## **CONTENTS**

Contributors

Preface	xi
HTS APPLICATIONS: PRESENT AND FUTURE PROSE	PECTS
Introduction Required Elements LTS Applications HTS Applications General Conclusions References	1 2 5 8 30 31
APPLICATION FIELDS OF HIGH-TEMPERATURE SUPERCONDUCTORS	
Roland HOTT	
Introduction Electronics Sensors Magnets Power Applications Cryocoolers Conclusion	35 36 37 38 39 41 43

References 44

## THE APPLICATION OF HIGH TEMPERATURE SUPERCONDUCTORS IN BRUSHLESS AC MACHINES

#### David DEW-HUGHES and Malcolm McCULLOCH

Introduction	49
Hysteresis Machines	52
Reluctance Machines	58
Pre-Trapped Flux Machines	62
Applications	63
Conclusions	64
References	64

## CURRENT STATUS OF HIGH-T<sub>c</sub> SUPERCONDUCTING BULK ROTATING ELECTRIC MOTORS APPLICATION

### Itsuya MUTA and Taketsune NAKAMURA

Introduction	67
Fundamental Aspects	68
Fractional Force Power Motors	72
Small and Middle Capacity Motors	77
Summary	79
References	79

# A MOTOR WITH HIGH-TEMPERATURE SUPERCONDUCTING LEVITATION AND ITS VIBRATION CONTROL

# Kosuke NAGAYA, Takaaki SUZUKI, Noriaki TAKAHASHI and Hiroyuki KOBAYASHI

Introduction	81
Mechanism of the Motor	. 82
Method for passing through the Critical Speeds	85
Response Analysis	87

Experiment	88
Conclusion	89
References	90

# LEVITATION APPLICATIONS OF HIGH TEMPERATURE SUPERCONDUCTORS

### John R. HULL

Introduction	91
Basic Levitational Physics	93
HTS Materials used in Levitation	95
Magnetic Levitational Methods	96
Levitational Physics – Part 2	110
PM/HTS Levitational Phenomena	113
Modeling of HTS Levitation	119
HTS Bearings	122
Static Levitated Structures	131
Maglev Transport	131
Other Linear Applications	133
Flywheel Energy Storage	133
Instrumentation	134
Miscellaneous Applications	134
Conclusions	135
References	135

## FIELDS AND FORCES FROM SUPERCONDUCTORS AND PERMANENT MAGNETS

### A.M.CAMPBELL

Introduction	143
Permeable Materials	144
Superconducting Sheets	146
Forces between Magnetic Arrays	150
Levitation above Conducting Sheets	158
References	173

# TREND OF APPLICATIONS TO HIGH-Te SUPERCONDUCTING POWER TRANSFORMERS IN JAPAN

#### Kazuo FUNAKI and Masataka IWAKUMA

Introduction	175
Background	176
A 500/800 KVA Demonstration Model	182
Design of Future Transformers in	
Urban Underground Substations	190
A 1 MVA Field-Test Model	192
Concluding Remarks	207
References	208
Appendix A	208
Appendix B	210

# APPLICATIONS OF HIGH - Te SUPERCONDUCTORS TO SUPERCONDUCTING MAGNETIC ENERGY STORAGE (SMES)

#### Takakazu SHINTOMI

Introduction	213
SMES and its Applications	214
Status of National R&D Project for High Tc SMES	215
Necessary Technologies to be developed	220
Summary	221
References	221

# UNRIVALLED SENSITIVITY - SQUIDS IN NONDESTRUCTIVE TESTING

#### Marc von KREUTZBRUCK

Introduction	223
Fundamentals and Theoretical Aspects of SQUID NDE	225
Possibilities and Limitations of SQUID NDE	245

Current SQUID NDE Applications	268
Concluding Remarks	290
References	292

# DC SQUID MAGNETOMETERS FROM YBa<sub>2</sub>Cu<sub>3</sub>O<sub>7-δ</sub> FOR BIOMAGNETIC APPLICATIONS

Henry-Jobes BARTHELMESS, Frank LUDWIG, Meinhard SCHILLING, Dietmar DRUNG and Thomas SCHURIG

Introduction	299
Design Rules for Directly Coupled DC SQUID	
Magnetometers	302
Directly Coupled DC SQUID Magnetometers in	
External Magnetic Fields	305
Bio-magnetic Measurement Systems	320
Conclusion and Outlook	332
References	334

## HTS APPLICATIONS: PROGRESS IN SQUID MICROSCOPY AND HIGH RESOLUTION NON-DESTRUCTIVE EVALUATION

### S.A. GUDOSHNIKOV and L.V. MATVEETS

Introduction	337
Scanning SQUID Microscopes based on	
HTS DC SQUIDS	338
SSM Applications	347
Current Research Engineering and Development Activity	355
Summary	359
References	359



# VORTEX MATTER AND SUPERCONDUCTING ELECTRONIC DEVICES

### Roger WÖRDENWEBER

Introduction	363
Vortex Matter in Patterned 2D Systems	364
Vortex Matter in Cryoelectronic Applications	385
Conclusions	404
References	406

# HTS MICROWAVE FILTERS: PROPERTIES, DESIGN AND SYSTEM APPLICATIONS

### Heinz J. CHALOUPKA and Tobias KAESSER

Introduction	411
Material and Manufacturing Issues	412
Filters: General Consideration	421
HTS Filters	436
System Applications	455
References	470

## RESPONSE ANALYSIS AND MODELING OF HIGH TEMPERATURE SUPERCONDUCTOR EDGE TRANSITION BOLOMETERS

#### Mehdi FARDMANESH

Introduction	477
Analysis of Low and Midrange Modulation Frequency	
Response and Interface Effects	479
Analytic Thermal Modeling for DC to Midrange	
Modulation Frequency Response	487
The Temperature Dependence of Responsivity and	
Deviations from the DR/DT Curve	496

Effects of Superconductivity Transition and Thermal	
Parameters on the Phases of the Response	503
DC Characteristics of the Bolometers and Artifacts	
Related to Joule Heating and the Film Microstructure	.508
Noise Characteristics and Spectral Detectivity of	
YBCO Superconductor Bolometers	514
Control of Responsivity and Detectivity through	
Substrate Properties	521
Summary and Conclusions	528
References	530

## HIGH TEMPERATURE SUPERCONDUCTING CABLES

### Ole TONNESEN and Jacob OSTERGAARD

Introduction	537
HTS Cable Designs	539
Cable Accessories	545
Energy Loss Components in Cables	549
The Cooling System	555
Research and Development HTS Cable Projects	557
Potential Applications and Future Market for	
HTS Cables	558
Future Market for HTS Cables	562
References	564

Subject Index

569

