

Index

a

absorption pigments 77
 acenaphthene 263
 5-acetoacetylaminobenzamidazolone 139
 acid pasting 267
 acid swelling 267
 Alkali Blue 423
 alumina flake pigments 94 ff.
 – application 95 f.
 – synthesis 94 f.
 aluminate pigments 47 f.
 – cobalt aluminates 47
 aluminum bronzes 96
 aluminum phthalocyanine 278 f.
 American Society for Testing and Materials (ASTM) 471
 American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) 486
 5-aminobenzimidazolone 145
 aminoiminoisoindoline 224
 anatase TiO_2 60
 β -anilino-acrylates 298
 2-anilinoacridone (AA) 322
 ASTM methods 471 ff.
 – ASTM C1549 471 f.
 – ASTM D281–84 69
 – ASTM D4803 472 f.
 – ASTM E1918 472
 – ASTM E903 471
 atomic absorption (AA) 358
 atomic force microscopy (AFM) 359
 azo carbonic acid 214
 azo pigments 143, 149
 – disazocondensation pigments 205 ff.
 azomethine-type isoindolinones 244 ff.
 – applications 257 ff.
 – bisazomethine pigments 251
 – crystal modifications 251

– history 244 f.
 – moieties 251
 – perbrominated isoindolinones 250
 – physicochemical properties 254 ff.
 – synthesis 246 ff.
 – tetrachloro isoindolinones 245 ff.

b

barbituric acid 227
 barium nickel titanium yellow 47
 barium pigments 440 ff.
 base pigment 270
 BASF 8, 271, 339
 basic lead carbonate 82
 Bayer 8, 271, 326
 Bayplast® Yellow R 238
 Beer-Lambert law 361
 benzimidazolone pigments 110, 139 ff., 158 ff.
 – applications 149
 – Color Index data 140 ff.
 – coupling components 139, 145
 – economics 158 ff.
 – finishing 146
 – history 143 f.
 – hydrogen bonds 149 ff.
 – light fastness 149
 – manufacture 145 ff.
 – manufacturers 144
 – physical properties 146 ff.
 – Pigment Brown 25 149 f.
 – pigment grades 154 ff.
 – Pigment Orange 64 144
 – Pigment Red 2 149 f.
 – spectrometric data 156
 – tinting strength 146
 – toxicity 164

benzimidazolone-dioxazine pigments, *see*
 imidazolone-annellated triphenedioxazine
 pigments
 bioaccumulative substances 416
 biomineralization 122
 bisazomethine pigments 251
 bismethine compounds 221 ff., 226 ff.
 bismuth oxychloride 82 f.
 bismuth vanadate pigments 7 ff.
 – applications 10 ff.
 – chemical properties 8
 – coatings 10 f.
 – coloristic properties 9
 – dispersibility 10
 – ecology 12
 – history 7 f.
 – light fastness 10
 – manufacture 8
 – physical properties 9
 – plastics 11
 – resistance 10
 – toxicity 12
 “black ash” 20
 black-listing 461
 boc-DPP 114
 bond vibrations 368 ff.
 borosilicate-based pigments 96
 Bragg’s law 381
 BTI pigment 117
t-butoxy carbonate (*t*-BOC) 214

C

cadmium 15 f.
 – chemistry 16
 – metal dissolution 19
 – oxide formation 19
 cadmium pigments 13 ff.
 – cadmium reds 13 f.
 – cadmium yellows 13 f.
 – calcination 21
 – color index 23
 – history 13 f.
 – lattice substitution 17
 – manufacture 17 ff.
 – particle size 23 f.
 – physical properties 22 ff.
 – precipitation 20
 – resistance 23
 – restrictions 24 f.
 – safety regulations 427 f.
 – strike standards 18
 – uses 25 f.
 cadmium sulphide 17, 20
 cadmoliths 13

calcination 21, 59
 camouflage tetrakisazo pigments 212
 Canadian Environmental Protection Act
 (CEPA) 411 ff.
 – inventory 411
 – toxicology 412
 Canadian safety regulations 411 ff.
 Carbazole Violet 132, 134, 195 ff., *see also*
 Pigment Violet 23
 – safety regulations 425 f.
 carbon black 4
 carcinogenic aromatic amines 446 f.
 catalase-like process 288
 ceramic applications
 – cadmium pigments 25
 cerium pigments 27 ff.
 – applications 34 ff.
 – characteristics 33
 – coating 32 f., 38
 – color change 37
 – doping 30
 – heat stability 35
 – light fastness 35
 – manufacture 31 ff.
 – paint 38 f.
 – plastics 34 ff.
 – reflectance curves 31
 – sesquisulfides 28 ff.
 – tinting strength 34
 – toxicity 39 f.
 cerium sesquisulfide 28 ff., *see also* cerium
 pigments
 – α -Ce₂S₃ 29
 – β -Ce₂S₃ 29
 – γ -Ce₂S₃ 29 f.
 – doping 30
 cerium sulfide pigments, *see* cerium
 pigments
 chrome iron black pigments 476 ff.
 chromite pigments 49 ff.
 chromium antimony titanate yellows 45
 chromium titanium buff 53
 chromophores 360
 Ciba 8, 271, 326
 “CIELAB” system 92, 364
 Clariant 271, 326
 clinobisvanite 7
 close packing 106 ff.
 – packing energies 108 f.
 coatings
 – bismuth vanadate pigments 10 f.
 – cerium pigments 38
 – doctor-blade coating 101
 – industry 133

