

High Resolution Absorption Study of Myoglobin

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The electronic structure of biological material is a key to understand its function. Metal protein, which contains transition metal ion inside the protein, is one of the interesting materials that the transition metal ion believed to be playing an important role in its function. The myoglobin (Mb) is one of the metal proteins that contains iron ion. The iron ion in the Mb forms many kinds of electronic structures, such as Fe(2+) and Fe(3+), low and high spin state. The resonant x-ray emission spectroscopy (RXES) can provide both its valence and spin state information. The final goal of this experiment is to investigate the valence and the spin state by using RXES and high resolution x-ray absorption spectroscopy (HRXAS) technique.

However there are several difficult things we have to deal with before we exercise the careful analysis. One of the main purposes of this experiment was to handle the beam damage problem by cooling the sample.

The experiment was carried out at IXS spectrometer at BL12XU. 1m spherical bent Si(531) analyser was used for the spectrometer. The sample was cooled at about 10K. The total energy resolution was about 1.5eV.

Fig.1 shows K_{1,3} x-ray emission spectrum of Carbonmonoxy-Myoglobin (MbCO), which has Fe(II) at low spin state. The sample was cooled with cryostat at about 10K. The intensity of K₁ emission line was monitored to measure the sample damage. No significant change of the intensity was observed up to about 15 minutes of exposure time. Due to the strong scattering from the window of sample cell, S/N ratio was not so good compare to other samples.

Fig.2 shows high resolution x-ray absorption spectrum (HRXAS) of MbCO. The feature b and c at 1s to 4p absorption are consistent with the previously measured XANES spectrum of MbCO[1]. The fine structure of the pre edge of the absorption (a) was smeared out due to the high background.

In spite of strong scattering from window, HRXAS spectra has been taken with sufficient count rate without sample being damaged. These results are promising result for further measurement of Mb samples.

[1] A. Bianconi, et al., Nature **318**,685(1985)

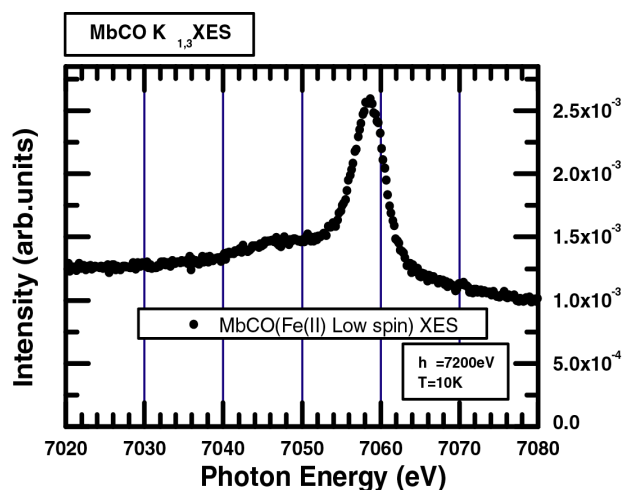


Figure 1. K $\beta_{1,3}$ x-ray emission spectra of MbCO (Fe(II) Low spin state).

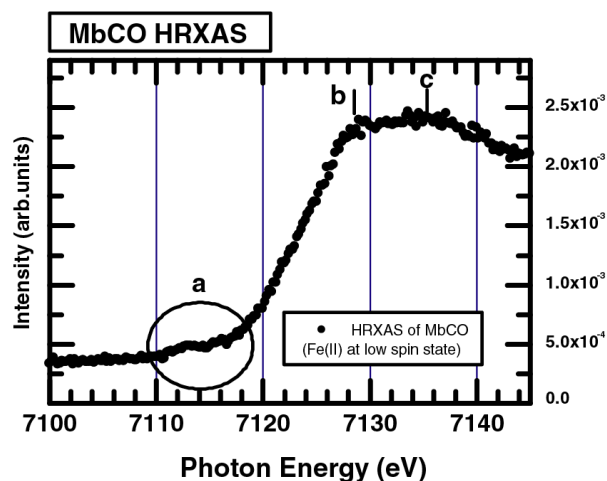


Figure 2. HRXAS spectra of MbCO