

Index

a

absorption 52, 53–57, 59, 61–66, 70, 71, 85, 88, 187
 absorption spectroscopy 54, 61, 62, 65, 66
 absorption spectrum 54, 62–64, 66, 85
 aerobic C–H bond functionalization approach 122
 aerobic linear allylic amination method 121
 alkoxylation 105, 160
 alkylzinc reagents 182
 4-allyl-2-methoxyphenols 30
 allylsilanes 32
 amino alkanes 107, 108
 8-aminoquinoline-derived benzamides 20
 aminyl anions 143
 anodic C–C homo-coupling reactions 29–30
 anodic coupling reactions 31, 33
 anodic oxidation 135, 156, 161–163, 209, 210, 212, 213, 215, 217–220
 anthraquinone 136, 145, 188, 194
 anthraquinone-2-sodium sulfonate ($2\text{-SO}_3\text{NaAQ}$) 188, 194
 anti-Stokes shift 57
 aryl C–N coupling reactions 81–82
 aryl C–S couplings 81–82
 aryl diazonium salts 46, 47
 aryl Grignard reagents 178, 180, 182

aryl halides 171, 173
 direct arylation of arenes 173–178
 electron-catalyzed cross-coupling reactions of 178–182
 aryl-alkynyl coupling 16, 17
 arylacetylenes 15, 16, 18
 arylsilanes 12
 atom transfer radical polymerization (ATRP) 78–80, 165
 1,3-azoles 10, 11, 15, 16

b

back electron transfer (BET) 60, 86, 87
 Beer's Law 54, 62–64
 benzamides 12, 15, 17, 18, 20, 105, 106, 115
 benzene 5, 7, 10–14, 17, 18, 76, 77, 84, 173–177, 214, 219
 benzonitrile 143, 176, 211
 benzothiophenes 34, 35
 4-benzoylpyridine (4-BzPy) 188, 190
 benzylamine 212
 1-benzyl-1,4-dihydronicotinamide 46
 binaphthol 164
 2,2'-biphenols 29, 33
 bipyridine 72, 73, 156, 165, 193
 4,4'-bipyridine 156, 193
 Birch reduction conditions 173
 1,2-bis(bromomethyl)benzene 219
 2,5-bis(2-hydroxyphenyl)thiophenes 34

- bithiophene 13, 164
 boronic acids 2, 4, 10, 12, 20, 106,
 111
 bromination 160, 161, 218
tert-butoxide 174–176, 182, 183
 1-(*tert*-butyl)-4-(dimethoxymethyl)
 benzene 214
 1-(*tert*-butyl)-4-methylbenzene 214
- c**
 carbon-sulfur bond formation 49
 cathodic reduction
 activated olefin and conjugated olefin
 142
 active hydrogen compound 143
 alcohol and carboxylic acid 143
 alkyl halides 142
 14-Family and 15-Family Element
 Species 144
 gem- and *vic*-dihalogeno compounds
 143
 ketone and imine 142
 cation-pool method 36
 C3-fluorinated oxindoles 39
 charge transfer (CT) complexes 50
 o-chloranil 12
 2-chloroanthraquinone (2-ClAQ) 188,
 190
 cobalt-catalyzed dehydrogenative
 cross-coupling 105
 concurrent reduction and substitution
 (CRS) method 162
 consecutive photoinduced electron
 transfer (ConPET) 82, 83
 copolymer synthesis 155–157
 copper salts 106, 108, 114, 120
 copper-catalyzed decarboxylative
 oxidative coupling 20
 cross-coupling reactions 9, 10, 18,
 20, 29–37, 49, 171, 172, 178,
 180–183
 cross dehydrogenative amination
 method 109, 120
- cross-dehydrogenative coupling (CDC)
 18–20, 39, 103, 104, 108–110, 113,
 119, 120, 124
 cyclic voltammetry (CV) measurement
 59, 67, 68, 155, 159, 160, 165
 cycloadditions 32, 37, 46–48, 77
 1,4-cyclohexadiene 90
- d**
 dehydrogenative C–O bond formation
 105–107
 dehydrogenative couplings 18, 39,
 103, 104, 108–111, 113, 119,
 124–125
 deprotonation 148, 154, 172, 174,
 175
 2,2'-diaminobiaryls 35
 diarylzinc reagents 180
 diastereoisomer α -diisoeugenol 30
 diastereoselective [2+2] photocyclo-
 additions of bis(enones) 47
 dibenzosiloles 12
 1,3-dicarbonyls 32
 1,9-dicyanoanthracene (DCA) 83
 Diels–Alder reaction 219
N,N-dihalo compounds 143
 dihydrophenazines 79, 81
 (3,4-dimethoxyphenyl)methanol 213
 2,4-dimethylphenol 29
 dinitrobenzenes 136
 4,7-diphenyl-1,10-phenanthroline
 (Ph-phen) 174, 176
 1,1-di(phenylsulfonyl)ethylene 190
- e**
 early photoredox catalysis 46
 El Sayed's rules 58
 electroauxiliaries
 coordination effects 136
 electron-transferable functional
 groups 135
 electrochemical micro reactor 212
 electrochemical oxidative arylation