- liquid crystal-based pigments 98 ff.
 - quinacridone pigments 313, 325
 - cobalt aluminate blue spinels 47
 - cobalt blacks 49 f.
 - cobalt chromite green 51
 - cobalt chromium aluminate blue-green spinel 48
 - cobalt titanate greens 46
 - Code of Federal Regulations (CFR) 415
 - color formulators 470 f.
 - color pigments 422
 - Color Pigments Manufacturers' Association (CPMA) 54
 - DCMA Handbook 54
 - color travel 92 f., 96
 - Commission Directive 67/548/EEC 436 f.
 - adaptations to technical progress (ATPs) 436
 - amendments 437
 - hazard categories 440
 - complex inorganic color pigments (CICPs) 41 ff., 48, 54, 426 f.
 - aluminates 44, 47 f.
 - black CICPs 49 f.
 - brown CICPs 50 f.
 - chromites 44, 49 ff.
 - elements 41 f.
 - ferrites 44, 49 ff.
 - IR reflecting CICPs 467 ff.
 - oxygen/metal (O/M) ratio 42
 - production 44
 - rutile CICPs 45
 - safety regulations 426 f.
 - structures 42 f.
 - titanates 44 ff.
 - CONEG regulations 407
 - Conrad-Limpach reaction 298
 - cool roofs 486 f.
 - rebate programs 487
 - cooling mechanisms 470 ff.
 - copper blacks 49
 - copper chromite blacks 49
 - Copper Phthalocyanine Green 490
 - copper phthalocyanines 275
 - crystallochromy 362
 - α -form 117 f.
 - β -form 276
 - ε -form 276
 - π -form 277
 - HPLC measurements 378 f.
 - LCD color filters 276
 - mass spectrometry 377
 - visible spectroscopy 362 ff.
 - X-ray diffraction 382 ff.
 - corundum structure 43
 - Council of the European Union 434
 - Council Directive 1999/45/EC 444
 - Council Directive 76/769/EEC 445 f.
 - Council Directive 94/62/EC 448
 - Council Regulation EEC 793/93 444 f.
 - resolutions 451 f.
 - Cromophtal™ Orange GP 141, 144
 - Cromophtal® Yellow RF 238
 - crudes 267
 - crystal design 105 ff.
 - crystal engineering 106 ff.
 - crystal structure calculation 115 ff.
 - crystal structure determination 113 ff.
 - crystal engineering 106 ff.
 - close packing 106 ff.
 - crystal energy 108 f.
 - force field methods 108 f.
 - imidazolone-annellated triphenedioxazine pigments 347 f.
 - neural network techniques 109
 - Pigment Violet 57 351 ff.
 - specific interactions 109 ff.
 - synthon approach 109 f.
 - crystal morphology 120
 - crystal structure calculation 115 f.
 - crystallochromy 118 f.
 - empirical scoring functions 116
 - global minimization 115 f.
 - morphology calculations 119 ff.
 - crystal structure determination 113 ff., 348 f.
 - CRYSCA 348
 - electron diffraction 113
 - imidazolone-annellated triphenedioxazine pigments 348 f.
 - packing energy minimizations 114
 - real-space crystallographic methods 113 f.
 - crystallochromy 118 f., 269, 362
 - CVD fluidized bed process 87
- d**
- Dainippon Ink and Chemicals 279, 326
 - Dangerous Preparations Directive (Directive 88/379/EEC) 440
 - de minimis* levels 414 f.
 - DEORASE 288
 - 6,8-diamino-2,4-dioxotetrahydroquinazoline 212
 - o*-dianisidine 249
 - diazabicyclononene (DBN) 264
 - 2,9-dichloroquinacridone 212
 - 4,11-dichloroquinacridone 211 ff.
 - photostability 314 f.

- 6,13-dichloroquinacridone 317
- differential scanning calorimetry (DSC) 404 ff.
- diffraction gratings 101
- diffraction pigments 101 f.
 - application 102
 - production 101
- dihydrotriphenodioxazine 201
- diiminoisoindoline 224
- diketopyrrolopyrrole (DPP) pigments 110, 132, 165 ff.
 - applications 185 ff., 190 f.
 - bathochromic shift 172
 - chemical properties 176 ff.
 - crystal packing 174
 - electrophilic aromatic substitution 177
 - fluorescence 172 ff.
 - history 165 f.
 - hypsochromic shift 172
 - LCD color filters 190
 - miscellaneous routes 169
 - N-alkylation 178 f.
 - nucleophilic aromatic substitution 177 f.
 - nucleophilic transformation 179 f.
 - particle sizes 180 f.
 - polymorphism 181
 - Reformatsky route 166 f.
 - single X-ray structure analysis 174 f.
 - solid solution formation 182 ff.
 - solid-state properties 180 ff.
 - spectral properties 170 ff.
 - succinic amide route 169
 - succinic ester route 168
 - surface modifications 184 f.
 - syntheses 166 ff.
- dimethyl 2-hydroxyterephthalate 297
- dimethyl succinate (DMS) 295
- dimethyl succinoylsuccinate (DMSS) 295 ff.
 - by-products 295 ff.
 - iso-DMSS 296
 - synthesis 295, 297 f.
- 2,9-dimethylquinacridone 211 ff.
- 6,13-dimethylquinacridone 317
- dioxazine pigments 117, 195 ff.
 - applications 202 f.
 - “aza quinoid” chromophore unit 243
 - by-products 199 f.
 - chemistry 195 f.
 - cyclization agents 199 ff.
 - cyclocondensation 197
 - cyclodehydrogenation 197 f.
 - dehydrochlorination. 201 f.
 - dianil cyclization 197 ff.
 - dianil formation 197
 - new pigments 204
 - parent structure 195
 - properties 202 f.
 - recycling 203
 - synthesis 196 ff.
- N,N'*-diphenyl-*p*-phenylene diamine 322
- disazocondensation pigments 205 ff.
 - applications 217 f.
 - bridging diamines 212
 - camouflage tetrakisazo pigments 212
 - chemical structures 207 ff.
 - chemistry 206 ff.
 - finishing 216
 - HALS stabilizers 213
 - history 205 f.
 - improvements 212 f.
 - mixed systems 213
 - particle size 216
 - physical characterization 216
 - properties 217 f.
 - synthesis 214 ff.
 - viscosity reducing additives 213
 - Yellow type I 206, 214
 - Yellow type II 206, 214
- dispersion quality evaluation 397 ff.
- Domestic Substances List (DSL) 411 ff.
 - assessment 412
- doped-cassiterite(SnO₂) pigments 53
- Doped-Rutile (DR) pigments 53 ff., 59 ff.
 - applications 62 f.
 - chemical properties 71 f.
 - CrSbTi buff DR 57, 60
 - CrWTi DR pigments 61
 - dusting 70
 - history 57
 - IR reflecting pigments 473 f.
 - mixed-phase DR pigments 60
 - MnSbTi DR pigments 62
 - NiSbTi DRs 57 ff., 60
 - oil absorptions 69
 - particle size 64 ff.
 - pH values 70 f.
 - physical properties 66 ff.
 - reflectance spectra 64 ff.
 - specific gravities 67 f.
 - spectral properties 63 ff.
 - SSA measurements 69 f.
 - synthesis 59 ff.
 - tinting strength 65
 - VSbTi gray DR pigments 61
 - weathering 71 f.
 - XRD properties 66 f.
- DPP-quinacridone solid-solution pigments 189 f.

