

Contents

INTRODUCTION	1
CHAPTER I	
The Superconducting State of Materials and Methods of Estimating It	9
The Phenomenon of Superconductivity	3
1. History of the Discovery	9
2. Superconductors of the First Group	11
3. Superconductors of the Second Group	12
4. Hard Superconductors	13
5. The BCS (Bardeen–Cooper–Schrieffer) Theory	14
6. The GLAG (Ginzburg–Landau–Abrikosov– Gor'kov) Theory	18
7. The Anderson Model	22
8. The Filament (Sponge) Model of a Hard Superconductor	25
Empirical Rules	27
Methods of Measuring the Critical Superconducting Characteristics of Metals and Alloys	37
1. Measuring the Temperature of the Transition into the Superconducting State	37
2. Measurement of Critical Magnetic Fields	41
3. Measurement of the Critical Current	44
Low-Temperature Technique	53

Metallography of Superconducting Alloys	59
1. Preparation of Microsections	59
2. Etching of the Microsections	62
3. Study of the Microstructure and Properties of Alloys	66
Literature Cited	73
 CHAPTER II	
Superconducting Elements	81
Properties of Superconducting Elements	81
Effect of Deformation and Interstitial Impurities on the Superconducting Properties of the Elements	90
Literature Cited	102
 CHAPTER III	
Superconducting Compounds	107
Compounds with the Cr_3Si Structure.	108
Interstitial Phases and Certain Other Compounds of Metals with Nonmetals	120
Sigma and Laves Phases and Similar Compounds	135
Superconducting Compounds with Other Types of Structures	150
Effect of Alloying Elements and Impurities on the Structure and Properties of Compounds	158
1. Effect of Transition Metals on the Properties of Cr_3Si -Type Compounds	159
2. Effect of B Subgroup Elements on the Proper- ties of Cr_3Si -Type Compounds	168
3. Influence of the Simultaneous Replacement of the A and B Components on the Properties of Compounds of the Cr_3Si -Type	179
3. Effect of Interstitial Impurities on the Proper- ties of Cr_3Si Compounds	179
5. Effect of Alloying on the Properties of Com- pounds with Other Types of Crystal Structure .	184

Effect of Heat Treatment and Other Factors on the Superconducting Characteristics of Compounds	194
Literature Cited	203
 CHAPTER IV	
Physicochemical Analysis of Superconducting Systems	215
Binary Superconducting Systems	221
1. Systems with Unlimited Solubility in the Liquid and Solid States	221
2. Systems with Unlimited Solubility and a Polymorphic Transformation of the Components	228
3. Systems of the Eutectic, Peritectic, and Monotectic Types	252
4. Systems Involving the Formation of Intermediate Phases	262
Ternary and More Complex Superconducting Systems	307
1. Ternary Systems	307
2. Quaternary System	351
3. Pseudoternary Superconducting Systems	353
4. Pseudoquaternary System	358
Literature Cited	361
 CHAPTER V	
Production of Superconducting Materials	373
Effect of Composition, Deformation, and Heat Treatment on the Critical Current of Superconducting Alloys	374
Technology of the Production of Superconducting Alloys	387
Properties and Production Technology of Parts Made from Superconducting Compounds	391
1. Production of Vanadium-Gallium Wire by Working the Quenched Solid Solution	392
2. Production of Superconducting Coatings	393
3. Production of Superconducting Wire from Compounds by Working a Mixture of the Original Components in a Soft Sheath with Subsequent Heat Treatment (Kunzler Method)	401

4. Production of Superconducting Coatings by Hydrogen Reduction	407
5. Production of Composite Superconductors from Compounds of the Cr ₃ Si-Type	409
6. Production of Large Superconducting Parts . . .	411
Literature Cited	414
CHAPTER VI	
Applications	419
Superconducting Magnets	420
Computing Technology.	430
1. Cryotrons	430
2. Memory Devices	431
Electronics and Measuring Technology.	433
1. Bolometers – Receivers of Thermal Radiation	433
2. Superconducting Magnetic Lenses	433
3. Masers.	434
Nuclear Power and Space	436
1. Magnets for Thermonuclear Reactions	436
2. Elementary-Particle Accelerators	439
3. Bubble Chambers	440
4. Resonance Pump	441
5. Gyroscopes	441
6. "Zero" Magnetic Field	442
7. Magnetohydrodynamic (MHD) Generators	442
8. Protection of Astronauts from Radiation.	444
9. Hydromagnetic Braking	445
10. Energy Stores	445
Electrical Machines	445
Conclusion	447
Literature Cited	451
Index	457