

Index

a

- acetic acid carbonylation process 171
 acetic acid production 336–337
 acetophenone 116
 γ -acetoxy- β -methoxyacrylates 260
 acid chlorides 69–72, 78, 388, 390
 acylation
 of 1,2-dimethylimidazole 117
N-acyl iminium chloride 57, 58
 12-acylindolo[1,2-*c*]quinazoline 217
 acylpalladacycle intermediate 238
 acylpalladium intermediate 199, 201,
 217, 251, 323
 addition–elimination mechanism 4
 additive carbonylation process 6, 264
 Ag/Nafion 308, 309
 3-alkenyl-2(5*H*)-furanones 201
 alk-4-enyl iodides 366, 376
 5-alkenyloxyamines 366
 alkoxy-alkoxycarbonylpalladium complex
 274
 [(β -alkoxycarbonyl)alkyl]palladium
 complex 243–245
 alkoxycarbonylation 5, 65, 90, 91, 115,
 116, 123, 126–128, 144, 175, 199,
 204, 207, 237–239, 241, 242,
 245–251, 253, 254, 256, 260, 262,
 263, 265, 266, 268, 269, 276, 277,
 316, 352–353, 356, 376, 378–383,
 393
 alkoxycarbonylmatal 3
 alkoxycarbonylpalladium iodide complex
 257
 alkoxycarbonylpalladium mechanism
 246, 262
 β -alkoxyacrylic esters 256, 260
 alkylamines 369–371
 alkyl- and arylacetylenes 257
N-alkyl azetidines 34
 alkyl α -(heteroaryl)acrylates 254
 alkyne oxidative carbonylation 256, 263
 2,3-allenoates 204, 207, 208
 allylic alcohols via ^{Cl}IPrCuCl-catalyzed
 hydrocarbonylative coupling 104
N-allyl-*N*-(2-bromoallyl)amines 306
 Allyltributyltin 377, 385
 aluminum-based Lewis acid 30
 α -cyclodextrin (α -CD) 21, 154
 amide formation 54
 amide synthesis 53, 56, 57, 95–104
 β -amidoaldehyde 35
 2-aminobenzoxazinones 201
 amines *via* palladium-catalyzed
 intramolecular cyclocarbonylation
 201
 aminocarbonylation 56, 91, 95, 97–101,
 103, 213–215, 238, 254, 263,
 266–268, 270, 271, 320, 385, 393
 Ampakines 35
 anilines 36, 66, 109, 110, 123, 129–132,
 167, 175, 275, 276, 315, 353
 anthraquinone 240
 anticancer activity 266, 271
anti intramolecular nucleophilic attack
 268
 anti-Markovnikov regioisomer 247

- antitumor activity 266, 273
- aqueous biphasic hydroformylation
156–161, 186
- arene diazonium salts 381
- arylboronic acid 54–56, 61, 66, 74, 75,
84, 86, 99, 101, 183, 220, 372–375
- aryl diazonium tetrafluoroborate 368
- aryl iodides 36, 58, 61, 64–66, 76, 84–86,
88, 96, 171, 179, 198, 214, 217, 218,
220, 315, 364, 375, 377–379,
385–389, 391, 392
- aryltrifluoroborates 86, 371, 373
- asymmetric hydroformylation (AHF)
351
- atmospheric-pressure carbonylative
Suzuki reactions 371
- axinellamine A 27
- azaarenes 214
- azetidines 33, 34
- 1-azido-2-iodobenzenes 201, 206
- azirines 210
- azobisisobutyronitrile (AIBN) 364
- b**
- Baldwin's rules 270
- bathophenanthroline 58, 59
- B–C bond of cyclopropyl bis(boronates)
108
- benzamides 37, 38, 214
- benzimidazothiazinones 267
- benzo/[7+1] cycloaddition of cyclopropyl-
benzocyclobutenes 180
- benzofuran derivatives 273, 274
- benzoic acid 36, 37, 53, 120, 296
- benzophenone 65, 240, 241, 327
- benzopyridopyrimidooxazinoquino-
linediones 271
- benzoylacetonitrile derivatives 218
- bioactive 2-aminobenzoxazine 201, 206
- bioactive benzoxazines 198
- biphasic hydroformylation 155, 156,
159–161
- bipyramidal trigonal cobalt(I) 19
- β -boroalkenylcopper complexes 104
- borocarbonylative coupling reaction
104, 105
- bis(boronate ester)-substituted
cyclopropanes 108
- 1,3-butadiene 248, 249
- η^2 -butenyl ligand 301
- N*-*tert*-butyl-(1-alkynyl)benzaldimines
217
- 1-butyl-1(2-iodobenzyl)-3-phenylurea
212
- c**
- carbamates 73, 110, 129–131, 269,
274–276, 309, 321, 354
- carbamylation 315
- carbamoyl-metal 2
- carbon monoxide 373
hydrogenation of 15
reactions of 2
use of 397
- α -carbonyl- α' -amide sulfoxonium ylides
216
- carbonylated organic product 2, 235
- carbonylation
of azetidines 33
of aziridines 33
chemistry 397
definition 1
of epoxides 30
of methanol 28, 29
- carbonylation/decarbonylation
equilibrium 385
- carbonylation reactions
molybdenum compounds
aryl or alkenyl halides 314–317
CO source 319–327
formal carbonylation processes
312–314
intramolecular carbonylation
coupling reactions 307–309
- silver compounds
Koch-type reactions 307–309
metal-silver bimetallic catalysts
309–312
third-row transition metals 398

