

BL04B1 : In situ observation of pressure induced phase transition of simple material

<Pressure induced phase transition of ZnTe>

Introduction

It has been well-known that some transition metal compounds (II-VI), such as ZnS and ZnTe, show the semiconductor-metal transition with increasing pressures. ZnTe shows two discontinuities in the electrical conductivity below 15 GPa as shown in figure 1. In this practice, we measure the electrical conductivity and the powder X-ray diffraction to determine the pressure of phase transitions of ZnTe. We consider the relation between the electrical resistance and the phase transition of ZnTe.

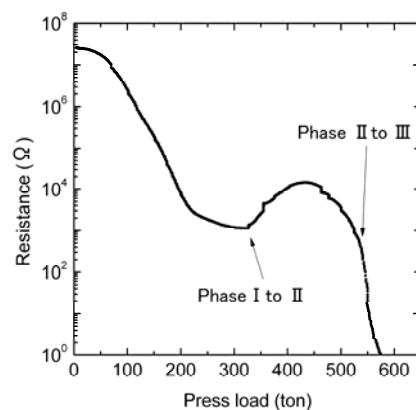


Fig.1 Change of the electrical resistance of ZnTe with increasing pressures.

Experimental method

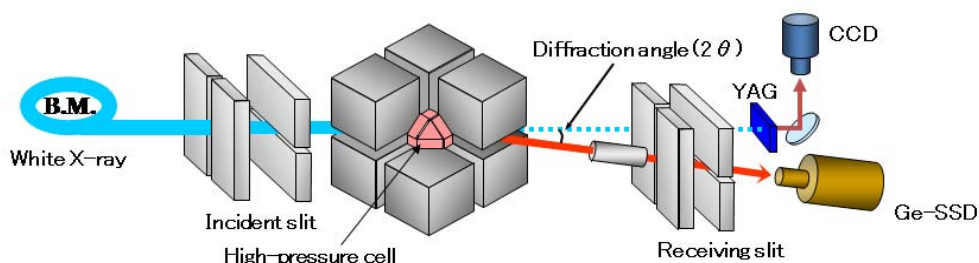


Fig. 2 Schematic illustration of the experimental set-up

High-pressure X-ray powder diffraction measurements are performed by using a large-volume multi-anvil device SPEED-1500 with the energy-dispersive technique. 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 high pressure sample can be observed by a Ge solid-state detector.

Practice

1. Put sample pieces (ZnTe & 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.

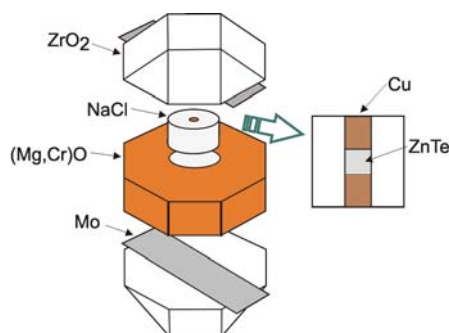


Fig.3 High-pressure cell assemblage

3. Set the high-pressure cell assemblage into the first stage anvils of SPEED-1500.
4. Observe the sample image using a CCD camera, and collect the diffraction patterns of ZnTe and NaCl at ambient condition.
5. Collect diffraction patterns of ZnTe and NaCl, and electrical resistance data with increasing pressure simultaneously. Observe the phase change from ZnTe- I to ZnTe- II , ZnTe- II to ZnTe- III (Fig. 4)
6. Decrease pressures and observe reversible phase change of ZnTe (back transformation).
7. Determine the produced pressure from the unit-cell volume of NaCl using the Decker scale (Decker, 1971).

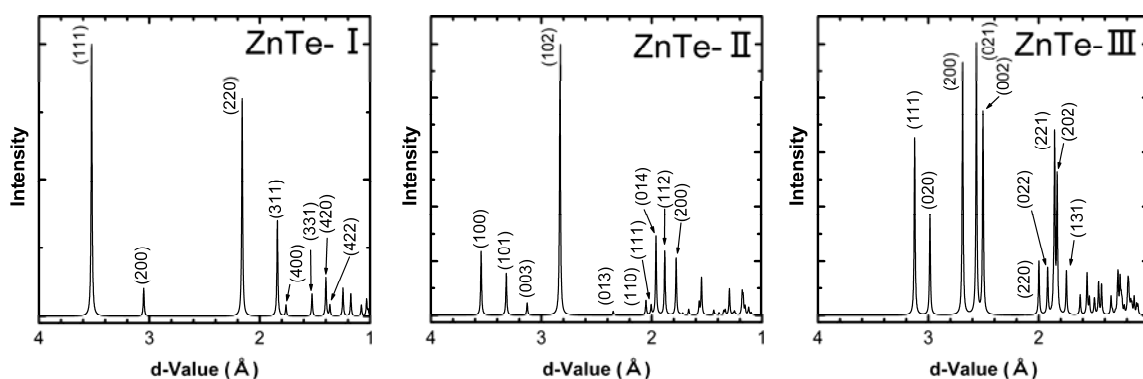


Fig.4 X-ray diffraction pattern of high pressure polymorph of ZnTe