

because they give a measure of the angular orbit. This may be seen from the electron of wavenumber k in

$$(10)$$

of the electron normal to H at angles to both v and H . Thus the Fermi surface in a plane normal to the orbit is thus, from equation

$$\frac{l}{eH \langle v \rangle} \quad (11)$$

and $\langle v \rangle$ is the harmonic mean of

$$\frac{2\pi \langle v \rangle}{l} \quad (12)$$

(9):

$$\frac{1}{\langle v \rangle} \quad (13)$$

number of orbits, we can in principle find the Fermi surface.

At how m_c^* should change with pressure. According to this model, m_c^* is proportional to S where $S^{1/2}$ is the surface area of the orbits (assuming the orbits do not, except at very low pressure, change in size). Thus from equation

$$\frac{1}{m_c^*} \frac{d \ln \langle v \rangle}{dP} \quad (14)$$

variation of m_c^* over the Fermi surface in the

approximation we are using here and is just proportional to k_F , i.e., to $V^{-1/3}$ where V is the volume of the metal. Thus:

$$\frac{d \ln m_c^*}{dP} = \frac{1}{2} \frac{d \ln S}{dP} - \frac{1}{3} \chi \quad (15)$$

where $\chi = -\frac{1}{V} \left(\frac{\partial V}{\partial P} \right)_T$, the isothermal compressibility of the metal.

O'Sullivan and Schirber tested this relation by measuring both the change with pressure of m_c^* and of S (as we have seen) for the extremal needle orbits normal to b_3 . They found:

$$\frac{d \ln m_c^*}{dP} = 14 \times 10^{-2} \text{ kb}^{-1}$$

compared to:

$$16 \times 10^{-2} \text{ kb}^{-1} \text{ for } \frac{1}{2} \frac{d \ln S}{dP}$$

(The second term on the right hand side of equation (15) is negligible). This again illustrates the value of this very simple, nearly-free-electron model of the Fermi surface.

We now turn to the results on cubic metals, such as aluminium and lead. Before doing so, however, we must see how the theory can be extended to cope with the more subtle changes in the Fermi surface under pressure in cubic materials where the approximation we have used hitherto would predict only a simple scaling effect.

C. THE PSEUDO-POTENTIAL METHOD

The general philosophy behind the pseudo-potential method (for a detailed account, see for example, Harrison, 1966) is that the forces on an electron inside an ion core are (1) a large attractive interaction with the nucleus and (2) a complicated interaction that arises from the presence of the other occupied electron orbitals about the nucleus. In some cases the second part can be considered to be derived from a repulsive potential (the pseudo-potential) which largely offsets the attractive potential corresponding to the first force. There thus remains a small effective potential which can be treated by standard methods, for example, by perturbation theory.