

X-ray inelastic scattering of Hemoproteins

※ Taikan HARAMI¹⁾, Shinji KITAO¹⁾, Gentaro MIYAZAKI²⁾, Takaya MITUI¹⁾, Yoshitaka YODA³⁾, Yasuhiro KOBAYASHI⁴⁾, Makina YABASHI⁵⁾, Makoto SETO⁴⁾,
 1) Synchrotron Radiation Research Laboratory, JAERI, 2) Faculty of Engineering Science, Osaka University, 3) Faculty of Engineering, Tokyo University, 4) Research Reactor Institute, Kyoto University, 5) Beamline Division., JASRI

1. Introduction

A protein molecule fluctuates among the conformational substates at physiological temperatures. It freezes into some substate at lower temperature and behaves glasslike. X-ray nuclear inelastic scattering by a specific metal atom in a biomolecule gives us a useful tool to investigate the dynamics of the atom. The hemoproteins have iron atoms in the molecule which bind oxygen molecules for respiration. The BL09XU beamline of the SPring-8 makes possible such an investigation by X-ray nuclear inelastic scattering on an iron atom. The high resolution monochromator and the nuclear analyzer lead to spectra in the energy transfer range of meV.

We have studied the X-ray inelastic scattering of hemoproteins such as hemoglobin

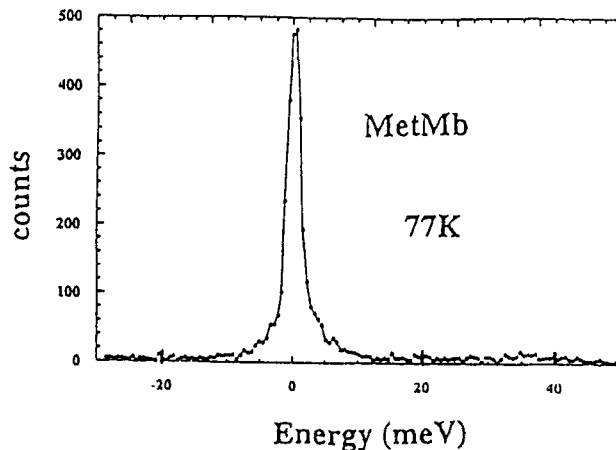


Fig.1 Nuclear inelastic spectra of MetMb

and myoglobin. The X-ray inelastic scattering spectra of ⁵⁷Fe-enriched metmyoglobin were last time measured at room temperature. This time we measured the spectra at liquid nitrogen temperature.

2. Experiment

The samples of ⁵⁷Fe-enriched metmyoglobin solution (MetMb) were prepared. Inelastic scattering spectra were measured in the beamline BL09XU. The monochromatic beam from a Si(111) double-crystal monochromator was incident onto a high resolution monochromator consisting of silicon crystals with asymmetric Si(5 1 1) reflections and asymmetric Si(9 7 5) reflections. SPring-8 was operated in the (21 × 3 bunch trains) bunch mode during the experiment. The nuclear inelastic scattering spectra were detected by an APD detector which can measure the nsec range time spectra coincident with the pulse photon from the storage ring.

3. Result

The nuclear inelastic scattering spectra on metmyoglobin were obtained at liquid nitrogen temperature (Fig. 1). The spectra show the quasielastic ones which indicate the diffusional motion of an iron atom in the heme of the solution samples even at such low temperature.