- zirconium compounds
 - sulfated-doped zirconia 295–299
 - zirconocene complexes 299–307
- [2+2+1] carbonylative asymmetric cycloaddition 59
- carbonylative cross-coupling reactions 5, 58, 84, 99, 375, 393
- carbonylative cycloaddition reaction 180
- carbonylative esterification process 203
- carbonylative Heck reactions 222
- carbonylative Negishi coupling 70, 71
- carbonylative polymerization (COPs) 76
- carbonylative Sonogashira coupling reaction 69, 85, 86, 221
- carbonylative Suzuki couplings 84, 121, 370, 372, 374, 375
- catalytic carbonylation
 - of acetylene 61
 - process 3, 4, 96, 352
- Cativa process 149, 336, 337, 339, 355
- ¹³C carbonylation reactions 17
- C-1 building block 397
- Celanese's Acid Optimization (AO Plus) technology 339
- cetirizine 56
- CH-carbonylation of arenes 115
- 5-chloro-2-nitrobenzotrifluoride 130
- [Co(acac)(diethylphosphinoethane)](BF₄) 18
- cobalt catalysts 15–17, 19, 21, 23, 40, 397
- cobalt-catalyzed carbonylations
 - of alkyl and aryl halides 36–37
 - BASF 15, 16
 - C–H bond carbonylations 37–39
 - CO/H₂ synthetic gas (syngas) 16, 17
 - of heterocycles 30–36
 - hydroformylation of alkenes 18–23
 - imine and epoxide 40
 - isocyanate and imine functions 39, 40
 - of methanol 28–29
 - Pauson–Khand reaction 23–28
 - polypeptides 39, 40
- CO carrier 208, 307
- Co₂(CO)₈ 17, 19, 21–24, 26–30, 32–37, 39, 40, 141
- CO gas-free cyclocarbonylation reaction of haloarenes 181
- CO/H₂ synthetic gas (syngas) 16, 17
- coixspirolactam 201
- concerted metalation-deprotonation (CMD) 239
- copper–carbene/manganese-carbonyl bimetallic system 84
- copper(I)-catalyzed hydrocarbonylative coupling 104
- copper(II)-catalyzed carbonylative acetylation of amines 101
- copper-catalyzed hydroxymethylation 106
- copper/iron co-catalyzed
 - alkoxycarbonylation of unactivated alkyl bromides 90
- copper/manganese-catalyzed Suzuki–Miyaura-type carbonylation 84
- copper/palladium catalytic mechanism 88
- η²-COR ligand 20
- Cp*RuH/xantphos-catalyzed hydroformylation of 1-decene 124
- Cp₂Zr 299–307
- cross-electrophile coupling (XEC) 64, 65
- CRTH2 receptor antagonist 201, 205
- C(sp²)/C(sp²)–H functionalization 99, 323
- C(sp²)–H activation 56, 241, 243, 251
- C(sp²)–H palladation 241–243, 251
- C(sp³)–H palladation 238, 239
- C(sp)–H aminocarbonylation conditions 266
- CuBr(Me₂S)-catalyzed carbonylation of indoles with hexaketocyclohexane 109
- CuBr(Me₂S)-catalyzed carbonylative 93
- Cu-catalyzed carbonylative coupling of alkyl iodides with amides 96
- CuCl₂ · 2H₂O-promoted double carbonylation 109

