CONTENTS

1.	Crystallography of Phase Transformations		1
	1.1.	Atomic Structure of Crystals, 1	
		Crystal Lattice and Reciprocal Lattice, 2	
		Diffraction and Reciprocal Lattice, 4	
		Phase Transformations and Crystal Lattice,	
		Rearrangements, 11	
	1.5.	Effect of Crystal Lattice Rearrangement on Geometry of	
		Crystal Lattice Planes, 14	
	1.6.	Various Orientations Produced by Phase Transformations,	
		15	
	1.7.	Invariant Plane Strain, 18	
	1.8.	Invariant Plane Strain and Crystal Lattice Plane	
		Orientations, 20	
	1.9.	Worked Examples, 22	
2.	Stabi	ility of Homogeneous Solid Solutions	26
	2.1.	Infinitesimal Fluctuations and the Concept of	
		Metastability, 26	
	2.2.		
3.	Ordering in Alloys		39
	3.1.	Static Concentration Wave Representation of Ordered	
		Phase Structures, 40	
	3.2.	Second-Order Transformations in Phenomenological	
		Theory of Ordering, 48	
	3.3.	Examples for Determining Particular Phase	
		Transformation, 53	
	3.4.	The Equilibrium Equation in the Long-Range Interaction	
		Model, 55	

x CONTENTS

2	3.5.	Static Concentration Waves and Diffraction, 59	
2	3.6.	Application of the Concentration Wave Method to the	
		Solution of the Mean-Field Equation (Simple Lattice), 60	
	3.7.	How to Find the Atomic Arrangement of the Most	
		Stable Superstructure, 65	
	3.8.	Examples of Solution of Mean-Field Equations for	
		Occupation Probabilities, 69	
3	3.9.	Symmetry of Superlattice Points in the Reciprocal Lattice	
		and Stability of Ordered Phases: Stable Structures in Fcc	
		and Bcc Solutions, 73	
	3.10.	Stability of Nonstoichiometric Ordered Phases:	
		Secondary Ordering and Decomposition, 82	
	3.11.	Ordering in Crystals Composed of Several Interpenetrating	
		Bravais Lattices, 90	
9 <u>8</u>	<u></u>		96
4.	Deco	mposition in Alloys	70
	4.1.	Thermodynamics of Decomposition, 97	
	4.2.	Free Energy of Heterogeneous Alloys, 103	
	4.3.	Extreme States of Solid Solutions, 108	
	4.4.	Critical Nucleus in a Solid Solution, 111	
	4.5.	Extreme States of One-Dimensional Heterogeneities in	
	Sir Control	Metastable Alloys, 117	
	4.6.	Worked Examples, 124	
5.	Diff	sion Kinetics in Solid Solutions	128
J.	Dille		
	5.1.	Crystal Lattice Site Diffusion in Solid Solutions, 129	
	5.2.	Percolation Mechanism of "Fast" Atom Substitutional	
	14_ N=	Diffusion in Binary Alloys, 136	
	522 12	Spinodal Decomposition, 138	
	5.4.	Computer Simulation of Spinodal Decomposition:	
		Formation of GP Zones, 143	
	5.5	Short-Range Order Relaxation Kinetics, 152	
6.	Diff	usionless (Martensitic) Transformations in Alloys	157
	6.1.	What is the Martensitic Transformation?, 157	
	6.2.	· · · · · · · · · · · · · · · · · ·	
	6.3.	The Montancitie	
	0.5.	Transformation, 163	
	6.4.	C. Mantanaita Dhaca 167	
	6.5.	- t ca the Theory of Martensite	
	0.5.	Transformations for Cubic-to-Tetragonal Crystal Lattice	
		Rearrangement, 172	
		Transparent	

	6.7.	Lattice Rearrangement: Numerical Example, 179 Slip Model of Formation of Lath Martensite in Ferrous Alloys, 182	
	6.8.	Crystal Lattice Abnormalities of Iron-Carbon Martensite, 190	
7.	Elast	Elastic Strain Caused by Crystal Lattice Rearrangement	
	7.2.	Introduction, 198 Strain Energy of Multiphase Alloy, 201 Strain-Induced Interactions between Coherent New Phase Inclusions, 210	
8.	Morp	hology of Single Coherent Inclusion	213
	8.1.	Strain Energy and Shape of Single Coherent Inclusion within Infinite Matrix, 213	
		Ellipsoidal Inclusion in Anisotropic Parent Phase: Homogeneous Modulus Case, 226	
	8.3.	Limit Transition to Eshelby's Theory of Ellipsoidal Inclusions in Isotropic Matrices, 230	
	8.4.	Ellipsoidal Inclusion in Anisotropic Parent Phase: The Case of Different Moduli, 237	
	8.5.	Crystal Lattice Parameters and Orientation Relations of Coherent Constrained Platelike New Phase Particles, 241	
	8.6.	Habit Plane and Orientation Relations of Tetragonal Precipitates in Cubic Parent Phases, 244	
	8.7.	Equilibrium Shape of Coherent Inclusion, 249	
	8.8.	Equilibrium Shape of Inclusion Characterized by	
		Invariant Plane Transformation Strain, 263	
	8.9. 8.10.	Shape of Ferromagnetic Precipitates, 266 Rodlike Precipitates, 273	
9.		t Plane and Orientation Relations in Precipitates: parison with Experimental Data	278
	9.1.	Morphology and Crystal Lattice Correspondence of Nitride Precipitates in Iron-Nitrogen Martensite, 282	
	9.2.	Morphology of Precipitates in Nb-O Interstitial Solution, 286	
		Morphology of β -Phase Precipitates in V-H Alloys, 289	
		Morphology of Coherent Precipitates of Cubic Phase in Cubic Matrix, 293	
		GP Zones in Solid Solutions: Al-Cu Alloys, 305	
	9.6.	Equilibrium Shape of Martensitic "Laths," 310	

