

Index

- ABA BCPs, 156
- ABA triblock copolymers, 148
- ABC-type BCPs, 152
- ABC-type star polymer, 159
- absorbance, 327–28, 386–87, 404–5, 480
- absorbance spectra, 403
- absorption, 8, 15–16, 18, 320, 326, 330, 391, 396, 407, 416, 452
 - main-chain, 213
 - narrow, 18
- absorption bands, 182, 206, 224, 229, 231, 318, 335, 382, 386, 393, 431–32, 480
 - intrinsic, 432
 - low-energy, 390
- absorption peaks, 232, 390, 429, 479
 - red-shifted, 429
- absorption region, 200, 203
- absorption shifts, 16
- absorption spectra, 8, 182, 185, 187, 233, 318, 320, 394, 415, 429
- absorption spectroscopy, 15
- absorption spectrum, red-shifted, 54
- AB-type monomer, 151, 153
- acceptor components, 390
- acceptors, 78, 224–25, 231, 237, 243, 245, 381–83, 386, 388, 390, 397–404
- acceptor units, 235–36, 239, 388, 390
- acenes, 25–31, 40, 58
- acetylene monomers, 197
 - disubstituted, 194
- achiral groups, 207
- acid groups, 488
- acid stimuli, 211
- acid vapors, 491
- ACQ, *see* aggregation-caused quenching
- ACQ behaviors, 424
- ACQ effect, 420, 425
- ACQ molecule, 420
- activated crystals, 303, 305–6
- activation barrier, 18
- active species, 195
 - unstable, 20
- actuation, 268, 276
 - micromechanical, 277
- actuators, 99, 275, 470
 - micromechanical, 254
- Adams' catalysts, 456
- adsorption, 303, 305–6
- ADTs, *see* anthradithiophenes
- AFM, *see* atomic force microscopy
- agent
 - reducing, 207
 - structure-directing, 483
- aggregates, 229, 234, 239, 355, 359
 - nonspecific oligomer, 229
 - ordered, 238
- aggregation, 203, 277, 355, 399, 404, 406, 419, 421–22, 425, 460–61, 494
 - tangled, 236
- aggregation-caused quenching (ACQ), 419, 421
- aggregation conditions, 359
- aggregation-induced emission (AIE), 400, 404, 406–7, 414, 419–22, 424–26, 428
- aggregation interactions, 404

- aggregation pattern, 318
- agrichemicals, 103
- AIE, *see* aggregation-induced emission
- AIE-active conjugated polymers, 419, 427
- AIE-active copolymers, 427
- AIE-active materials, 422–23, 425
- AIE-active molecules, 419, 421, 425
- AIE-active organoboron complexes, 420
- AIE-active polymeric materials, 427
- AIE-active polymers, 424–25
- AIE emission, 423
- alcohol gas source method, 458
- alcohol oxidations, 4
- aldol condensation, 29, 34
 - regioselective, 33
- alignment, 184, 262, 267, 271, 273, 337, 350
 - columnar, 359
 - linear, 444
 - magnetic, 273
 - mesogenic, 269, 271, 273
 - ordered, 262
 - ordered planar, 263
 - shear, 262
- alignment direction, 265
- alignment samples, 265–66
- alkaline etching, 275
- alkoxylation, 100
- alkyl chains, 102, 174–75, 290, 296, 350, 354, 357, 360, 362, 368, 371–72
 - branched, 243
 - flexible aliphatic, 360
- alkyl linkers, 301
- alternating copolymers, 73, 98, 102, 104, 414, 433
 - conjugated, 125
- amide groups, 199–200, 205
- amphiphiles, 257
- amphiphilic ionic moieties, 357
- amphiphilicity, 203
- amyloid-like behavior, 238
- angle, 237, 255, 265–66, 321, 391, 399, 451
 - azimuthal, 266
 - biaryl torsional, 78
 - dihedral, 237, 330
 - inferior plane, 391
 - spot, 266
- anion binding, 363–65
- anionic linking reactions, 159
- anionic species, 357, 363
 - π -electronic, 363–64
- anion receptor, 364, 366
 - neutral, 371
- anion-responsive enhancement, 365
- anion-responsive supramolecular gels, 365
- anisotropic response, 263
- anisotropy, 254, 273
 - conformational, 273
- annelation, 26
 - angular, 26
 - zigzag, 26
- anodic fluorination, 103
- anodic fluorodesulfurization, 103–4
- anodization, 493
- anthradithiophenes (ADTs), 32–34
- antiaromaticity, 415
- arc discharge, 455
- arene–arene stacking interactions, 78
- arene scaffold, 293, 295, 321–22
- aromatic components, 72, 78
- aromatic cores, 356, 362
- aromatic dopants, 486, 488–89
- aromatic groups, 71, 235, 344
- aromaticity, 28
- aromatic monomers, 93, 96–97, 107

- aromatic nucleophilic substitution, 102
- aromatic protons, 238, 390
- aromatic rings, 3, 26, 28, 68, 173, 235–36, 243, 472
- aromatic stacking interactions, 74, 78
- aromatic units, 178, 243
 - layered, 172
 - stacked, 178
- aromatization, 29, 31, 71, 82
- arylation, 36, 48, 51–54, 57
- aryl substitutions, 68
- aspect ratio, 275, 277, 488, 495–96
 - high, 491
- assemblies, 229, 283, 287, 309–10, 350, 352–53, 355, 357, 359–60, 368, 371
 - cage-type a-CD, 287
 - cage-type g-CD, 287
 - channel, 286
 - channel-type, 285–87
 - charge-segregated, 353, 369
 - columnar, 295, 308, 353, 369
 - dimension-controlled, 353, 363, 378
 - ion-based, 363, 371
 - ion-pairing, 353, 363, 372
 - molecular, 349–50, 354
 - ordered, 369
 - polymeric, 227
 - programmable, 347, 378
 - stable, 371
 - supramolecular polymeric, 234
 - supramoleuclar, 388
 - tetrameric, 369
- assembling modes, 352–56, 358, 365–66, 372
 - hierarchical, 351
 - intermediate, 353
- assembling structure, 234
- association constant, 223–28, 231, 234, 237, 243–44
- asymmetric aldol reactions, 200
- asymmetric catalyst, 3, 193
- asymmetric epoxidation, 3
- asymmetric reactions, 84–85
- asymmetric synthesis, 44, 47, 49, 51
- atomic force microscopy (AFM), 202, 204, 226, 228–30, 232, 234, 239, 246, 355, 358, 366–68
 - tapping mode, 226
- atom transfer radical polymerization (ATRP), 154–56
- ATRP, *see* atom transfer radical polymerization
- axial chirality, 3, 203, 339
- backbone, 200, 209, 236, 257, 391
 - π -conjugated, 187
- ball-and-stick representation, 298
- bandgap, 141, 188, 450, 452–54, 456, 459, 470, 472–73, 476
 - narrow, 416
 - optical, 472
 - zero, 448
- bandgap energy, 480
- band theory, 440, 472
- base pairs, 172
- base stimuli, 211
- base vapors, 491
- bathochromic shifts, 77, 79, 235, 393, 415–16, 429, 480
- BCP, *see* block copolymer
 - crystalline-crystalline, 156
 - donor-acceptor, 153
 - linear, 159
 - soluble, 152
- BCP synthesis, 148, 153
- Beer-Lambert's law, 386
- behaviors
 - pH-responsive, 427
 - switching, 209
- benzene tricarboxylic acid (BTA), 488

- Bergman cycloaromatization, 33, 35
- BHJ, *see* bulk heterojunction
- bias, 7, 40, 204
 negative, 40
 positive, 40
- binding, tight, 9
- binding constant, 226, 229
- biological imaging, 400
- biological systems, 234
 functionality simulating, 247
- biomacromolecules, 193–94
- biomedical imaging, 398–99, 404, 406–7
- biopolymers, 84, 399
- biotechnical tools, 416
- birefringence, 253, 263–64, 274, 308
- block copolymerization, 122
 direct, 268
- block copolymer (BCP), 81, 114, 122, 133, 140–41, 146, 150, 152–53, 155–57, 268–70, 278, 281
 all-conjugated donor–acceptor, 153–54
 amorphous, 272
 distributed LC, 270
 functional, 138, 281
 liquid-crystalline, 281
 main-chain LC, 269
 side-chain LC, 268–69
- block copolythiophenes, 150, 153
 all-conjugated, 150–51
- bond angle, 442–43
- bond cleavage, 32, 48, 84, 429
- bond formation, 37, 51–52, 55–56, 58, 97, 443
 dative, 430
- bonding, 383, 439–40, 442, 444
 atomic, 440
 noncovalent, 232
 sp^2 hybrid, 446
 sp^2 hybridization, 447
 sp^2 -hybridized, 439, 447, 453
- bonds, 26, 51–52, 54, 392, 395, 421, 425, 429, 440, 442, 444, 446, 492
 carbon-heteroatom, 52, 54
 chemical, 73
 hybridized, 446
 mechanical, 209
 single, 68, 195
 sp^3 , 453
 sp - sp , 443
 three-center four-electron, 430
 weak dative, 430
 weak noncovalent, 408
- bond strength, 442–43
- boron complexation, 422–24
- Bradsher reaction, 33
- Bragg reflections, 258, 266
- Bragg's law, 266
- branched polymers, 159, 161
- Brillouin zone, 449
- Bronstein and Luscombe's method, 118
- Brownian motion, 209
- BTA, *see* benzene tricarboxylic acid
- Buchwald–Hartwig coupling reaction, 51
- building blocks, 5, 140, 174, 228, 284, 295, 307, 310, 352–53, 355, 360, 362–63, 420
- bulk heterojunction (BHJ), 157
- bulk supramolecular assemblies, 283–84
- bulk supramolecular materials, 283
- Cadogan cyclization, 35
- cage-type packing, 285, 287
- calcination, 304, 483
- calix[3]amide scaffolds, 326, 333
- capacitance, 494–95
 high electrochemical, 96
- capacitance value, 494–95

