CONTENTS

1.	Crystallography of Phase Transformations		1	
	1.1.	Atomic Structure of Crystals, 1		
	1.2.	Crystal Lattice and Reciprocal Lattice, 2		
	1.3.	Diffraction and Reciprocal Lattice, 4		
	1.4.	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.			
	1.8.			
		Orientations, 20		
	1.9.	Worked Examples, 22		
2. Stability of Homogeneous Solid Solutions		ility of Homogeneous Solid Solutions	26	
	2.1.	•		
		Metastability, 26		
	2.2.			
		Fluctuations, 29		
3.	Ord	ering in Alloys	3	
	3.1.	Static Concentration Wave Representation of Ordered		
	5.1,	Phase Structures, 4Q		
	3.2:			
	3.2.	Theory of Ordering, 48		
	3.3	•		
	2.3	Transformation, 53		
	3.4			
		Model.55		

4.

5.

	3.5. 3.6. 3.7. 3.8. 3.9. 3.10! 3.11	Static Concentration Waves and Diffraction, 59 Application of the Concentration Wave Method to the Solution of the Mean-Field Equation (Simple Lattice), 60 How to Find the Atomic Arrangement of the Most Stable Superstructure, 65 Examples of Solution of Mean-Field Equations for Occupation Probabilities, 69 Symmetry of Superlattice Points in the Reciprocal Lattice and Stability of Ordered Phases: Stable Structures in Fcc and Bcc Solutions, 73 Stability of Nonstoichiometric Ordered Phases: Secondary Ordering and Decomposition, 82 Ordering in Crystals Composed of Several Interpenetrating Bravais Lattices, 90	
4.	Decon	nposition in Alloys	96
	4.1 4.2. 4.3. 4.4. 4.5.	Thermodynamics of Decomposition, 97 Free Energy of Heterogeneous Alloys, 103 Extreme States of Solid Solutions, 108 Critical Nucleus in a Solid Solution, 111 Extreme States of One- Dimensional Heterogeneities in Metastable Alloys, 117 Worked Examples, 124	
5.	Diffus	ion Kinetics in Solid Solutions	128
	5.1.5.2.5.3.5.4.5.5	Crystal Lattice Site Diffusion in Solid Solutions, 129 Percolation Mechanism of "Fast" Atom Substitutional Diffusion in Binary Alloys, 136 Spinodal Decomposition, 138 Computer Simulation of Spinodal Decomposition: Formation of GP Zones, 143 Short-Range Order Relaxation Kinetics, 152	
6.	Diffusionless (Martensitic) Transformations in Alloys		
	6.1.6.2.6.3.6.4.6.5.	What is the Martensitic Transformation?, 157 Nucleation and Growth of Martensites, 159 Shape Deformation Produced by Martensitic Transformation, 163 Structure Domains of a Martensite Phase, 167 Example of Crystallographic Theory of Martensite Transformations for Cubic-to-Tetragonal Crystal Lattice Rearrangement, 172	

	6.6. ' 6.7. ' 6.8.	Martensite Crystal Morphology in the Case of Fcc+Bcc Cryst Lattice: Rearrangement: Numerical Example, 179 Slip Model of Formation of Lath Martensite in Ferrous Alloys, 182 Crystal Lattice Abnormalities of Iron-Carbon Martensite, 190	stai
7.	Elasti	c Strain Caused by Crystal Lattice Rearrangement	198
	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	
	8.2.	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	
		Shape of Ferromagnetic Precipitates, 266 Rodlike Precipitates, 273	
9.	Habit Plane and Orientation Relations in Precipitates: Comparison 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	
	9.3. 9.4.	Morphology of J3-PhasePrecipitates in V-H Alloys, 289 Morphology of Coherent Precipitates of Cubic Phase in Cubic Matrix, 293	
	9.5. 9.6.	GP Zones in Solid Solutions: AI-Cu Alloys, 305 Equilibrium Shape of Martensitic "Laths," 310	

10.	Stran	n-Induced Coarsening in Coherent Alloys Consisting of Two c-Symmetry Phases	31
	10.1. 10.2. 10.3. 10.4. 10.5. 10.6.	Modulated Structure in Coherent Mixture of Two Cubic-Symmetry Phases, 316 Strain Energy of Concentration Heterogeneity in Cubic Solid Solutions, 321 One-Dimensional Modulated Structures, 327 Two-Dimensional Modulated Structures, 335	
11.		sology of Coherent Mixture of Cubic and Tetragonal Phases olled by Elastic Strain Effect Stable Configurations in Coherent Mixture of Cubic and Noncubic Phases, 368 Strain Energy of a Two-Phase Alloy Formed by Cubic and Tetragonal Phases, 372 Minimization of "Homogeneous" Strain Energy and Equilibrium Structure of Coherent Mixture of Cubic and Tetragonal Phases, 377 Strain Energy of Semi-Coherent Interphase and Equilibrium Domain Structure, 381	368
	11.5.11.6.	Strain-Induced Coarsening in Coherent Mixture of Cubic and Tetragonal Phases, 399 Morphology of Alloys Composed of Cubic and Tetragonal Phases: Comparison with Experimental Observations, 401	
12.	Compus Solids 12.1. 12.2. 12.3. 12.4.	The Martensite Transformation, 408 Path and Kinetics of Martensitic Transformation, 419 Computer Simulation of Pseudo- Two- Dimensional Martensitic Transformation, 423 Computer Simulation of Strain-Induced Coarsening of Tetragonal Precipitates in Cubic Matrix: "Tweed" Structure Formation. 431	408

575

		Structure in Cubic Alloys, 440	
13.	Microscopic Elasticity Theory of Macroscopically Homogeneous Solid Solutions		445
	13.2.	Introduction, 445 Elastic Energy of Solid Solutions, 447 Calculation of Strain-Induced Interaction in Bcc and Fcc Substitutional and Interstitial Solid Solutions, 464	
	13.4.	Strain-Induced Interaction of Pairs of Solute Atoms in Bcc Solutions Based on iXFe,Ta, Nb, and V, 471	
	13.5.	Limit Transition to Continuum Theory: Eshelby's Theory of Solid Solution; Elastic Energy and Spinodal Decomposition; Discussion of Cook-de Fontaine's Version; "Elastic Energy Paradox"; Limit Transition to Coherent Inclusions, 483	
	13.6.	The Role of Elastic Energy and Vacancies in Thermodynamics of Stable Segregations: <i>K-State</i> , 497	
14.	Application of Microscopic Elastic Theory to Thermodynamics of Phase Transformations		504
	14.1. 14.2.	8	
		Comparison with Experimental Observations, 524 Ordering in Iron-Carbon Martensite, 530 Spinodal Decomposition in Iron-Carbon Martensite, 534	
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 $E_{\mbox{\tiny edge}}$	557
Refe	rences		562
Inde	X		571

Errata

12.5. Computer Simulation of Formation of Modulated