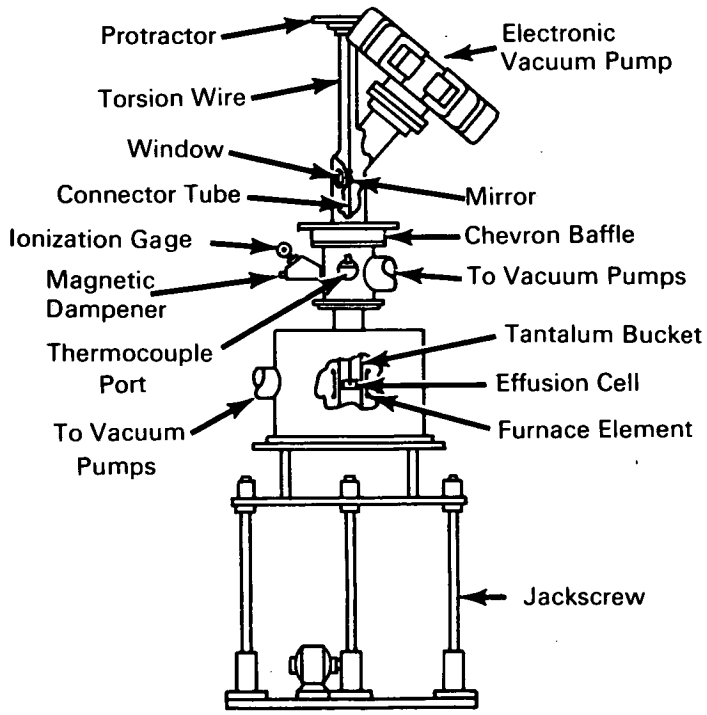
September 1967

Brief 67-10324

AEC-NASA TECH BRIEF

Thermodynamic Properties of Solid Palladium–Silver Alloys and Other Alloys Are Investigated by Torsion–Effusion Technique



The problem:

To obtain the thermodynamic properties of transition-metal alloys in order to study the contributions to these properties associated with changes in the electronic structure upon alloying. The electromotive-force method was rejected because the desired emf is often masked by interfering side reactions. The Knudsen vapor-pressure method also was rejected because of the possibility of surface depletion and contamination during the long experimental runs.

The solution:

The thermodynamic properties of several transition-metal alloy systems were derived from vapor pressure data obtained by the torsion–effusion method. For example, the vapor pressure of silver over solid silver and over palladium–silver alloys was measured by this method in the temperature range of 1100° to 1300°K. The results were more accurate than those found previously by the emf technique, and enabled the computation of the chemical activities, free energies,

(continued overleaf)

entropies, and enthalpies of formation of the alloys at 1200°K.

The activities of silver exhibit large deviations from ideal behavior over the entire compositional range. The activities of palladium deviate positively in the palladium-rich alloys and negatively in the silver-rich alloys. Since the excess entropies and enthalpies, both of which are negative, agree with the values found by calorimetric methods, it is evident that the data are quite reliable. The palladium–silver alloy system was selected for the investigation because the band structure is known and other information related to the properties of the electrons is available.

How it's done:

The alloys were prepared by arc-melting the required amounts of pure palladium and silver on a water cooled hearth in a helium–argon atmosphere. The specimens were homogenized, quenched, and machined into coarse turnings, which were then cleaned and loaded into tantalum effusion cells. The cells, which have two eccentrically located orifices, are suspended vertically from a fine tungsten wire. An elastic torsional strain is induced in the wire as the metal vapor effuses through the orifices. The vapor pressure, p, is related to the angle through which the cell rotates, θ, by the expression $p = 2\tau\theta/\Sigma$ Adf, where τ is the torsion constant of the wire, A is the cross-sectional area of the orifice, d is the horizontal distance of the orifice from the suspension axis, and f is the orifice correction factor.

Notes:

1. Additional information is contained in:
   (a) *Acta Metallurgica,* vol. 13, Feb. 1965, p. 109–113
   (b) *Jour. Phys. Chem.,* vol. 68, no. 1, Jan. 1964, p. 64–69.
   (c) *A Study of the Thermodynamic Properties of the Vanadium-Iron Alloy System,* by Kevin Michael Myles, ANL-6657, Argonne National Laboratory, Feb. 1963. This report is available from the Clearinghouse for Federal Scientific and Technical Information, Springfield, Virginia 22151, $3.00 each (microfiche, $0.65).
2. Inquiries concerning this innovation may be directed to:

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   Reference: B67-10324

   Source: K. M. Myles,
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Patent status:

Inquiries about obtaining rights for commercial use of this invention may be directed to:

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