- capacitors, 470, 494, 501
 - electrochemical, 494
- capacity retention, 493
- capsule-type homodimer, 324
- carbohelicenes, 43, 45, 48
- carbonization, 305
- carbon nanorings, 68
- carbon nanotube (CNT), 68, 156,
 - 439–40, 448, 452–53
 - double-walled, 453–54
 - multiwalled, 453–54
 - single-walled, 439–40, 454
 - unrolled, 451
- casting, 174, 357, 434
- catalysis, 4, 6, 501
 - asymmetric, 3–4, 11
 - electrochemical, 502
- catalyst migration, 460
- catalysts, 1, 7, 11, 99, 113–15, 117,
 - 119–21, 123–25, 127–31,
 - 145–47, 153, 391, 455–57, 463
 - bimetal, 456
 - electron-poor, 127
 - electron-rich, 126–27
 - foldamer-based covalent, 208
 - Grubbs, 47
 - molecular, 24
 - nonmetal, 456
- catalyst transfer condensation
 - polymerization, 115, 117–19,
 - 122–28
- cathodic electropolymerization, 97
- cavity, 207–8, 284–85, 297–98,
 - 300, 304, 319
 - isolated, 285
- CD, *see* circular dichroism
- CD intensity, 9, 341
- CD signals, 197, 201, 206, 211,
 - 213, 237
 - bisignated, 203, 206
 - induced, 201, 207
 - intense, 199–200, 203, 206
- CD simulations, 202
- CD spectra, 7, 211–13, 341
- CD spectroscopy, 9
- cells, 262, 264, 400, 404
 - electrochemical, 105
 - electrolytic, 92, 94, 104
 - fuel, 502
 - photovoltaic, 98–99, 114, 142,
 - 172, 413
 - untreated, 406
- CellTiter-Glo assay, 406
- cellulose backbone, 407
- cellulose template, 399
 - semicrystalline, 404, 407
- cell viability, 404
- chain coupling, 126
- chain dissociation, 103
- chain-growth polymerization,
 - 113–14, 131–33
 - catalyst transfer, 122
- cationic, 131
- channels
 - 1D, 285, 299–300, 304–5
 - conductive, 40
 - preorganized porous, 483
- channel-type packing, 285
- charge-by-charge assembly, 353,
 - 363, 366, 368–72
- charge-by-charge mode, 353
- charge-by-charge stacking, 370
- charge carrier mobility, 318, 351,
 - 369, 474
- charge carriers, 413, 472
 - negative, 474
- charge carrier transporting
 - property, 371–73
- charged species, 352–53, 360, 373
 - electron-deficient, 353
 - electronic, 352–53, 356–57,
 - 359–60, 372
 - electronic planar, 352
 - organic, 352
 - planar, 353, 367, 369
- charge mobility, 142
- charge ordering, 390
- charge-segregated structures, 369

- charge transfer
 - ligand-to-ligand, 16
 - ligand-to-metal, 15
 - twisted intramolecular, 331
- charge transfer band, 78
- charge transfer complexation, 43–44
- charge transfer complex, 363, 381, 383, 386
- charge transfer energy, 385
- charge transport, 41, 55, 353
- C–H bond functionalization, 56
- chemical crosslinks, 481
- chemical oxidation, 477
- chemical oxidation polymerization, 476–77
- chemical sensors, 415
 - responsive, 490
- chemical vapor deposition (CVD), 455, 457, 463
 - plasma-enhanced, 455
- chemistry
 - basic quantum, 440
 - click, 156, 363
 - dedoping, 470, 474
 - host–guest, 201, 319, 325
 - optical, 411
- chiral auxiliaries, 44
- chiral catalysis, 194
- chiral catalytic ability, 84
- chiral environments, 3, 7
- chiral helical topologies, 341
- chirality, 9, 197, 199, 206–9, 211, 324, 337, 340, 439, 453–54, 456, 460
 - absolute, 85
 - molecular, 325
 - single, 454–55, 464
 - stable helical, 26, 43
 - twisted, 337
- chiral ligands, 3, 46, 197
- chiral smectic phase, 258
- chiral stationary phase (CSP), 203
- chiroptical properties, 25–26, 43–44, 199, 332, 338
- chromatography, 39
 - gel permeation, 102, 124
 - reverse phase column, 236
 - size-exclusion, 400, 433–34
- chromophores, 213, 317, 321, 326–27, 331–33, 336–37, 342–43, 347
 - conjugated, 329, 332–33, 337–38, 342
 - donor and acceptor, 388
 - main-chain, 207
 - self-assembled, 328
- CIE, *see* crystallization-induced emission
- circular dichroism (CD), 7, 9, 43, 74, 197, 203–6, 208, 237, 334, 336, 342
- circular dichroism spectra, 8
- circular polarized luminescence (CPL), 83, 365
- Clar’s aromatic sextet, 28
- Clar’s theory, 28
- clefts, 226–27
- CNT, *see* carbon nanotube
- CNT growth, 455–56, 468
- CNT properties, 439–40
- CNT synthesis, 440, 463
- coatings, 405, 492–93
 - anticorrosion, 470
 - functional, 490
 - protective, 492
 - spin, 174
- coefficients
 - large absorption, 246
 - molar extinction, 387, 432
- columnar channels, 293, 308
 - pillar-shaped, 308
- columnar structures, 285, 340, 361–62, 366, 369
- columns
 - helical HBC stacking, 351
 - homeotropic, 80

- neighboring, 340
 - one-dimensional stacking, 53
 - slant helical, 308
- column structures, 261
- comonomers, 431–34
 - active, 200
 - alternating, 416
- compatibility, 96, 238
- complementarity, 223–24, 247
- complexation, 2, 201, 228, 231, 237, 240, 242, 290, 420
 - competitive, 231
 - step, 233
- complexes, 3, 7, 9, 15, 285, 363–64, 366, 371, 381, 383, 386, 405–6, 416, 420, 430–34
 - dinuclear, 5, 195
 - higher-order, 383
 - host-guest, 297
 - light-harvesting antenna, 172
 - molecular, 382–83
 - nonsymmetrical, 18
 - organic, 390, 398
 - organometallic, 414
 - receptor-anion, 363–64, 366, 370
 - receptor-ion, 372
 - salen ligand radical, 21
- compounds
 - cross-conjugated, 171–72
 - mixed-valence, 18
 - π -conjugated, 171–72, 187
 - pillar-shaped macrocyclic host, 300
 - π -stacked, 171, 173
 - σ -conjugated, 171–72
- concurrent reduction and substitution (CRS), 106–7
- condensation, 1, 68, 323, 400, 415, 419
 - direct cyclic, 338
 - intra-molecular ring-closing, 34
 - step-wise, 476
- conducting polymers, 92–93, 97–99, 103, 471–74, 482, 490, 492, 494, 502
 - conjugated, 470–71
 - soluble, 102
- conductivity, 99–100, 106, 140, 173, 224, 472–74, 491, 495–97
 - anion, 356
 - charge carrier, 361
 - high, 476, 494–95
 - ionic, 356
 - low, 477, 495
 - strong, 491
 - time-resolved microwave, 361
- conformation, 9, 74–75, 81–82, 199–200, 204, 273, 276, 320–21, 323, 325–26, 328, 330, 338, 341, 343
 - compact, 203, 235
 - cone, 294–95
 - controlled, 234
 - crosslinked, 402
 - definite, 319
 - distorted, 8
 - foldamer, 213
 - folded, 213
 - main-chain, 268, 271–72
 - planar, 3, 7–8, 10–11, 418
 - stable, 272, 294
 - unstacked, 178
- conformational behaviors, 74, 85
- conformational entropy, 272
- conformational flexibility, 297
- conformational modularity, 237
- conformational variation, 308
- conformer ratio, 326
- conformers, 9, 74, 78, 308, 319, 323–24, 326, 328, 337, 444
 - multiple, 9
- conformer stability, 78
- conjugated backbones, 100, 172, 365
- conjugated compounds, through-space, 171, 173

- conjugated head groups, 355
- conjugated molecules,
 - organoboron-containing, 428
- conjugated polymer backbones, 107
- conjugated polymer family, 471
- conjugated polymers, 93, 128, 174, 176–77, 411, 414–16, 419, 422, 430–31, 433–34, 470, 472–73, 490, 493, 496–97
 - common, 433
 - electrochemistry of, 111
 - functional, 220
 - stable, 428
 - sulfur-containing, 111
 - through-space, 171–74, 176, 178–79, 187–88, 321, 470, 473
- conjugated polymers and oligomers, 172
- conjugation, 77, 177, 414–15, 420, 428
 - effective, 178
 - extended, 141, 418
 - higher, 393
 - main-chain, 413
- conjugation system, 413–15, 420, 428, 431, 433–34
 - general through-bond, 177
 - heteroatom-containing, 434
 - robust, 418
- constant
 - dielectric, 480
 - dimerization, 226
 - elastic, 267
- conversion, polarity, 212
- conversion efficiency, 430
- copolymerization, 71, 73, 98, 200–201, 203
 - electrochemical, 98
- copolymers, 83, 98, 103, 239
 - achiral phenylacetylene, 202
 - branched, 139
 - conjugated, 185, 416
 - diblock, 119
- copolymer synthesis, 98
- core, 30, 37, 159, 231, 256, 276, 291, 301, 362, 483, 486–87
 - charged, 363
 - glycerol, 276
 - saddle-shaped, 307
- core cationic, 359
- core electrons, 440
- core material, 483
- core-shell LC elastomers, 276
- core units, 359–60, 365
 - electronic, 357
 - rigid, 350
- corrosion efficacy, 492
- Cotton effect, 211, 334–35, 341
 - negative, 341
- Coulomb interaction, 385
- Coulomb repulsion, 297
- counteranions, 10, 204, 359–60, 362
- countercations, 366, 370
- counterelectrode, 94–95, 105
- counterions, 352, 355, 357, 360
 - organic, 352
- coupling, 38, 69, 72, 84, 93, 128, 365, 433, 478
 - dominant, 93
 - efficient, 140
 - reductive, 130
 - transition-metal-catalyzed, 31
- coupling polymerization, 103, 429
 - oxidative, 173
 - Stille, 130
- covalent bond, 319, 383
- CPL, *see* circular polarized luminescence
- CPL, one-handed, 83
- CPL one-handedness, 83
- CPL reflection, 83–84

- one-handed, 83
- cross-coupling reactions
 - catalyzed, 69
 - palladium-catalyzed, 51, 320, 429
- cross-coupling step, first, 125
- crossed polarizers, 264, 290
- crosslinked chain structures, 479
- crosslinked form, 402
- crosslinked structures, 482
- crosslinker, 276–77
- crosslinking, 103, 243, 276, 402, 478
- crosslink structure, 481
- crown ethers, 197, 209–11, 283–84, 290–91
 - face-to-face, 293
- CRS, *see* concurrent reduction and substitution 106–7
- CRS cycles, 106
- cryo-TEM, 276, 359
- crystal film, 307
- crystal growth, 468
- crystalline domains, 153, 159
- crystalline pillar, 301, 304
- crystalline solids, 286
- crystalline structure, 256–57
- crystallinity, 270, 392, 394, 482, 496–97
- crystallites, 160
- crystallization, 75, 425, 502
- crystallization-induced emission (CIE), 425–26
- crystal network structure, 340
- crystal packing, 7, 76, 293
- crystal packing structures, 421
- crystals, 172, 202, 254, 267, 270, 303, 305, 307, 322, 382, 392, 425, 468
 - diamond, 447
 - organic, 303
- crystal state, 322–23
- crystal structure, 285, 293, 303, 305, 322, 331, 340, 363, 369, 399, 448, 463
 - liquid, 302
- CSP, *see* chiral stationary phase
- CT, *see* charge transfer, 78, 185, 188, 223–24, 298, 363, 381, 385, 400, 404–6, 420, 427, 433, 492
- CT absorption, 238, 240, 244
 - solvent-dependent, 239
- CT absorption band, 235, 382
- CT absorption spectra, 390
- CT band, 79, 229, 236, 238, 386, 390, 396, 403
- CT complexes, 388, 390, 398–99, 401–4, 406–7
 - organic, 381
- CT interaction, 78, 223–26, 228–29, 231, 234–35, 240–43, 245–47, 388, 408
 - host-stabilized, 231, 233
 - intramolecular, 246
 - organic, 381
- CT spectrum, 385
- Cubbi assemblies, 360
- Cubbi mesophases, 361
- cubic microstructures, 286
- current density, 447, 493, 495
- curve-fitting analysis, 227
 - nonlinear, 226
- CV, *see* cyclic voltammetry, 53, 74, 94–95, 100, 175, 229
- CV measurement, 94, 101, 229
- CVD, *see* chemical vapor deposition
 - thermal, 455
- CVD system, 457
 - cold-wall, 457
- cyanation, 102
 - anodic, 102
- cycles, heating-cooling, 302
- cyclic trimerization, 339
- cyclic voltammetry (CV), 53, 74, 94–95, 100, 175, 229

