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CMI-2154

To: Mr. C. C. Bigelow

From: D. P. Gregory & H. W. Leavenworth

November 20, 1959

Subject: Diffusion of Xenon in Columbium

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Normally the inert gases A, Ke, and Xe are insoluble in metals and will not diffuse through them, even at high temperatures and pressures. LeClair(1) and Tobin(2) have found that these gas atoms are very mobile and will diffuse through silver if the gas is introduced into the metal by some energetic process. The diffusion coefficients that they determined are:

A in Ag: $D = 0.12 \exp. (-33,600/RT)$ cm^2/sec

Kr in Ag: $D = 1.05 \exp. (-35,000/RT)$ cm^2/sec

Xe in Ag: $D = 0.036 \exp. (-37,500/RT)$ cm^2/sec

These elements should not permeate columbium unless they too are introduced into the metal lattice by some energetic process such as fission fragments from a nuclear reaction.

Assuming that this reaction has taken place it then becomes necessary to determine the extent of their mobility by calculating diffusion coefficients as a function of temperature. Although there is little data available on the physical properties of these elements, the authors were able to calculate the bulk modulus of Xe from the silver data by using the equations of Swalin(3). This value of the bulk modulus was then used in the equations of Leavenworth and Gregory(4) to calculate the diffusion coefficient for the diffusion of Xe through Cb. The result of this effort is

$$D = 0.064 \exp. (-18,600/RT)$$

This equation means that Xe will diffuse rapidly in columbium at temperatures greater than 1000°F.

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3. R. A. Swalin, "A Model for Solute Diffusion in Metals", Acta Met. 5, 443 (August 1957)

4. H. W. Leavenworth & D. P. Gregory, "A Model for Diffusion in BCC Lattice", FEM

END