DPPI pigment 117
 dreyerite 7
 Dry Color Manufacturers' Association (DCMA), *see* Color Pigments Manufacturers' Association (CPMA)

e

eco-labels 448 f.
 effect pigments 77 ff., *see also* pearlescent pigments
 – alumina flake pigments 94 ff.
 – basic lead carbonate 82
 – bismuth oxychloride 82 f.
 – borosilicate-based pigments 96
 – characterization 81
 – color effects 81, 88 ff.
 – color travel 92 f., 96
 – diffractive pigments 101 f.
 – holographic pigments 102 f.
 – liquid crystal-based pigments 98 ff.
 – metal effect pigments 96 f.
 – mica-based effect pigments 5, 84 ff.
 – micaceous iron oxide 83
 – natural pearl essence 82
 – optical coatings 97 f.
 – optical effects 92
 – optical principles 79 ff.
 – optically variable pigments (OVP) 98
 – properties 87
 – silica flake pigments 90 ff.
 – technical data 88
 – titanium dioxide flakes 83
 Electrokinetic Sonic Amplitude (ESA) measurements 233 ff.
 electromagnetic spectrum 359
 electron impact (EI) ionization mass spectrometry 374
 electron paramagnetic resonance (EPR) 358
 electron spectroscopy for chemical analysis (ESCA) 358
 electron spin resonance (ESR) 359
 electronic transitions 360
 electrophotographic photoreceptors 283 ff.
 electrophotographic reprography 283
 electrospray ionization (ESI) 373
 Emergency Planning Community Right-to-Know Act (EPCRA) 419
 Environment Canada (EC) 411
 Environmental Protection Agency (EPA) 410 ff.
 – inventory 410
 EU safety regulations 431 ff.
 – black-listing 461
 – classification 440 ff.

– confidentiality 462
 – dangerous preparations 444
 – dangerous substances 436 ff.
 – eco-labels 448 f.
 – food packaging 449 ff.
 – marketing 445 ff.
 – national regulations 452 ff.
 – notification 438 f.
 – packaging 448
 – pollution control 448
 – precautionary principle 460 f.
 – risk assessment 444 f.
 – safety data sheets 444
 – trade barriers 452
 – websites 462 ff.
 – white papers 463
 Eupolen® Yellow 09–6101 338
 Eupolen® Yellow 11–5501 225, 239
 European Commission 432
 – Commission Directive 2001/58/EC 444
 – Commission Directive 2002/72/EC 450
 – Commission Directive 67/548/EEC 436 ff.
 European Court of Justice 435
 European Inventory of Existing Chemical Substances (EINECS) 437 ff.
 – barium pigments 440 ff.
 – classification 440 ff.
 – notification obligation 438 f.
 – R53 phrase 443
 European Law 434
 European List of Notified Chemical Substances (ELINCS) 437
 European Parliament (E.P.) 433 f.
 European Union (EU) 431 ff.
 – Council 434
 – directives 435 ff.
 – Framework Regulation 1935/2004 449 ff.
 – legal instruments 434 f.

f

Fabry-Perot effect 97
 face-selective additives 123
 Fanchon® Fast Yellow Y-5700 225, 239
 Fast Brown HFR 01 149
 Fast Yellow HG 141, 144
 Fast Yellow H2G 140, 144
 Fastogen 326
 Fastogen Blue 8120 284
 Federal Food and Drug Administration (FDA) 415
 Federal Food, Drug and Cosmetic Act 411
 Federal Insecticide, Fungicide and Rodenticide Act 411
 ferrite pigments 49 ff.

fiber-optic sensor 228
 Fisher Sub-Sieve Sizer (FSSS) 66
 Florida exposure 38
 fluorescein 114
 food contact applications 407
 – bismuth vanadate pigments 11
 – cadmium pigments 23 f.
 – DPP pigments 186 ff.
 – Doped-Rutile (DR) pigments 57
 food packaging legislations 449 ff.
 force field methods 108
 – Cerius²® 108
 free-flowing DR powders 70
 French safety regulations 455 ff.
 FT-IR spectroscopy 368 ff.
 – applications 370 ff.
 – attenuated total reflectance (ATR) devices 369 ff.
 – particle analysis 372
 – phthalimido methyl quinacridone (PMQ) 371
 – pigment separation 369
 – quantitative FT-IR 370
 – reference library 369
 – sample preparation 369 f.
 functional pigments 4, 275

g

gas chromatography–mass spectrometry (GC–MS) 359, 407
 German Consumer Goods Ordinance 453
 German safety regulations 453 ff.
 – “Chemikalien-Verbotsverordnung” 454
 – dioxin limits 454 f.
 – water hazard classes 453 f.
 “gold bronzes” 96
 Good Manufacturing Practice (GMP) 450
 Graphitol™ Carmine HF4C 149
 Graphitol® Yellow H2R 238

h

HDPE gas pipes 338
 HDPE injection molding 11, 218
 heating mechanisms 469 f.
 hematite structure 43, 88
 heterocyclic pigments 243 f.
 hexachlorobenzene (HCB) 358, 407
 high performance liquid chromatography (HPLC) 359, 378 ff.
 – applications 378 ff.
 – copper phthalocyanines 378 f.
 – quinacridone mixtures 379
 – reversed phase HPLC 379
 high performance naphthols 133