- CuF₂-catalyzed carbonylative acetylation of amines 102
 CuI₂-catalyzed carbonylation reaction to synthesize oxime carbonates 110
 Cu or Mn-catalyzed carbonylative coupling of alkyl iodides with amides 95
 Cu₂O-catalyzed aminocarbonylation of arylboronic acids with *N*-chloroamines 101
 Cu(I)-catalyzed carbonylation of alkanes 92
 Cu(OAc)₂-catalyzed carbonylation of C(sp²)-H bonds with MeNO₂ 100
 Cu(OTf)₂-catalyzed carbonylation of *N*-fluoro-sulfonamides 94, 95
 Cu(OAc)₂-catalyzed carbonylation to synthesize carbamates 110
 Cu(OTf)₂-catalyzed intermolecular aminocarbonylation 101
 Cu/Mn bimetallic catalysis of carbonylative Suzuki–Miyaura reaction 84, 85
 Cu/Pd-catalyzed borocarbonylation of vinylarenes 89
 Cu(TMHD)₂-catalyzed carbonylative Sonogashira coupling reaction 86
exo cyclization 250
 cyclization–alkoxycarbonylation 251, 254
 cyclization–carbonylation–cyclization (CCC) coupling 270
 cyclization–cyclocarbonylation 251
 [2+2+1+1] cycloaddition of alkynes 137
 cyclocarbonylation–alkoxycarbonylation 251, 265, 266
 cyclodextrins 157, 158
 1,4-cyclohexadienes 248
 cyclohexanecarboxylic acid 236, 237
 cyclopentadienones 263, 304–306
 cyclopentenones 23–25, 27, 133, 176, 183, 271, 273, 301, 302, 304, 353
- d**
 DBU (1,8-diazabicyclo[5.4.0]undec-7-ene) 370
 decarbonylation/nucleophilic addition/elimination process 311
 dendritic mesoporous silica nanospheres (DMSN) 156
 deprotonation 239, 354, 370
 5,5-dialkoxyfuran-2-(5*H*)-ones 257
 1,2-diarylethanone intermediate 373
 1,4-diaryl-2,3-diazabutene ligand 257
 diaryl ketones 65, 68, 86, 271
 1,8-diazabicyclo[5.4.0]undec-7-ene (DBU) 17, 370
 1,2-dibromoethane 240
 diethyl 2-allyl-2-(prop-2-yn-1-yl) malonates 271
 diethyl carbonate (DEC) 275
 difluoroalkyl ketones 54, 55
gem-difluoropropargyl bromide 54
gem-dihalocyclopropanes 364, 365
 dihydrofurofuranones 271
 dihydrofuroindolones 271
 dihydro-oxazinone 34, 365
 1,4-dihydroisoquinolin-3(2*H*)-ones 254
 dihydro-oxazinone 34, 35
 4,5-dihydro-4-phenylfuran-2,3-dione 32
 1,4-diiodobenzene 61, 65
 diisocyanates 129
 diisopropyl azodicarboxylate (DIAD) 38, 110
 4-dimethylaminopyridine (DMAP) 214–216
 α, α-dimethyl-(2-bromoaryl)methanols 181
 2,3-dimethyl-but-2-ene and 4-methyl-pent-2-ene 19
 dimethyl carbonate (DMC) 275, 354
 dimethyl 2,3-diphenylmaleate 263
 dimethylformamide (DMF) 68, 150, 310, 349
 dimethyl hex-3-ene-1,6-dioate 277
 1,2-dimethylimidazole 116, 117