6.6. Martensite Crystal Morphology in the Case of Fcc→Bcc Crystal

10.		-Induced Coarsening in Coherent Alloys Consisting of Two -Symmetry Phases	315
	10.1.	Modulated Structure in Coherent Mixture of Two Cubic-Symmetry Phases, 316	
	10.2.	Strain Energy of Concentration Heterogeneity in Cubic Solid Solutions, 321	
	10.3.	One-Dimensional Modulated Structures, 327	
	10.4.	Two-Dimensional Modulated Structures, 335	
	10.5.	Ordering of Mutual Arrangement of Precipitates, 342	
	10.6.	Morphology of Modulated Structures in Two-Phase Coherent Mixtures of Cubic Phases: Comparison with Experiment, 346	
	10.7.	Strain-Induced Tetragonality of Cubic Phases in	
		Modulated Structures: Cu-Ni-Fe and ALNICO Alloys, 358	
11.	 3	hology of Coherent Mixture of Cubic and Tetragonal Phases	260
	Contr	olled by Elastic Strain Effect	368
	11.1.	Stable Configurations in Coherent Mixture of Cubic and Noncubic Phases, 368	
	11.2.	Strain Energy of a Two-Phase Alloy Formed by Cubic and Tetragonal Phases, 372	
	11.3.	Minimization of "Homogeneous" Strain Energy and Equilibrium Structure of Coherent Mixture of Cubic and Tetragonal Phases, 377	
	11.4.	Strain Energy of Semi-Coherent Interphase and Equilibrium Domain Structure, 381	
	11.5.	Strain-Induced Coarsening in Coherent Mixture of Cubic and Tetragonal Phases, 399	
	11.6.	Morphology of Alloys Composed of Cubic and	
		Tetragonal Phases: Comparison with Experimental Observations, 401	
12.	Computer Simulation of Phase Transformation in Crystalline Solids		408
	12.1.	- Participated and American Control of the Control	
		Path and Kinetics of Martensitic Transformation, 419	
		Computer Simulation of Pseudo-Two-Dimensional Martensitic Transformation, 423	
	12.4.	Computer Simulation of Strain-Induced Coarsening of Tetragonal Precipitates in Cubic Matrix: "Tweed" Structure Formation, 431	

		Structure in Cubic Alloys, 440	
13.		scopic Elasticity Theory of Macroscopically geneous Solid Solutions	445
		Introduction, 445	
		Elastic Energy of Solid Solutions, 447 Calculation of Strain-Induced Interaction in Bcc and Fcc	
	13.4.	Substitutional and Interstitial Solid Solutions, 464 Strain-Induced Interaction of Pairs of Solute Atoms in	
	13.5.	Bcc Solutions Based on αFe, Ta, Nb, and V, 471 Limit Transition to Continuum Theory: Eshelby's	
	15.5.	Theory of Solid Solution; Elastic Energy and Spinodal	
		Decomposition; Discussion of Cook-de Fontaine's Version; "Elastic Energy Paradox"; Limit Transition to	
	12.6	Coherent Inclusions, 483	
40	13.0.	The Role of Elastic Energy and Vacancies in Thermodynamics of Stable Segregations: K-State, 497	
14.	Application of Microscopic Elastic Theory to Thermodynamics of Phase Transformations		504
	14.1. 14.2.	Screening of Pairwise Interaction in Solid Solutions, 504 Elastic Energies and Atomic Structure of Ordered Bcc Interstitial Solutions, 508	
	14.3.	Comparison with Experimental Observations, 524	
	14.4. 14.5.	Ordering in Iron-Carbon Martensite, 530 Spinodal Decomposition in Iron-Carbon Martensite, 534	
	14.6.	Phase Transformation in Martensite of Carbon Steel Involving Carbon Atom Condensation into Irradiation	
		Defects, 542	
App	endix 1	. Basic Definitions of Matrix Algebra	551
App	endix 2	Bilinear Representation of a Hermitian Operator	555
App	endix 3	. Calculation of the Energy $E_{\rm edge}$	557
Refe	erences		562
Inde	ndex		

12.5. Computer Simulation of Formation of Modulated