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Pressure dependence of the structure of liquid $Sn_{0.74}Pb_{0.26}$ alloy

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Introduction

It is known that the crystal structures in the same group elements generally have universalities of their pressure-induced phase transitions: they transform into those of the heavier atoms with increasing pressure. However, it isn't applicable for some group14 elements. On the other hand, the pressure-induced structural change of liquids is different from that of crystals: Liquids of group 14 elements have universalities in pressure dependence of local structure [1-4].

The melting temperature of eutectic $Sn_{0.74}Pb_{0.26}$ alloy is lower than those of Sn and Pb. Large entropy term in the free energy should reduce the free energy of liquids. For the structure of liquid eutectic $Sn_{0.74}Pb_{0.26}$ alloy, two models have been proposed: (1) a mixture of local structures of liquid Sn and liquid Pb, and (2) a structure which is different from those of liquid Sn and liquid Pb.

X-ray diffraction was measured for liquid Pb and liquid eutectic $Sn_{0.74}Pb_{0.26}$ alloy.

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 PF-AR-NE5C. From the measured diffraction intensities, the static structure factors *S(Q)* of liquid metals were deduced.

Results and discussion

With increasing pressure, the local structure of liquid Pb contracts uniformly as shown in Fig.1. On the other hand, *S(Q)* of liquid $Sn_{0.74}Pb_{0.26}$ is drastically changed at about 6GPa and 8GPa. We found that three kinds of local structures (1) from 1.4 GPa to 5.7 GPa, (2) from 6.1GPa to 7.7 GPa and (3) from 9.9 GPa to 12.9 GPa are different. The pressure dependence of the local structure of liquid liquid$Sn_{0.74}Pb_{0.26}$ alloy is different from those in other group 14 elements. The changes around 6 GPa and 8 GPa may arise from the pressure-induced phase transitions in the crystalline phase.

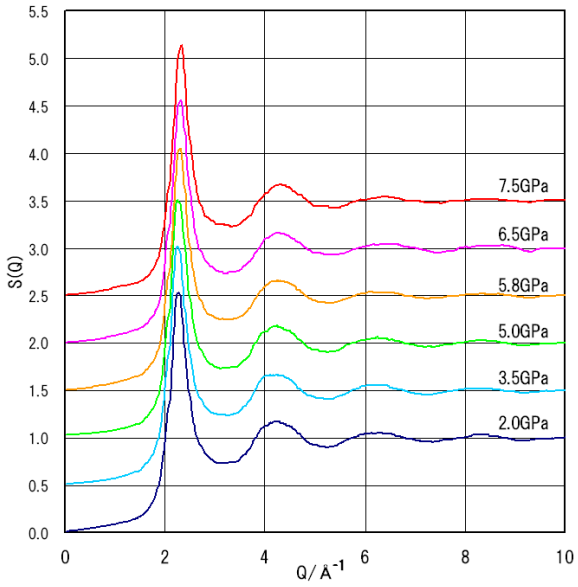

Figure 1. *S(Q)* of liquid Pb at various pressures. Uniform contraction of the local structure of liquid was observed.

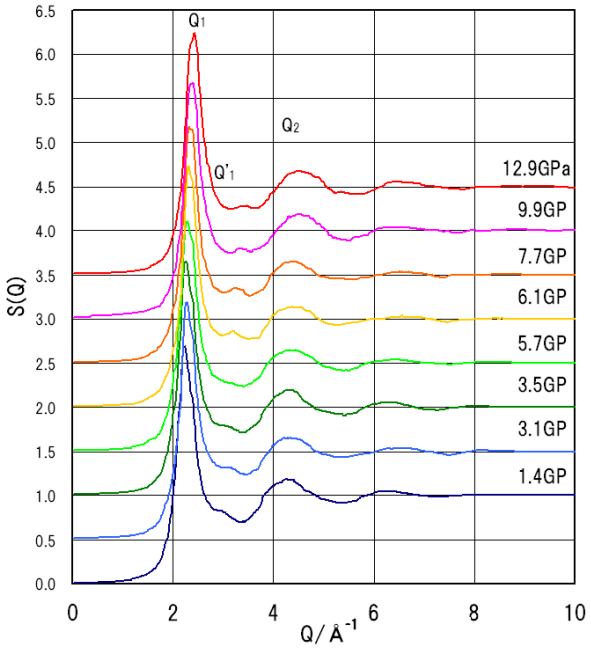

Figure 2. *S(Q)* of liquid $Sn_{0.74}Pb_{0.26}$ alloy at various pressures. Structural changes were observed around 6 GPa and 8 GPa.

References

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