X-ray Diffraction Measurements for Expanded Fluid Selenium

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A great deal of effort has been made to study the semiconductor-metal (SC-M) transition of fluid Se which occurs in the supercritical region near the liquid-gas critical point (the critical data of Se [1]: Tc=1615 ℃, pc=385 bar, dc=1.85 g/cm^3). To understand the SC-M transition it is very important to investigate how the atomic arrangement is changed when fluid Se is expanded. Recently x-ray diffraction measurements using an in-house x-ray source were made for expanded fluid Se, giving information on the first neighbour coordination [2]. In this report the first experiments of the x-ray diffraction measurements using synchrotron radiation, extending from the liquid to the dense vapor region, are described.

We have performed energy-dispersive x-ray diffraction measurements for expanded fluid Se using the spectrometer installed at the BL-04B1 in SPring-8. The storage ring was operated at 8 GeV with 20 mA. White x-rays were generated through the bending magnet ranging energy up to 150 keV. The incident x-ray beam was collimated down to 0.2×0.2 mm^2 using the horizontal and vertical slits located at the upper stream. After a careful setup of the internally-heated high pressure vessel, which permits the measurements up to 1700℃ and 2000 bar, the good experimental condition was achieved.

The fluid Se was contained in the specially designed sapphire cell being transparent to x-rays and resistant to chemical corrosion by fluid Se [2]. The sample thickness was 400 μm in the experiments. The x-ray diffraction measurements were carried out at constant pressure of around 800 bar in the temperature ranges from 300 ℃ to 1500 ℃.

After the data analysis [2], the interference function, *S(k)*, of fluid Se at each temperature and pressure are obtained. Figure 1 shows *S(k)* of fluid Se at high temperatures and high pressures. Further analysis is now in progress.

[1] S. Hosokawa, T. Kuboi and K. Tamura, Ber. Bunsenges. Phys. Chem. **101** (1997) 120.
[2] K. Tamura and S. Hosokawa, Ber. Bunsenges. Phys. Chem. **96** (1992) 681.

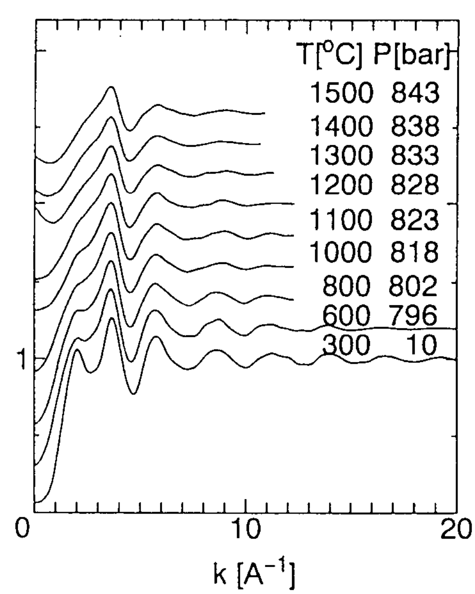

Figure 1. *S(k)* of fluid Se