Contents

Preface —— vii

Guoquan Zhang, Daohong Song, Zhibo Liu, Mengxin Ren, Zhigang Chen, Jianguo Tian, Jingjun Xu

1 **Recent progresses on weak-light nonlinear optics** —— 1
1.1 Ultraviolet photorefraction in $LiNbO_3$ —— 2
1.1.1 Ultraviolet photorefractive materials, their effects and applications —— 3
1.1.2 Ultraviolet photorefractive effects in $LiNbO_3$ —— 4
1.1.3 Ultraviolet band edge photorefractive effects —— 12
1.1.4 Enhancement on ultraviolet light-induced absorption —— 14
1.1.5 Absorption edge and related defect structures in $LiNbO_3$ —— 16
1.1.6 Other effects and applications in the ultraviolet spectral range —— 20
1.2 Incoherent nonlinear optics and discrete spatial solitions —— 20
1.2.1 From coherent to incoherent light —— 21
1.2.2 From bulk to discrete media —— 22
1.2.3 Introduction to spatial optical solitons —— 22
1.2.4 Nonlinear optics with incoherent light —— 23
1.2.5 Spatial solitons in discrete systems —— 28
1.3 Nonlinear optical properties of novel carbon-based materials —— 39
1.3.1 Carbon-based materials —— 40
1.3.2 Progress of optical nonlinearities of carbon-based materials —— 42
1.3.3 Optical nonlinearities of carbon nanotube and its hybrid materials —— 44
1.3.4 Optical nonlinearities of graphene and its hybrid materials —— 53
1.4 Nonlinear optics from metallic plasmonics —— 65
1.4.1 Introduction to surface plasmonic polariton —— 67
1.4.2 Nonlinear processes in metals —— 72
1.4.3 Metallic plasmon-enhanced second-harmonic generation —— 74
1.4.4 Metallic plasmon-enhanced third-order nonlinear optics —— 75
1.4.5 Metallic plasmon-enhanced nonliner optical activity —— 81
1.5 Summary —— 87

Bibliografische Informationen
http://d-nb.info/1045094587

digitalisiert durch DEUTSCHE NATIONAL BIBLIOTHEK

Xianfeng Chen
2 Polarization coupling and its applications in periodically poled lithium niobate crystal — 105
2.1 Introduction — 105
2.2 Polarization-coupling theory based on transverse electro-optical effect — 108
2.2.1 Transverse electro-optical effect — 108
2.2.2 Jones matrix method — 114
2.2.3 Polarization-coupling mode theory — 119
2.3 Tunable wavelength filter and optical switch based on polarization-coupling effect — 124
2.3.1 Solc-type filter based on polarization-coupling effect in PPLN crystal — 124
2.3.2 Tunable multiwavelength filter by local-temperature-control technique — 127
2.3.3 Flat-top bandpass Solc-type filter and optical switch in PPLN crystal — 133
2.4 Control of linear polarization and its applications — 138
2.4.1 The evolution of the polarization state in the PPLN and the control of linear polarization state via electro-optical effect — 138
2.4.2 Linear polarization state modulator — 140
2.4.3 Electro-optic chirality control in PPLN — 144
2.4.4 Optical isolator based on the electro-optic effect in HPPLN — 147
2.4.5 Polarization based all-optical logic gates — 149
2.5 Control of angular momentum and its applications — 155
2.5.1 The angular momentum of light — 155
2.5.2 The evolution of polarization state of light by changing electric field — 155
2.5.3 Control of spin angular momentum of light — 159
2.5.4 Control of orbital angular momentum and its applications — 162
2.6 Polarization-coupling cascading and its applications in PPLN crystal — 169
2.6.1 Second-harmonic generation (SHG) cascading — 169
2.6.2 Polarization-coupling cascading and nonlinear phase shift — 171
2.6.3 Cross-modulation — 175
2.6.4 Fast and slow light — 179

Heping Zeng
3 Ultrafast nonlinear optics — 191
3.1 Introduction — 191
3.2 Cascaded quadratic nonlinearity and spatiotemporal modulational instability — 192
3.2.1 Two-dimensional (2D) multicolored transverse arrays — 192
3.2.2 2D multicolored up-converted parametric amplification — 195
3.2.3 Colored conical emission (CCE) — 198
3.2.4 Seeded amplification of colored conical emission (SAC) — 199
3.2.5 Carrier envelope phase stabilization via difference frequency generation — 200
3.3 Interaction of intense ultrashort filaments — 201
3.3.1 Filament-interaction-induced nonlinear spatiotemporal coupling — 202
3.3.2 1D plasma channels — 205
3.3.3 Plasma grating — 207
3.3.4 2D plasma grating — 209
3.3.5 Third harmonics generation enhancement — 211
3.4 Molecular alignment assisted filament interaction — 214
3.5 Ultrafast optical gating by molecular alignment — 217
3.6 Conclusions — 222

Qi Guo, Daquan Lu, Dongmei Deng
4 Nonlocal spatial optical solitons — 227
4.1 Introduction to optical soliton research — 227
4.1.1 Historical background of optical solitons — 227
4.1.2 Optical Kerr effect and its spatial and temporal nonlocality — 238
4.1.3 Nonlinear propagation model of optical envelope: The nonlocal nonlinear Schrödinger equation — 241
4.1.4 Soliton solutions and their physical essence — 250
4.2 The phenomenological theory of the nonlocal spatial solitons — 260
4.2.1 The classification of the nonlocality — 261
4.2.2 The Snyder–Mitchell model — 262
4.2.3 The weak-nonlocality — 269
4.2.4 The general nonlocality — 270
4.2.5 Interaction of double solitons — 272
4.3 Nematicons — 278
4.3.1 Nonlinear propagation models of beams in the nematic liquid crystal — 279
4.3.2 The voltage-controllable nonlinear characteristic length and the nonlinear refractive index coefficient — 283

4.3.3 The propagation model of the liquid crystal in strong nonlocal condition — 285
4.3.4 The approximate analytical solution of a single nematicon — 287
4.4 The thermal nonlinear nonlocality — 291
4.4.1 Spatial optical solitons in the lead glass — 292
4.4.2 Other thermal nonlinear materials — 295

Weilong She, Guoliang Zheng
5 **Wave coupling theory and its applications of linear electro-optic (EO) effect — 307**
5.1 Introduction — 307
5.2 Wave coupling theory of linear EO effect in transparent bulk crystal — 309
5.3 Wave coupling theory of linear EO effect in absorbent medium — 319
5.4 Wave coupling theory of mutual action of linear EO, OA, and Faraday effects — 325
5.5 Wave coupling theory of QPM linear EO effect — 330
5.5.1 Wave coupling theory of Linear EO effect in periodically poled crystals — 333
5.5.2 Linear EO effect in linear chirped-periodically poled crystals — 338
5.5.3 Wave coupling theory of united effect of QPM linear EO effect, second-harmonic generation, and sum/difference frequency generation — 344
5.5.4 Wave coupling theory of QPM linear EO effect for a focused Gaussian beam — 355

Index — 367