Progress at PLS x-ray nano/micromachining beamline and major research activities

J. H. Kim[1], S. S. Chang[1], K.B.Kim[2], J.P.Lee[2] and S.J.Lee[2]
[1]Pohang Accelerator Laboratory, POSTECH,
[2]Department of Mechanical Engineering, POSTECH

Microfabrication using synchrotron radiation has been well established for last decade and used to obtain microstructures with high aspect ratio and optical quality of the sidewall which take interest in precision miniatures like micro-optical and micro-machinery system. This technology is based on the LIGA process.

In PLS (Pohang Light Source), we have carried out the development of microstructure technology and excellent results, such as micro-optics, micro mechanics and probe for bio application, are also obtained in recent years.

To improve our beamline performance, we designed and manufactured high-performance UHV X-ray mirror systems last year and have continued the installation. We are now testing the mirror systems to characterize the mirror reflective properties and our beamine will be operated with two options - 'white light mode' and 'mirror light mode'. Besides, to expand our research fields, we renamed our beamline as "X-ray Nano/Micromachining Beamline" in 2006. After renaming of beamline, we have researched in development of more accurate patterning and fabrication skills.

In this paper, first, we will introduce X-ray Nano/Micromachining Beamline at PLS and current status.

As one of our important research fields, we have studied about CRL (Compound Refractive Lens) development. We made CRL using poly(methyl methacrylate)(PMMA) resists and SU-8 series resists with thickness ranging from 100 ㎛ to 1 ㎜ for lens materials. The whole deep x-ray lithography process based on these resists is carried out at 9C1 nano/micromachining beamline in PLS. In order to evaluate the quality of patterned structure and the focusing effect, lenses having various shapes are fabricated and the intensity profile and transmission of x-ray focused by CRLs are measured. We devised a novel X-ray energy filter based on LIGA fabricated compound refractive lenses. The filter consists of both of lenses array and slits, which are exactly aligned to optical axis by a lens -guide built on the same plane with slit. Its fine resist microstructure is obtained through an exposure/development process to be characterized, optimized, and stabilized. In addition, the resist structure of slits is filled as Cu by using electroforming with accurate replication after the developing process. Using this method, we can solve the align difficulty between lens and slits. We describe a manufacturing process of the filter and describe some quantitative results to prove that our proposal is feasible. Besides, in our beamline, several typed CRL systems and applications for X-ray optics are on developing.

In this paper, we will also show results of major research activities in PLS Nano/Micromachining Beamline.