Structure of liquid InSb under pressure

Takanori HATTORI, Naohito TAGA, Yukinobu TAKASUGI, Tomohiro KINOSHITA,
Kazuhiko TSUJI*
Keio Univ., Hiyoshi, Kohoku-ku, Yokohama 223-8522, Japan

Introduction

In order to elucidate the effects of the ionicity in chemical bonding on the structure of covalent liquids, we have investigated the structure of liquid III-V compounds. Recently we reported the structure of liquid GaSb [1] under pressure, which is relatively less ionic among III-V compounds. Succeeding to the study, we have investigated the structure of liquid InSb, which is more ionic than liquid GaSb, at pressures up to 6.7 GPa.

Experimental

X-ray diffraction patterns were taken by an energy-dispersive method using the synchrotron radiation source and the multi-anvil high-pressure apparatus. The pressure and temperature conditions of the measurements are shown in Fig. 1, together with the previously reported phase diagram [2,3]. The data were taken by MAXIII and MAX80 installed at BL-14C2 and AR-NE5C, respectively.

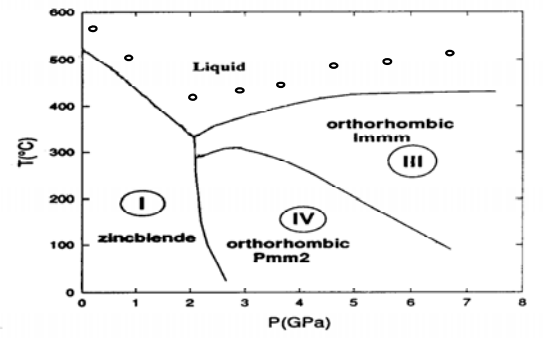

Fig.1 PT conditions for the data collection.

Results and Discussion

The structure factors, S(Q), at high pressures are shown in Fig. 2. The presence of the shoulder at the right-side of the first peak implies a non-simple local structure in the liquid. With increasing pressure, the first and second peaks shift toward lower and higher Q values, respectively. It shows that, in a microscopic scale, the local structure of liquid InSb does not contract uniformly, but changes anisotropically with increasing pressure.

The pair distribution functions, g(r), at high pressures are shown in Fig. 3. The position of the first peak is almost constant with increasing pressure in spite of the volume contraction. On the other hand, the positions of the hump and the second peaks shift markedly with pressure. From the analysis of g(r) on the basis of a quasi-crystalline model, it is suggested that the local structure of liquid InSb consists of the mixture of the beta-tin-like and the body-centred cubic (bcc)-like structures. The fractional ratio of bcc was found to increase with pressure. Corresponding to this view, the coordination number of liquid InSb increases from about 5.8 to 7.5. These results shows that liquid InSb contacts by changing its local structure from the low coordinated beta-tin-like structure to the high-coordinated bcc-like one under pressure. The pressure-induced change in the local structures is almost the same as that in liquid GaSb. In spite of the difference of ionicity in chemical bonding between InSb and GaSb, no remarkable differences were observed in their local structures and the pressure dependence.

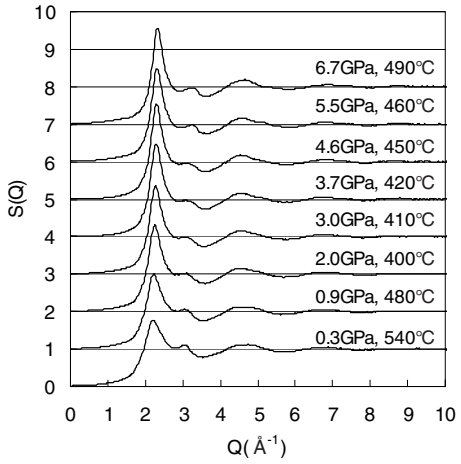

Fig. 2 S(Q) of liquid InSb at high pressures.

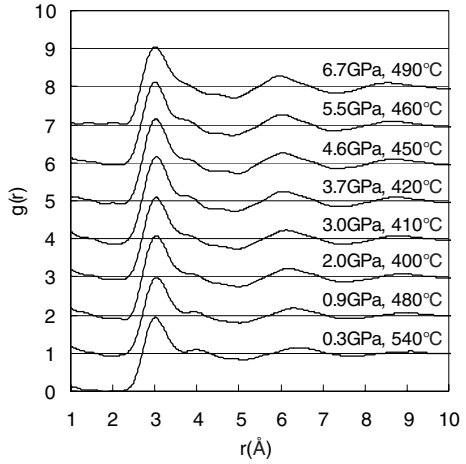

Fig. 3 g(r) of liquid InSb at high pressures.

References

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* tsuji@phys.keio.ac.jp