Lattice Modulation and Charge Ordering Associated with the Spin Ordering in CeP

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1. Introduction

The purpose of the present experiment is to find superlattice reflections originated from a lattice modulation or a charge density wave associated with the spin wave in CeP. By neutron scattering experiments, SDW was fond under low temperature and magnetic field. Also similar SDW was found under low temperature and high pressure. The expected intensity of the superlattice reflection is 10^{-5} compared with a fundamental Bragg reflection .

To carry out the experiments, we have to develop many techniques at BL02B1 as follows: 1) Focusing of X-ray beam by using a mirror and a monochromator, 2) Developing a scanning program in a reciprocal space, 3) Testing a low temperature cryostat for a large sample-can which is available for a diamond anvil cell, 4) A capability of back-scattering geometry for high resolution experiments of lattice parameters, 5) Handling a diamond anvil cell for a single crystal. We have tested and developed those technique, and the current status of the study is reported. The final goal, 10w temperature and high pressure experiments for a single crystal, is not achieved yet, and further efforts are required.

2. Experimental

X-ray diffraction studies were performed at the Crystal Structure Analysis beam-line (BL02B1) in SPring-8. A single crystal of CeP was settled in a diamond anvil cell. The pressure is almost 1MPa, and the sample size is 0.08x0.08x0.03mm3. Double Si 111 monochromators and a double-mirror were used. X-ray energy was settled at 30keV and the energy was calibrated at the absorption edge of Sn(29.17keV). Ring current was about 19rnA.

3. Results and Discussion

Fig. I shows a profile of an X-ray beam at the sample position after the focusing by a mirror, which was observed by scanning the basement along the vertical direction with a pin-hole slit. The beam was well focused by the mirror almost to 0.2mm. On the other hand, the focusing by a monochromator was not good enough so that we used a flat monochromators.

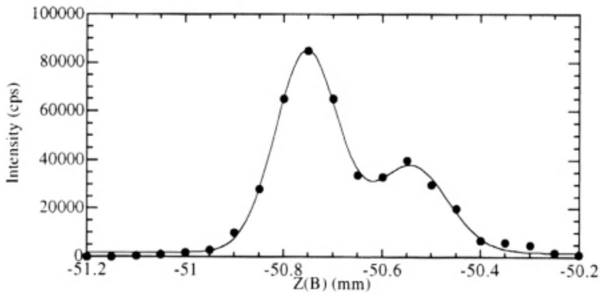

Fig. 1 profile of the beam.

We found 13 Bragg reflections to make a UB matrix, and scanned several directions in a reciprocal space. The program works pretty well for the scanning. Peak intensity of typical Bragg reflections is about 250kcps, and the background will be reduced to be 1cps so that it might be possible to measure a weak superlattice reflection, if there is.

We measured 0 -16 2 reflections whose diffraction angle is about 172degree and -172 degree. We have observed both of them as shown in Fig.2. First we survey them by using a photographic technique, and then used scintillation counter. Calculated lattice parameter is 5.94524(7)A, and the precision is very good since we used a back-scattering geometry.

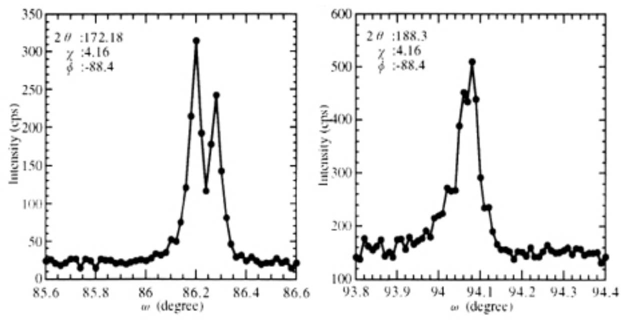

Fig.2 Two 0 -16 2 Bragg reflections.