- cyclization, 33, 36, 341
 - intramolecular triple, 37
 - iodine-mediated, 36
 - radical, 39
 - reductive, 37–38
- cycloaddition, 44–47, 50–51, 72, 159, 287
- cyclodehydrogenation, 55
- cyclodextrin, 197, 283–84, 319–20
- cylindrical microdomains, 270
- cylindrical structures, 453

- data
 - experimental, 444
 - magnetic susceptibility, 15
 - spectroscopic, 339
- deboronation, 128
- dechalcogenation, 37
- decomposition, 367, 464
- dedoping, 98, 491
- defects, 72, 264, 434, 472
 - chemical, 472
 - structural, 482
- defect sites, 461
- deformations, 267, 472
 - out-of-plane, 480
 - ring, 11–12
 - structural, 12
- degradation, 420
- dehalogenation, 97, 128
- dehydrogenation, 45–46
- delocalization, 12, 18, 21, 393, 445, 470, 474
- demethylation, 417
 - quantitative, 418
- denaturation, 84
 - heat, 237
- dendrimers, 68, 229
- dendrons, 68, 301
- density, 6, 74, 187, 341, 394, 440
 - electronic, 452
 - high energy, 493–94
 - low power, 494
 - optical, 386
 - time-dependent, 184
- density functional theory (DFT), 6, 74–76, 78, 184–85, 187, 196, 341, 394
- deprotonation, 93
- derivatization, 39
- desorption, 303, 305–6
 - matrix-assisted laser, 434
- Dexter mechanism, 184, 188
- Dexter-type energy transfer, 185
- DFT, *see* density functional theory
- DFT calculations, 90, 205, 396
- diad regioisomers, 142–43, 160
- Diels–Alder approach, 44, 49
- Diels–Alder cycloaddition, 44, 49
- Diels–Alder method, 44
- Diels–Alder reaction, 30, 45
- differential scanning calorimetry (DSC), 266, 362
- diffraction peaks, 482
- diffusion, 144–45, 491
- diffusion constant, 228
- diffusion-ordered spectroscopy, 228
- dimensional ESI, 234
- dimerization, 43
- dimer packing distances, 293
- dimer stack, 237
- dimethyl formamide (DMF), 175, 199, 206, 330
- dimethyl sulfoxide (DMSO), 238, 355, 399–400, 402–4
- dipole interactions, 303
- dipole moment
 - electric transition, 336–37
 - magnetic transition, 337
 - net transition, 335
- dipole moments, 184
- Dirac equation, 449
- director vectors, 255, 260, 262–65
- discotic mesophases, 290
- disorder, 199
 - morphological, 472
- dispersabilities, 490

- dispersion, 276
 - linear, 450
 - stable, 275
 - stimuli-responsive, 277
- dispersities, 139
 - low, 140, 156, 159
- disproportionation, 126
- dissipation, 472
- dissociation rate, 458
- distance, 83, 209, 211, 213, 239, 296, 301, 321, 329, 362, 366, 451
 - edge-to-edge, 328
 - fibril period, 160
 - intercolumnar, 351, 368
 - intersheet, 75
 - periodic, 260, 266
 - repeating, 370
- distortion, 421
- DLS, *see* dynamic light scattering
- DMF, *see* dimethyl formamide
- DMSO, *see* dimethyl sulfoxide
- DNA, 172, 188, 193–94, 213, 234, 246, 257, 338, 438
 - double-stranded, 172
- DNA duplex, 243
- DNA fluorescence label, 329
- DNA recognition, 501
- DNA wires, 438
- domain morphologies, 267
- donor–acceptor assemblies, 154
- donor–acceptor interaction, 154
- donor–acceptor pair, 154
- donor units, 235–36, 239, 242, 388, 390
- dopant acids, 477, 479, 485–86, 488–89, 496
- dopants, 96–97, 104, 473–74, 477, 479, 481–82, 485–89, 493–94
 - aromatic acid, 486
 - different-core-size, 486
 - nonaromatic, 486
 - nonnucleophilic, 100
 - planar, 486
 - symmetrical, 489
- doping, 96–100, 140, 470, 473–74, 480, 491, 493, 495, 498
 - anodic, 100, 104
 - cathodic, 104
 - chemical, 173
 - electrochemical, 93, 96, 101, 107
 - proton, 479
- doping agent, 473
- doping behavior, 106
- doping levels, higher, 473, 496
- double bonds, 195, 470–72
 - alternating, 195
 - sequential, 447
- double cyclization, 36
 - reductive, 39
- double-twisted structure, 258
- drop-casting, 351, 356
- drug delivery, 470
- DSC, *see* differential scanning calorimetry
- DSC thermograms, 302
- dumbbell structure, 292
- durability, 223, 247, 414, 428, 433
- dynamic light scattering (DLS), 229–30, 232, 234, 404
- ECD, *see* electronic circular dichroism
 - positive, 336
- Eglinton coupling, 226
- elastic energy, 267
- elasticity, 253
 - rubber, 275
 - segment, 232
- electrical conductivity, 93, 96, 98, 173, 369, 439, 474
- electrical currents, high, 453
- electric charges, 350
- electric conductivity, 96, 474
- electric fields, 253, 263–64, 275, 308, 473, 492
- electrochemical chlorination, 101, 103

- electrochemical polymerization, 92–94, 96, 98, 174–75, 476
- electrochemical
 - postfunctionalization, 99
- electrochemistry, 91, 99, 109, 111
 - bipolar, 108, 111
- electrodes, 92–93, 100, 105, 107, 175, 263, 449, 454, 477
 - bipolar, 107
 - drain, 40–41
 - gate, 40
 - inert metal, 477
 - saturated calomel, 495
 - source, 40
 - transparent, 263
 - transparent conducting, 449
 - working, 93–96, 477–78
- electrode surface, 96, 99
- electroluminescence, 172
- electrolysis, 104–5
 - anodic, 92
 - current, 92
 - paired, 105
 - potential sweep, 101
- electrolyte, 92, 94, 98, 100–102, 105, 107, 141, 477
 - monomer-free, 96
 - solid, 495
- electrolytic dielectrics, thin, 494
- electrolytic polymerization
 - method, 141
- electromagnetic shielding, 470
- electron-accepting ability, 239, 420
- electron acceptor, 18, 232, 235, 237, 298, 383, 386, 390, 398
- electron conduction, 473
- electron configuration, 440, 445
- electron density, 101
- electron-donating, 2, 7, 51, 54, 224, 231, 239, 241–42, 298, 350, 388, 420, 432
- electron donor, 18, 224, 226, 228, 231–32, 235, 237–38, 245, 298, 347, 382–83, 386, 390, 398–99
- electronic circular dichroism (ECD), 335–37
- electronic interactions, 41, 178, 423, 428, 431–32
 - moderate, 18
 - strong, 18
 - two-dimensional, 41
 - weak, 331
- electronic structures, 11, 17, 20–21, 26–29, 327, 390, 414, 422, 429–30, 451–52, 454, 468, 472
 - nondegenerate, 472
 - unique, 448
- electron microscopy, 440
 - cryo-transmission, 276
 - scanning, 237, 351, 457
 - transmission, 276, 351, 457
- electron paramagnetic resonance (EPR), 15
- electron transfer, 17–19, 93, 95, 99, 107, 184
 - chemical, 93
 - photoinduced intramolecular, 16
- electron transfer cascades, 321
- electron-transporting properties, 38
- electron-withdrawing, 54, 78, 388, 427, 432
- electropolymerization, 72, 95–96, 98, 100–101, 106–7
 - anodic, 94
- electrostatic interactions, 350, 352, 359–60, 495
- electrostatic repulsions, 211, 245, 353
- electrosynthesis, 91
 - organic, 91–92, 107
- elimination, 97, 130–31
 - acetic acid, 46
 - reductive, 115–16, 119, 131, 144, 147
- elongation, 232, 242, 433
 - main-chain, 200

- emeraldine form, 475, 477, 479–81
- emission, 25, 106, 179–83, 336, 342, 406–7, 413, 416, 419–21, 424, 426, 431–34, 452
 - aggregation-induced, 400, 419
 - bright, 414, 419–20
 - brilliant, 419
 - broad, 342
 - enhanced, 415
 - excimer, 319, 329, 331
 - fluorescence, 331
 - red-shifted, 417
 - strong, 425
 - weak, 421, 425, 432
- emission efficiencies, larger, 425
- emission enhancement, 418, 425
- emission intensities, 421, 425, 427
- emission maxima, 327–28
- emission peak, 179–80, 404, 432
- emission spectra, 320, 332, 342, 415–16, 418–22, 424–25
 - fluorescence, 320, 330, 342
 - red-shifted, 416
- emission spectrum, blue-shifted, 426
- enantiomeric excess, 44, 49, 201
- enantiomers, 43, 57, 324–25, 333–34, 340
 - active, 341
- enantiopurity, high, 47
- enantioselective epoxidation, 4
- enantioselective reactions, 7
- enantioselectivity, 5, 10–11, 46, 84, 203
 - high, 4, 6, 10–11, 51
 - low, 11
 - moderate, 11
- encapsulation, 207
- end-capping, 124
- end-capping groups, 181
- end groups, 69–70, 74, 76–77, 80, 84, 114–15, 117, 129, 276, 434
- energy, transfer, 185
- energy bandgaps, 188, 472
 - narrow, 472
- energy bands, 450
- energy barrier, 324
- energy densities, 494
- energy dispersion, 450, 452
- energy gaps, 28, 452
- energy levels, 188, 430, 441, 445
- energy storage, 449, 493–94, 502
- energy transfer, 179, 206
- energy transfer efficiency, 184, 206
- EPR, *see* electron paramagnetic resonance
- Eyring equation, 76
- EXAFS, *see* extended X-ray absorption fine structure
- excitation, 404–7, 472, 496
- excitation energy, 16, 420
- excitation wave numbers, 458
- excited state, 77, 331, 345, 385, 433
 - electronic, 382, 384
- excitons, 171–72
- exciton states, 335–37
- explosion technique, 447
- extended X-ray absorption fine structure (EXAFS), 468
- exTTF, 228–30
- face-to-face conformation, 319
- face-to-face electronic interaction, two-dimensional, 41
- face-to-face orientation, 69, 359
- face-to-face stacking, 237
- facile detection techniques, 427
- feedstock gas, 455–56
- Fermi energy, 450
- Fermi level, 450, 452
- FET, *see* field-effect transistor
- fiber axis, 271
- fibers, 246, 271, 350–51, 354–55, 359, 486–88
 - cellulose-based, 403

