Static and Dynamic Structure of Supercritical Fluid Metals

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Liquid metals transform into an insulating state with volume expansion. The metal-nonmetal (M-NM) transition in expanded fluid metals has been an important subject in studies on liquid metals. Continuous volume expansion from liquid to vapor is possible by passing through the supercritical region above the liquid-vapor critical point as indicated in Fig.1. So far, great numbers of studies on the M-NM transition in expanded fluid Hg have been reported due to the lowest critical temperature of 1751 K (the critical pressure is 167 MPa) among liquid metals after the first indication of the M-NM transition by Hensel and Frank [1]. In general the large critical constants in liquid metals have forced one to conduct experiments under extreme conditions of high temperature and high pressure.

We have carried out structural studies on expanded fluid metals such as fluid Hg, Rb and Se up to the supercritical region using synchrotron radiation at SPring-8 to understand the microscopic mechanism in the M-NM transition [2]. The results of inelastic X-ray scattering measurements for expanded fluid Hg show that the excitation energy of the acoustic mode disperses three times faster than the adiabatic sound velocity in the M-NM transition [3]. Static structure factors of expanded fluid Hg obtained from wide and small angle X-ray scattering were recently related to the large fast dispersion in the M-NM transition [4]. In this talk we will present how the static structure was related to the dynamic one in expanded fluid Hg in detail and report a possibility of the fluctuation inherent to the M-NM transition in expanded fluid metals.

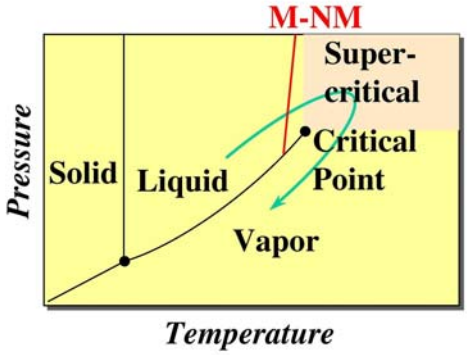

Figure 1: Schematic phase diagram of Hg. The M-NM transition occurs at 9 gcm-3 indicated by a red line.

References

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