

BL04B1 : In situ observation of high-pressure phase change of simple material

<Pressure induced phase transition of KCl>

Introduction

The BL04B1 beamline is designed particularly for conducting researches on the precise crystal structures and physical properties under high pressure and high temperature conditions. KCl is one of the well-known simple ionic materials which has a cubic structure (rock salt structure: B1 phase) at ambient condition. However, the KCl structure changes reversibly from B1 to B2 phase (CsCl structure) with pressures. In the practice, we observe the phase change of KCl (B1 to B2) and determine the transition pressure using the X-ray diffraction technique.

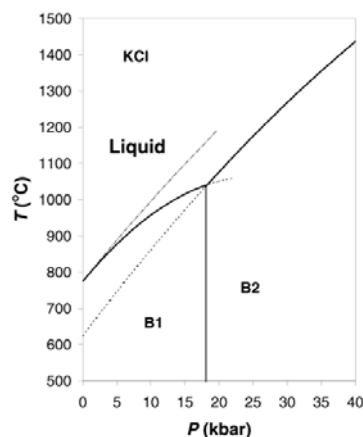


Fig.1 Phase diagram for KCl^[1]

Experimental method

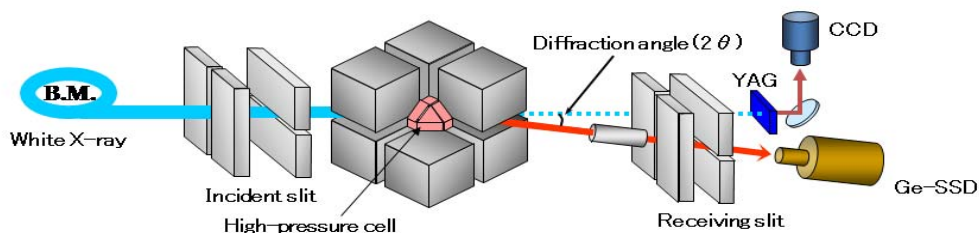


Fig. 2 Schematic illustration of the experimental set-up

High-pressure and high-temperature experiments are performed combining a large-volume multi-anvil device (SPEED-1500) and an energy-dispersive X-ray diffraction. Incident white X-ray from bending magnet is introduced via the slits and then passes the high-pressure cell through the anvil gap (Fig. 2.). The diffracted X-ray from the sample can be observed by a Ge solid-state detector.

[1] Walker et al. (2002), American Mineralogist, 87, 805.

Practice

1. Put sample pieces (KCl & NaCl pellet) into the high-pressure cell like fig. 3.

2. Set the high-pressure cell on the cavity of eight tungsten carbide cubes surrounded by the glass-epoxy box.

3. Set the packed high-pressure cell assemblage into the first stage anvils of large-volume multi-anvil device (SPEED-1500).

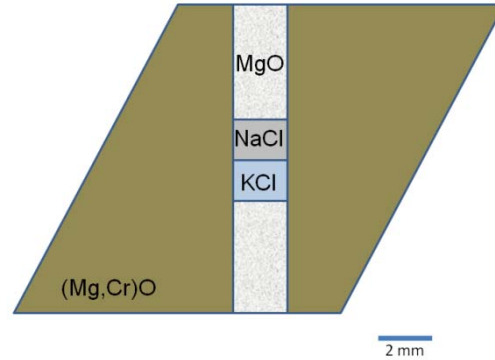


Fig.3 Cross section of the cell assembly

4. Observe the sample image using a CCD camera, and collect the diffraction patterns of KCl and NaCl at ambient condition.

5. Collect the diffraction patterns of KCl and NaCl with increasing pressures, and observe the process of the phase change from B1 to B2 phase of KCl (Fig. 4).

6. Decrease the pressures and observe the process of the reversible phase change from B2 to B1 phase of KCl (back transform).

7. Determine the produced pressures from the unit-cell volumes using the lattice constants of KCl and NaCl.

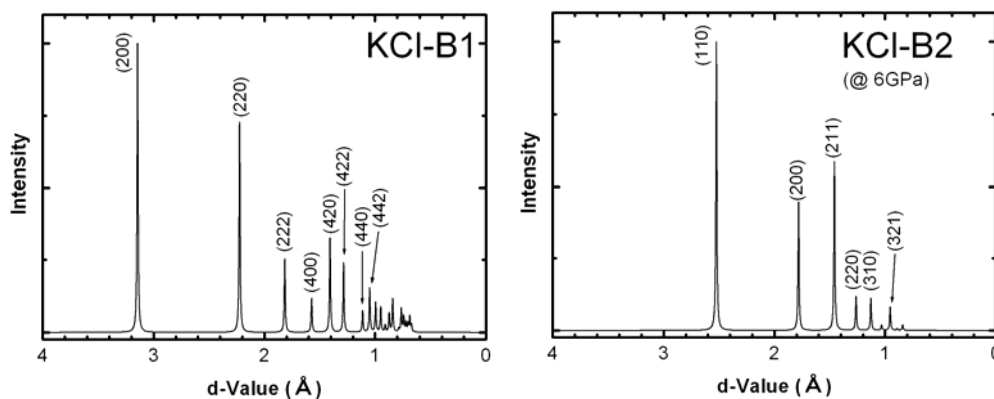


Fig.4 X-ray diffraction pattern of KCl-B1 and KCl-B2