

Effect of High Pressure on Self-Diffusion in Concentrated FeCo Alloys*

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The effect of high pressure on the diffusion of Fe^{59} in near-equiatomic FeCo alloys has been measured at 944.5°C. The value of the activation volume determined from these measurements is $4.38 \pm 0.89 \text{ cm}^3/\text{mole}$ or 0.60 ± 0.12 times the molar volume. ΔK obtained from this value of ΔV is compared to the earlier reported value from isotope-effect measurements, $\Delta K = 0.73$. The values of both of these parameters indicate that diffusion in the disordered phase of bcc FeCo is similar to that expected for a simple monatomic metal.

In recent work, measurements of the mass dependence or isotope effect for self-diffusion in near-equiatomic FeCo alloys have been reported.¹ It was found that in the fcc and disordered bcc phases of this system, the magnitude of the isotope-effect parameter $E_{F_e} = f_{F_e} \Delta K$ was approximately equal to values found in corresponding monatomic metals, where diffusion is by a simple monovacancy mechanism. In the ordered bcc region, however, E_{F_e} was observed to decrease drastically with decreasing temperature, which could indicate an increasing amount of correlation. This effect is consistent with the high degree of correlation expected for the six-jump vacancy mechanism thought to be operative in such CsCl-type ordered metallic alloys.^{2,3} In the expression for E , f is the correlation factor and ΔK is defined as the fraction of the total kinetic energy of a single diffusion jump which is possessed by the jumping atom. By its definition, ΔK is thus closely related to the degree of nontracer atom participation in the diffusion jump process.

Another parameter which measures the cooperative motion of nontracer atoms, or the amount of relaxation around lattice defects, is the activation volume ΔV determined from measurements of the pressure dependence of diffusion.⁴ In this note are reported measurements which were made of the diffusion at several pressures of Fe^{59} in the disordered bcc phase of near-equiatomic FeCo alloys. The value of the activation volume so obtained is compared with those measured in other metallic systems and with the approximate value of ΔK calculated previously for this alloy system.

The growth and preparation of the large-grained FeCo specimens used in this work were the same as described previously.¹ The specimens were hand polished and plated with Fe^{59} by evaporation. A thin polished cap of FeCo was then pressure

welded to the plated face using a molybdenum welding rig similar to that described by Mock.⁵ The purpose of the cap was to prevent oxidation or evaporation of the tracer during the diffusion anneal.

The high-pressure diffusion anneals were carried

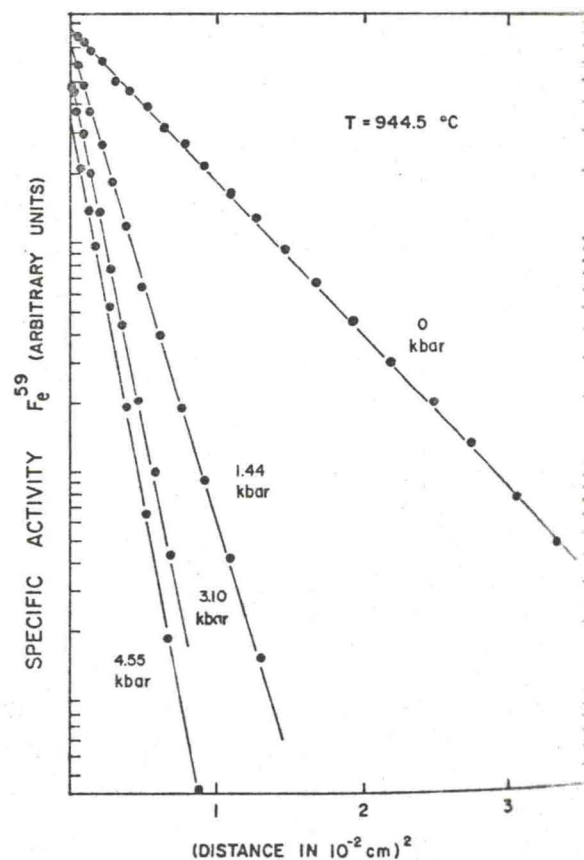


FIG. 1. Penetration profiles for diffusion of Fe^{59} into equiatomic FeCo alloys at 944.5°C.