- of alkynes 39
 - of olefins 36–39
 - electrochemical oxidative benzyl-aryl cross-coupling reaction 35–36
 - electrochemical
 - oxidative cross-dehydrogenative coupling
 - of C(sp³)—H and C(sp²)—H bonds 39
 - electrochemical post-functionalization 153, 159
 - electrochemical reactions
 - characteristics of 129–130
 - organic electrochemical reactions 130–131
 - electrochemical redox
 - by anodic substitution 159–162
 - aromatic monomers
 - oxidative electropolymerization 154–155
 - reductive electropolymerization of 157
 - cathodic reduction and paired reactions 162
 - conducting polymers 154–158
 - copolymer synthesis 155–157
 - electroactive polymers 164–165
 - electrochemically induced film formation 167
 - electrogenerated transition-metal catalysts 164
 - electropolymerization processes 158
 - oxidation-induced intramolecular cyclization 163–164
 - polyaniline functionalization 162–163
 - polymerization 165–167
 - electrochemical reductive transformations
 - direct and indirect electrochemical reductions 144–145
 - electrogenerated bases 148–150
 - reductive mediators 145–147
 - electrolysis 31, 33, 133, 148, 155, 156, 158, 159, 161–163, 165, 167, 209–221
 - electromagnetic radiation 50
 - electromagnetic spectrum 50–51
 - electron catalysis 172, 179
 - electron donor-acceptor (EDA) complexes 49
 - catalytic EDA reactions 91
 - definition 85
 - electron transfer 86
 - enantioselective reactions of 91–92
 - environmental factors 86–87
 - light interaction 85–86
 - photoredox catalysis 87–88
 - sacrificial donors and acceptors 89–90
 - stoichiometric EDA reactions 88–89
 - electron transfers
 - Marcus theory 60–61
 - mechanisms of 59–60
 - photoinduced electron transfer 58–59
 - electrophiles 9, 22, 131, 143, 183
 - electropolymerization 153–155, 157, 158, 160, 163–165
 - electroreduction method 144
 - enolate-enolate oxidative cross-coupling reaction 20
 - excitation spectrum 64
 - excited state absorption (ESA) 66
 - π-extended poly aromatic hydrocarbons (PAHs) 12
 - extinction coefficient 54
- f**
- flow cell 209–213, 215, 220–221
 - fluorene-containing conjugated polymer 160, 161, 163
 - 9-fluorenone 162, 213
 - fluorescence 52, 56–58, 64, 92
 - fluorophore 64, 65

