X-ray Absorption Fine Structure of Selenium Free Cluster

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X-ray absorption fine structure (XAFS) is a powerful tool for structure analysis. We have investigated the X-ray absorption process of the selenium free microclusters by using the total ion yield (TIY) measurement and the photoion photoelectron coincidence(PEPICO) measurement. Recently we have proposed that the size selective XAFS of the cluster could be achieved by measuring the branching ratio, the abundance ratio from the parent cluster to the daughter ions, which is derived from PEPICO spectrum, as a function of photon energy(1). In this study, we develop a method for the XAFS-PEPICO synchronous measurements, and examine the possibility of the size selective XAFS.

The XAFS-PEPICO synchronous measurement were carried out at BL10XU. The experimental setup is shown schematically in Figure 1. Selenium cluster beam was produced in a vacuum vessel by a supersonic jet expansion method. The neutral cluster beam intersects the X-ray beam at the right angle in the horizontal, and then some of the clusters are photo-ionized. The photoions are extracted upward by a electric field and detected by a time of flight mass spectrometer, while the photoelectrons are extracted downward. For the PEPICO measurement, the electron signal provides a start pulse for a time-to-amplitude converter (TAC) and the ion signal gives a stop pulse. The output signal of the TAC is stored in the memory of a multichannel analyzer (MCA). By using the modified experimental station control software, we can synchronize the action of the MCA with the angle of monochromator. The measurement were carried out at 140 energy points between 12.4 keV and 13.4 keV.

Fig. 2 shows the X-ray absorption spectra for selenium cluster beam measured in TIY mode. The EXAFS oscillation $\chi(k)$ for the cluster beam is presented in the inset of Fig. 2 as a function of photoelectron wave number k. Clear EXAFS oscillation is observed in the spectrum. Moreover, the branching ratio depends little on photon energy above the Se K-edge. These results fulfill the requirement for the size selective XAFS.

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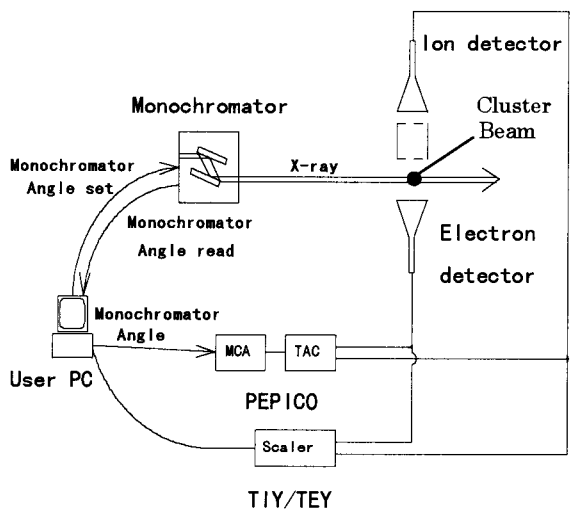

Figure 1. Block diagram of the XAFS-PEPICO synchronous measurements.

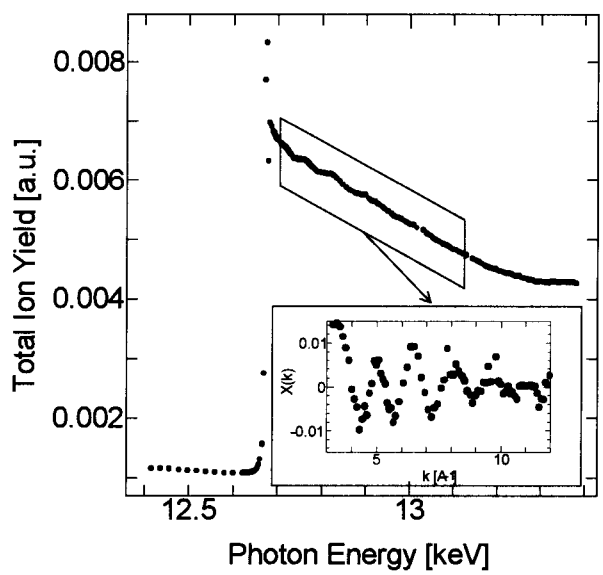

Figure 2. The X-ray absorption spectra for selenium cluster beam measured in TIY mode. Inset: EXAFS oscillation $\chi(k)$