- functional, 399
 - straight, 230
 - uniform, 354
- fiber structures, 304, 355
- field-effect transistor (FET), 80,
 - 172, 318, 414, 449, 452, 456, 459
 - organic, 26, 142, 188
- films, 83–84, 93, 95, 100–103, 277,
 - 305–6, 399, 419, 425–27, 434, 491, 495
 - bulk, 491
 - cast-coated, 102
 - elastic freestanding, 228
 - fumed, 426
 - multilayer, 305–6
 - nanofiber, 491
 - polymer, 94
 - product, 96
 - thick, 491
 - thin, 159–60, 305, 491
- film thickness, 491
- film-type optical sensor, 427
- film-type sensor, 428
- first-order kinetics, 76
- Fischer indole synthesis, 35, 37
- FL, *see* fluorescence luminescence
- flash-photolysis, 361
- flash-photolysis time-resolved
 - microwave conductivity (FP-TRMC), 361, 371
- fluorescence, 327–28
 - multicolored, 398
 - turn-on, 427
 - weak, 336
- fluorescence luminescence (FL), 366
- fluorescence quantum yield,
 - 38–39, 49, 320, 331
- fluorescence quenching, 318, 321
 - concentration-dependent, 246
- fluorescence resonance energy transfer (FRET), 181, 182, 184–85
- fluorination, 103, 107
 - electrochemical, 103–4
 - nucleophilic, 103
 - quantitative, 106
- foldamers, 193, 203, 207–8,
 - 212–13, 235, 238, 241
 - conjugated, 194, 207, 213
 - helical, 204–6
- force, polarization, 383
- force-sensitive CT, 391
- Förster mechanism, 184
- Förster radii, 184
- Fourier transform infrared (FTIR), 101, 173, 392, 480–81
- FP-TRMC, *see* flash-photolysis time-resolved
 - microwave conductivity
- free energy, 76, 237, 273, 386
- FRET, *see* fluorescence resonance energy transfer
- Friedel–Crafts acylation, 43
- Friedel–Crafts-type intramolecular cyclization, 45
- Friedel–Crafts-type reactions, 46
- fringe pattern, 276
- FTIR, *see* Fourier transform infrared
- FTIR spectroscopy, 173, 395
- functional groups, 68, 80, 99, 118,
 - 145–48, 195, 211, 268, 293, 301, 319, 421, 433, 488
 - polymerizable, 433
- functionalities, 1, 5, 68, 85, 90,
 - 98–99, 148, 247, 283–84, 310, 365, 399, 434, 486
 - chain-end, 140–41
 - chemical, 469
 - electronic, 148
 - high, 425
- functionalization, 92, 107, 147,
 - 196, 284, 324, 425
 - electrochemical, 91
 - facile, 284
 - nanomaterial, 73

- regioselective, 24
- selective, 148
- functional macromonomers, 281
- functional materials, 58, 193, 214, 316, 411
 - high-performance, 26
 - new, 20, 25, 438
 - organic, 26, 28, 52
- furan analogues, 33
- fused metalloporphyrin dimers, 310
- fused oligothiophene skeletons, 37
- FWHM, *see* full-width half-maxima
 - small, 417
- full-width half-maxima (FWHM), 416

- gases, 254, 303–4, 306, 455
 - chemical, 497
 - ethanol, 457
 - flow, 455
 - toxic, 491
- gas sensors, 491
 - high-performance chemical, 490
- gel, 225, 233, 236, 243–44, 367–68, 370
 - monomer-bearing silica, 203
 - swollen, 243
 - viscous, 236
- gelation, 233, 287, 502
 - heat-induced, 237
- gel decomposition, 367
- gel formation, 233
- gel permeation chromatography (GPC), 102, 124, 126, 326
- gel states, 367
- geometries, 5, 78, 195, 357, 360, 366, 382
 - 31-helical, 76
 - anion-binding, 365
 - open helical, 74–75
 - planar, 350
 - symmetric, 335

- GIWAXS, *see* grazing incidence wide-angle X-ray scattering 154
- GIXS, *see* grazing incidence X-ray scattering, 159
- globular polymer structure, 240
- glucopyranose units, 284
 - constituent, 285
- GPC, *see* gel permeation chromatography
- GQD, *see* graphene quantum dot
- Gracer-type side reaction, 434
- gradient electrochromism, 107
- graft copolymers, 114, 133, 138
 - all-conjugated, 158, 160
- graphene, 68, 439–40, 447–50, 467, 494–95
- graphene layers, 449, 451–52, 460–61
 - exfoliated, 462
- graphene nanoribbons, 68
- graphene nanosheets, 494
- graphene oxide sheet, 489
- graphene quantum dot (GQD), 489, 495, 501
- graphene sheet, 446, 453
- graphene walls, 453
- graphite, 75, 446–49, 461–62
- graphite substrate, 460
- graphite surface, 460–61
 - raw, 460
- grazing incidence wide-angle X-ray scattering (GIWAXS), 154
- grazing incidence X-ray scattering (GIXS), 159
- Grignard agents, 145
 - moisture-sensitive, 145
- Grignard exchange reaction, 143
- Grignard metathesis
 - polymerization (GRIM), 143
- Grignard monomers, 121
- Grignard reagents, 73, 145, 147
- Grignard-type pyrrole monomer, 121

- GRIM, *see* Grignard metathesis
polymerization
- grinding, 396–97
- ground state, 74, 178, 229, 331,
383–85, 397, 429, 472
degenerate, 472
spin-Peierls, 390
- group polarity, 76
- growth, 131, 133, 231–32, 234,
406, 439, 453, 456, 462, 464,
468
bidirectional, 117
high-rate, 456
large-area, 455
linear, 225
nanotube, 468
potentiostatic, 478
selective, 454
unidirectional, 117, 119
- growth temperature, 458–59,
462–63
- guest-induced depolymerization,
227
- gyroid structure, 273
- halogenation, 103
oxidative, 102
- halogen exchange reaction, 121
- Hamiltonian, 444
massless Dirac, 450
- Hamiltonian operator, 383
- Hammett substituent constants, 78
- hard-template method, 483
- head-to-head (HH), 143
- head-to-tail (HT), 117, 142–43,
195
- head-to-tail connection, 232
- head-to-tail coupling, 478
- head-to-tail photodimer, 309
- Heck cross-coupling, 174
- HeLa cells, 404–7
- helical conformation, 77, 199–200,
203–5
biased, 200
fixed, 206
folded, 212–13
initial, 204
large, 212
one-handed, 199, 201, 204, 206
perfect, 76
triple-stranded, 341
- helical folding, 76–78
perfect, 76, 78
spontaneous, 43
- helical geometry, 69–70, 77, 79–80
closed, 74, 82
cylindrical, 80
symmetric, 78
- helical handedness, 204
opposite, 197
- helical inversion, 76, 83, 85
pressure-dependent, 83
- helical inversion barrier, 76
- helical inversion rate constant, 76
- helical PANI nanofibers, 485
- helical pitch, 75, 199, 202, 204,
209–10
- helical polymers, 202
artificial, 84, 193–94, 213
conjugated, 209
rigid rod, 84
synthetic, 203
- helical structure, 75, 82, 84, 194,
198–200, 202, 207–9, 258,
260, 265, 338
clear, 206
closed, 74
folded, 203–7
intertwining, 338
nonplanar, 26
one-handed, 205–6
rigid, 83
stable, 43, 84
triple-stranded, 342
- helicenes, 25–27, 42–50, 57–58
double, 47
multisubstituted, 44

- helices, 194, 204, 207
 - biomolecular, 193
 - folded, 204
 - left-handed, 75
 - one-handed, 203
- helicities, 197, 199, 333, 337
 - left-handed, 333, 336
 - macromolecular, 202
 - main-chain, 203
 - one-handed, 337
 - triple-stranded, 333, 337
- helix, 83, 194, 200, 202–3, 205,
 - 210, 260
 - double, 194
 - left-handed, 43
 - one-handed, 211–12
 - reversible, 194
 - right-handed, 43
 - triple, 194
- helix inversion barriers, small, 194, 200
- herringbone packing, 318
 - edge-to-face, 318
- herringbone structure, 285
- heteroduplex, 243
 - zipper-styled, 243
- heterohelicenes, 28, 48–52, 56, 57
- hexagonal geometry, 309
- hexagonal-packed structure, 261
- hexagonal-shaped structure, 304
- hexamers, 229, 235, 284
 - cyclic, 300
- hexane-saturated chamber, 355
- highest occupied molecular orbital (HOMO), 28, 185, 188, 390, 395, 472
- high-performance liquid chromatography (HPLC), 70, 203, 334
- high-performance materials, 133, 142, 415
- hollow structures, 483
- HOMO, *see* highest occupied molecular orbital
- homocoupling, 70–71
- HOMO energies, 77
- HOMO energy level, 53
- homologation, 31–32
- homopolymerization, 73, 156
- homopolymers, 98, 161, 433
- honeycomb structure, 298
- host stabilization, 231
- HPLC, *see* high-performance liquid chromatography
- HPLC, recycling, 70
- Hückel method, 440
- Hückel theory, 444–45
- hybrid materials, 315–16, 438, 502
 - inorganic, 352
- hybrids, 441–42
 - organic-inorganic polymer, 438
- hydrocarbon salts, 363
- hydrocarbon solvents, 354
 - gelated, 366
- hydrogels, 237, 399
 - complex, 411
 - small molecular, 502
- hydrogenation, 456
 - reductive, 105
- hydrogen bonding, 199, 211, 223–25, 234–35, 243, 247, 293, 299–300, 338, 350, 354
 - head-to-tail, 293
 - internal, 308
 - regulated intramolecular, 205
- hydrogen-bonding interactions, 304, 324, 327, 396
- hydrogen-bonding motifs, 225
- hydrogen bonds, 172, 210, 295
- hydrolysis, 2, 155
- hydrophilicity, 359
- hydrophobicity, 359
- hypochromism, 213, 235
- hypsochromic shifts, 77
 - demonstrated, 328

