X-ray inelastic scattering of myoglobin

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1.Introduction

The high brilliant synchrotron radiation beamline gives us a useful tool to investigate the dynamics of materials and biomolecules in the energy range of meV by using the high resolution monochromator and the nuclear analyzer. When the Moessbauer isotopes are enriched in the sample, the nuclear inelastic scattering from the atom at the specific site can be observed.

We study the inelastic scattering from the hemoproteins such as hemoglobin and myglobin. The protein molecule is considered to fluctuate among the conformational substates and behave like a liquid. At low temperature, it will freeze into some substate and become glasslike. The conformational fluctuation of a protein is considered to be important not only from the viewpoint of biological functions, but also as a typical example of the fluctuation of a complex system.

The structural changes of the environment around the heme iron atom by denaturation take place by changing temperature and pH ,and adding denaturants such as urea and guanidine hydrochloride.

2.Experiment

The samples of native 57Fe-enriched metmyoglobin solution was prepared. Denatured metmyoglobin was obtained by adding guanidine hydrochloride. 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 4 bounce monochromator consisting of channel-cut crystal of silicon with asymmetric reflections and symmetric Si(12 2 2) reflections. SPring-8 was operated in the 21 bunches during the experiment.

3.Result

The nuclear inelastic scattering spectra were obtained on the samples of native myoglobin and denatured myoglobin at room temperature. Both show the quasielastic spectra with the similar linewidth. On the other hand, Moessbauer spectra of the quickly frozen samples in the liquid nitrogen show that the electronic structures are quite different from each other. The vibration spectra of the iron atom are necessary to be measured in the low temperature.