- dimethyl 4-(2-oxobut-3-yn-1-yl)-3-(prop-1-en-2-yl)cyclopent-2-ene-1,1-dicarboxylates 255
- N,N*-dimethyl-2-pyridinylaniline 121
- dimethyl(2-pyridyl)(vinyl)silane 134
- 2,5-dimethyltetrahydrofuran 30
- dinickel complexes 62
- dioxane 266
- 1,4-dioxane 29–31, 34, 103, 106, 107, 316
- 1,3-dioxin-4-one derivatives 214
- 3,4-diphenylfuran-2(5*H*)-one 263
- bis(diphenylphosphino)ethane (dppe) 170, 346
- 2-(diphenylphosphino)ethyltriethoxysilane (DPPES) 153
- N*-diphenylphosphinoyl 60
- diphenylurea (DPU) 131, 132, 275
- diphosphine ligand 25, 29, 166, 178, 351–353
- direct carbonylation process 5
- dissociative mechanism 151
- 2,4-disubstituted 2,3-allenoates 204, 207
- α , β -disubstituted cyclopentenones 302
- 1,2-disubstituted epoxides 30–32
- 2,2-disubstituted epoxides 30
- di-*tert*-butylperoxide (DTBP) 56, 237
- dry reforming of methane 17
- DTBP-induced alkane C—H bond carbonylation 386
- e**
- electrophilic palladation 236
- EmimEtSO₄ 266
- enantioenriched *trans*- β -lactones 32
- enantioselective catalytic Pauson–Khand reactions 25
- enantioselective hydroformylation (EHF) 150, 161–164, 170, 351
- enantioselective transfer hydroformylation (ETHF) 170
- esters synthesis 90
- ethanol carbonylation 63, 172
- 2-ethenylidene 5-methyl cyclohexanol 138
- ethyl chloroformate 68
- 1-ethyl-3-methylimidazolium bis(trifluoromethylsulfonyl)imide 156
- 5-*exo-trig* cyclization 375
- ExxonMobil process 21
- f**
- Fe(acac)₃-catalyzed intramolecular aminocarbonylation of oxime esters 103
- Fe₃(CO)₁₂-catalyzed carbonylation, succinimides 97
- Fe₃CO₁₂-catalyzed carbonylation of terminal alkynes 98
- [Fe(CO)₄]-catalyzed carbonylation of tertiary amines 102
- Fe(OTf)₂-catalyzed carbonylative alkyl-acylation of heteroarenes 88
- Fenofibrate 370, 371, 375
- Fenofibric acid 374
- Fischer–Tropsch synthesis (FTS) 15, 16, 115, 138–139, 363
- flavones 76, 77, 197, 221
- N*-fluoro-sulfonamides 93, 94, 100, 101
- N*-formylsaccharin 220, 375
- Friedel–Crafts acylation 87, 241, 251, 252
- Frovatriptan 35
- furan-3-carboxylic esters 268, 269
- 2(5*H*)-furanones 201, 207, 264
- 2,5-furandicarboxylic acid (FDCA) 230
- furobenzofuranones 271
- g**
- Gabriele's catalyst 275
- gas-to-liquid plant 17
- Gimbert's mechanism 25
- gold-based catalysts 354
- h**
- 2-(2-haloalkenyl)aryl halides 213
- α -(*o*-haloaryl)-substituted ketones 198
- 2-halostyrenes 323

- Heck/carbonylation desymmetrization of
cyclopentene 222, 226
- Heck/carbonylation reactions 222
- Heck/carbonylative lactonization 201
- Hedgehog pathway 220–221
- heptyltriphenylphosphonium acetate
140
- heteroaromatic stannanes 327
- heteroaryl amines 321
- (hetero)arylcarboxylic acids 240
- heteroaryl iodides 376
- heterocyclic compounds 177, 198, 199,
209
- heterogenization process 172
- [2+2+1] hetero Pauson Khand reaction
134
with imines 136
for γ -lactones synthesis 135
- [4+1] hetero Pauson–Khand reaction
136
- hexagonal mesoporous silica (HMS) 153
- H-mordenite (HMOR) 52
- homogeneous methanol carbonylation
171, 345
- hydridocobalt(II) complex 18
- hydrido cobalt tetracarbonyl
[Co(H)(CO)₄] 28
- hydroaminomethylation 124, 166, 167
- hydroesterification 246, 247
- hydroformylation–acetalization reaction
125
- hydroformylation reaction 264
biphasic medium 21
of camphene 22
[Co(H)(CO)₃] 19
of epoxides 22
of epoxy-alkenes 22
using [HRu₃(CO)₁₁][−] as catalyst 125
- iridium catalysts 346–349
- linear and branched aldehydes 22, 345
- mechanism for 23
- metal catalysts 345, 346
- of 1-octene using
K[Ru(III)EDTA(H₂O)] 126
- of olefins 18
- osmium catalysts 351
- (−)- α -pinene 22
- platinum catalysts 349–351
- of propene 18
- of propylene oxide 23
- rhodium complexes 153
- with Ru₃(CO)₁₂/1,10-phenanthroline
125
- of 10-undecenitrile 123
- hydrohydroxymethylation 166, 168, 185
- 2-hydroxyacetophenone 221, 224
- ω -hydroxyacyl iodide 376
- ω -hydroxyalkyl iodides 376, 377
- hydroxycarbonylmetal 3
- hydroxyl-containing 3-iodofurans 199
- hydroxymethyl furfural (HMF) 182
- N*-hydroxyphthalimide (NHPI) 388
- hydrozirconation 299
- hyperbranched poly(arylene oxindole)
(HBPAO) 154
- i**
- imidazopyridinyl-*N*, *N*-dialkylacetamides
270
- imidazothiazinones 267
- 1,2-iminoacylation of oxime
ester-tethered alkenes 69, 70
- 1,2-iminoester 136
- indane 270, 300
- indenones 120, 181
- indole-2-carboxylic esters 178
- industrial hydroformylation reactions
processes 21
- [2+2+1] intermolecular Pauson–Khand
reactions 133
- intramolecular C(sp²)-halogen
carbonylation 242, 326
- [2+2+1] intramolecular Pauson–Khand
reaction 134
- N*-(2-iodoaryl)enaminones 220, 224
- iodide anion 141, 341
- iodide-catalyzed radical
carbonylation–benzylation of
benzyl chlorides 373
- iodide immobilization 172

