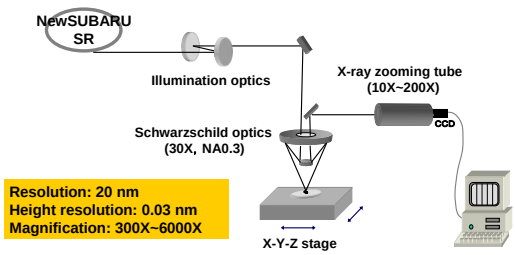
Improvement of High Resolving EUV Microscope Using an EUV Beam Splitter

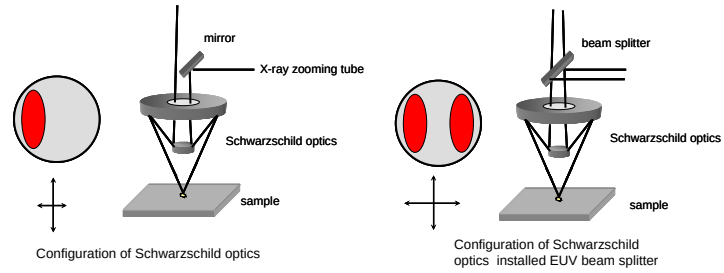
Kazuumi Tanaka [1,3], Masafumi Osugi [1,3], Noriyuki Sakaya [2,3], Kazuhiro Hamamoto [2,3], Takeo Watanabe [1,3], and Hiroo Kinoshita [1,3]
[1] University of Hyogo, [2]HOYA Corporation, [3]CREST-JST

EUV microscope system



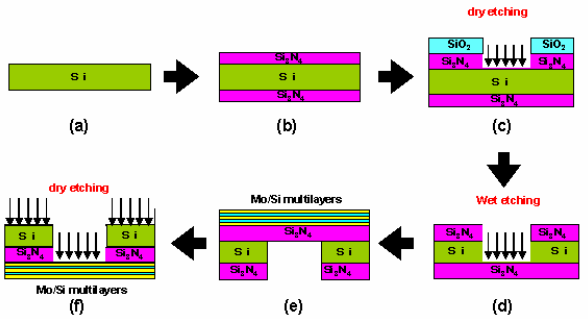
This figure shows the configuration of an EUV microscope. Schwarzschild optics has numerical aperture of 0.3 and magnification of 30. And, the X-ray zooming tube with electromagnetic lenses can vary the magnification in the range from 10 to 200. So, the total magnification of the microscope system can vary from 300 to 6000, and the calculated resolution is 20 nm.

Expansion of NA using an EUV beam splitter



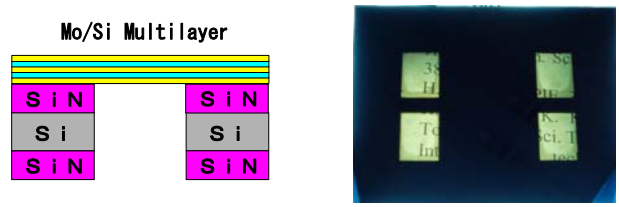
These figures show the Schwarzschild optics before installing beam splitter (left) and Schwarzschild optics of after installing beam splitter (right). In this optics, as NA has different number between horizontal and vertical direction, resolution decreases in one direction. However, by installing EUV beam splitter above Schwarzschild optics, NA becomes uniform for all planar direction and resolution improves.

Process of EUV beam splitter



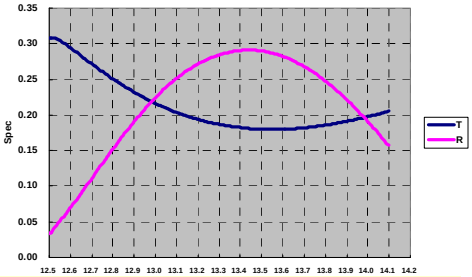
We prepared a Si wafer with SiN film in the both sides approximately 300 nm thick (b). SiN is removed by dry etching using a glass mask with a demanded aperture (c) and Si is removed by wet etching (d). Mo/Si multilayer are deposited on the surface (e). SiN film is removed by dry etching again to obtain of high transmission. (f)

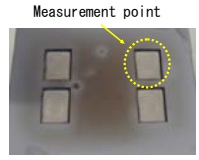
Completed EUV beam splitter



Left figure shows structure of EUV beam splitter.Right picture shows a completed EUV beam splitter.

Evaluation of EUV beam splitter

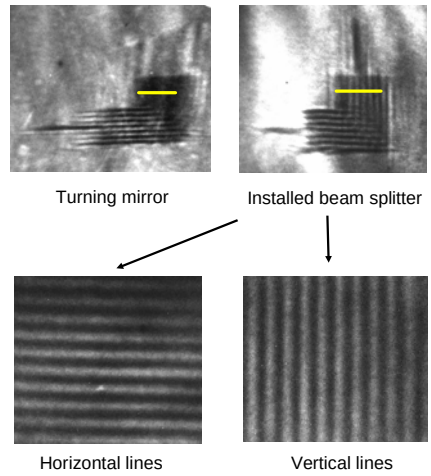




Transmission and reflectivity measuring equipment

We succeeded to fabricate an EUV beam splitter which has high reflectivity and high transmission around 13.5 nm wavelength.

Resolution enhancement by using an EUV beam splitter



This picture shows the exposure results of elbow-pattern width of 300 nm in size. Before installing beam splitter, lines of vertical direction could not be resolved. However, after installing beam splitter, the 300 nm L&S elbow pattern for all planar direction has been clearly resolved.

Summary

- **We have fabricated an EUV beam splitter which has high reflectivity and high transmission.**
- **We have developed an EUV microscope with an EUV beam splitter for the first time and succeeded in the highly precise pattern inspection.**