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Thermodynamics; 2.2 Linear Irreversible Thermodynamics; 2.2.1 General Coupling between Forces and Fluxes; 2.2.2 Force-Flux Relations when Extensive Quantities are Constrained; 2.2.3 Introduction of the Diffusion Potential; 2.2.4 Onsager's Symmetry Principle; Bibliography; Exercises; 3 Driving Forces and Fluxes for Diffusion; 3.1 Concentration Gradients and Diffusion
3.1.1 Self-Diffusion: Diffusion in the Absence of Chemical Effects
3.1.2 Self-Diffusion of Component i in a Chemically Homogeneous Binary Solution; 3.1.3 Diffusion of Substitutional Particles in a Chemical Concentration Gradient; 3.1.4 Diffusion of Interstitial Particles in a Chemical Concentration Gradient; 3.1.5 On the Algebraic Signs of Diffusivities; 3.1.6 Summary of Diffusivities; 3.2 Electrical Potential Gradients and Diffusion; 3.2.1 Charged Ions in Ionic Conductors; 3.2.2 Electromigration in Metals; 3.3 Thermal Gradients and Diffusion; 3.4 Capillarity and Diffusion
3.4.1 The Flux Equation and Diffusion Equation
3.4.2 Boundary Conditions; 3.5 Stress and Diffusion; 3.5.1 Effect of Stress on Mobilities; 3.5.2 Stress as a Driving Force for Diffusion: Formation of Solute-Atom Atmosphere around Dislocations; 3.5.3 Influence of Stress on the Boundary Conditions for Diffusion: Diffusional Creep; 3.5.4 Summary of Diffusion Potentials; Bibliography; Exercises; 4 The Diffusion Equation; 4.1 Fick's Second Law; 4.1.1 Linearization of the Diffusion Equation; 4.1.2 Relation of Fick's Second Law to the Heat Equation
4.1.3 Variational Interpretation of the Diffusion Equation
4.2 Constant Diffusivity; 4.2.1 Geometrical Interpretation of the Diffusion Equation when Diffusivity is Constant; 4.2.2 Scaling of the Diffusion Equation; 4.2.3 Superposition; 4.3 Diffusivity as a Function of Concentration; 4.4 Diffusivity as a Function of Time; 4.5 Diffusivity as a Function of Direction; Bibliography; Exercises; 5 Solutions to the Diffusion Equation; 5.1 Steady-State Solutions; 5.1.1 One Dimension; 5.1.2 Cylindrical Shell; 5.1.3 Spherical Shell; 5.1.4 Variable Diffusivity; 5.2 Non-Steady-State Diffusion
5.2.1 Instantaneous Localized Sources in Infinite Media

Sommario/riassunto

A classroom-tested textbook providing a fundamental understanding of basic kinetic processes in materials. This textbook, reflecting the hands-on teaching experience of its three authors, evolved from Massachusetts Institute of Technology's first-year graduate curriculum in the Department of Materials Science and Engineering. It discusses key topics collectively representing the basic kinetic processes that cause changes in the size, shape, composition, and atomistic structure of materials. Readers gain a deeper understanding of these kinetic processes and of the properties and applicati

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