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Materials -- ; 1. The Electron Configuration of Atoms -- ; 1.1. Atoms With a Single Electron -- ; 1.2. Atoms With More Than One Electron -- ; 1.2.1. Penetration and Shielding -- ; 1.2.2. Energetic d-Orbital Collapse of Free Neutral Atoms at the Beginning of the Transition Rows -- ; 2. Bonding Within Crystal Structures -- ; 2.1. Bonding in Ionic Crystals -- ; 2.1.1. Energy for Forming the Ions From Neutral Atoms -- ; 2.1.2. Thermodynamic Viewpoint of Bond Energy -- ; 2.2. Covalent Bonds -- ; 2.2.1. Formation Energy and Mechanism of Covalent Bonding -- ; 2.3. Metallic Bonds -- ; 2.3.1. Cohesive Energy of Metals -- ; 2.4. Effect of Bonding on the Material Properties by Means of the Potential-Well Concept -- ; 2.4.1. Elastic Modulus -- ; 2.4.2. Melting Temperatures -- ; 2.4.3. Thermal Property -- ; 3. The Structures of Crystalline Crystals -- ; 3.1. Arrangements of Atoms and Ions in Crystalline Solids: Space Lattice -- ; 3.2. Metallic Structures -- ; 3.3. Ionic Structures -- ; 3.3.1. Pauling's Rules -- ; 3.4. Structural Distortion in Ionic Structures -- ; 3.4.1. Effects of Crystal Field on the Structures of the Oxides -- ; 3.4.2. Crystal Field Stabilization Energy -- ; 3.4.3. Effects of the d Electron Configuration on the Radii of Transition Metal Ions -- ; 3.4.4. Jahn -- Teller Distortions -- ; 3.4.5. Structure Distortions Arising From Asymmetric Electron Density or Inert Pair Effect -- ; 3.5. Structure of Material Technological Interest -- ; 3.5.1. Structure and the Related Feature of ZnO -- ; 3.5.2. Structure and the Related Feature of SiC -- ; 3.5.3. Structure and the Related Feature of TiO2 -- ; 3.5.4. Structure and the Related Feature of ZrO2 -- ; 3.5.5. Structure and the Related Feature of Spinel (AB2O4) -- ; 3.5.6. Structure and the Related Feature of Perovskite ABO3 -- ; pt. II Defects of Crystalline Materials -- ; 4. Point Defects in Crystalline Materials -- ; 4.1. Point Defects in Metals -- ; 4.1.1. Solid Solutions -- ; 4.1.2. Factors Affecting the Solubility of Impurity Atoms in a Substitutional Solid Solution -- ; 4.1.3. Factors Affecting the Solubility of the Impurity Atoms in an Interstitial Solid Solution -- ; 4.1.4. Equilibrium Concentration of Point Defects -- ; 4.2. Point Defects in Ionic Solids -- ; 4.2.1. Notation for the Description of Point Defects in Binary Metal Oxides -- ; 4.2.2. Defect Structures in Stoichiometric Ionic Crystals -- ; 4.2.3. Defect Structures in Nonstoichiometric Ionic Crystals -- ; 4.2.4. Defect Reactions -- ; 4.2.5. Formulation of Defect Equations -- ; 4.2.6. Defect Equilibrium in Ionic Solids -- ; 4.2.7. Defect Association -- ; 5. Line Defects in Crystalline Solids -- ; 5.1. The Discrepancy Between the Theoretical and Observed Yield Stresses of Crystals -- ; 5.2. Observations of Dislocations -- ; 5.3. Crystallographic Slip -- ; 5.4. Elementary Geometric Characteristics of Dislocations -- ; 5.4.1. The Edge Dislocation -- ; 5.4.2. The Screw Dislocation -- ; 5.4.3. The Mixed Dislocation -- ; 5.5. Critical Resolved Shear Stress -- ; 5.6. Plastic Flow Associated With the Slip of the Dislocation Motion -- ; 5.7. Stress Fields of Dislocations -- ; 5.7.1. Constitutive Equations With Lame Constants -- ; 5.7.2. Stress Field of a Screw Dislocation -- ; 5.7.3. Stress Fields of an Edge Dislocation -- ; 5.8. Energy of a Dislocation -- ; 5.8.1. Strain Energy of a Screw Dislocation -- ; 5.8.2. Strain Energy of an Edge Dislocation -- ; 5.9. Line Tension of a Dislocation -- ; 5.10. Forces Upon Dislocations -- ; 5.11. The Bowing of a Dislocation -- ; 5.12. Force Between Dislocations -- ; 5.13. Peach-Koehler Equation -- ; 5.14. Reactions Between Dislocations -- ; 5.14.1. Dislocation Nodes -- ; 5.14.2. Kinks and Jogs -- ; 5.14.3. Intersections of Dislocations -- ; 5.15. Extended Dislocations -- ; 5.15.1. Partial Dislocations -- ; 5.15.2. Faults in the Stacking in FCC Crystals -- ; 5.15.3. Equilibrium Separation Between Partial Dislocations -- ; 6. Two-Dimensional (Interfaces) and Three-Dimensional (Second Phases) Imperfections in Solids -- ; 6.1. Grain Boundaries -- ; 6.1.1. Tilt Boundary -- ; 6.1.2. Twist Boundary -- ;

6.1.3. Coincidence Site Lattice -- ; 6.2. Interphase Boundaries in Solids -- ; 6.2.1. Coherent Boundary -- ; 6.2.2. Incoherent Boundary -- ; 6.2.3. Partially Coherent or Semicoherent Boundary -- ; 6.3. Surface Tension, Surface Stress, and Surface Free Energy of Interfaces -- ; 6.4. Free Surface -- ; 6.4.1. Calculate the Surface Free Energy of a Pure Solid FCC Metal -- ; 6.5. Interfaces of Phases -- ; 6.5.1. Wetting -- ; 6.5.2. Equilibrium Shapes of Grains -- ; 6.5.3. Morphological Changes of Second Phases -- ; 6.6. Effect of Interface Curvature on the Equilibrium Pressure Between Two Phases -- ; 6.7. Effect of the Interface Curvature on the Equilibrium Solubility Between Two Phases -- ; 6.8. Equilibrium Vacancy Concentration Changes at Curved Surfaces: Driving Force for Sintering.
Pt. 1. Structure of the crystalline materials -- The electron configuration of atoms -- Bonding within crystal structures -- The structures of crystalline crystals -- Part II. Defects of Crystalline Materials -- Point defects in crystalline materials -- Line defects in crystalline solids -- Two-dimensional (interfaces) and three-dimensional (second phases) imperfections in solids.