

# CONTENTS

<i>preface</i> . . . . .	vii
<b>Chapter 1. DIFFUSION EQUATIONS</b> . . . . .	<b>1</b>
1-1. Fick's First Law . . . . .	2
1-2. Fick's Second Law . . . . .	5
1-3. Solutions to Fick's Law (Constant $D$ ) . . . . .	6
1-4. Kinetics of Precipitation . . . . .	19
1-5. Stress-assisted Diffusion . . . . .	23
1-6. Solutions for Variable $D$ . . . . .	28
1-7. Diffusion in Noncubic Lattices . . . . .	32
<b>Chapter 2. ATOMIC THEORY OF DIFFUSION</b> . . . . .	<b>40</b>
2-1. Random Movement and the Diffusion Coefficient . . . . .	41
2-2. Mechanisms of Diffusion . . . . .	43
2-3. Random-walk Problem . . . . .	47
2-4. Calculation of $D$ . . . . .	54
2-5. Zener's Theory of $D_0$ . . . . .	62
2-6. Empirical Rules for Obtaining $\Delta H$ and $D_0$ . . . . .	65
2-7. Calculation of $\Delta H$ and $\Delta S$ from First Principles . . . . .	67
2-8. Experimental Determination of $\Delta H_t$ , $\Delta H_m$ , and $\Delta S$ . . . . .	71
2-9. Divacancy Formation . . . . .	78
2-10. Effect of Hydrostatic Pressure on Diffusion . . . . .	81
<b>Chapter 3. DIFFUSION IN DILUTE ALLOYS</b> . . . . .	<b>86</b>
3-1. Anelasticity Due to Diffusion . . . . .	87
3-2. Impurity Diffusion in Pure Metals . . . . .	95
3-3. Correlation Effects . . . . .	100
3-4. Diffusion in Dilute Binary Alloys . . . . .	111
<b>Chapter 4. DIFFUSION IN A CONCENTRATION GRADIENT</b> . . . . .	<b>115</b>
4-1. The Kirkendall Effect . . . . .	116
4-2. Darken's Analysis . . . . .	117
4-3. Phenomenological Equations . . . . .	122
4-4. Relationship between Chemical $D_1$ and Tracer $D_1^*$ . . . . .	125
4-5. Test of Darken's Assumptions . . . . .	127
4-6. Ternary Alloys . . . . .	130

4-7. Diffusion in Multiphase Binary Systems . . . . .	132
4-8. Variation of $\tilde{D}$ across a Binary Phase Diagram . . . . .	133
<b>Chapter 5. DIFFUSION IN NONMETALS . . . . .</b>	<b>137</b>
5-1. Defects in Ionic Solids . . . . .	137
5-2. Diffusion and Ionic Conduction . . . . .	140
5-3. Experimental Check of Relation between $\sigma$ and $D_T$ . . . . .	143
5-4. Effect of Impurities on $D_T$ and $\sigma$ . . . . .	145
5-5. Effect of Impurities on Conductivity in Crystals with Frenkel Disorder . . . . .	149
5-6. Relation of $\sigma$ to $D_T$ in AgBr (Frenkel Disorder) . . . . .	151
5-7. Diffusion in Semiconductors . . . . .	155
5-8. Diffusion in Ordered Alloys and Intermetallic Compounds . . . . .	162
<b>Chapter 6. HIGH-DIFFUSIVITY PATHS . . . . .</b>	<b>164</b>
6-1. Analysis of Grain Boundary Diffusion . . . . .	166
6-2. Experimental Results on Grain Boundary Diffusion . . . . .	171
6-3. Dislocation Effects . . . . .	175
6-4. Diffusion Driven by Surface Tension . . . . .	179
6-5. Determination of $D_s$ from Grain Boundary Grooving . . . . .	184
6-6. $D_s$ from Field Emission Studies . . . . .	186
<b>Chapter 7. THERMAL DIFFUSION AND ELECTROLYSIS IN SOLIDS . . . . .</b>	<b>188</b>
7-1. Thermal Diffusion . . . . .	189
7-2. Electrolysis of Solids . . . . .	196
<b>index . . . . .</b>	<b>201</b>