high performance organic pigments (HPOP)s 357 ff.
 – 2 θ angles 389 f.
 – applications 357 f.
 – characterization 357 ff.
 – crystallite size 387 ff.
 – decomposition temperatures 404 ff.
 – differential scanning calorimetry (DSC) 404 ff.
 – FT-IR spectroscopy 368 ff.
 – GC–MS measurements 407.
 – HPLC measurements 378 ff.
 – inorganic extenders 389
 – light scattering 392
 – mass spectrometry (MS) 358, 373 ff.
 – microscopic methods 392
 – optical microscopy (OM) 396 ff.
 – packing 106 f.
 – particle shape 392
 – particle-sizing methods 390 ff.
 – performance criteria 358
 – pigment concentration measurement 361
 – safety regulations 407
 – solid probe mass spectrometry 369
 – solid solutions 384 ff.
 – TEM measurements 393 ff.
 – thermogravimetric analysis (TGA) 404 ff.
 – ultracentrifugal sedimentation 398 ff.
 – visible spectroscopy 359 ff.
 – X-ray fluorescence 369
 – X-ray powder diffraction 369, 380 ff.
 high performance pigments (HPPs) 3 ff., 131
 – benzimidazolone pigments 139 ff.
 – bismuth vanadates 7 ff.
 – cadmium pigments 13 ff.
 – Canadian regulations 411 ff.
 – cerium pigments 27 ff.
 – complex inorganic color pigments (CICPs) 41 ff., 48, 54
 – compositions 4 f.
 – crystal design 105 ff.
 – crystal structure calculation 116 ff.
 – crystallochromy 118 f.
 – definition 131
 – diketopyrrolopyrrole (DPP) pigments 110, 132, 165 ff.
 – dioxazine pigments 117, 195 ff.
 – disazocondensation pigments 205 ff.
 – Doped-Rutile (DR) pigments 53 ff., 59 ff.
 – effect pigments 77 ff.
 – EU regulations 431 ff.
 – French regulations 455 ff.
 – German regulations 453 ff.

- imidazolone-annellated triphenedioxazine pigments 341 ff.
 - inorganic pigments 3 ff.
 - IR reflecting CICPs 467 ff.
 - isoindoline pigments 221 ff.
 - market studies 131 ff.
 - Mexican regulations 413 f.
 - morphology 119 ff.
 - organic pigments 106 ff., 357 ff.
 - packing 106 ff.
 - perylene pigments 110, 133, 261 ff.
 - phthalocyanine pigments 118 f., 121, 133, 275 ff.
 - producers 133
 - quinacridone pigments 110, 132, 293 ff.
 - quinophthalone pigments 243, 331 ff.
 - safety regulations 409 ff.
 - single crystals 113
 - surface modifiers 122
 - survey 4
 - Swiss regulations 457 f.
 - “Three Essential Es” 6
 - titanate pigments 44 ff., 53 ff.
 - toxicology 489 ff.
 - trade flow 134 ff.
 - US regulations 409 ff.
 - High Production Volume (HPV) substances 423 f.
 - testing initiative 460
 - hindered amine light stabilizers (HALS) 213
 - holographic pigments 102 f.
 - application 103
 - holographic mirror 102
 - Hostaperm 326
 - Hostaperm™ Blue R5R 144, 346
 - Hostaperm™ Brown HFR01 149
 - Hostaperm™ Red Violet R5B 352
 - Hostaperm™ Yellow H3G 140, 154 ff.
 - Hostaperm™ Yellow H5G 144
 - hydroxygallium phthalocyanine 284
 - 2-hydroxynaphthalene-3,6-dicarboxylic acid 212
 - 5-(2'-hydroxy-3'-naphtyoylamino)-benzimidazolone, *see* Naphtolon™
 - 3-hydroxyquinophthalone 333
- i**
- imidazolone-annellated triphenedioxazine pigments 341 ff., 344 ff.
 - crystal engineering 347 f., 351 ff.
 - crystal structure determination 348 f.
 - dimethyl derivative 346 ff.
 - phases 347
 - Pigment Blue 80 346
 - Pigment Violet 23 341 ff.
 - Pigment Violet 57 351 ff.
 - properties 346 ff.
 - structure 341
 - syntheses 345 ff.
 - inclusion stains 26
 - inductively coupled plasma (ICP) 358
 - infrared light 468
 - ink jet inks 278 ff.
 - inorganic extender detection 389
 - inorganic pigments, *see* high performance inorganic pigments
 - Integrated Pollution Prevention and Control (IPPC) 448
 - integrating sphere spectrometer 471
 - Interagency Testing Committee (ITC) 425
 - interference effects 80 f., 84
 - LCP pigments 99 ff.
 - interference pigments, *see* pearlescent pigments
 - International Commission on Illumination (CIE) 364
 - International Council of Chemical Associations (ICCA) 460
 - International Uniform Chemical Information Database (IUCLID) 445
 - IR absorbers 280 f.
 - manufacturers 281
 - IR reflecting pigments 467 ff., 473 ff.
 - absorptions 484
 - black pigments 479 ff.
 - blue pigments 480 f.
 - chrome iron black pigments 476 ff.
 - CICP pigments 473 ff.
 - doped rutile titanate pigments 57, 62, 66, 71, 473 f.
 - formulation 482 ff.
 - green pigments 481 f.
 - markets 485 f.
 - opacity 483
 - IR reflectivity 468 ff.
 - chromites 50 f.
 - cooling mechanisms 470 ff.
 - heating mechanisms 469 f.
 - measurements 471 ff.
 - physics 468 ff.
 - IR spectroscopy 368 ff.
 - Irgazin® Orange 3GL 225
 - iridescence 80
 - iron oxides 4
 - iron titanate browns 46 f.
 - Iron-Free Browns 62
 - isoindoline pigments 221 ff.

