TEMPERATURE DEPENDENCE OF THE RESISTIVITY OF LIQUID ALKALI METALS

V.Veljković, S.Zeković, F.Vukajlović
Laboratory for Theoretical Physics
Boris Kidrič Institute, Beograd

In the preceding report /1/ we gave the results of the liquid metal resistivites calculated by means of Ziman theory of transport properties /2/ and general model pseudopotential (GMP) /3/. Good agreement between the theoretical and experimental results obtained there, triggered the folowing investigations of the temperture dependence of the resistivities of liquid Na and Rb. Our calculations are compared with experimental and some other theoretical results /4/.

In the calculation of the temperature dependence we have followed different procedures for Na and Rb /4/. For Na the variation of compressibility with temperature is known experimentally and from the thermodynamic limit for long wave lenght

$$a(0) = n k_B T \chi_T \qquad (1)$$

where χ_T is isothermal compressibility, n is number density, it is possible to get the variation of the packing density η with temperature /4/.

Theoretical hard sphere value for a(0) is:

$$a(0) = (1-\eta)^4 \cdot (1+2\eta)^{-2} \qquad (2)$$

The temperature dependence of η can be obtained from (1) and (2).

Besides the averaged form for GMP, given with the expressions (2) in the report /1/, the temperature dependence of resistivities is also calculated with the orginal form of GMP. The original expression for GMP with the parameter β_2 tabulated in /3/ is

$$\langle \vec{k}+\vec{q} | W | \vec{k} \rangle = -\frac{2}{3} E_F \cdot \frac{\sin(2\pi/\beta_2 \cdot q/2k_F)}{2\pi/\beta_2 \cdot q/2k_F} \qquad (3)$$

Our calculations for Na with Hartree (HAR) and Sham (SH) /5/ dielectric functions and potentials (2) in /1/ and (3) are given in fig. 1a.

Compressibility data for Rb are not available. The neutron difraction experiments were performed at for temperatures, and the authors of the work /4/ had determined the parameter η by fitting a(K) to give the correct height, a_{max} of the structure factor.

The temperature dependence of the resistivity of liquid Rb with mentioned potentials and dielectric functions are given in fig. 1b. We have taken the effective mass to be unity for the Na and Rb.

In conclusion, we want to point out that the agreement between our theoretical and experimental results is good. This indicate that the simple form of GMP can be successfuly used for investigations of other electronic properties.

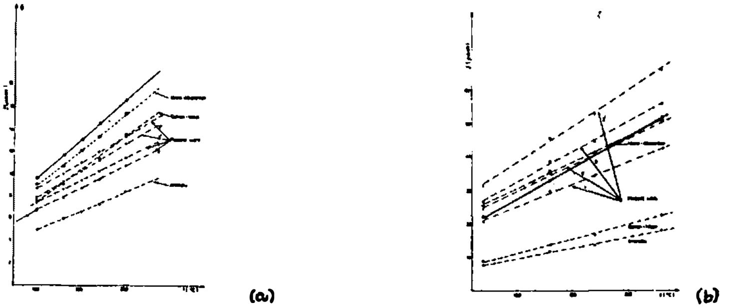

Fig. 1 Temperature dependence of the resistivity of liquid Na (a) and liquid Rb (b). Experimental points are given by triangles. Resistivities corresponding to some other potentials /4/ are given by dashed curves. Our results 1(HAR), 1'(SH) and 2(HAR), 2'(SH) were obtained on the basis od designated dielectric functions and potentials (3) and (2) (Ref./1/), respectively.

References

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