fine pinhole array of 130nm and 200nm diameter with the very thick Cr film on the thin SiO2 membrane substrate using fine electron beam lithography. Basic idea for fabrication technique is the standard lift off process.

2. 実験（Experimental）

The high NA wavefront sensor uses source mask with pinhole array on the object plane of optics under test to filter the aberration of illumination optics as well as provide sufficient power required by wavefront sensor. A coupling objective, which is installed at the confocal position of the optics under test, transforms the high numerical aperture spherical waves to plane waves. A null mask, which has similar structure with source mask, can be inserted at the image plane of the test optics. With the null mask installed and source mask uninstalled, the systematic measurement errors mainly caused by coupling objective can be calibrated by the relative measurement process. The structure of the high NA Hartmann wavefront sensor is shown in figure 1.

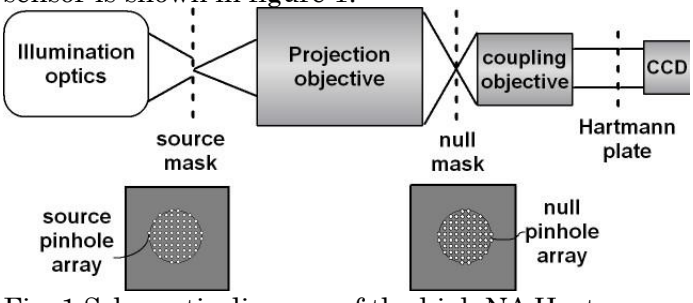

Fig. 1 Schematic diagram of the high NA Hartmann wavefront sensor

In this high NA sensor, the null mask is an important element to achieve high measurement accuracy. A principle experiment had been conducted using pinhole array with diameter of 1um. The result shows that quasi-spherical wavefront with aberration of 2.7 nm rms can be obtained.

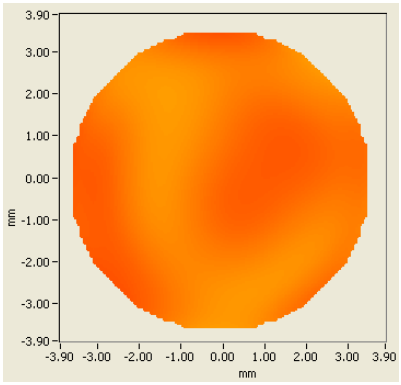

Fig.2 Experimental result using pinhole array with diameter of 1um. Wavefront error aberration is 2.7 nm rms.

Electron beam lithography (JBX6300SJ) in Nanotechnology platform of Tokyo Institute of Technology supports the fabrication of Cr pinhole array. The thickness of Cr membrane is 200 nm. The substrate material is SiO2. The minimum Cr pinhole diameter is 130 nm. The minimum Cr pinhole spacing is 500 nm.

3. 結果と考察(Results and Discussion)

The SEM photo of 200 nm thickness Cr pinhole array with diameter of 130 nm is shown in figure 3. The typical pinhole diameter is about 210nm.

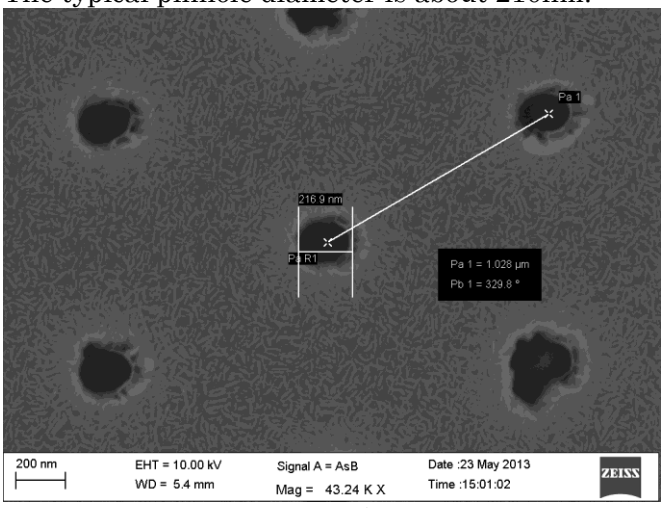

Fig.3 SEM of 200 nm thickness Cr pinhole array with pinhole diameter of 130 nm. (Provided by Professor Takeshi Yamaguchi, Tokyo Institute of Technology)

The SEM photo of 200 nm thickness Cr pinhole array with diameter of 200 nm is shown in figure 3. The typical pinhole diameter is about 250nm.

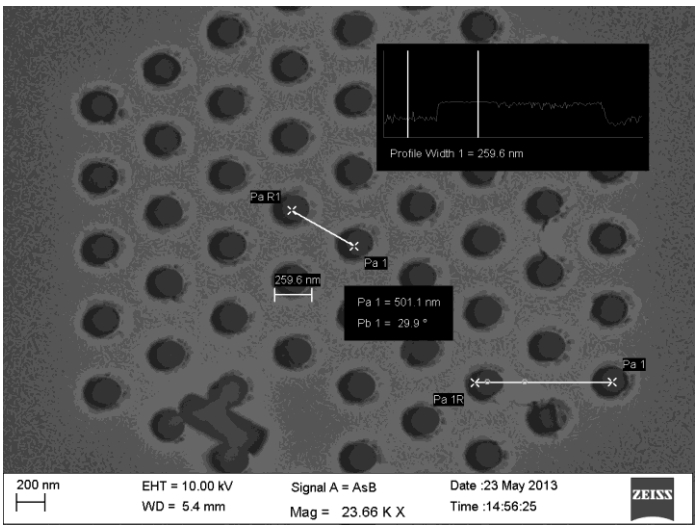

Fig.4 SEM of 200 nm thickness Cr pinhole array with pinhole diameter of 200 nm. (Provided by Professor Takeshi Yamaguchi, Tokyo Institute of Technology)

4. その他・特記事項（Others）

The principle experiment had been finished. The Cr pinhole array mask pattern with SiO2 substrate had been delivered. The mask will be assembled and tested in the wavefront measurement system in Beijing Institute of Technology.

5. 論文・学会発表（Publication/Presentation）

N/A

6. 関連特許（Patent）

N/A