

THEORY

1. The Diffusion Problem

There are two basic approaches to the diffusion problem. The first, or atomic approach, is through the solution of a random walk problem. This method considers, statistically, the probability of an atom migration from one site in a crystal lattice to another by a series of random jumps over some potential barrier. The second, or macroscopic approach, is through the solution of Fick's law for various boundary conditions.¹⁴ Of the two, the random walk approach comes closer to dealing with the actual physical situation; but in doing so, is much more complicated mathematically than the second. However, problems of this type have been solved for special geometries (see, for instance, Ree¹⁵ or Shewmon).¹³ Both approaches lead to the same asymptotic form for the equations involving observable properties of the diffusion system.

2. Criteria for Diffusion

Chemical diffusion, in a macroscopic sense, is the mechanism by which a heterogeneous chemical system approaches equilibrium. Thermodynamically, the criteria that such a system be in equilibrium is that the chemical potential of each component of the system be constant throughout the system.¹⁶