- immobilization, 423, 429
- inhibitor, 492
 - corrosion, 492
- initiation, 121, 147–49
 - external, 125
- initiation efficiency, 196
- initiators, 73, 92, 113–15, 117–19, 125–27, 148, 326
 - chiral, 82
 - functional, 148
 - radical, 73
 - virtual, 144
- insertion, 73–74, 97, 153, 194–95
 - oxidative, 144
- insolubility, 173
- instability, 428
 - intrinsic, 415
- insulators, 99, 470, 472
 - gate, 40
- intensity, 8, 18, 183, 336, 370, 397, 432, 462, 479
 - complex, 396
 - fluorescence, 233–34, 239
 - signal, 143
- intensity ratio, 457–59
- interactions, 223–25, 231, 233, 240, 298, 305, 318–19, 350, 353, 360, 382–83, 396, 403, 408, 491–92
 - anisotropic, 262
 - chiral, 200
 - chromophore, 328
 - complex, 408
 - double-faced, 235
 - excitonic, 336
 - host–guest, 283–84
 - interchain, 474
 - interlayer, 396
 - ionic, 240, 291, 355
 - molecular, 421
 - noncovalent, 198, 350, 366
 - noncovalent bond, 319
 - noncovalent chiral, 201
 - physical, 492
 - quadrupole, 299
 - short-ranged, 254
 - solvophobic, 235
 - strong coordination, 120, 305
 - weak dipolarization, 383
- interconnections, 454
- interconversion, slow, 74
- interference, 16
 - electromagnetic-shielding, 470
- intermolecular interactions, 224, 349, 360, 372, 421, 425
- intermolecular transfer, 128–29
- interplanar distances, 75–76
- intramolecular charge repulsion, 245
- intramolecular charge transfer, 433
- intramolecular crosslinking, 417–18
 - efficient, 418
- intramolecular hydrogen bonding, 199–200
- intramolecular interactions, 234–35, 328, 342
- intramolecular reactions, 71, 402
- intramolecular transfer, 115, 128–30
- iodination, 70, 100, 365
- ion-based supramolecular assemblies, 363
- ion-based supramolecular gels, 366
- ionic charge transfer, 363
- ionic liquids, 92, 96, 104
 - room-temperature, 96
- ionic self-assemblies (ISA), 352
- ionic species, 92, 350, 360, 372, 378
 - electronic, 347, 362, 373, 378
- ionization, 385–86, 390, 434
- ion-pairing materials, 372–73
 - electronic, 373
- ion pairs, 361–63, 366–67, 369, 371

- ISA, *see* ionic self-assemblies
- isodesmic model, 226–27
- isoelectronic structure, 27
- isomerization, 2, 100
- isomers, 26, 33, 35, 43, 337, 339
 chiral catalyst, 197
 cone, 320
 conformational, 195
 diastereomeric, 231, 336
 optical, 334
- isothermal titration calorimetry (ITC), 244
- isotropic liquid, 289, 307
- isotropic melt, 271
- isotropic phase, 255, 258, 268, 273, 275, 290, 307
- isotropic phase transition, 267, 272, 276–77
- isotropic phase transition temperature, 270
- ITC, *see* isothermal titration calorimetry
- Janus structures, 310
- Job's plot, 231, 245
- jump, two-site, 291–92
- Kasha's exciton model, 335
- KCTP, *see* Kumada catalyst transfer polycondensation
- Kekulé structure, 28
- ketoiminate polymers, 423
- ketoiminates, 421–22, 425
- kinetic resolution, 47
 hydrolytic, 3–4, 20
- Kumada catalyst transfer polycondensation (KCTP), 144–45, 150, 153–57, 159
- Kumada coupling reaction, 143
- Kumada-Tamao catalyst transfer condensation polymerization, 116, 128
- Kumada-Tamao coupling polymerization, 113–15, 117–21, 123, 125, 133
- lamellae, 270, 272–73
 bilayer, 257
- lamellar bilayer, 356
- lamellar interfaces, 271
- lamellar microdomains, 271
- lamellar structure, 246, 288, 368
 ordered, 288
- laser ablation, 455
- laser amplification, 413
- lasers, 181, 460, 490
- lattice constant, 449, 451
- layer-by-layer assembly, 306
- layer deformation, 272
- layered structure, 258, 261, 272
 periodic, 259
- LC, *see* liquid crystalline
- LCD, *see* liquid crystalline display
- LCP, *see* liquid crystalline polymer
 bicontinuous, 273
 crosslinked, 275
 main-chain, 257, 275
 photochromic, 274
 rigid-rod, 257
- LC phases, 254–59, 261, 264, 266, 273, 290, 292
 calamic, 258
 discotic, 258
 thermotropic, 257
- LCST, *see* lower critical solution temperature
- LCST phase transition, 243
- LCST-type phase transition, 243
- LCST-type thermoresponsive behavior, 244
- LED, *see* light-emitting diode
- Lewis acids, 96, 132, 385
- Lewis bases, 383, 385, 415, 420
- ligand, 3, 10, 15–16, 36, 50–55, 57, 113–14, 120, 400, 430
- ligand coordination, 223–25, 247
- ligand exchange, 118, 153
- ligand groups, 84, 382
- ligand moiety, 21, 420

- ligand-to-ligand charge transfer (LLCT), 16, 18
- ligand-to-metal charge transfer (LMCT), 15
- light absorption property, 413
- light-emitting devices, 470
 - organic, 415
- light-emitting diode (LED), 68, 80, 318, 413, 490
- light irradiation, 204, 206, 307
- linkages, 102, 158, 237, 482
 - covalent, 229, 336
 - flexible, 237
 - meta-bridge, 293
 - two-point, 206
- liquid chromatography, 176
 - high-performance, 203, 334
- liquid crystal columns, 308–9
- liquid crystal film, 308
- liquid crystalline (LC), 198, 253–54, 267–68, 272–73, 276–77, 307
- liquid crystalline behavior, 281
- liquid crystalline display (LCD), 254, 263
- liquid crystalline phases, 290, 301
- liquid crystalline polymer (LCP), 254, 257, 268, 274, 276
- liquid crystalline properties, 253, 289, 292, 294, 296
- liquid crystalline states, 295, 302, 360, 372
- liquid crystalline structures, 290
- liquid crystallinity, 270
- liquid crystal materials, 287, 293
- liquid crystal properties, 307
- liquid crystals, 188, 193, 253–56, 258, 262–65, 267, 277–78, 283–84, 293, 301, 307, 350, 352–53, 362, 365
 - calamic, 258
 - chiral nematic, 197
 - columnar, 294, 308
 - discotic, 80, 172
 - homeotropic, 264
 - ion-based, 369
 - ionic, 360–61
 - thermotropic, 256, 301, 349
- liquid electrolytes, 495
- live cell imaging, 3
- living anionic polymerization, 156–57
- living coordination polymerization, 347
- living polymerization, 82, 84, 156, 161
- living radical polymerization, 269
- LLCT, *see* ligand-to-ligand charge transfer
- LMCT, *see* ligand-to-metal charge transfer
- London dispersion forces, 287
- loss
 - enthalpic, 272
 - entropic, 272–73
- lower critical solution temperature (LCST), 242
- lowest unoccupied molecular orbital (LUMO), 28, 105, 188, 390, 394–95, 415, 430, 472
- luminescence, 83, 391, 420, 425
 - polarized, 43, 365
- luminescence properties, efficient, 38
- LUMO, *see* lowest unoccupied molecular orbital
- LUMO levels, low-lying, 415
- Luscombe's method, 118
- lyotropic phases, 256–57, 374
- macrocycles, 5, 290–93, 307–8, 364
- macrocyclic compounds, 283–84, 296, 307–8, 310
 - first synthetic, 290
 - π -conjugated planar, 226
 - pumpkin-shaped, 296
 - symmetrical, 310

- macrocyclic hosts, 283–84
- macrocyclic molecules, 310
- macrocyclic oligosaccharides, 284
- macrocyclic rings, 292
- macrocyclic scaffolds, 229
- magnetic susceptibility, 15, 273
- main-chain backbones, 271–72
- main-chain structure, 211
- MALDI-TOF mass spectrometry, 70, 229–30, 339
- mass spectroscopy, wave ion mobility, 234
- mechanical grinding, 391, 397–99
- memory devices, 491–92
 - nonvolatile, 492
 - nonvolatile flash, 492
 - ultrafast nonvolatile, 490
- MEMS, *see* microelectromechanical systems
- mesogens, 256–59, 262, 265, 275–76, 289
 - interdigitated, 260
 - macromolecular, 257
 - polar, 260
 - short, 276
 - side-chain, 272–73
 - three-ring, 276
 - wedge-shaped, 290
- mesophases, 289, 293, 360, 362, 369–71
 - columnar, 290
 - columnar liquid crystalline, 310
 - lamellar, 372
 - ordered smectic, 296
 - smectic, 290
 - stable, 360
- metal-binding site, 5
- metal catalyst, 55, 433, 455–56, 460, 462
- metal-catalyzed cross-coupling reaction, 416
- metal complexes, 2–3, 12, 419
- metal exchange reaction, 70, 147
- metallic carbon nanotube, 452
- metalloenzymes, 7, 24
- metal nanomaterials, 501
- metal nanoparticles, 496
- metal-organic frameworks, 5
- metastable state co-conformation (MSCC), 242
- metathesis, 195–96
 - ring-closing olefin, 47–48
- micelles, 140, 257, 362, 374, 484
- microdomain, 268–74, 281
- microdomain structures
 - light-controllable, 274
 - manipulation of, 268, 271
- microelectromechanical systems (MEMS), 277
- microfluidics, 276
- micromechanical manipulation, 254, 277
- microphase-segregated structure, 269, 271, 273
- microphase segregation, 268, 272–73
- microscopy, 226
 - confocal fluorescence, 354, 356
 - scanning tunneling, 202
- Migita–Kosugi–Stille coupling copolymerization, 246
- miniemulsion techniques, 275–76
- misfolding, partial, 77
- mixture, 9, 11, 33–35, 47, 183, 203, 206, 274–77, 287, 356–57
 - diastereomeric, 39
 - inseparable, 33
 - physical, 475
- Mizorogi–Heck cross-coupling, 179, 339, 341, 433–34
- mobility, 41, 209, 371–72
 - carrier, 447
 - molecular, 254, 256
 - target, 41
- modulus, 276
 - elastic, 453
 - Young's, 228, 447

