

γ -uranium, the stable modification of the element at high temperatures, is body-centred cubic with a space lattice constant = 3.48 Å at 785°C.⁽¹¹⁾ This corresponds to a density = 18.78 g/cm³ at 785°C. At the melting point of U, = 1133 ± 2°C or 1406°K,⁽¹¹⁾ the density of the solid = 18.39 g/cm³, based on a linear coefficient of thermal expansion = 1.92 × 10⁻⁵ °K⁻¹. Assuming, as is true for a number of metals, a volume increase on fusion = +2.5 per cent, the density of liquid uranium, at the melting point, should equal: 17.92 g/cm³, or have $V_A = 13.28$ cm³/g atom. ANDRADE'S formula for η at the melting point (see p. 333) applies to uranium, since it is body-centred cubic and leads to the value:

$$\eta_{m.p.} = \frac{5.7 \times 10^{-4} \cdot \sqrt{(258.07 \cdot 1406)}}{13.28^3} = 5.86 \times 10^{-2} \text{ poise}$$

$$= 5.86 \text{ centipoise at } 1406^\circ\text{K.}$$

The interpolated activation energy, H_η for a metal melting at 1406°K., from Fig. 2, = 4300 cal/g atoms. Thus the viscosity of liquid uranium, η_u ,

$$\eta_u = a \cdot \exp(4300/RT).$$

At the melting point or 1406°K.

$$\eta_u = 5.86 \times 10^{-2} = a \cdot \exp(4300/1.99 \cdot 1406)$$

and thus the constant a for uranium,

$$a = 12.62 \times 10^{-3} \text{ poise.}$$

The final Andrade equation becomes:

$$\eta_u = 12.62 \times 10^{-3} \cdot \exp(4300/RT) \text{ poises.}$$

ϵ -plutonium, the high temperature modification, at 500°C., is body-centred cubic.⁽¹⁴⁾ The same is true⁽¹⁵⁾ for thorium. Thus the ANDRADE relationship (see p. 336) applies to both metals.

TABLE 2.—PHYSICAL CONSTANTS OF LIQUID URANIUM, PLUTONIUM AND THORIUM⁽¹²⁾

	A	$T_{m.p.}$ (°K)	$D_{liq. at m.p.}$ (g/cm ³)	V_A (cm ³ /g)	H_η (cal/g atom), from Fig. 2.	η , (centipoise) at m.p. at 2000°K.	
U	238	1406	17.92 (est.)	13.28	4300	5.88	3.71
Pu	239	912.7	16.639 ⁽¹³⁾	14.36	3200	4.51	1.72
Th	232	2020	10.79 (est.)	21.55	5300	5.04	—

⁽¹¹⁾ J. KATZ and E. RABINOWITCH, *National Nuclear Energy Series, The Chemistry of Uranium*, Div. VIII, Vol. 5, pp. 133–152. McGraw-Hill, New York (1951).

⁽¹²⁾ See J. J. KATZ and G. T. SEABORG, *The Chemistry of Actinide Elements*. J. Wiley, New York (1957).

⁽¹³⁾ C. E. OLSEN, T. A. SANDERNAW and C. C. HERRICK, Report LA-2358 (1959); in contrast to most other metals plutonium contracts on melting.

⁽¹⁴⁾ J. J. KATZ and G. T. SEABORG, *The Chemistry of Actinide Elements*, pp. 266–267. J. Wiley, New York (1957).

⁽¹⁵⁾ J. J. KATZ and G. T. SEABORG, *The Chemistry of Actinide Elements*, pp. 28, 29 and 30. J. Wiley, New York (1957).