ESRF	Experiment title: The Dynamic Structure Factor of Expanded Liquid Sodium	Experiment number: HS-364
Beamline: ID16	Date of experiment: from: 16.-Sept.-97 to: 27-Sept-97	Date of report: 08 Feb. 1998
Shifts: 24	Local contact(s): Claudio Masciovecchio	*Received at ESRF:* 13 FEV. 1998

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Report:

Liquid alkali metals are typical examples of liquids with state dependent structural and electronic properties /l/. If their density is reduced in expanding them along the liquid-vapour coexistence line the conduction electrons continuously localise at their parent atoms causing the interatomic interactions to change gradually. It is therefore expected, that structure and dynamic of the liquid should noticeably vary with density. In contrast to dense Lennard-Jones systems the dynamic of dense liquid alkali-metals is characterised by solid state like longitudinal collective excitations /2/. One of our objectives in the reported experiment was to investigate the density dependence of this property. Another purpose of the experiment was the identification of molecular structures in the metallic liquid. Results from inelastic neutron scattering experiments on liquid rubidium indicate that such units similar to those known from the dilute vapour phase may also be formed in the liquid under conditions of sufficient expansion /3/.

The experiments were carried out using our newly developed high-temperature high-pressure setup, designed for the use in x-ray scattering experiments under pressures up to 190bar and 2000K. $S(Q,\omega)$ for liquid sodium could be measured for several states along the vapour-pressure curve at 388K, 773K, 1073K, 1173K, 1173K, 1273K and corresponding pressures to keep the metal in the liquid phase. It is found that collective excitations can be observed up to the high temperatures and pressures applied in this experiment. The corresponding dispersion relations as obtained from fitting a set of three lorentzians to each spectrum at constant momentum transfer are given in figure 1. Figure 2 shows the development of the scattering law along the measured density range exemplary for $Q \approx 0.7 Å^{-1}$. It is apparent that the scattering law is still characterised by collective excitations even at the highest temperature obtained.

Indications for the existence of molecular units in the liquid were not yet found. To investigate this phenomenon further, additional experiments at higher T and p are necessary.

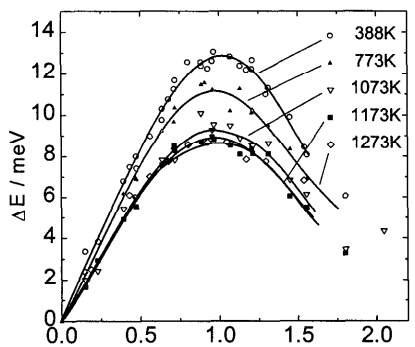

Figure 1

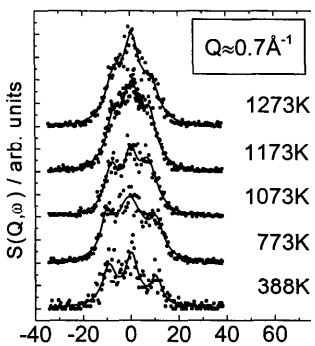

Figure 2

/I/ F. Hensel, Physica Scripta T25,283 (1989)

/2/ J. R. D. Copley and M . Rowe, Phys. Rev. A 9, 1656 (1974)

/3/ W.-C. Pilgrim, M. Ross, L. Yang, F. Hensel, Phys. Rev. Lett. 78,3685 (1997)