- applications 236 ff.
- constitutions 222 f.
- crystal structures 229 ff.
- economics 239 f.
- ESA measurements 233 ff.
- finishing 227
- history 224 f.
- hydrogen bonding 232 f.
- manufacture 226 f.
- manufacturers 225 f.
- one-step synthesis 227
- optical properties 237 f.
- packing 232 f.
- particle size 227 f.
- pigment grades 236 ff.
- Pigment Orange Synthesis 229
- Pigment Yellow Synthesis 227 ff.
- properties 229, 234 ff.
- reflectance spectra 228 f.
- scattering properties 228
- structure 221 f.
- toxicity 240
- isoindolinone pigments 243 ff.
- applications 257 ff.
- azomethine-type 244 ff.
- commercial products 257 ff.
- diamine bridge 255
- history 244 f.
- light absorption properties 256
- metal complexes 253 f.
- methine-type 244, 252 f.
- physicochemical properties 254 ff.
- structure 244
- synthesis 246 ff.
- tetrachloro isoindolinones 245 f.

k

- Kerr effect 287
- Kubelka-Monk theory 484

l

- Lake Red C 218
- latent pigments 214
- LCD color filters 190
- copper phthalocyanine blue pigments 276 ff.
- Pigment Red 254 186
- Leadership in Energy and Environmental Design (LEED) rating 486
- liquid chromatography–mass spectrometry (LC–MS) 359
- liquid crystal polymers (LCP) 98 ff.
- cholesteric materials 99 f.
- siloxanes 100

- liquid crystal-based pigments 98 ff.
- color design 99
- doctor-blade coating 101
- Lithole® Fast Yellow 1090 333
- Lithole® Fast Yellow 1840 225
- lithopones 15
- cadmium lithopones 13 ff.
- production 18, 20
- luminescence spectroscopy 359
- Luprofil Yellow 09–6105 338

m

- magnesium ferrites 51
- manganese antimony titanate browns 45
- manganese titanium brown pigments 53
- market studies 131 ff.
- demand factors 136 f.
- marketing strategies 138
- new markets 137
- trade flow 134 ff.
- mass spectrometry (MS) 358, 373 ff.
- copper phthalocyanines 377
- EI ionization MS 374 ff.
- ESI 373
- MALDI 373
- mass spectrum 373
- principle 373 ff.
- solid probe MS 374 ff.
- matrix-assisted laser desorption ionization (MALDI) 373
- mercadiums 13
- metal complex pigments 253 f.
- metal deco printing 203
- metal effect pigments 77, 96 f.
- synthesis 96
- methine-type isoindolinones 252 f.
- applications 258
- methyl 4-chloroacetate 297
- Mexican safety regulations 413 f.
- mica minerals 84
- mica-based effect pigments 5, 84 ff.
- color effects 88 ff.
- combination 88
- gold pigments 88 f.
- history 84
- inorganic colorants 89
- iron oxide-mica 86 ff.
- metal-oxide-coated mica 84 f.
- titanium dioxide-mica 85 f.
- micaceous iron oxide 83
- microencapsulated pigments 279
- Minnesota Listed Metals Advisory Council (LMAC) 427
- mixed crystal pigments 183, 266, 268

mixed metal oxide (MMO) pigments, *see*
complex inorganic color pigments
(CICPs)

Monastral 326

morphology calculations 119 ff.

multilayer interference coating 98

n

nacreous effect 81

nanoscale materials 420 ff.

– regulations 420 ff.

nanoscale silicon 6

nanotechnology 422

naphthalic acid anhydride 263

Naphthol AS pigments 110, 149

Naphtolon™ 139, 145

– color strength 146

natural pearl essence 82

Neolor™ 27, 39

nickel antimony titanate yellows 45, 53

nickel blacks 49 f.

“Non-Domestic Substances List” (NDSL)

nonlinear optical materials 287 f.

Novoperm™ Carmine HF4C 149

Novoperm® Yellow M2R70 239

nuclear magnetic resonance (NMR) 358

o

Occupational Safety and Health

Administration (OSHA) 428

oil absorptions 69

optical coatings 97 f.

– manufacture 98

– multilayer interference configurations 97

– release layer 98

optical microscopy (OM) 359, 396 ff.

– applications 397 f.

– dispersion quality evaluation 396 ff.

optically variable pigments (OVP) 98

OPTRON 285

organic photoconductor materials (OPC)
283

organic pigments, *see* high performance
organic pigments (HPOP)s

Organization for Economic Cooperation and
Development (OECD) 423

oxidase-like process 288

p

packaging coefficient (PKC) 232

packaging inks 236

paints 137

– azomethine-type isoindolinones 257 ff.

– cerium pigments 38 f.

– disazocondensation pigments 217 ff.

– DR pigments 62

– industry 133 f.

– isoindoline pigments 236 ff.

– LCP films 100

– Pigment Violet 23 202 f.

– quinophthalone pigments 338 f.

– viscosity control 213

Paliogen® Brown K 2683 225

Paliogen® Orange L 3180 HD 225

Paliogen® Red L 3585 HD 225

Paliogen® Red L 3875 124

Paliotan® Yellow L 1145 339

Paliotol® Yellow D 0960 338

Paliotol® Yellow D 1155 225

Paliotol® Yellow D 1819 238

Paliotol® Yellow K 0961 337 f.

Paliotol® Yellow K 1841 238

Paliotol® Yellow L 0960 HD 336, 338 f.

Paliotol® Yellow L 0962 HD 336 f., 339

Paliotol® Yellow L 1829 238

Paliotol® Yellow L 1970 239

Paliotol® Yellow L 2140 HD 225, 234, 239

particle shape 392 ff.

– chunkiness factor 392 f.

particle size distribution (PSD) 66 ff., 391 ff.

– benzimidazolone pigments 154 ff.

– disc centrifuge PSD 401

– measurements 390 ff.

– perylene pigments 269

particle-sizing methods 390 ff.

– light scattering 392

– microscopic methods 392

– optical microscopy (OM) 396 ff.

– transmission electron microscopy (TEM)
393 ff.

