Performance of a 100-150 keV Monochromator for High Energy Synchrotron Radiation

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The characteristics of a 100-150 keV monochromator has been studied. This monochromator is designed for a single crystal arrangement and doubly-bent. A symmetric Johann type Si 400 reflection is used. The crystal surface is set horizontally. It is bent to get a vertically focused beam at the position given by $q/p=1$, where p and q are distances from source to crystal and crystal to focal point, respectively. In the sagittal direction, the crystal is bent with a fixed radius of 820 mm ($q/p=1/3$). The crystal is cooled indirectly through the Cu holder through which precise slot water-cooled channels is bored, and the holder is nickel plated. The bender design is based on a 4-point bending system operated at either end of the crystal or the crystal holder using two stepper motors each in a sine-bar configuration.

The photon flux is measured to be about ~1×10^{12} photons/s at the stored current of 20 mA, the ID gap width of 30 mm and beam energy of 115.54 keV by a SSD (Ge) assuming the SSD efficiency of 10 %. In the measurement we set the detector onto the directly-diffracted beam position by inserting 47-cm-thick Al filter. The results also show that there are higher harmonics diffraction of Si 800 and Si 1200.

To get better energy spread, we have to cut the beam partially (photon flux ~2×10^{11} photons/s). In this condition the energy spread is measured to be about 144 eV ($\delta E/E\sim1.25\times10^{-3}$) which value is derived from results of the UO_2 K-absorption edge measurement at 115.54 keV by using ion chambers filled with air.

Figure 1 shows a typical results of the focused beam at 115.54 keV. Due to the problem that the Si crystal dose not fit smoothly to the crystal holder, especially for sagittal direction, the horizontal beam size of about 5 mm is bigger than the calculated value.

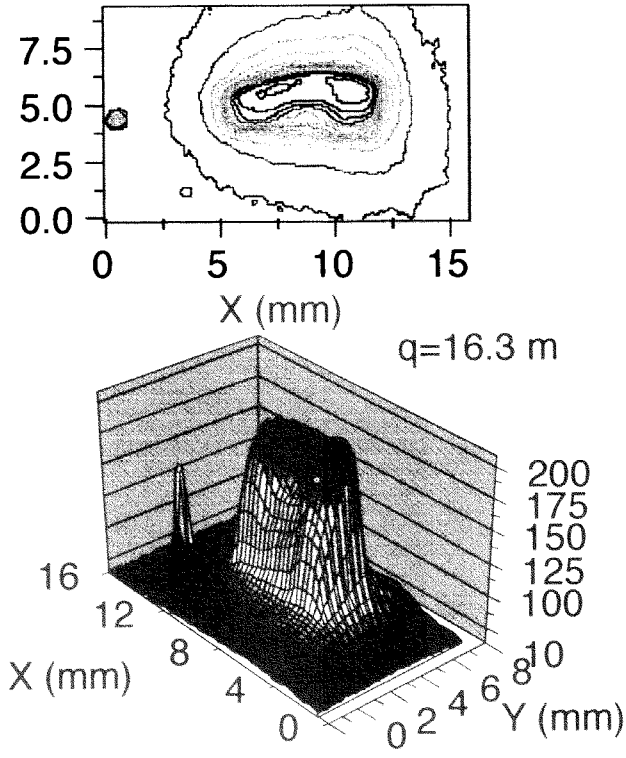

Fig. 1 Image of the focused beam at 115.5 keV.