- moieties, 3, 57–58, 104–5, 159, 176, 178, 182–83, 206, 229, 231, 294–95, 298–99, 301–2, 304–5, 363–64
- adjacent donor, 246
- aliphatic, 365–66
- anionic, 305
- cationic, 360
- conjugated, 321, 343
- double-faced interacting, 224
- exTTF, 228–29
- ionic, 357, 360
- radical, 15
- solubilizing, 102
- molar ratio, 477, 485, 487–88
- molecular alignment, 255, 267
- molecular box, 295
 - self-assembled, 295
- molecular circuit, 438
- molecular dynamics, 196, 463
- molecular mechanics, 196, 205
- molecular modeling, 205, 237
- molecular necklace, 231, 298
- molecular orbitals, 382, 390, 442, 445, 471
 - delocalized, 471
 - highest occupied, 28, 188, 390, 472
 - layered integrated, 196
 - lowest unoccupied, 28, 105, 188, 390, 472
 - low-lying lowest unoccupied, 415
- molecular structure, 27, 30, 33, 254, 256, 351, 383, 421, 443–44, 446, 477
- molecular weight, 73, 102, 119, 121, 124, 126, 128, 139–40, 229–30, 269, 433–34, 483
 - controlled, 84, 120, 125
 - high, 70, 123, 230
 - uncontrolled, 114
- molecular wires, single, 172, 185, 188
- monolayer, 453
 - self-assembled, 232
 - undoped graphene, 450
- monomers, 73, 92–94, 96–99, 113–14, 120, 122–23, 126–27, 129, 131–33, 145, 197–98, 212–13, 244, 432–33, 477
 - conjugated, 132
 - heterocycle, 122
 - heteroditopic, 227–28, 230
 - neutral acceptor, 401
- monomer units, 69, 74–75, 77–78, 98, 194, 203, 337, 433–34, 483
- MRI contrast agents, high-performance, 447
- MSCC, *see* metastable state conformation
- MTT assay, 404
- Mulliken's theory, 383
- multimetallic salen complexes, 6
- multimetallic systems, 5
- multiple reduction, 97
- multiscale porosity, 502
- multistimuli responsibility, 277
- multiwalled carbon nanotube (MWCNT), 447, 453–55
- MWCNT, *see* multiwalled carbon nanotube
- nanoarchitectures, 420
- nanobelts, 356
- nanocarbon, 447, 453
 - π -conjugated, 68
- nanodevices, 496
- nanodiamond, 447, 456
- nanofibers, 353–55, 358, 483, 485–87, 491, 495–97
 - counterclockwise, 197
 - fluorescent, 354
 - left-handed helical, 485
- nanofibril structures, 140
 - hierarchical, 159

- nanoparticle (NP), 274, 287,
399–400, 404, 406–7
complex, 407
inorganic oxide, 483
silicon, 493
- nanoprecipitation, 399, 404, 406
- nanoribbons, 357–59
- nanorods, 358–59, 496
- nanoscale objects, 350
self-assembled, 360
- nanostructures, 159, 269, 301,
303, 351, 357, 359, 469–70,
474, 482–83, 485–86, 488,
490–91, 494–95, 497
- nanotubes, 301, 351, 357–59,
451–52, 482–83, 485, 488
- nanowires, 276, 496
crosslinked LCP, 275
- NCTP, *see* Negishi-type catalyst
transfer polymerization
- near infrared (NIR), 16, 416, 419
- Negishi coupling polymerization,
143
- Negishi-type catalyst transfer
polymerization (NCTP),
145–46
- Negishi-type cross-coupling, 69
- nematic, 258, 261, 264–66
columnar, 262
supertwisted, 264
twisted, 264
- nematic alignment, 264
- nematic liquid crystals, 265, 267
- nematic phase, 258–59, 264,
266–67, 270, 272–73
- networks, 287, 298, 350, 440
hydrogen-bonded, 199
- network structures, 251, 303
fibrous, 228
open, 303
- next-generation polymeric
optoelectronic technologies,
490
- NIR, *see* near infrared
- NIR absorptions, 16, 18–19, 21
broad, 18
narrow, 18–19
- NIR absorption spectroscopy, 16
- nitroxy-mediated radical
polymerization (NMP), 148,
155–56
- NMP, *see* nitroxy-mediated radical
polymerization
- NMR, *see* nuclear magnetic
resonance
- NMR analysis, 103–4, 242
- NMR signals, 13–14, 20
- NMR spectra, 12–15, 76, 143, 232,
240, 326, 330, 335, 339–40,
400, 429, 434
- NMR spectroscopy, 12, 14, 195,
226, 232, 236, 323, 390
- no-bond resonance, 386
- NOE, *see* nuclear Overhauser
effects
- NP, *see* nanoparticle
- NP aggregation, 405
- nuclear magnetic resonance
(NMR), 12–14, 16, 74, 78,
102–3, 117, 226–30, 232, 235,
237–39, 241, 243–44, 291,
319, 390, 418
- nuclear Overhauser effects (NOE),
228, 236
- nucleophilicity, 100, 145
- nucleophilic reaction, 100
- nucleophilic substitution, 100
- octamers, 80, 284
- octane gel, 366, 368
- ODT, *see* order–disorder
transformation
- OFET, *see* organic field-effect
transistor
- off-center spin-coating method, 41
- OLED, *see* organic light-emitting
diode, 26, 39, 114

- oligomer backbones, 391, 395
 - π -conjugated, 399
 - squaramide-pyrene, 393
- oligomer helical folding, 76, 78
- oligomer homocoupling, 71
- oligomerization, 93
 - cyclic, 330, 333
- one-handed helix induction, 208, 211
- one-handedness, predominant, 197–98
- one-handed polymers, 82
- OOT, *see* order–order transformation
- open-shell electron, 390
- optical anisotropy, 263–64
- optical materials, 415
 - nonlinear, 193
- optical microscopy, 362, 367
 - polarized, 351
- optical rotation measurements, 202
- optimization, 47, 52
- optoelectronic properties, 28, 157, 161, 246, 321
- OPV, *see* organic photovoltaic
- order–disorder transformation (ODT), 272
- order–order transformation (OOT), 272–73
- organic electronic devices, 381–82
- organic field-effect transistor (OFET), 26, 40–41, 142, 188
- organic light-emitting diode (OLED), 26, 39, 114
- organic photovoltaic (OPV), 26, 59, 152, 157, 188
- organogelation ability, 287
- organogelators, 286
- organogels, 287, 355
- overoxidation, 94
- oxidation, 4–5, 31, 49, 93–96, 100, 103–4, 106, 304–5, 427, 433, 474–75, 478, 490–91, 493, 495
 - aerobic, 4, 20
 - anodic, 101–2, 105, 477
 - atmospheric, 495
 - chemical, 175, 473, 477
 - electrocatalytic, 497
 - electrochemical, 103, 175, 490
 - one-electron, 75–76
 - two-electron, 105
 - oxidative addition, 115–17, 119–20, 131
 - oxidative coupling, 31, 173
 - oxidative photocyclization, 43
- PANI, *see* polyaniline 470, 472, 474–87, 489–97, 501–2
- PANI nanofibers, 486, 492–93, 495–96
- PANI nanosphere, 483
- PANI nanostructure, 470–71, 476, 479–80, 484–91, 493, 496, 501
 - conjugated conducting, 501
 - controlled, 483
- PANI nanotubes, 486, 489, 495
- PANI nanowire, 483
- PANI salts, 482
- PANI synthesis, 476–78
 - soft-template, 501
 - soft-template nanostructure, 485
- paracyclophanes, 174–75, 185, 187, 319–20
- paramagnetic molecules, 12, 14–15
- paramagnetic shifts, 14, 20–21
- Pauli matrix, 450
- π -acceptors, 388–89
- π -conjugated compounds, 25–26, 57–58, 178, 188
- π -conjugated helical polymers, 203, 209
- π -conjugated molecules, 318–21, 325, 350
- π -conjugated planes, 223–25, 234
- π -conjugated polymer films, 99

- π -conjugated polymers, 91–93, 96–101, 107, 113–14, 123, 128, 140–42, 151, 169, 194, 197, 203, 207, 214, 289
 - electron-deficient, 126
 - well-defined, 114, 130
- π -conjugated systems, 154, 319, 336, 347, 378
- π -conjugation, 53–54, 94, 144, 150, 393–94, 432, 471
 - extended, 77, 471
- PDI, *see* polydispersity index
- π -donors, 388–89
- PECVD, *see* plasma-enhanced chemical vapor deposition
- π -electrons, 223, 226, 228, 474
- π -electron systems, 171, 173, 176, 187–88
 - end-capping, 180–81
 - layered, 171–72
 - neighboring, 184
 - stacked, 171–72, 176, 179–82, 184–85, 187–88
- pendant groups, 146, 199–200, 203–4, 287
- periodicity, 266, 482
 - layered, 260
 - long-range, 266
- permeability, higher, 416
- permittivity, 263
 - anisotropic, 263
- phase behavior, 267, 270, 273
 - liquid crystalline, 281
- phase transition, 266, 268, 288, 307, 362
- phase transition temperatures, 267
- photocyclization, 43, 48–49
 - sextuple, 43
- photoemission, 468
- photoinitiator, 275–77
- photoirradiation, 43
- photoisomerization, 206
- photoluminescence (PL), 404–5, 440, 460
 - photooxidative resistance, 30
 - photophysical behavior, 394
 - photoreaction, 308
 - photostabilities, high, 416–17
 - photovoltaics, 470
 - physical crosslinking reaction, 400
- planar receptor, 363, 372
 - charged, 371
- planes, 179, 391, 399, 441
 - basal, 447
 - charged, 369
 - nodal, 335
 - π -conjugated, 41
 - π -electronic, 360
- Plank's constant, 480
- plasma-enhanced chemical vapor deposition (PECVD), 455
- PL, *see* photoluminescence
- PL quantum efficiency, 179
- PL spectra, 180–83
 - time-resolved, 181
- PMMA, 156–57, 159
 - chain-end-functional, 159
- polarized optical microscopy (POM), 264, 267, 274, 351, 362–63, 369–72
- polarons, 96, 100, 472–74, 479
 - positive, 473
- polyaniline (PANI), 470, 472, 474–87, 489–97, 501–2
- polycondensation, 92, 153, 269
 - chain-growth, 145, 326
 - imidation, 238
 - quasi-living Kumada catalyst transfer, 144
- polydispersity, 84
 - low, 118
 - narrow, 195
- polydispersity index (PDI), 102, 175–77, 181, 224, 238–43
- polymer backbone, 120, 157, 200, 211–12, 237, 246, 399
- p-type donor–acceptor, 158

- polymer chains, 83, 92, 115, 120, 143, 176–77, 182, 231, 235, 246, 470–72, 474, 481–82, 492, 496
 - activated, 144
 - conjugated, 470, 473
 - linear, 234
 - long, 177, 232
 - single, 178
 - supramolecular, 226
 - synthetic, 224, 247
- polymer film, 83, 96, 103–4, 262
- polymerization, 71–73, 82, 90, 92–97, 99, 114–15, 117–33, 144, 147, 194–97, 230, 232, 411, 434, 477–78, 481, 483, 485
 - catalyst transfer condensation, 115, 127
 - chain-growth, 114, 121
 - general, 141
 - step-growth, 73
- polymers, 71–73, 98–99, 114–15, 119–22, 128–32, 173–82, 203–4, 206, 209–14, 238–44, 246, 297–98, 413–19, 423–35, 469–76
 - acceptor, 245
 - achiral, 207
 - acidified, 213
 - acidified ionic, 213
 - active, 133, 203
 - amorphous, 281
 - bioelectronic, 411
 - chiral, 85
 - conductive, 470
 - covalent, 232
 - crosslinked, 275
 - electroluminescent, 502
 - electron-accepting, 241
 - emissive, 416, 434
 - helical coordination, 5
 - high-molecular-weight, 106, 130
 - hyperbranched, 138, 347
 - independent, 246
 - inorganic, 438
 - insoluble, 243
 - liquid crystalline, 254, 281
 - living anionic, 156
 - lower-molecular-weight, 119
 - main-chain type, 416
 - neutral, 473
 - n-type, 125
 - objective, 132
 - π -conjugated, 99, 101, 103–6, 140
 - postfunctionalized, 102
 - π -stacked, 178
 - rigid-rod, 257
- POM, *see* polarized optical microscopy
- porous materials, 303, 308
 - electronic, 411
 - organic, 299–300
 - storage, 283–84
- positive charge, effective, 440
- powder X-ray diffraction (PXRD), 355, 393, 397
- precursor polymer, 99, 104–5
- product polymers, 94, 96, 103, 105
 - hydrogenated, 105
 - overoxidation of, 95–96
- proof-of-concept, 105
- propagation, 115, 117, 130
 - bidirectional, 117
 - chain, 228
- protection, 145, 148, 492–93, 495
 - corrosion, 492–93
 - environmental, 490
- proteins, 193, 234, 238
 - folded, 237
 - natural, 246
- protonation, 79, 106, 427, 475, 479
- protons, 14, 105, 143, 229, 235–36, 238, 339, 390, 486
- π -stacked array, 172
- π -stacked structure, stable, 178
- π -stacked structures, 171–72