– ultracentrifugal sedimentation 398 ff.

PBiT chemicals 412 f.

pearl luster effect 77

– luster flop 88

pearl luster pigments 77

pearlescent pigments 77 ff., *see also* effect
pigments

– alumina flake pigments 94 ff.

– basic lead carbonate 82

– bismuth oxychloride 82 f.

– borosilicate-based pigments 96

– characterization 81

– color effects 81, 88 ff.

– color travel 92 f., 96

– liquid crystal-based pigments 98 ff.

– mica-based effect pigments 5, 84 ff.

– micaceous iron oxide 83

– metal effect pigments 96 f.

- natural pearl essence 82
- optical effects 92
- optical principles 79 ff.
- properties 87
- silica flake pigments 90 ff.
- technical data 88
- titanium dioxide flakes 83
- use 79, 87
- performance enhancers 267
- perinone DHP 114 f.
- Permanent™ Carmine FBB 02 149
- Permanent™ Red FRR 149
- persistent, bioaccumulative and toxic (PBT)
 - chemicals 409 ff., 492
 - background 415 ff.
 - cadmium pigments 427 f.
 - carbazole violet pigments 425 f.
 - complex inorganic color pigments 426 f.
 - Form R report 418 ff.
 - lead PBT reporting rule 420
 - PBT-TRI rules 414 ff., 418 ff.
 - perylene pigments 426
 - phthalocyanine pigments 424
 - quinacridone pigments 424 f.
- Persistent Organic Pollutants (POPs) 420
- perylene pigments 110, 133, 261 ff.
 - alkylation 265
 - applications 270 ff.
 - color physics 269 f.
 - condensation 266
 - conditioning 267 f.
 - conversion 263 ff.
 - crystallochromy 119, 269
 - drying 268
 - functional colorants 271
 - fusion reaction 263 f.
 - half imide/half anhydrides 266
 - history 261
 - hydrolysis 265
 - interaction map 111 f.
 - leuco form 263
 - mixed crystals 266, 268
 - morphology 270
 - particle size 269
 - performance enhancers 267
 - Perylene Red 266
 - perylene-tetracarboxylic acid diimide (PTCDI) pigments 111
 - PDCI-type additive 123
 - pricing 272
 - producers 271 f.
 - safety regulations 426
 - solid solutions 268
 - surface treatment 268
 - syntheses 263 ff.
- perylene tetracarboxylic acid 110, 261
- perylene tetracarboxylic acid dianhydride (PTCA) 265
- perylene tetracarboxylic acid diimide (PTCI) 263
- PHARE Programme 458 ff.
- photoconductive phthalocyanine compounds 284
- photodynamic therapy 288 f.
- phthalimido methyl quinacridone (PMQ) 371
- phthalocyanine OPCs 283
- phthalocyanine pigments 118 f., 121, 133, 275 ff., 424
 - absorption spectra 276 f.
 - aluminum phthalocyanine 278 f., 284 ff.
 - CD-R products 281 ff.
 - copper phthalocyanine pigments 275
 - deodorizers 288
 - electrophotographic photoreceptors 283 ff.
 - hydroxygallium phthalocyanine 284
 - ink jet inks 278 f.
 - π - π interaction 287
 - IR absorbents 280 f.
 - isomer mixtures 282
 - LCD color filters 276 f.
 - microencapsulation 279
 - nonlinear optics 287 f.
 - photodynamic therapy 288 f.
 - polybrominated zinc phthalocyanine 277
 - Rietvelt analysis 286 f.
 - safety regulations 424
 - structure 276
 - titanyl phthalocyanines 283 ff.
 - X-form metal-free phthalocyanines 284 f.
- o-phthalodinitrile 225
- Pigment Black 12 58
- Pigment Black 23 49
- Pigment Black 26 49
- Pigment Black 27 49
- Pigment Black 28 49
- Pigment Black 29 49
- Pigment Black 30 49 f.
- pigment blends 81 f.
- Pigment Blue 15 275
- Pigment Blue 15:3 276 ff.
 - microencapsulation 279
- Pigment Blue 15:4 278
- Pigment Blue 15:6 276 f.
- Pigment Blue 28 47
- Pigment Blue 36 48
- Pigment Blue 61 423
- Pigment Blue 72 47

- Pigment Blue 79 275
- Pigment Blue 80 345 ff.
- crystal structure 349 f.
- Pigment Brown 11 50 f.
- Pigment Brown 23 218
- Pigment Brown 24 45, 473
- Pigment Brown 25 149 f., 158
- Pigment Brown 29 51, 475
- Pigment Brown 31 50 f.
- Pigment Brown 33 51
- Pigment Brown 35 51
- Pigment Brown 38 222
- Pigment Brown 41 212, 218
- pigment concentration measurement 361
- Pigment Green 7 275, 490
- Pigment Green 17 51, 476 ff.
- formulations 477 f.
- particle size 477
- Pigment Green 26 51, 481 f.
- Pigment Green 36 275 f.
- pigment morphologies 121 f.
- “platy” morphologies 121
- Pigment Orange 36 157
- Pigment Orange 42 322
- Pigment Orange 48 320
- Pigment Orange 61 257
- Pigment Orange 62 157
- Pigment Orange 64 144, 157
- Pigment Orange 66 222
- Pigment Orange 69 222
- synthesis 229
- Pigment Orange 71 189
- Pigment Orange 72 157
- Pigment Orange 73 184 f., 189
- Pigment Red 2 149 f.
- Pigment Red 53:1 357
- Pigment Red 123 272
- Pigment Red 144 218
- Pigment Red 146 149
- Pigment Red 149 270 f.
- Pigment Red 166 218
- Pigment Red 175 157
- Pigment Red 176 157
- Pigment Red 177 190
- Pigment Red 179 264 ff.
- Pigment Red 185 149, 157
- Pigment Red 206 319
- Pigment Red 207 320
- Pigment Red 208 157
- Pigment Red 209 313
- Pigment Red 214 218
- Pigment Red 220 218
- Pigment Red 221 218
- Pigment Red 224 265
- Pigment Red 242 213, 218
- Pigment Red 254 181, 184 ff.
- applications 186, 190
- Pigment Red 255 184, 187
- Pigment Red 260 222
- crystal structure 230
- synthesis 229
- Pigment Red 262 207, 212
- Pigment Red 264 185, 187 f.
- applications 187 f.
- Pigment Red 272 188
- Pigment Red 282 304
- Pigment Red 283 188 f.
- Pigment Violet 19 347, 383 f., 425
- Pigment Violet 23 134, 195 ff., 202 ff., 341
- applications 344
- properties 202 f.
- structure 342 ff.
- synthesis 197 ff., 342
- Pigment Violet 29 263, 269
- Pigment Violet 32 158
- Pigment Violet 37 196 ff.
- applications 203
- crude 197
- dianil 197
- Pigment Violet 42 320
- Pigment Violet 57 351 ff.
- Pigment Yellow 53 45, 473
- Pigment Yellow 93 218
- Pigment Yellow 95 218
- Pigment Yellow 109 257
- Pigment Yellow 110 257
- Pigment Yellow 119 50 f., 475
- Pigment Yellow 120 156
- Pigment Yellow 128 218
- Pigment Yellow 138 333 ff.
- properties 335 f.
- synthesis 334
- Pigment Yellow 139 222, 225
- crystal structure 231
- opaque forms 239
- semiopaque form 239
- synthesis 227
- transparent forms 238
- Pigment Yellow 151 156
- Pigment Yellow 154 156
- Pigment Yellow 164 45, 475
- Pigment Yellow 175 156
- Pigment Yellow 177 253
- Pigment Yellow 179 253
- application 258, 270
- Pigment Yellow 180 156 f.
- Pigment Yellow 181 157
- Pigment Yellow 184 7