- Fourier-transform infrared (FT-IR) spectroscopy 160
- Frank–Condon principle 53, 57, 60
- Fujiwara–Moritani reaction 2, 4–10, 104
- g**
- gel permeation chromatography (GPC) 160
- Grignard compounds 32
- Grignard cross-coupling reaction 178–181
- Grignard reaction 132
- ground state bleach (GSB) 66
- h**
- heteroaromatics 5, 17
- heterobiaryls 33
- 1,1,1,3,3,3-hexafluoroisopropanol (HFIP) 30, 31, 33, 35, 36
- 3-hexylthiophene 158, 160
- Hofmann–Löffler–Freytag (HLF) reaction 187, 197, 198
- homo-coupling reactions 29, 30, 33, 211
- homolytic aromatic substitution (HAS) 173–175
- hydrogen atom transfer (HAT) process asymmetric transformations 194–195, 200–201 direct HAT, of excited photocatalyst 188–189 indirect HAT 188–195 photocatalytic functionalization of C(sp³)–H bonds 189–194 hydrogen bonding 31, 33, 136 hydrogenated graphene derivative 113 1,4-hydroquinone 219 β-hydroxy ketone 194 9-hydroxyphenanthrene 30
- i**
- indole carboxylic acids 7
- inner sphere electron transfer (ISET) 59, 86, 130
- inner-filter effect 65
- internal conversion 52, 56, 58
- internal oxidants C–H bond functionalization methods 115–116 postulated mechanism 117–118 intersystem crossing (ISC) 52, 57–58, 64, 80, 82 intramolecular Pschorr cyclization 47 iridium polypyridyl complexes 46 isobenzofuran-1(3H)-one (phthalide) 214
- k**
- Kipping method 157 Klinger, Heinrich 45
- l**
- Laporte selection rule 51 leucoemeraldine base (LB) 162 Lewis acid 136, 200, 201 low-valent transition metal 171
- m**
- Marcus theory 60–61 metal-based oxidants copper salts 108–109 silver salt oxidants 105–108 methyl 2-(3,5-dichloro-4-hydroxyphenyl) acetate 212 10-methyl-9,10-dihydroacridine 46 2-methoxynaphthalene 30 2-methylquinoline 46 microwave irradiation 174 Mizoroki–Heck reaction 1 arylmetal reagents 2–4 molar absorptivity 54, 55, 62, 63, 71

n

2-naphthol 30
 nitrenes 143
 nitrobenzene 46, 145, 211, 212
 nitrosobenzene 211, 212
 non-conductive polymers 153, 154, 159
 non-crossed dimerization 140
 nonradiative processes 55, 58
 non-selective oxidation processes 31

o

O₂, use of 119–124
 octafluoronaphthalene 13
 open shell photoredox catalysts 82–84
 optical density (OD) 54, 62
 organic electrochemical reductions
 addition type 138
 asymmetric synthesis type 141
 chemoselectivity 133
 cleavage type 141
 crossed dimerization 140
 cyclization type 140
 dimerization type 139–140
 elimination type 139
 insertion type 138
 metalation type 141
 polymerization type 141
 polymorphism formation type
 140
 reaction pathway selectivity 133
 regioselectivity 133–134
 stereoselectivity 134–135
 substitution type 139
 substitutive exchange type 139
 transformation type of functional
 group 137–138
 umpolung 131–132
 organic oxidants
 organic peroxides 110–112
 quinones 112–115
 organic peroxides 110–112
 organocatalysis 47

organozinc reagents 180, 181
 outer sphere electron transfer (OSET)
 59–60, 86, 130
 oxidative aryl–aryl bond formation
 aniline derivatives 17
 oxidative C–C bond formation
 18–22
 oxidative C–H/C–M biaryl
 cross-coupling 10–12
 phenyloxazine-containing
 benzamides 17
 2-(pyridine-2-yl)isopropylamine 18
 robust palladium-based catalyst
 system 17
 Sonogashira coupling 16
 oxidative C–C bond formations 1–23,
 29–39
 oxidative C–H bond functionalization
 techniques 113
 oxidative electropolymerization
 153–155
 oxidative strategy 1, 22

p

paired electrolysis
 divided cell 214–215, 219–220
 flow cell 211–213, 215, 220–221
 undivided cell 210–211, 213–214,
 216–219
 palladium catalysts 1–2, 31
 palladium catalyzed C–H
 functionalizations 107
 palladium-catalyzed reaction 171
 persulfates 109
 phenol–arene cross-coupling products
 33
 phenols 29, 31–34, 38, 89, 109, 112,
 120
 phenoxazine PC 79, 82
 phenoxazines 80–82
 phosphorescence 52, 58, 63–64
 photocatalytic 1,5-HAT reactions
 189