- π -stacking structures, multiple, 225
- π -systems, extended, 490
- pulsed arc plasma gun, 462
- purification, 2, 70, 236, 326, 370, 454
- purity, high, 84
- PXRD, *see* powder X-ray diffraction
- pyrene moieties, 391, 399, 403–6
- pyridine moieties, 208, 297
- pyridinium moieties, 101, 290

- quantum yield, 331, 424, 427, 434

- racemic crystal, 339
- racemic mixtures, 4, 75, 341
- racemization, 84, 325, 333
- racemization barrier, lower, 57
- racemization profile, 76
- radical breathing mode (RBM), 457–58, 460, 462
- radical anion, 390
- radical cation, 93, 478
- radical cation delocalization, 76
- radical polymerization, 156, 269, 347
- Raman measurements, 460
- Raman shifts, 457–59, 462
- Raman spectra, 457–60, 462
- Raman spectroscopy, 457
- rate constant, 76, 184–85
 - charge separation, 184
 - energy transfer, 184
- RBM, *see* radical breathing mode
- reaction, 10–11, 29, 31–32, 43–44, 47–51, 54–55, 91–93, 105, 118, 120, 130–31, 268–70, 296–98, 400–402, 418
 - biorelated, 428
 - click, 242, 297
 - esterification, 400
 - intermolecular, 401
 - linking, 140, 156
 - stepwise, 391
 - three-stage, 159
- receptors, 228, 363–64, 366–67, 369–72, 391
 - cationic, 371
 - charged anion, 371
 - conjugated anion, 378
 - ditopic, 365
 - electronic dicationic, 370
 - heteroditopic, 293
 - monocationic, 371
 - synthetic, 201
- receptor stick representation, 293
- recrystallization, 75, 285, 298
- redox behavior, 96
- redox centers, 17–19
- redox cycles, 4, 96
- redox properties, 21, 96
- red shift, 53, 83, 206, 213, 233, 318, 320, 393, 403, 418
- reduction, 29, 31, 96, 105, 228–29, 291, 415, 458, 473, 490–91, 493, 495–96
 - asymmetric, 200
 - concurrent, 106–7
 - electrochemical, 97, 105
 - one-electron, 101
 - two-electron, 105
- reductive annulation, 206
- reference electrode, 92, 94
 - standard calomel, 478
- regioisomers, 34, 47, 55–56, 143
- regioregularity, 139–43
- regioselectivity, 32, 55, 196
- resonance, 156, 383–84, 458, 473
 - dative, 384
 - electron paramagnetic, 15
 - surface plasmon, 232
- reverse microemulsions, 484
- reversibility, 96, 207, 495
- ring construction, 30, 51–52, 57
 - transition-metal-catalyzed, 38, 45, 48
- room temperature, 114, 237, 308, 332, 335–36, 342, 372, 391, 397, 399–400, 496

- rotation, 264, 274–75, 291–92, 320, 331, 334–35, 341
 - inverse, 265
 - large optical, 199
 - partial, 291–92, 341
 - stage, 265
- sacrificial reactions, 105
- salen complexes, 1–4, 6, 8, 10–12, 14–16, 18, 20–22, 24
 - chiral, 4
 - dinuclear, 5
 - nonsymmetrical, 2, 18
 - paramagnetic, 6
- salen ligand, 1, 3–5, 8–15, 18, 20–21
 - chiral, 3
 - class II, 18
 - deuterated, 12
 - diamagnetic, 13
 - noninnocent, 4
 - symmetrical, 16, 18
- salen ligand radicals, 4, 11–12, 15–20
 - delocalized, 12, 17–18
- SAM, *see* self-assembled monolayer
- sandwiched structure formation, 238
- saturated calomel electrode (SCE), 478, 495
- SAXS, *see* small-angle X-ray scattering
- scaffolds, 209, 329, 350, 483
 - reliable, 342
 - well-defined, 347
- scanning electron microscopy (SEM), 237, 286, 351, 354–56, 359, 366–68, 457, 462, 484–85
- scanning tunneling microscopy (STM), 202
- scattering, 226
 - dynamic light, 404
 - wide-angle X-ray, 154, 301, 351
- SCE, *see* saturated calomel electrode
- Scotch tape technique, 449
- SC, *see* solar cell
- SDW, *see* spin density wave
- SEC, *see* size-exclusion chromatography
- selective sorption, 299
- self-aggregation, 318
- self-assembled monolayer (SAM), 232
- self-assemblies, 363
- self-cleaning ability, 399
- self-healing behavior, 241
- SEM, *see* scanning electron microscopy
- semiconducting carbon nanotube, 452
- semiconducting materials, 30, 40, 93, 318, 454
 - organic, 41, 68
- semiconductors, 454, 460, 468
 - classical, 472
 - organic, 26, 36, 55, 103
 - p-type, 142
 - wide-bandgap, 468
- semiconjugated block copolymers, 154–55, 157
- Senkovskyy's method, 118
- sensing material, 277
 - efficient, 491
- sensors, 93, 99, 470, 490, 502
 - molecular, 391
 - optical, 427
- SERS, *see* surface-enhanced Raman scattering
- single-crystal X-ray crystallography, 53, 55, 58, 330
- single-crystal X-ray structures, 369
- single-molecule fingerprint vibration, 496
- single-molecule force microscopy (SMFS), 232, 238
- single-turnover reactions, 11

- single-walled carbon nanotube (SWCNT), 440, 447, 451–64, 468
- size-exclusion chromatogram, 418
- size-exclusion chromatography (SEC), 400, 418, 433–34
- small-angle X-ray scattering (SAXS), 301–2
- smectic layers, 260–61, 265–66, 271–72, 276, 296, 301
 - stable, 270
 - unbent, 276
- smectic order, 271
- smectic phases, 258–60, 265–66, 273, 291
 - higher-ordered, 261
- smectic phase transition, 273
- SMFS, *see* single-molecule force microscopy
- SOF, *see* supramolecular organic framework
- soft-template method, 484–85, 489, 495
- solar cells
 - colorful, 414
 - thin-film, 68, 80
- solar cell (SC), 318, 430
- solubility, 29, 120, 141–42, 175, 212, 365, 414, 429, 462, 464, 470
 - low, 28, 296
 - moderate, 296
 - reduced, 400
- solution polymerization, 142
- solvent etching, 483
- solvent polarity, 237, 324, 479
- solvophobic effect, 213
- Sonogashira–Hagihara coupling, 179, 339, 341, 433–34
- Sonogashira–Hagihara cross-coupling, 174, 176, 431
- sorption, 300, 303
- Soxhlet extraction, 434
- sp² bonds, 442, 446, 453
- sp² carbon frameworks, 176
- sp² hybrids, 443
- sp³ hybridization, 441
- sp³ hybrids, 441
- spectra, 76, 79, 184, 237, 319, 327–28, 334–35, 382, 392, 401, 418, 424, 431–32, 481
 - fluorescence, 77, 205, 327, 404
 - predicted theoretical, 90
 - sharp, 416
 - UV-Vis, 232, 238
- spectroscopy, 7, 12, 173, 226, 237, 336, 345, 400–401, 440, 480
 - angle-resolved photoemission, 468
 - fluorescence, 74, 190
 - ultraviolet photoelectron, 390
 - UV-Vis, 229, 232, 237, 239
- spectrum, 117, 179–80, 335, 460
 - fluorescence, 329, 335
 - mirror-image, 337
- spin coating, 172, 434
- spin density wave (SDW), 382, 390
- spin-down electrons, 450
- SPR, *see* surface plasmon resonance
- spray coating, 172
- square-wave voltammetry (SWV), 230
- stabilization, 206, 351, 443, 445–46
- stacked π -array, 76
- stacking, 141, 160, 237, 239–40, 246, 294, 318, 350, 353, 355, 359, 361–63, 369, 403, 407, 421
 - alternating, 391
 - efficient, 370
 - lamellar, 359
 - one-by-one, 366
 - plane, 356
 - slipped, 359
 - staggered cofacial, 356

- stacking interactions, 213, 301, 353, 396–97, 403
- stacking structures, 262, 350, 354, 359, 370
 - complex, 398
 - local, 369
 - regular CT, 404
- star polymers, 114, 133, 159
 - asymmetric, 159
 - miktoarm, 159
- stereochemistry, 322, 325, 342, 347, 378
- stereoregularity, 140, 195–96
- steric hindrance, 2, 82, 121, 125, 156, 210, 235, 331, 402, 421, 433
 - higher, 402
- steric influence, 209, 323
- steric repulsion, 43, 194, 199
 - high, 200
- Stille coupling polymerization, 113–14, 143, 153
- Stille coupling reaction, 153
- Stille cross-coupling reactions, 433
- STM, *see* scanning tunneling microscopy
- STN, *see* supertwisted nematic 264
- supercapacitors, 449, 454, 494, 501
- superconductivity, 224, 382, 390
- supergrowth technique, 456
- supersaturation, 463
- supertwisted nematic (STN), 264
- supramolecular architectures, 223–24, 247
- supramolecular gels, 350
- supramolecular ion conductors, 356
- supramolecular monolayer, 298
- supramolecular organic
 - framework (SOF), 298–99
- supramolecular organogels, 366
- supramolecular polymerization, 227, 231, 233, 304–5
- supramolecular polymers, 225–26, 228, 230–32, 298
 - head-to-tail, 228
 - linear, 233–34
- surface-enhanced Raman scattering (SERS), 496, 501
- surface plasmon resonance (SPR), 232
- Suzuki–Miyaura catalyst transfer condensation polymerization, 128, 130
- Suzuki–Miyaura catalyst transfer polymerization, 128
- Suzuki–Miyaura coupling polymerization, 113–14, 127–29, 146
- Suzuki–Miyaura coupling reaction, 128
- Suzuki–Miyaura cross-coupling, 69–70, 174
- Suzuki–Miyaura polycondensation reaction, 102
- SWCNT, *see* single-walled carbon nanotube
 - chirality distribution of, 460
 - metallic, 452
 - millimeter-scale, 456
 - purified, 454
 - semiconducting, 452–53, 456, 460
 - small-diameter, 459
- SWV, *see* square-wave voltammetry
- system, 14, 16, 21, 27, 143–44, 148, 155, 195, 332–33, 382, 391, 398, 467, 470, 473
 - anion recognition, 200
 - chiral amplification, 201
 - condensed, 386
 - electrolytic, 105
 - electronic, 352, 355
 - emulsion, 274
 - foldamer, 212
 - ion-pairing, 362
 - living, 145

