Low Temperature Apparatus for Protein Crystals in Bio-crystallography (MIR-OAS) Beamline

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X-ray diffraction work at low temperature is indispensable to protein crystallography, because protein crystals are, in general, easily damaged by X-ray irradiation. This problem could be much more serious in the case of highly brilliant X-ray beams realized at third-generation synchrotron sources such as SPring-8. We have been developing low temperature apparatus which can be attached to the camera system of the bio-crystallography (MIR-OAS) beamline, in order to effectively cool the protein crystals. Currently we are now planning the following two experimental modes; a) measurements of frozen crystals at liquid nitrogen temperature, which is so-called cryo-crystallography and b) conventional intensity data collection of cooled crystals at *ca.* 0 to -50 °C.

In cryo-crystallography, experiments are proceeded in accordance with the three steps as follows: i) rapid freezing of a protein crystal, ii) setting of the frozen crystal to the goniometer head of the X-ray camera, and iii) upkeeping of the low temperature for the crystal on the camera. The facilities responsible for the steps i) and ii) are still under development, while a commercially available cooling device using liquid nitrogen gas-flow has been already functioning for the step iii). By using this system we could successfully perform a preliminary experiment, collecting the data of a lysozyme crystal. Fig. 1 shows the outline of the system, where the cooling device is placed on the top of the goniometer system of the camera. Usually the goniometer head is covered with a chamber in which helium gas is fulfilled to reduce the X-ray background due to air scattering. The present cooling device, however, makes it difficult to equip the helium gas chamber.

In the cooling apparatus employed in the conventional intensity data collection mode the cold helium gas will be introduced to a chamber around the goniometer head. We plan to cool the cold helium gas with a thermal exchanger of liquid nitrogen flow. The outline of this system is illustrated in Fig. 2.

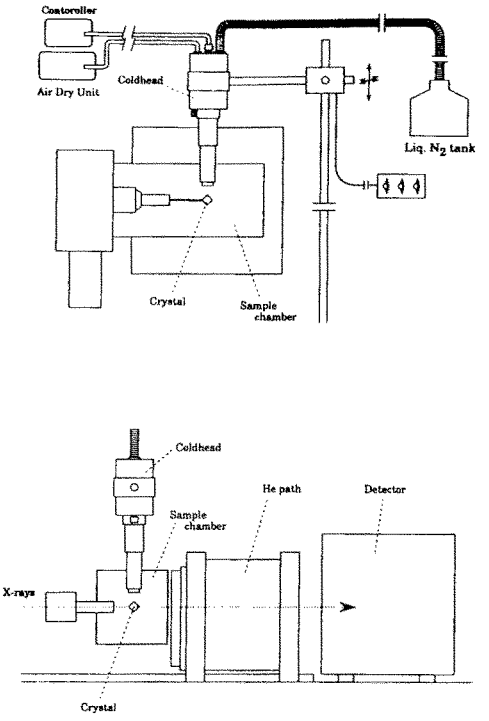

Fig.1. The cooling system for cryo-crystallography using gas-flow of liquid nitrogen.

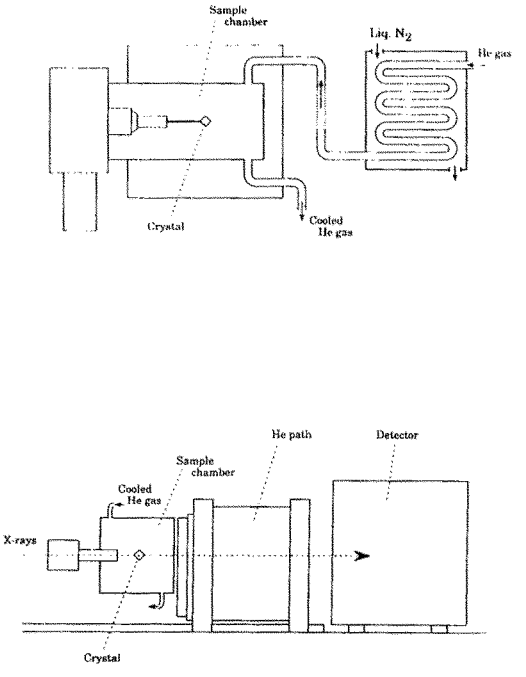

Fig.2. The cooling system using cold helium gas for low temperature measurement at *ca.* 0 to -50 °C.