- Pigment Yellow 185 222, 225, 239
 - crystal structure 231
 - synthesis 229
- Pigment Yellow 192 144
- Pigment Yellow 194 157
- Pigment Yellow 213 157
- plastics 137
 - azomethine-type isoindolinones 257 ff.
 - bismuth vanadate pigments 11
 - cadmium pigments 25
 - cerium pigments 34 ff.
 - disazocondensation pigments 217 ff.
 - DPP pigments 186 ff.
 - DR pigments 62 f.
 - isoindoline pigments 236 ff.
 - Pigment Violet 23 202 f.
 - quinacridone pigments 325 f.
 - quinophthalone pigments 338 f.
- polychlorinated biphenyls (PCBs) 358, 407
- polychlorinated dibenzodioxins (PCDDs) 358, 407
- polychlorinated dibenzofurans (PCDFs) 358, 407
- polyphosphoric acid (PPA) 300 ff.
- polysiloxanes 100
- porphyrin compounds 289
- portable solar reflectometer 471 f.
- precautionary principle 460 f.
- priderite 47, 53
- priderite pigments 58
 - BaNiTi yellow 58, 61
 - synthesis 61 f.
- printing ink 79
 - cerium pigments 39
 - disazocondensation pigments 217 ff.
 - DPP pigments 166, 186 ff.
 - Pigment Violet 23 202 f.
- Prior Informed Consent (PIC) procedure 494 f.
- pseudo-Stobbe condensation 168
- pseudobrookite pigments 53, 58, 62
 - synthesis 62
- pucherite 7
- pyranometer 472
- q**
- quantitative structure activity relationship (QSAR) assessment 491
- quantum effect pigments 6
- quinacridone pigments 110, 132, 293 ff., 424 f.
 - absorption spectra 304 ff.
 - applications 325 f.
 - compositions 304
 - conditioning 323 ff.
 - crystal habits 122
 - crystallochromy 118
 - 6,13-disubstitution 317
 - economics 26 f.
 - α -form 309 ff.
 - β -form 308 ff., 382 ff.
 - γ -form 308 ff., 382 ff.
 - history 293
 - IR spectrum 306
 - mixed crystals 319
 - photostability 313 ff.
 - photovoltaic properties 326
 - polymorphism 308 ff.
 - polyphosphoric acid (PPA) process 295, 300 ff.
 - predominant type 319
 - α -quinacridone 117
 - *cis*-quinacridone 294
 - *trans*-quinacridone 294
 - safety regulations 424
 - solid solutions 318 ff.
 - structural data 305 f.
 - substitutions 311 ff.
 - surface treatment 323 ff.
 - syntheses 295 ff.
 - thermal process 295, 298 ff.
 - TiO₂ extension 323
 - toxicity 326
 - Ullmann reaction 303
 - visible spectra 364 ff.
 - X-ray diffraction 382 ff.
 - zwitterionic form 306
- Quinacridone Red 382 ff.
- quinacridone sulfonic acid (QSA) 372
- Quinacridone Violet 382 ff.
- quinacridonequinone (QAQ) 293, 315 ff.
 - photochemical stabilization 322
 - solid solution formation 319 ff.
- Quindo 326
- quinones 299
- quinophthalone pigments 243, 331 ff.
 - applications 336 ff.
 - compositions 332
 - economics 339
 - ESA measurements 338
 - grades 336 ff.
 - history 333
 - manufacture 334
 - properties 335 f.
 - remission spectra 337
 - toxicity 340
- QUV-A testing 38

r

- rare earth sulfides 28, *see also* cerium pigments
- sesquisulfides 28
- real-space crystallographic methods 113 ff.
- Monte-Carlo method 114
- “real-time” infrared spectroscopy 301
- recordable compact discs (CD-R) 281 ff.
- Reformatsky reagent 167
- refractive index 80 f.
- Registration, Evaluation and Authorisation of Chemicals (REACH) 447
- Rietvelt analysis 286 f.
- rutile structure 42 f.
- rutile TiO₂ 42 f., 45
- passivation 45
- photoactive surface 45