- photochemical reactions
 choice of light source 69
 factors 68
 photoreactor design 68–69
 photoinduced electron transfer (PET) 58–60, 82, 85, 91
 photoirradiation 172, 176, 188
 photophysical processes
 absorption 53–55
 fluorescence 56–57
 internal conversion 56
 intersystem crossing 57–58
 Jablonski diagrams 52–53
 phosphorescence 58
 vibrational relaxation 55–56
 photoredox 47
 dehalogenation reactions 49
 [2+2] enone cycloadditions 48
 photoredox catalysis 46
 effective absorption of light 70–71
 favorable thermodynamics 71–72
 long lived excited state 71
 mechanisms of 69–70
 quantum yield 71
 photoredox processes
 cyclic voltammetry 67–68
 emission spectroscopy 63–65
 transient absorption spectroscopy 65–67
 UV-visible spectroscopy 61–63
 pinacol-type couplings 46
 classical tin-mediated dehalogenations 48
 poly(3-(2-ethylhexyl)thiophene) 161
 poly(3-(4-fluorophenyl)thiophene) 160
 poly(3-alkylselenophene) (P3AS) 160
 poly(3-alkylthiophene) (P3AT) 160
 poly(3-hexylselenophene) 161
 poly(3-methylthiophene) (P3MT) 159–160
 poly(9,9'-dioctylfluorene-*alt*-thiophene) 160, 162
 poly(*p*-phenylenevinylene) (PPV) 157
 polymer reaction 153, 160, 161–162, 213
 polypyrrole 160
 Priestley, Joseph 45
 product selectivity 134
 proton-coupled electron transfer (PCET) process 188
 pump-probe spectroscopy 65
N-pyrimidylindoles 15
- q**
 quantum yield 64, 71
 quasi-reversible 67
 quinone derivatives 110, 114, 167
- r**
 radical-cation pool method 31–32
 redox reversibility
 inorganic photocatalysts 72–75
 open shell photoredox catalysts 82–84
 organic excited state oxidants 75–78
 organic excited state reductants 78–82
 reductive quenching 70, 72–73, 83
 regioselectivity 3, 6, 10, 13, 133–134, 176–177
 reorganization energy 60–61
 reoxidation system 7
 rod–rod block copolymer 161
 ruthenium 6, 46, 165
- s**
 self-supported paired electrolysis 215
 sequential Diels–Alder reaction 219
 silver salt oxidants 105–108
 silver trifluoroacetate (AgTFA) 107
 silylenol ethers 32
 single electron transfer (SET) processes 46, 105, 110, 172, 174–176, 178–179, 180, 188, 189, 195, 200
 single wavelength kinetics 66

- solvatochromism 57
Sonogashira coupling 16
Stark–Einstein Law 54
Stern–Volmer quenching 64, 66
stimulated emission (SE) 66
styrenes 2, 5, 37, 74, 177, 218
sulfonium salts 46
symmetric OCO-pincer ligands 33
- t**
tetrabutylammonium decatungstate 191
tetrahydrofuran (THF) 58, 111, 178–182, 216–217
tetrahydroisoquinoline 18–19, 73
tetrahydrothiophen-3-one 113
transient absorption spectroscopy (TAS) 65–67
transition metal catalysts 16, 75, 108, 164, 171, 174
transition metal photocatalysts 46
transition metal-catalyzed cross-coupling reaction 160, 171–172
- 2,2,2-trifluoroacetic acid 35
trifluoromethylation 81, 87
2,4,6-triphenylpyrylium tetrafluoroborate salt (TPT) 188, 199
2,5,5-trisubstituted oxazoles 122
twisted intramolecular charge transfer (TICT) 58
- u**
 α,β -unsaturated δ -lactams 4
 α,β -unsaturated carbonyls 2
UV-visible spectroscopy 61–63
- v**
vibrational relaxation 52, 55–56, 58
- x**
X-ray photoelectron spectroscopy (XPS) analysis 51, 159–160
- z**
zinc-porphyrin 156–157