(2-iodophenyl)hydrosilanes 221
 ionic liquid (IL)-in-oil Pickering emulsion system 156
 IPr · CuCl-catalyzed synthesis
 of cyclopropyl bis(boronates) 108
 of stereodefined cyclopropyl bis(boronates) 107
 IPrCuCl-catalyzed borocarbonylation of unactivated alkenes with alkyl halides 89, 90
 IPrCuCl-catalyzed carbonylative silylation of alkyl halides 107
 IPrCuCl-catalyzed hydrocarbonylative C–C coupling 86
 IPrCuI/NHC-catalyzed double carbonylation reaction 96
 [Ir(CO)₂(xantphos)X] 347
 iridium catalysts
 heterogeneous carbonylation 344
 mechanism for 339–342
 promoters role 342–343
 iron-catalyzed carbonylation of alkynes 98
 iron-catalyzed carbonylative Suzuki–Miyaura reaction 86
 isobenzofuranimines 268
 isocoumarins *via* palladium-catalyzed intramolecular cyclocarbonylation 198
 isocyanates 39, 40, 99, 123, 129, 130, 184, 201, 211, 275, 321, 323, 354
 isoindolinones 57, 270

k

ketones synthesis 83–90, 217–223
 β -ketonitriles synthesis 71, 72
 K₂[Fe(CO)₄]-catalyzed carbonylation of tertiary amines 102
 K[Ru(III)EDTA(H₂O)] complex 125
Klebsiella oxytoca 155
 Koch carbonylation reaction 296
 Koch type-reactions 297
 silver carbonyl ion catalyst 307–309
 silver Lewis acids under CO atmosphere 309

l

[LA]⁺[Co(CO)₄]⁻ complexes 33
 lactamization sequence 201
 β -lactams 33, 177, 197, 209–211, 214, 238, 239, 266
 lactonyl π -allylpalladium complex 217, 250, 257, 277
 LCu(I)Bpin complex 108
 ligand exchange mechanism 4, 5
 light-induced FTS 139
 linear olefins 126, 128, 138
 low-pressure oxo (LPO) process 150

m

maleic acids 260
 manganese-catalyzed carbonylative difunctionalization of alkenes 91
 manganese(I)-catalyzed C–H aminocarbonylation of heteroarenes 100
 manganese catalyzed Heck–Breslow cycle 84
 Markovnikov 99, 247
^{Me}IPrCuCl-catalyzed carbonylative hydroxymethylation of unactivated alkyl iodides 106
 metal-catalyzed carbonylation processes 7, 397
 metal-free carbonylation 7, 132, 399
 metal-organic framework (MOF) 22, 75
 methanol 314
 acetic acid production 336–337
 carbonylation 52
 iridium catalysts 339–345
 Rh catalyst 337–339
 methoxycarbonylation
 of 1-butene 127
 with carbon dioxide 128
 of ethylene 127
trans-bis(5-methoxy-1- η^3 -cyclohexenyl) palladium chloride complexes 248
 2-methoxy pyridine 22
 1-methyl benzimidazole 117
 methyl diphenylsilacarboxylic acid 17

