Now $\beta(V)$ can be found from

$$\beta = (1-h)\rho_\theta = (1-h)\ (\alpha\,\theta + \beta)$$

$$\beta(V) = \frac{(1-h)}{h}\ \alpha\ (V)\ \theta(V)$$

Finally, the hydrostat is given by

$$\frac{\rho(V,T)}{\rho(V_o,T)} = \frac{\alpha\ (V)}{\alpha\ (V_o)}\ \frac{\left(1 + \frac{1-h}{h}\ \frac{\theta(V)}{T}\right)}{\left(1 + \frac{1-h}{h}\ \frac{\theta(V_o)}{T}\right)} \qquad (4)$$

This implies that at 120 kbar α/α_o (Eq. (3)) is multiplied by 0.977.

For the resistivity change due to the shock temperature rise, the form used was

$$\frac{\Delta\rho_T}{\rho_o} \equiv \frac{\rho(V,T) - \rho(V,T_o)}{\rho(V_o,T_o)} = \frac{\alpha\ (V)}{\alpha\ (V_o)}\left(\frac{T}{T_o} - 1\right) \Big/ \left(1 + \frac{\beta(V_o)}{\alpha(V_o)T_o}\right)$$

(T_o is 298°K and V and T are volume and temperature in the shocked state.)

The isothermal shock resistivity one wishes to compare to the hydrostatic resistivity (Eq. (4)) is

$$\frac{\rho(V,T_o)}{\rho(V_o,T_o)} = \frac{\rho(V,T) - \Delta\rho_T}{\rho(V_o,T_o)}\ .$$

From the shot one obtains $\rho(V,T)/\rho(V_o,T_o')$ where T_o' is ambient temperature. This varied from 295.6° to 298.4°K. The relation needed is

$$\frac{\rho(V,T)}{\rho(V_o,T_o)} = \frac{\rho(V,T)}{\rho(V_o,T_o')}\ \frac{\rho(V_o,T_o')}{\rho(V_o,T_o)}$$

where

$$\frac{\rho(V_o,T_o')}{\rho(V_o,T_o)} = 1 + a(T_o' - T_o)$$

($a = 0.00408/°K$). The above forms for isothermal resistivity were used in analyzing the data.

5. Resistance to Resistivity Transformation

What is measured in the experiment is the resistance ratio, R/R_o. For a slab geometry resistance is related to resistivity by $R = \rho L/A$, where L is the length and A is the cross-sectional area. In the shock wave experiment the compression is in one dimension only so that L is unchanged and A is decreased. Hence,

$$\frac{\rho}{\rho_o} = \frac{R}{R_o}\ \frac{A}{A_o} = \frac{R}{R_o}\ \frac{V}{V_o}$$

since $V/V_o = (AL)/(A_oL)$.

In a hydrostatic compression, however, all dimensions decrease by the same proportion. So

$$\frac{\rho}{\rho_o} = \frac{R}{R_o}\ \frac{A}{A_o}\ \frac{L_o}{L}\ .$$

But $A/A_o = (L/L_o)^2 = (V/V_o)^{2/3}$. Finally, then

$$\frac{\rho}{\rho_o} = \frac{R}{R_o}\ \frac{L}{L_o} = \frac{R}{R_o}\left(\frac{V}{V_o}\right)^{1/3} .$$

6. Piezoresistance Effects

The effect of the piezoresistance tensor of isotropic elastic material in the present work was considered (Ginsberg, Grady and DeCarli, 1972; Barsis, Williams, and Skoog, 1971).