

Precursor Phenomena on the First-Order Phase Transition in Ferroelastic Compounds

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Introduction

On the first-order phase transition, it has been understood that, in general, the crystal structure changes suddenly at the phase transition temperature, without particular indication prior to the phase transition. However, it has been known that so-called precursor phenomena are observable even on the first-order phase transition. Recently, a new type of precursor phenomena, as broadening of the Bragg reflections over the wide temperature-range near the phase-transition temperature, has been found in ferroelastic compounds LaNbO_4 ¹⁾ and NdNbO_4 .²⁾

In this study, we investigate the precursor phenomena in LaNbO_4 taking advantage of high resolution and high energy of synchrotron radiation. The phase transition from a tetragonal phase to a monoclinic phase occurs at the zone center in the reciprocal lattice at 768K in LaNbO_4 .

Experimental

X-ray diffraction studies were performed on the specially designed seven-axis diffractometer installed at the Crystal Structure Analysis beam-line (BL02B1) in SPring-8. A single crystal of LaNbO_4 was settled in a vacuum furnace with a hemisphere-type Be-window, and was heated up to 1000K on the diffractometer. The high energy X-ray radiation of 30keV was used to know the nature of the bulk crystal.

Results and Discussion

As shown in Fig. 1, the peak intensity of the Bragg reflection decreased and the profile got broad gradually as the phase transition temperature was approached on cooling.

After the transformation, the peak intensity increased and the profile became sharp again. These phenomena were different from the critical phenomena due to a fluctuation at the second-order phase transition. It was found that the Bragg broadening was not originated from the surface-effect but bulk-nature.

Other precursor phenomena, as the ghost lattice, which is the noncommensurate satellite reflection often observed on the martensitic phase transformation in alloys were not observed at the present experiment.

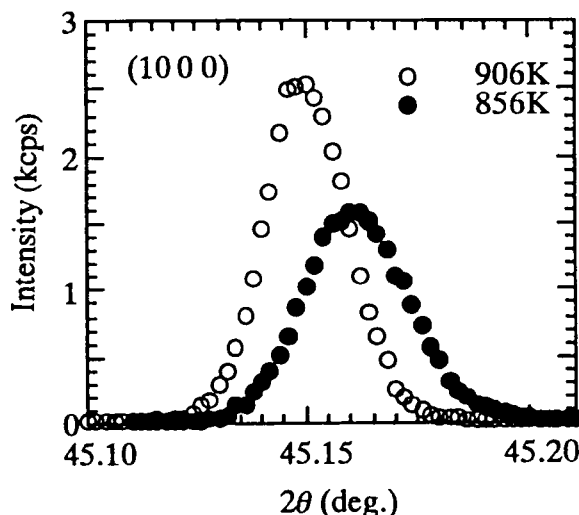


Fig.1 Profiles parallel to the θ - 2θ direction of (1000) Bragg reflection

References

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