- methyl (*E*)-4-(1*H*-indol-3-yl)-4-oxobut-2-enoates 263
- 9-methyl-9*H*-fluorene-9-carbonyl chloride 17
- methyl 11-formylundecanoate 159
- N*-methylguanidine 22
- methyl oleate 159, 165
- methylphenidate 208, 210
- 1-methyl-2-phenylimidazole 118
- 2-(*o*-methylphenyl)oxazolines 121
- 1-methyl-4-(2-pyridinyl)piperazine 121
- Micro-Fluidized Bed Reactor
Analyst-Particle (MFBRA-P)
63, 64
- microwave-assisted aminocarbonylation of ynamides 97, 98
- microwave-assisted indirect carbonylation 75
- microwave (MW) radiation calcined catalyst 62
- migratory insertion 2–4, 19, 20, 22, 24, 25, 29, 38, 51, 53, 99, 102, 151, 159, 235–237, 243, 313, 319, 335, 341
- Mn₂(CO)₁₀-catalyzed carboacylation 93
- Mn(OAc)₃ · H₂O-catalyzed ring-opening carbonylation of aryl cyclobutanols 93
- Mn-catalyzed ring-opening carbonylation 94
- MnBr(CO)₅-catalyzed C-H aminocarbonylation of heteroarenes 99
- Mo(CO)₆ complex 66
- carbonylative cross-coupling 326–327
- cascade and intramolecular cross-coupling procedures 323–326
- intermolecular cross-coupling procedures 320–323
- Mo(CO)₆ promoted carbonylative Suzuki–Miyaura cross-coupling reactions 327
- Hiyama and Negishi cross-coupling 326
- molecular weight enlargement (MWE) 153
- monoalkoxycarbonylation–monoaminocarbonylation 256
- monocarbonylation of aryl halides 36, 37
- monosubstituted 1,2-epoxybutane carbonylation reaction 30
- Monsanto process 16, 141, 337–339, 355, 363
- Moore's reaction *n*-alkenes 116
- mordenite 52, 172
- morpholine 122, 132, 167
- muffle furnace (MF) calcination catalyst 62
- n***
- Nafion 308, 309
- nanocopper-catalyzed carbonylative Suzuki reaction 83, 84
- natural bond order (NBO) charges 25
- Negishi coupling 70, 71
- Negishi reagent 301
- (NHC)CuCl-catalyzed borocarbonylative coupling 105
- (NHC)copper(I)/palladium-catalyzed 88
- Ni(acac)₂-catalyzed aminocarbonylation 56
- Ni/activated carbon (Ni/AC) 63
- NiBr₂ · diglyme-catalyzed carbonylation 69
- Ni-catalysed Mo(CO)₆ promoted carbonylative coupling reactions 327
- Ni(CO)₄ 16, 28, 51, 52, 64
- Ni(COD)₂ catalyst 58
- Ni(COD)₂-catalyzed asymmetric [2+2+1] carbonylative cycloaddition 59
- Ni/Fe₃O₄ catalyzed indirect carbonylation 73
- Ni(NO₃)₂ · 6H₂O 74
- Ni(OTf)₂ mediated carbonylation 67
- nickelacyclopentadienes 305
- nickel-catalyzed carbonylations 397
- cyclopentanone derivatives 73

