

## CONTENTS

Preface

**INTRODUCTION TO NONLINEAR OPTICS**

1. Linear and Nonlinear Polarizability : A Primer	2
2. Second-Order Nonlinear Optical Processes in Molecules and Solids	31
3. Third-Order Nonlinear Optical Effects in Molecular and Polymeric Materials	50
4. Nonlinear Optical Properties of Molecules and Materials	67
5. Electronic Hyperpolarizability and Chemical Structure	89
6. Electrooptic Polymer Waveguide Devices : Status and Applications	103
7. Waveguiding and Waveguide Applications of Nonlinear Organic Materials	113
8. Nonlinear Optical Materials : The Great and Near Great	128

**UNDERSTANDING STRUCTURE-PROPERTY RELATIONSHIPS ON THE SECOND-ORDER MICROSCOPIC SUSCEPTIBILITY**

9. Donor-and Acceptor-Substituted Organic and Organometallic Compounds : Second-Order Nonlinear Optical Properties	158
10. Use of a Sulfonyl Group in Materials for Nonlinear Optical Materials : A Bifunctional Electron Acceptor	170
11. Organic and Organometallic Compounds : Second-Order Molecular and Macroscopic Optical Nonlinearities	187
12. Chemistry of Anomalous-Dispersion Phase-Matched Second Harmonic Generation	200

**PREPARATION AND CHARACTERIZATION OF POLED POLYMERS**

13. Applications of Organic Second-Order Nonlinear Optical Materials	216
14. Chromophore-Polymer Assemblies for Nonlinear Optical Materials : Routes to New Thin-Film Frequency-Doubling Materials	226
15. Novel Covalently Functionalized Amorphous $X^2$ Nonlinear Optical Polymer : Synthesis and Characterization	250
16. Second-Order Nonlinear Optical Polyphosphazenes	258
17. Molecular Design for Enhances Electric Field Orientation of Second-Order Nonlinear Optical Chromophores	267
18. Nonlinear Optical Chromophores in Photocrosslinked Matrices : Synthesis, Poling, and Second Harmonic Generation	279
19. Thermal Effects on Dopant Orientation in Poled, Doped Polymers : Use of Second Harmonic Generation	294
20. Organic Polymers as Guided Wave Materials	303

## **ORGANIC AND INORGANIC CRYSTALS**

21. Functional Waveguides with Optically Nonlinear Organic Materials	316
22. Observing High Second Harmonic Generation and Control of Molecular Alignment in One Dimension : Cyclobutenediones as a Promising New Acceptor for Nonlinear Optical Materials	331
23. Strategy and Tactics in the Search for New Harmonic-Generating Crystals	343
24. Development of New Nonlinear Optical Crystals in the Borate Series	360
25. Defect Chemistry of Nonlinear Optical Oxide Crystals	380
26. Defect Properties and the Photorefractive Effect in Barium Titanate	394
27. What Is Materials Chemistry?	410

## **NOVEL APPROACHES TO ORIENTATION OF MOLECULAR UNITS**

28. From Molecular to Supramolecular Nonlinear Optical Properties	436
29. Control of Symmetry and Asymmetry in Hydrogen-Bonded Nitroaniline Materials	446
30. Molecular Orbital Modeling of Monomeric Aggregates in Materials with Potentially Nonlinear Optical Properties	457
31. Strategies for Design of Solids with Polar Arrangement	472
32. Ferroelectric Liquid Crystals Designed for Electronic Nonlinear Optical Applications	484
33. Model Polymers with Distyrylbenzene Segments for Third-Order Nonlinear Optical Properties	497

## **COMPOSITE MATERIALS**

34. Composites : Novel Materials for Second Harmonic Generation	516
35. Clathrasils : New Materials for Nonlinear Optical Applications	528
36. Inorganic Sol-Gel Glasses as Matrices for Nonlinear Optical Materials	541

## **MOLECULAR AND SUPRAMOLECULAR METAL-BASED SYSTEMS**

37. Intrazeolite Semiconductor Quantum Dots and Quantum Supralattices : New Materials for Nonlinear Optical Applications	554
38. Small Semiconductor Particles : Preparation and Characterization	582
39. Synthetic Approaches to Polymeric Nonlinear Optical Materials Based on Ferrocene Systems	602
40. Transition Metal Acetylides for Nonlinear Optical Properties	605
41. Third-Order Near-Resonance Nonlinearities in Dithiolenes and Rare Earth Metalloence	616
42. Nonlinear Optical Properties of Substituted Phthalocyanines	626

## **SIGMA AND PI DELOCALIZED THIRD-ORDER NONLINEAR OPTICAL MATERIALS**

43. Nonlinear Optical Properties of Substituted Polysilanes and Polygermanes	636
44. Design of New Nonlinear Optic-Active Polymers : Use of Delocalized Polaronic or Bipolaronic Charge States	661
45. New Polymeric Materials with Cubic Optical Nonlinearities Derived from Ring-Opening Metathesis Polymerization	672
46. Polymers and an Unusual Molecular Crystal with Nonlinear Optical Properties	683
47. Quadratic Electrooptic Effect in Small Molecules	687
48. Third-Order Nonlinear Optical Properties of Organic Materials	704

## **INDEX**

Author Index	724
Affiliation Index	725
Subject Index	726