BL08W
High Energy Inelastic Scattering

1. Introduction

BL08W is the beamline that can deliver the highest energy X-rays emitted by the only wiggler source at SPring-8. This beamline is used in several research fields, including Compton scattering, high-energy X-ray diffraction, and high-energy X-ray fluorescence analysis. Three methods of Compton scattering can be performed in this beamline. The first method is magnetic Compton scattering for studying magnetic states. The second method is high-resolution Compton scattering with a high momentum resolution of 0.1 a.u. for studying electronic states and fermiology. The third method is Compton scattering imaging (CSI) using a CdTe two-dimensional detector (HEXITEC) having energy dispersive capability in each pixel. Also, structural studies of disordered materials by pair distribution function analysis using high-energy X-ray diffraction and studies on cultural properties by high-energy X-ray fluorescence analysis can be performed.

2. Advancement of Compton Scattering Imaging

Compton scattering is characterized by its sensitivity to light elements and low-density materials, such as gases. Furthermore, since Compton scattering does not need to transmit X-rays through materials, it has a clear advantage for examining surface layers with a voluminous structure that cannot transmit X-rays. The intensity and shape of the Compton profile, which means the energy spectrum of Compton scattered X-rays, provide information on the density and composition of the scatter medium, respectively.

CSI has been performed at BL08W by the plane-by-plane method, which means the pinhole camera system. This method is very easy to set up and readily provides cross-sectional images. Furthermore, since we can also obtain the energy spectrum of fluorescence X-rays from heavy elements using the HEXITEC, it is possible to measure the fluorescence imaging simultaneously with CSI.

Since the background X-rays are very high owing to the high-energy X-rays above 100 keV, the detector and the Compton scattering X-ray path between the pinhole and the detector must be covered with a shield to measure the very weak

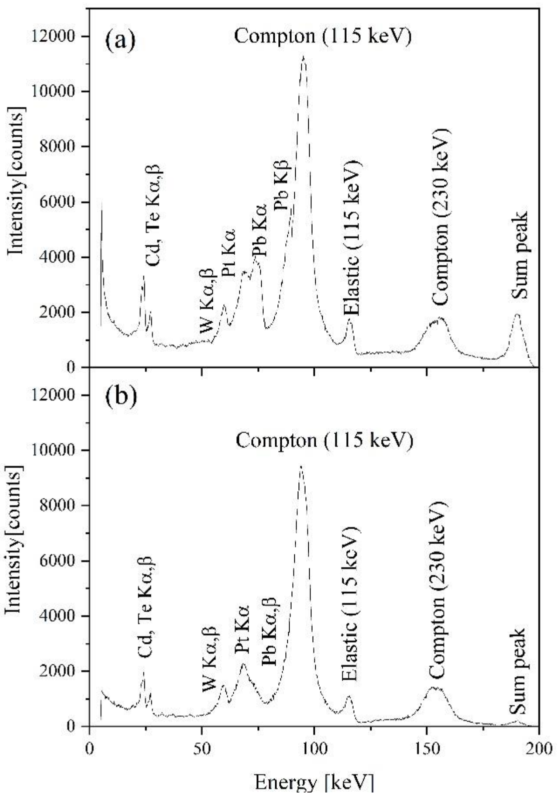

Fig. 1. Energy spectra of Pt-Co alloy: (a) Pb shield and (b) tungsten shield.

Compton scattering signal through the pinhole. The pinhole and shield were made of tungsten and lead, respectively. Figure 1(a) shows the energy spectrum of Compton scattering from the Pt-Co alloy with the lead shield. The Pb Kb fluorescence spectrum overlaps with the Compton profile, which makes the analysis of the Compton profile difficult. It should be noted that the tungsten fluorescence observed in Fig. 1(a) comes from the tungsten pinhole. Moreover, since the distance from the pinhole to the detector of the lead shield was fixed at 75 mm, it is difficult to change the distance to optimize the magnification and resolution. Therefore, the shield was changed from lead to tungsten to reduce the influence of Pb fluorescence and was changed from a fixed type to a variable type to change the distance between the pinhole and the detector. Figure 1(b) shows the energy spectrum of Compton scattering from the Pt-Co alloy with the tungsten shield. The overlap between the Compton profile and the Pb fluorescence almost disappears. Figure 2 shows the variable-length shield. The variable shield is screwed and the distance can be changed from 20 mm to 150 mm. Figure 3 shows the CSIs of the Cu standard sample with gaps of 0.1 mm. We can obtain the CSI with various magnifications by changing the detector distance and resolution.

Fig. 2. Tungsten shield.

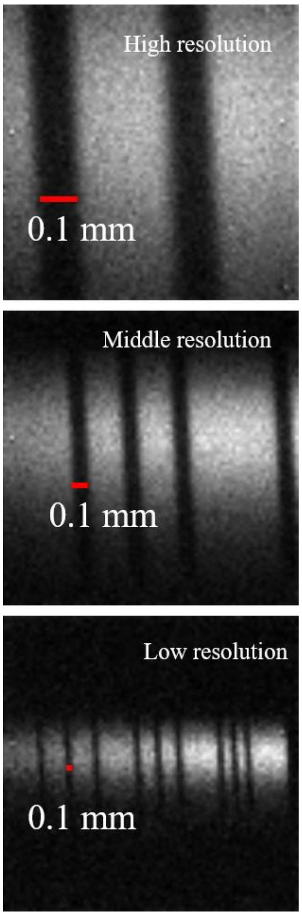

Fig. 3. CSIs of the Cu standard sample.

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