INSTRUMENTATION & TECHNIQUES

Since commissioning of beamlines in April 1997, intensive projects have been pursued in development of X-ray optics, monochromators, microbeams, imaging techniques, detectors and other advanced system. At present, SPring-8 provides the most intense X-ray beam in the hard X-ray regions that has never been achieved, but the improvement of instruments is still essential. Because we do not have enough space to describe every aspect of this research field, we will introduce here some typical examples of eminent works.

The key advantage of SPring-8 is its high brilliance and low emittance of X-ray beam, vertical emittance of electron beam (several tens of p m·rad) approaching to intrinsic emittance of hard X-ray photons. However, handling the spatially coherent X-ray beam involves the serious obstacles to beam position monitoring (BPM). In order to use a coherent X-ray beam, it is necessary to measure the beam position non-destructively with micrometer accuracy. A diamond photo-conductive detector is one of the candidates for transparent BPM. The recent results for this device are presented in this section.

X-ray focusing and collimating optics for hard X-rays are also pioneering work. Mirror optics is usually used in soft and hard X-ray regions below 20 keV. For higher energy, refractive optics is one of the candidates. "Bubble lens" is a unique optical device developed at SPring-8. Two-dimensional focus around 19 keV X-rays has been tested. These focusing optics may be very useful for the experiment where the preparation of a large sample is difficult.

Refractive optics is also applied to collimate divergent X-ray beam. Here, the array of parallel holes is used as a cylindrical lens. Undulator radiation from the SPring-8 storage ring is not perfectly parallel. By using the newly developed refractive collimator, the angular divergence is reduced to one-third. This collimator will be a powerful tool for speckle, interference, high energy resolution and high angular resolution experiments.

X-ray fluorescence holography has recently been developed to obtain direct three-dimensional atomic images. However, because of the lack of photon flux, only the holograms of single crystals with the known structure have been demonstrated. By using a high-intensity primary X-ray beam, the atomic structure around doped zinc atoms (200 ppm) in gallium arsenide has been revealed. The X-ray fluorescence holography is the only method for the direct measurement of a three-dimensional structure that has no long-range ordering. Application to structural analysis of biomolecules may be possible in the future.

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