- dinickel complexes 62
 history of 51, 52
 indirect carbonylative cycloaddition of
 unactivated amides 74
 microwave-assisted indirect
 carbonylation 75
 nanoparticles 60–62
 Ni/activated carbon (Ni/AC) 63–64
 Ni-chelates as precatalysts 56–60
 nickel halides 52–56
 Ni/Fe₃O₄ catalyzed indirect
 carbonylation 73
 Suzuki reaction 75
 THF and EO polymerization 76
 use of CO-surrogates
 acid or acid chlorides 69–72
 formate 67–68
 metal carbonyls 64–67
 nickel-catalyzed molybdenum-promoted
 carbonylative homo-coupling
 reaction 327
 NiCl₂(dmg)/4,4'-bipy as catalytic system
 66
 nitroarenes 103, 123–132, 144
 nitrobenzene 129–131, 309, 310
 nitromethane 99
 NiXantphos 154, 160, 170
N-methylmorpholine-*N*-oxide (NMO)
 27
 nonconventional solvents 399
 nucleophilic displacement 3, 4, 238, 239,
 241, 242, 244, 245, 251, 253, 254,
 257, 260, 261, 265, 271
- O**
- olefin oligomerization reactions 51
 oleic succinyl-cyclodextrins (OS-CDs)
 158
 one-pot hydroaminomethylation 166
 organoboranes 83, 84
 organocarbonylpalladium(II)
 intermediates 235, 236
 organopalladium(II) complexes 235
 organophilic nanosolvent filtration (OSN)
 156
 organostannanes 83, 84
 organotrifluoroborates 373
 osmium catalysts 351
 oxazinoquinolinones 271
 oxazolidines 34, 35
 oxazolopyrimidines 271
 oxidative alkoxy-alkoxycarbonylation of
 alkynes 260
 oxidative alkoxycarbonylation of alkanes
 383
 oxidative carbonylation 6, 129, 131, 132,
 235–237, 242, 243, 245, 249, 251,
 255, 256, 260, 263–265, 268, 269,
 271, 274–277, 354–356, 386, 387,
 398
 oxidative dialkoxycarbonylation 6, 7,
 245, 248, 250, 257–259, 272, 273
 oxidative monoalkoxycarbonylation
 243, 244, 260, 261
 oxidative oxycyclodicarbonylation process
 256
 (*Z*)-2-[oxoisobenzofuran-1-3(*H*)-ylidene]
 acetates 269
- P**
- palladium catalysts 55, 57, 309, 372, 373,
 398
 palladium(0) bis(dibenzylideneacetone)/
 (*S*)-(-)-5,5'-bis(diphenylphosphino)-
 4,4'-bi-1,3-benzodioxole 204
 palladium(0)-catalyzed carbonylations
 amide derivatives
 five, six, seven-membered cyclic
 amides 211–214
 β-lactams 209–211
 benzamide derivatives 21–216
 carbonyl derivatives 197
 dithiocarbonylation 225
 ester derivatives
 alkynes 201–208
 aryl halides 198–201
 benzyl amines 208–209
 FDCA 219
 ketone derivatives

- palladium(0)-catalyzed carbonylations (*contd.*)
 - α,β -alkynyl ketones derivatives 223–225
 - aryl halides 217–223
 - substrates 223
 - mechanism for 198
 - thioacetates 227
 - thioester-containing six-membered ring lactones 225
- palladium(II)-catalyzed carbonylations
 - alcohol and amine 275
 - alkenes 245–247
 - of alkanes and saturated C–H bonds 236–239
 - allene 249
 - of arenes and heteroarenes 239–243
 - functionalized alkenes and allenes 250–255
 - functionalized alkynes 264–274
 - of β, γ -unsaturated acids or esters 277
 - olefins 243–247
 - organic substrates 235, 236
 - unfunctionalized alkynes 255–264
- palladium-catalyzed asymmetric Heck/carbonylative lactonization 201
- palladium-catalyzed intramolecular
 - cyclocarbonylation 198, 199, 201, 212
 - of 1-butyl-*l*-(*o*-iodobenzyl)-3-phenylurea 212
 - and intermolecular carboalkoxylation 202
- palladium-catalyzed Markovnikov regioselectivity 99
- palladium hydride mechanism 247, 249, 253, 254, 262, 271, 276, 277
- paraformaldehyde 17, 128, 166, 170, 183, 392
- Pauson–Khand reaction (PKR) 62, 115, 353, 397
 - cyclopentenones *via* [2+2+1] cycloaddition 23, 24
 - enantioselective catalytic 25
 - intramolecular diastereo- and enantioselective 26
 - intramolecular version of 25, 27
 - microwave activation of 25
 - microwave heating 27
 - regioselectivity of 25
 - ring closing metathesis and subsequent hetero 135
 - ruthenium-catalyzed 133
 - simplified catalytic cycle 24, 25
 - tetramethylthiourea 27
- Pd(0)-catalyzed alkoxycarbonylation of propargylic mesylate 204
- Pd(0)-catalyzed carbonylation 203, 207, 217, 398
 - of (*Z*)-2-en-4-yn carbonate 203, 207
- Pd(0)-catalyzed thiolative lactonization 204, 208
- Pd(II)-catalyzed Pauson–Khand reaction 271, 273
- Pd/C-catalyzed carbonylative esterification 199
- Pd/C-catalyzed carbonylative Suzuki–Miyaura cross-coupling 220, 222
- Pd-catalyzed carbonylative Sonogashira/cyclization sequences 323
- PdCl₂-promoted stoichiometric dichlorocarbonylation 256
- Pd–Cu bimetallic system 237
- Pd₂(dba)₃ catalyzed carbonylative synthesis of 2(*5H*)-furanone 207
- PdI₂-catalyzed oxidative dialkoxycarbonylation of alkynes 6, 7
- n*-pentane carbonylation 298, 299
- pent-4-enyl iodides 365, 375
- pent-4-enyl radicals 365, 375
- 2-phenoxy pyridines 241, 242
- phenylacetanilide 36
- phenylboronic acid 75
- phenylcarbamate 310
- 1-phenyl-1*H*-pyrazole 118
- 3-phenylpropanol 300

