

Contents

1 Introduction

<i>L.E. Cross and W. Heywang</i>	1
--	---

Part I Basics and Materials

2 Basic Material Quartz and Related Innovations

<i>A. Ballato</i>	9
-------------------------	---

3 The Role of Ferroelectricity for Piezoelectric Materials

<i>W. Wersing, W. Heywang, H. Beige, and H. Thomann</i>	37
---	----

4 Piezoelectric PZT Ceramics

<i>G. Helke and K. Lubitz</i>	89
-------------------------------------	----

5 Relaxor Ferroelectrics

<i>L.E. Cross</i>	131
-------------------------	-----

6 Piezoelectric Polymers and Their Applications

<i>S. Bauer and F. Bauer</i>	157
------------------------------------	-----

Part II Applications and Innovations

7 Electromechanical Frequency Filters

<i>W. Wersing and K. Lubitz</i>	181
---------------------------------------	-----

8 Ultrasonic Imaging

<i>W. Wersing and R. Lerch</i>	199
--------------------------------------	-----

9 High Effective Lead Perovskite Ceramics and Single Crystals for Ultrasonic Imaging

<i>Y.(J.) Yamashita and Y. Hosono</i>	223
---	-----

10 High-Power Ultrasound Transducers for Therapeutic Applications	
<i>D. Cathignol</i>	245
11 Piezoelectric Motors and Transformers	
<i>K. Uchino</i>	257
12 Piezoelectric Positioning	
<i>S. Arnold, P. Pertsch, and K. Spanner</i>	279
13 Piezoelectric Injection Systems	
<i>R. Mock and K. Lubitz</i>	299
14 Advanced RF Signal Processing with Surface Acoustic Waves on Piezoelectric Single Crystal Substrates	
<i>R. Veith, K. Wagner, and F. Seifert</i>	311
15 Piezoelectric Films for Innovations in the Field of MEMS and Biosensors	
<i>P. Murali</i>	351
16 Piezoelectric Composites by Solid Freeform Fabrication: A Nature-Inspired Approach	
<i>A. Safari and E.K. Akdoğan</i>	377

Part III Characterisation Methods

17 Microstructural Analysis Based on Microscopy and X-Ray Diffraction	
<i>M.J. Hoffmann, H. Kungl, R. Theissmann, and S. Wagner</i>	403
18 Small Signal Resonance Methods	
<i>W. Wersing</i>	423
19 Large Signal Resonance and Laser Dilatometer Methods	
<i>A. Wolff</i>	445
20 Ferroelastic Characterization of Piezoelectrics	
<i>T. Fett</i>	457

Part IV Multiscale Modelling

21 First-Principles Theories of Piezoelectric Materials	
<i>R.E. Cohen</i>	471
22 Thermodynamic Theory	
<i>G.A. Rossetti, Jr.</i>	493

23 Effective Medium Theories
W. Kreher 517

**24 Finite-Element Modelling of Piezoelectric Actuators:
Linear and Nonlinear Analyses**
T. Steinkopff 535

Part V The Future

25 Trends in Ferroelectric/Piezoelectric Ceramics
N. Setter..... 553

Index 571