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Commissioning of a Strip x-ray Detector for the RIXS Spectrometer at BL12XU

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The Inelastic X-ray Scattering (IXS) spectrometer at the Taiwan beamline BL12XU at SPring-8 is a powerful instrument designed for a wide range of IXS experiments on electronic excitations of a variety of systems. It features two major setups, one for non-resonant IXS (NIXS) and the other for resonant IXS (RIXS) experiments. In the RIXS setup uses a horizontal dispersion plane for the analyzer. The energy scan of the scattered photons is done by scanning the analyzer and the detector simultaneously within the Rowland circle of the analyzer to maintain the focusing condition. In a typical spectrometer, a perfect crystal is bent to a curvature radius of twice the radius of Rowland circle in order to focus the radiation on a detector. To bent the crystal, however, causes elastic deformations which broaden the bandwidth of the reflection. For high-resolution application, another type analyzer is developed so called diced analyzer crystal, which are built by fixing a large number of small flat single crystals on a spherical substrate. In this way practically all elastic deformations are avoided, but it is still not useful in applications because the finite size of a single flat dice causes a contribution to the resolution [1, 2]. The dispersion relation between the energy and the dispersive position within the focus is dE/dx = E/2R*cotθB. At this commission (E=8986 eV, R=1000 mm, θB=87.08o), the dispersion is 0.229 eV/mm. The accuracy of the energy measurement is directly related to the accuracy in the measurement of the position of the x-rays. One could use a position insensitive point detector with a selected size slit to match the needed resolution but result in relatively poor efficiency. Using a position sensitive strips detector has the advantages that with a large sensitive area and the resolution only limited by the pixel-size effect. For this proposal, a 32 strips position sensitive x-ray detector is designed and fabricated for RIXS system. The energy resolution is limited only geometrically by the strip size of the detector, and by the focusing quality of the analyzer. At this commission, a Ge(337) analyzer was chosen to realize the performance of the whole RIXS setup under Cu absorption edge. From the experimental results, each strip (0.125 mm width) corresponds to 29 to 35 meV depends on the RIXS setup as a function as the incident x-ray energy. The energy resolution of the whole RIXS setup achieved here were 80, 110, 110 meV as the incident x-ray energy were 8986, 8990, 8995 eV individuality, which was approached to the limitation of the whole energy broadening convoluted by the incident beam bandwidth, beam size contribution and the resolution the backscattering analyzer.

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