

Fig. 9. The activation energy of viscosity, H_η (in g-cal/g-atom), plotted against melting point (in degrees Kelvin) for various metals.

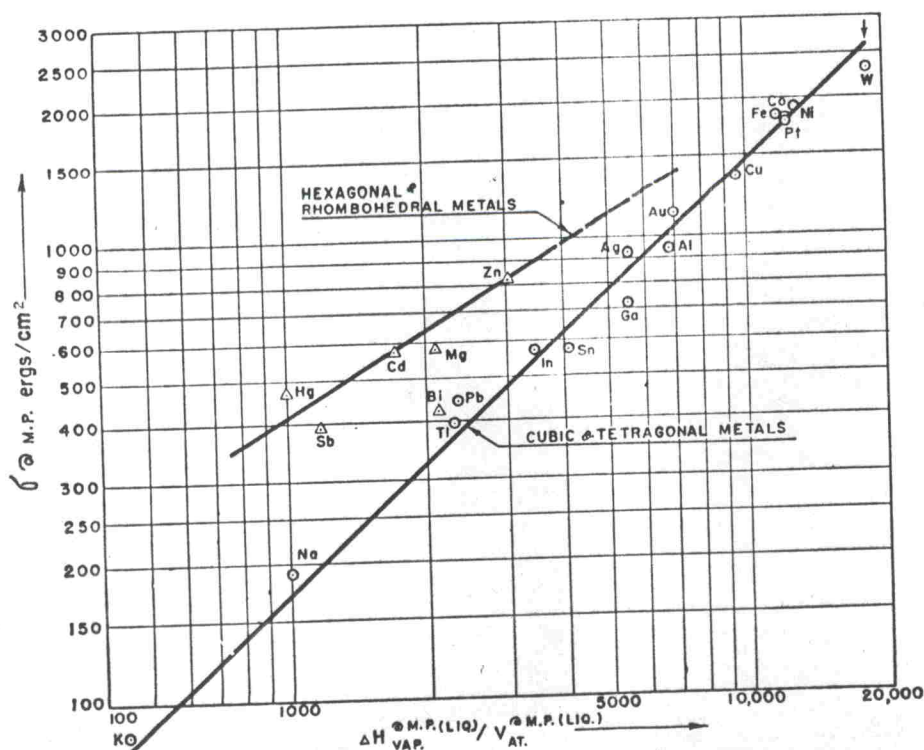


Fig. 10. Surface tension at melting point plotted against heat of vaporization per cubic centimeter at melting point for various metals.

can be readily estimated in accordance with the Widemann-Franz law. I will discuss here, however, only the viscosity and surface tension of liquid metals.

Andrade's simple formula (32) relates the viscosity η (in poises) and T (in degrees Kelvin) according to the expression

$$\eta_T = a \times \exp(H_\eta/RT)$$

It has been found recently (33) that the logarithm of the activation energy of viscosity H_η is a linear function of the logarithm of the melting point of the metal, as shown in Fig. 9.

Expressed in algebraic form, the relationship is

$$\log H_\eta = 1.348 \log T_{mp} - 0.366$$

(where the logarithm is to the base 10), or

$$H_\eta = 0.431 \times T_{mp}^{1.348}$$

This relationship, coupled with Andrade's expression (34) for the viscosity of a liquid metal at the melting point,

$$\eta_{mp} = 5.7 (A \times T_{mp})^{1/2} / (10^4 V_{at}^{2/3})$$

where A is atomic weight and V_{at} is atomic volume, permits us to estimate the viscosity of any metal at any temperature.

A simple relationship, shown graphically in Fig. 10, exists between the surface tension (in dynes per centimeter or ergs per square centimeter) of a liquid metal (at saturated-vapor pressure) at its melting point, σ_{mp} , and its heat of vaporization per cubic centimeter, $\Delta H_{vap}^{119}/V_{at}$, at its melting point. Clearly, the surface tensions of metals belonging to the cubic or tetragonal systems lie along one straight line, while those of metals of the hexagonal or rhombohedral systems fall on a second and higher line. This fact tends to support the current belief that some elements of the crystal structure or space configuration of the solid state persist in the liquid state.

A practically equivalent relationship, also represented by two lines for the two types of metals, exists between the total surface energy Σ [which equals the product of σ and O_{at} , where O_{at} is the total surface in square centimeters per gram atom ($1.091 \times V_{at}^{2/3} \times N^{1/3}$ for close-packed spheres)] and the heat of vaporization.

This relationship was first deduced theoretically by Skapski (35); Taylor (36) used it to predict unknown sur-