Lattice Modulation and Charge Ordering in $La_{2-x}Sr_xCuO_4$(x=1/8)

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1. Introduction

The mechanism of a high T_c super conductivity is still unclear yet. Recent topics of this field is the so called a stripe model. This model tells that there is a hole ordering. Recently, Zimmermann *et al* found diffuse scattering in $La_{1.48}Nd_{0.4}Sr_{0.12}CuO_4$ by using the synchrotron radiation at DESY. They used 100keV high energy X-ray, and the observed intensity ratio of the diffuse scattering and fundamental (2 0 0) Bragg reflection was 10^{-8}. This report seems only one evidence for the existence of a hole stripe in a high T_c sample at the moment. The purpose of the present experiment is to find superlattice reflections or diffuse scattering associated with the ordering of a hole in a more suitable sample.

2. Experimental

X-ray diffraction studies of a single crystal $La_{0.185}Sr_{0.115}CuO_4$ were performed at the Crystal Structure Analysis beam-line (BL02B1) in the SPring-8. The sample with the size $\phi 1.1 \times 1.2 mm^3$ was mounted in a Be sample can along c*-direction, in which He gas was filled, and then the sample can was installed in a He-gas closed-cycle refrigerator cryostat. A double-Si111 monochromator and a double-mirror were used. X-ray energy was settled at 30.029keV and the energy was calibrated at the absorption edge of Sn(29.17keV). Ring current was about 16mA. We observed the superlattice reflections which appear at low temperature orthorhombic phase associated the ordinary structural phase transition whose phase transition temperature is about 250K. Then we tried to observe the diffuse scattering due to the hole ordering associated with the superconductivity.

3. Results and Discussion

The UB-matrix was successfully determined by using (10 0 0), (0 10 0) and (0 0 26) Bragg reflections. The mosaicness of the sample was 0.075degree. Fig. 1 shows a profile of a superlattice Bragg reflection (1/2 15/2 2) taken at 20K and its diffuse scattering at 300K Even the superlattice reflections, the intensity was strong enough to do experiments.

We found several unknown diffuse scattering. One is diffuse streak around fundamental Bragg reflection, such as (0 10 0), and the other is broad diffuse scattering around (0 10 1) lattice point. We could not give a clear interpretation for these diffuse scattering at the moment. Concerning the diffuse scattering due to the stripe or a hole ordering, we could not get any intensity up to 10^{-6} compared with the fundamental reflection. The beam intensity was not enough for the present experiments. We need more intensity probably more than 10 times by using focusing technique and full current of the storage ring.

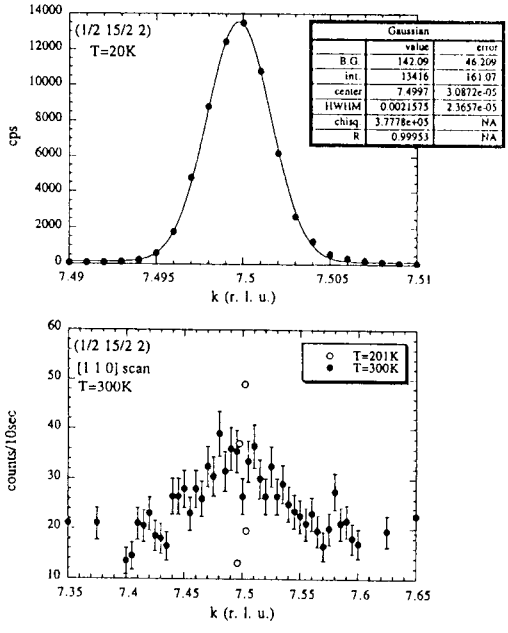

Fig.1 a superlattice reflection (1/2 15/2 2)