s

- safety data sheets (SDS) 444
- safety regulations 431 ff.
- Canadian regulations 411 ff.
- EU regulations 431 ff.
- French regulations 455 ff.
- German regulations 453 ff.
- Mexican regulations 413 f.
- Swiss regulations 457 f.
- US regulations 409 ff.
- Sandofil™ Yellow S-RL 144
- Sandorin Violet 2R-CSA 202
- scanning electron microscopy (SEM) 359
- Scherrer equation 381
- Science Advisory Board (SAB) 420
- Scientific Committee for Food (SCF) Guidelines 451
- Screening Information Data Set (SIDS) 423
- selenium 15, 17
- chemistry 17
- Sicoflush® P Yellow 0960 339
- silica flake pigments 90 ff.
- coating process 91 f.
- color travel 92 f.
- metal oxide/silica-flake pigments 92 f.
- properties 91
- synthesis 91 ff.
- solar reflectance index (SRI) 486
- solid solutions 182 ff., 268, 318 ff.
- mixed crystal 183, 319
- photochemical stabilization 322
- predominant type 319
- preparation 321
- X-ray diffraction 384 ff.
- special azos 132
- specific gravities (SG) 68

- specific interactions 109 ff.
- chlorine–chlorine interaction 110
- Coulomb interactions 111
- herringbone-like interactions 111
- hydrogen bonds 110
- π -stacking 110
- van der Waal interactions 111
- specific surface area (SSA) measurements 69 f.
- spinel structure 42 ff.
- inverse spinels 43
- π -stacking 110, 121, 175
- “steam cadmium yellow” 14
- Stokes’ law 398
- Structural Activity Relationship (SAR) analysis 423
- succinic acid 295
- Sun Chemical 271, 326
- Sunfast 326
- surface modifications 184 f., 323 ff.
- surface modifiers 122, 268
- sustainable development 3
- Swiss Agency for the Environment, Forests and Landscape 457
- Swiss Federal Office of Public Health 457
- Swiss safety regulations 457 f.

t

- tailor-made additives 122 ff.
- face-selective additives 123
- terephthalic acid 300
- meso-tetraaryl-tetrabenzoporphyrin zinc complex 253
- Tetrachloro Dibenzodioxin Threshold Equivalency Quotient (TEQ) 426
- tetrachloro isoindolinones 245 ff.
- intermediates 248
- synthesis 245 ff.
- tetrachlorophthalic anhydride 248
- tetrachlorophthalimide 247
- tetrachlorophthalonitrile 248
- thermogravimetric analysis (TGA) 404 ff.
- thiazine-indigo pigment 110
- thioindigo 243
- titanate pigments 44 ff., 53 ff.
- classification 54 f.
- crystal classes 55
- Doped-Rutile (DR) pigments 53 ff., 59 ff.
- history 55 ff.
- patents 56
- priderite pigments 54, 58, 61 f.
- pseudobrookite pigments 54, 58
- raw materials 59
- reflectance curves 45 f.

- rutile titanates 45 ff., 54
- spectral properties 63 ff.
- spinel titanates 46 ff.
- synthesis 58 f.
- titanium dioxide 4
- titanium dioxide flakes 83
- titanyl phthalocyanines 283 ff.
 - crystal modifications 284
 - Y-form 284
- o-tolidine 249
- Toreador Red 270
- total solar reflectance (TSR) 470
- Toxic Release Inventory (TRI) 414
- Toxic Substances Control Act (TSCA) 409 ff., 437
 - inventory 420
 - nanoscale materials 420 ff.
 - premanufacture notice (PMN) 409 f.
 - Section 4 410
 - Section 6 410
 - Section 8 410
 - Section 12 410 f.
 - Section 13 410
- Toxic Substances Interagency Testing Committee (TITC) 490
- toxicology 489 ff.
 - assessment programs 493 f.
 - bismuth vanadate pigments 12
 - cerium pigments 39 f.
 - false positives 491
 - isoindoline pigments 240
 - quinacridone pigments 326
 - quinophthalone pigments 340
 - testing 489 f.
 - White Paper 494
- transmission electron microscopy (TEM) 359, 393 ff., 400 ff.
 - applications 394 ff.
 - sample preparation 393 f.
- triphenodioxazines, *see* dioxazine pigments, *see also* imidazolone-annellated triphenodioxazine pigments

u

- Ullmann reaction 303
- ultracentrifugal sedimentation 398 ff.
 - applications 399
 - disc centrifuge analysis 401
 - drying process evaluation 400
 - milling process evaluation 400
 - sample preparation 399
 - Stokes' law 398
 - turbidity measurements 398
- ultramarine blue 6

- United Nations Environmental Program (UNEP) 494
- US safety regulations 409 ff.
- UV absorbers
 - cerium pigments 34 ff.
 - CICPs 41 f.
 - cobalt chromium aluminates 48
 - copper chromite blacks 49
 - DR pigments 57, 66, 71
- UV-Vis spectroscopy, *see* visible spectroscopy

v

- vatting 268
- viscosity reducing additives 213
- visible spectroscopy 359 ff.
 - applications 362 ff.
 - Beer-Lambert law 361
 - chromophores 360
 - copper phthalocyanines 362 ff.
 - electronic transitions 360
 - extinction coefficients 366 f.
 - pigment concentration measurement 361
 - quinacridone pigments 364 ff.
- volatile organic compounds (VOC) 185

w

- Waste Minimization Prioritization Tool (WMPT) 416 f.
- water hazard classes 453 f.
- weathering 71 f.
- wurtzite structure 16

x

- X-form metal-free phthalocyanines 284 f.
- X-ray diffraction (XRD) 67, 358, 380 ff.
 - advantage 382
 - 2θ angles 389 f.
 - applications 382 ff.
 - Bragg's law 381
 - copper phthalocyanines 382 ff.
 - crystallite size 387 ff.
 - Hall-Williamson method 381
 - inorganic extender detection 389
 - powder diffraction 380 ff.
 - principle 380 f.
 - quinacridones 382 ff.
 - sample preparation 382
 - Scherrer equation 381
 - solid solutions 384 ff.
- X-ray fluorescence (XRF) 358

z

- zinc blende structure 16
- zinc ferrites 51