- microelectromechanical, 277
 - molecular, 24
 - multimetallic, 5
 - photosynthetic, 172
 - three-component, 390
 - three-electrode, 95
 - two-electrode, 92, 95
 - two-phase, 298
- tail-to-tail (TT), 143
- TBA, *see* tetrabutylammonium
- TCNB, *see* tetracyanobenzene
- TCNE, *see* tetracyanoethylene
- TCNQ, *see*
tetracyanoquinonedimethane
- TD-DFT, *see* time-dependent
density functional theory
- TEG, *see* tetraethyleneglycol
- TEM, *see* transmission electron
microscopy
- temperature, 200, 226, 239, 243,
253, 257–58, 271–73, 275–76,
301, 324, 327, 330, 336, 477,
479
- ambient, 125, 130, 271
 - diastereomeric signal
coalescence, 76
 - high, 243, 245, 291, 455, 479,
481
 - isotropic, 272
 - low, 14, 20, 238, 287, 330, 336,
342, 479
 - low mesophase, 370
 - moderate, 195
 - peak-top, 266
- template polymerization, 483
- tetrabutylammonium (TBA), 363
- tetracyanobenzene (TCNB),
397–403
- tetracyanoethylene (TCNE), 157,
398, 400–402
- tetracyanoquinonedimethane
(TCNQ), 157, 224, 388,
390–91, 394–404, 407
- tetraethyleneglycol (TEG), 241,
351
- tetrahydrofuran (THF), 71,
128–29, 144, 146, 195, 206,
326, 328, 330, 332, 334–36,
341–42, 351, 421–22, 424–25,
431–32
- tetrathiafulvalene (TTF), 224, 228,
230–31, 242
- TFT, *see* thin-film transistor; 113
- TGA, *see* thermogravimetric
analysis
- thermal conductivity, 447
room-temperature, 447
- thermal degradation behavior, 402
- thermal fluctuation, 257
- thermal stability, 174, 207, 417,
474
highest, 422
- thermogravimetric analysis (TGA),
402–3
- THF, *see* tetrahydrofuran
- thin-film transistor (TFT), 113
- Thomson effect, 463
- three-electrode setup, 94
- through-space-conjugated system,
172, 176, 416, 423, 425, 433,
445–46, 470
- TICT, *see* twisted intramolecular
charge transfer
- time-dependent density functional
theory (TD-DFT), 77–78, 184,
394
excited-state, 77
- time-of-flight (TOF), 369
- TN, *see* twisted nematic
- TNB, 231
- TOF, *see* time-of-flight
- transformation, 57, 156, 159, 489
conformational, 275, 281
microscopic structural, 211
reversible morphological, 277
solid-state electrochemical, 107
solvent-induced, 5

- transistors, 68, 98–99, 454, 460
 - field-electron, 449
 - thin-film, 113
- transition dipole moments, 184, 336
- transition metal, 68–70, 196
- transition metal catalysis, 54
- transition metal catalysts, 133, 194, 455–56, 462–64
- transitions, 8, 15–16, 258, 336, 368, 385, 432, 479–80
 - electronic, 390
 - first-order, 266
 - gel-to-solution, 368
 - glass, 289
 - irreversible, 236
 - overlapping, 15
- transition temperature
 - gel-to-solution, 367
 - glass, 245, 270
 - volume phase, 243
- transmetallation, 115–19, 121, 131, 144
- transmission electron microscopy (TEM), 276, 351, 354–59, 457–59, 462–63
- traveling wave ion mobility mass spectroscopy (TWIM-MS), 234
- triple bond, 443
 - distorted, 73
- TTF, *see* tetrathiafulvalene
- tubular structures, 309, 357
- tuning, 98, 188, 205, 209, 359–60, 431
 - facile, 101
- TWIM-MS, *see* traveling wave ion mobility mass spectroscopy
- twisted chiral structure, 336
- twisted intramolecular charge transfer (TICT), 331
- twisted nematic (TN), 264
- twisted structure, 258
- two-by-two stacking mode, 366
- ultracapacitors, 494
- ultrafine resolution lithography, 274, 277
- ultrasonication, 275
- ultraviolet (UV), 185, 226, 229–32, 236–39, 275, 277, 366, 382
- unfolding, 236
- unit cell, 391, 399, 449–50
- unit model, 301–2
- unpaired electron, 6, 14, 18, 24, 473
- up-field shift, 235, 238, 240, 390
- uptake, 305
 - effective cell, 405
 - guest, 283–84
 - selective CO₂, 303
 - shape-selective, 306
- UV exposure, 276–77
- UV light irradiation, 307
- UV spectral analysis, 185
- UV spectrum, 335
- UV-Vis, 74, 205, 320, 327–28, 432
- UV-Vis absorption, 8, 53, 102, 178, 183, 186, 330, 342, 392, 396, 402, 404–5, 429–31
- UV-Vis-NIR absorptions, 16–17, 19
- UV-Vis spectra, 77, 204, 212–13, 342, 397, 479–80
- UV-Vis spectroscopy, 479
- vacuum, 392, 400, 440, 468
 - high, 457, 468
- vacuum gauge, 457
- valance electrons, 383, 449, 470
- valence band, 188, 472–73
- valence tautomers, 14
- valency, mixed, 18–19
- van der Waals forces, 495
- van der Waals interactions, 287, 300, 350, 354, 360, 369–70
- van Hove singularities (vHS), 452
- vapor-liquid-solid (VLS), 463
- vapors, 83, 173, 306, 426, 468
 - alkaline, 491

- chemical, 491
 - organic, 304
- variable temperature (VT), 319
- VCD, *see* vibrational circular dichroism
- VCD signal pattern, 337
- VCD spectra, 336–38
- versatile functionalization, 301
- versatile reactivity, 39
- vesicles, 350, 374, 486
 - aniline-filled, 486
 - aniline-filled BTCA, 486
- vibrational circular dichroism (VCD), 336–37
- viscosity, 226, 234, 237, 240, 262
 - anisotropic, 262
 - flow, 262
 - high, 246
- VLS, *see* vapor-liquid-solid
- voltage, 40, 141
 - maximum gate, 41
 - open-circuit, 430
- volume phase transition
 - temperature (VPTT), 243
- VPTT, *see* volume phase transition temperature
- VT, *see* variable temperature, 319
- VT-NMR measurement, 229
- VT-NMR spectra, 324

- water, deionized, 404
- wave function, 382–83, 443
 - corresponding, 384
- wavelength, 83, 183, 258, 327–28, 332, 341–42, 386, 394, 397, 403, 430, 480
 - common, 265
 - excitation, 183, 458–60
 - fluorescence maximum, 331
 - high, 403
- wavenumber, 481
- WAXS, *see* wide-angle X-ray scattering
- WAXS profiles, 302
- weight distributions, 434
- wide-angle X-ray scattering (WAXS), 301, 351, 355, 359, 362–63
- Wilkinson's catalyst, 195
- Wittig reaction, 43

- xerogel, 355, 367–69
 - fibrous, 368
- XPS, *see* X-ray photoelectron spectroscopy
- X-ray analyses, 100, 102
 - single-crystal, 69–70, 75, 202, 231, 235, 241, 339, 367, 421
- X-ray crystal analyses, 422
- X-ray crystal structure, 3, 7–8, 10–11, 14, 297, 299–300
- X-ray diffraction (XRD), 82, 202, 265–66, 351, 355, 358–59, 362, 366, 368, 370–72, 393, 396–97, 482
 - powder, 355, 393
 - single-crystal, 82
 - synchrotron, 351
- X-ray exploration, 77
- X-ray measurements, 246, 267
- X-ray photoelectron spectroscopy (XPS), 102
- XRD, *see* X-ray diffraction
 - synchrotron, 371
 - synchrotron radiation, 360
- XRD analysis, 361, 370, 396

- Yamamoto coupling, 153
- Yamamoto cross-coupling reaction, 70
- yarn balls, 275

- zigzag array, 321
- zwitterion, 131
- zwitterionic complex, 195

Conjugation is the overlap of one π -orbital with another across an intervening σ -bond. π -Conjugated objects, constructed from a conjugated frame, contain connected π -orbitals with delocalized electrons in compounds with alternating single and multiple bonds. Examples of the largest conjugated objects are graphene, graphite, conducting polymers, and carbon nanotubes.

Conjugated Objects: Development, Synthesis, and Application comprises 17 chapters written by young researchers and discusses the current trends in π -conjugated systems for successful development and application in broad research areas, such as new design of unique π -conjugation, catalysts, self-assembly, charge transfer complexes, liquid crystals, supramolecules, and nanostructures, by using π -conjugated small and/or macro-objects organically or electrochemically. This book can be used as a textbook of basic learning by undergraduate and graduate students of chemistry, electrical and electronics engineering, and materials science and by supramolecular researchers in nanotechnology and biotechnology.



Atsushi Nagai is visiting assistant professor at the University of Texas, Southwestern Medical Center, USA. He obtained his PhD in polymerization mechanisms and polymerizable monomer structure design from Yamagata University, Japan, in 2005. The activities pursued during his postdoctoral fellowship at Kyoto University, Japan, gave him the idea of teaching how fundamental scientific discoveries can translate into actual functional materials such as conjugated polymers. In 2010, Dr. Nagai joined the Institute for Molecular Science (IMS), Japan, as assistant professor and co-taught many international students and postdoctors at the Graduate University for Advanced Studies. He was also responsible for the design and concept of the project "Chemical, Optical Chemical, and Polymer Synthetic." Since 2015, he is the editor of *International Journal of Global Advanced Materials and Nanotechnology* and *SM Journal of Biomedical Engineering*.



Koji Takagi is associate professor at the Nagoya Institute of Technology, Japan. He started his academic career at the Nagoya Institute of Technology and launched several research themes, including controlled radical polymerization by utilizing chalcogen compounds, the synthesis of hyperbranched polymers based on triazine chemistry, and the development of π -conjugated oligomeric and polymeric materials. He also developed a novel living coordination polymerization of allene derivatives by the π -allyl nickel catalyst and gained many experimental skills, not only for polymerization but also for organic synthesis. Dr. Takagi's research focuses on the precision spatial arrangement of chromophores using well-defined scaffolds, the controlled synthesis of 2D polythiophene derivatives, and the manipulation of electron donor–acceptor interaction in fused π -conjugated imidazolium compounds.