

Structure of liquid IV-VI compounds under pressure

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Introduction

In order to elucidate the effects of the dimensionality of the covalent bond network on the pressure dependence of the structure of liquids, we have investigated the structure of liquid IV-VI compounds under pressure. Recently we have reported the pressure dependence of the local structure of liquid III-V compounds [1-3] and liquid II-VI compounds [4-6]. In liquid group 14 elements and liquid III-V compounds with three-dimensional network of covalent bonds, a continuous structural change has been observed in a wide pressure region. On the other hand, in liquid CdTe, which has also three dimensional network structure, with high ionicity in chemical bonding a sharp structural change has been observed.

In the crystalline phase, GeTe crystallizes in the rhombohedral structure at normal pressure and at room temperature. It is reported that with increasing temperature at normal pressure and with increasing pressure at room temperature, phase transitions occur to the rocksalt structure. At high temperature, however, phase diagram has not been investigated.

Liquid group 15 elements and liquid IV-VI compounds are known to have a structure with two-dimensional network of bonding. They consist of two kinds of bonding; strong and relatively weak bonding. With increasing pressure, it is expected that the difference between these bonding decreases. It is interesting to investigate the pressure dependence of the local structure of liquid IV-VI compounds and compare the results with those of other liquids.

Experimental

X-ray diffraction patterns were taken by an energy-dispersive method using the synchrotron radiation. Pressure was generated by using the multi-anvil high-pressure apparatus, MAX80, installed at AR-NE5C.

Results and Discussion

Example of the diffraction intensity of liquid GeTe at several pressures is shown in Fig. 1. Broad curve is the diffraction from the liquid and sharp peaks is the fluorescence x-rays and the diffraction peaks from the sample container.

With increasing pressure, the height of the subpeak at about 4.6 \AA^{-1} decreases while the change in the height and the position of the first peak at about 3.5 \AA^{-1} is small. Drastic change was observed between 5.4 GPa and 6.6 GPa: A peak at about 2.5 \AA^{-1} appears above 6.6 GPa. It may suggest the drastic pressure-induced structural

change in the low-dimensional network liquids. Detailed analysis is in progress.

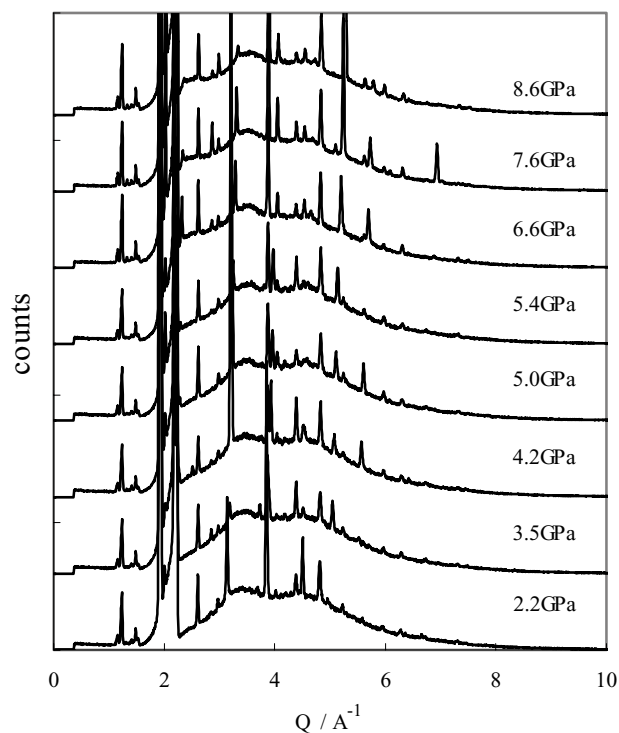


Fig. 1. Example of the diffraction intensity of liquid GeTe at several pressures.

References

- [1] T. Hattori *et al.*, Phys. Rev. **B 68**, 224106 (2003).
- [2] T. Hattori *et al.*, J. Phys.: Condens. Matter **16**, S997 (2004).
- [3] T. Hattori *et al.*, Phys. Rev. **B72**, 064205 (2005).
- [4] T. Kinoshita *et al.*, Phys. Rev. **B 72**, (2005) 060102R-1-4.
- [5] T. Hattori *et al.*, Phys. Rev. **B 73** (2006) 054203-1-9.
- [6] T. Narushima *et al.*, Proc. 20th AIRAPT Conference, Karlsruhe, 2005, T2-O80.

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