

Pressure-induced phase transition of LaBi with NaCl-type structure

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Introduction

By use of synchrotron radiation, powder x-ray diffraction of LnBi (Ln = Ce and Pr) with the NaCl-type structure has been studied to 30 GPa at room temperature. The first-order phase transition in CeBi occurs from the NaCl-type (Fm3m) to the tetragonal (P4/mmm) and CsCl-type (Pm3m) structures at around 13 GPa. Both structures in the high-pressure phase coexist in a wide pressure range [1]. The structural phase transition of PrBi also occurs at around 14 GPa [2]. The structural behavior for the high-pressure phase of PrBi is similar to that of CeBi. The high-pressure forms of PrBi have the tetragonal (P4/mmm) and cubic (Pm3m) structures. Both structures also coexist in the wide pressure range.

Using synchrotron radiation, we have studied powder x-ray diffraction of LaBi with the NaCl-type structure up to 35 GPa at room temperature.

Experimental

LaBi was prepared by reaction of stoichiometric amounts of lanthanum and bismuth in a sealed silica tube at around 850 °C. Using synchrotron radiation, powder x-ray diffraction patterns of LaBi were measured with a diamond-anvil cell and the imaging plate up to 35 GPa at room temperature. Incident beam was monochromatized by Si(111) double crystal to a wavelength of 0.62 Å. The pressure in the diamond-cell was determined from a pressure shift in the sharp R-line fluorescence spectrum of ruby. A fluorinert solution was used as the pressure transmitting fluid.

Results and Discussion

Figure 1 shows powder x-ray diffraction patterns of LaBi at high pressures. The profile indicates only characteristic lines of the NaCl-type structure at around 1 atm. The d-values of 111, 200, 220, 222, 400, 420 and 422 lines of LaBi decrease with increasing pressure up to 10 GPa. New diffraction lines appear above 11.5 GPa and grow with increasing pressure. The reflections of the NaCl-type structure disappear around 17 GPa. The x-ray diffraction pattern of the high-pressure phase of PrBi and CeBi consists of the cubic and tetragonal forms at high pressures [1,2]. Both structures coexist to about 35 GPa. The structural behavior for the high-pressure phase of LaBi is similar to that of PrBi and CeBi. The lattice constants of the high-pressure phase of LaBi are $a = 3.698(6)$ Å for the CsCl-type structure and $a = 3.98(1)$ Å, $c = 3.30(1)$ Å for tetragonal structure at around 17 GPa.

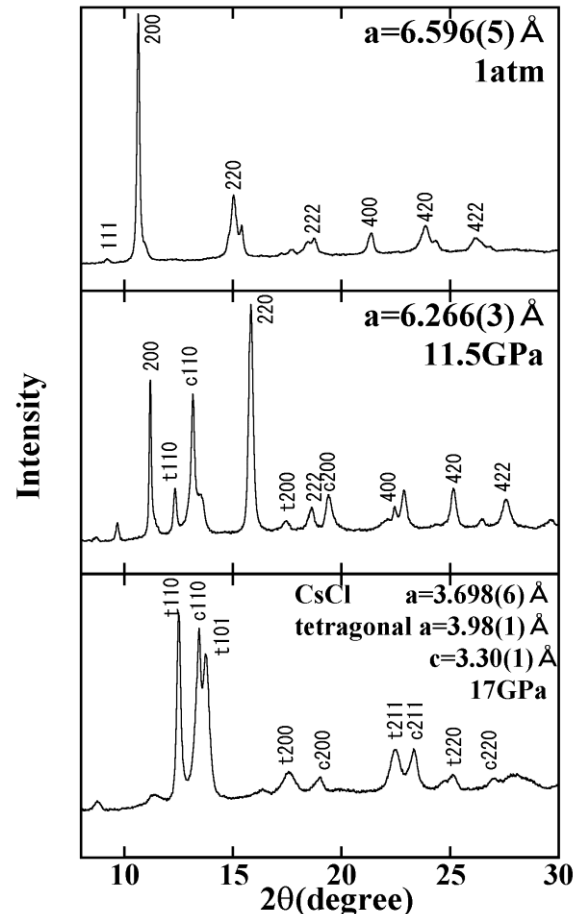


Fig. 1 Powder x-ray diffraction patterns of LaBi at high pressures.

References

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