phobane-based diphosphines 23
 phosphines 29, 37, 65, 76, 135, 150, 151,
 153–154, 156–161, 163, 166–168,
 171, 178, 201, 301, 305, 306, 335,
 345, 346, 348, 351
 phthalimides 37, 38, 388
 phthalimide *N*-oxyl (PINO) 388
 2-picolylamide structure 122
 pincer ligands 69, 71, 144, 345
 platinum-catalyzed hydroformylation of
 alkenes 150
 poloxamines (Tetronics®) 154
 polyether guanidinium ionic liquids
 (PolyGILs) 155
 poly(hydroxyalkanoate) 33
 poly(methylhydrosiloxane) (PMHS) 171
 polyvinylpyrrolidone (PVP) 138
 porous organic ligand (POL) 154
 porous organic polymers (POs) 154
 positron emission tomography (PET) 58
 primary alcohols 66, 106, 132, 170, 199,
 297, 308, 312
 propane carbonylation 299
 propylene oxide 23, 32–34, 252
N-(2-(6-(propoxymethyl)pyridin-2-yl)
 ethyl)acetamides 238
 2-(prop-2-ynylthio)benzimidazoles 267
 2-(prop-2-ynylthio)imidazoles 267
 protonolysis 143, 247, 253, 267, 272, 302,
 342
 pyrano[3,2-*b*]pyran-2,6-dione (PPD) 199
N-pyridylformamide 56
 2-(2-pyridyl)benzimidazole polymeric
 Ru-Py-Mer catalyst 131
 pyrrolidine 132, 163, 174, 217
 pyrrolidine-or piperidine-substituted
 enones 217
 pyrrolidinones 33

q

quinazolinones 197, 214, 310, 311
 2-quinolones from 2-(2-haloalkenyl)aryl
 halide substrates 213
 QuinoxP* 25, 26

r

radiochemical yield (RCY) 58
 Ramatroban 35
 Raney ruthenium 139
 1,2-reduction tandem sequence 104
 reductive carbonylation process 5–7, 68,
 130, 178, 179, 263, 264, 309, 310,
 398
 reductive displacement 3, 4
 regioselective hydrocarbonylation of
 propargylic alcohol 230
 Reppe carbonylation 6, 61
 Rh(acac)(CO)₂/Biphephos system 165
 Rh-catalyzed hydroformylation reactions
 19, 151
 rhodium-based system embedded in a
 peculiar polysaccharide matrix
 (Rh-EPS) 155
 rhodium-catalyzed carbonylations
 acetic acid 178
 benzo/[7+1] cycloaddition of
 cyclopropyl-benzocyclobutenes
 180
 carbonylative cycloaddition reaction
 180
 cyclopropanes 177
 homogeneous or heterogeneous
 catalysts 171
 hydroformylation
 aqueous biphasic hydroformylation
 156–161
 catalyst recovery 152–156
 catalytic cycle for 152
 enantioselective hydroformylation
 161–164
 of α -olefins 151
 syngas surrogates 169–171
 tandem hydroformylation 164–169
 maleimide derivatives 175
 methyl acetate to acetic anhydride 173
N,N-dimethylacetamide 172
 patents and patent applications
 acetic acid 185
 alcohols 184
 hydroformylation 184

- rhodium-catalyzed carbonylations
(*contd.*)
- primary and secondary aliphatic amines 174
 - 2-pyridylmethylene cyclobutanes 183
 - Reppe's experiments 175
 - vapor-phase ethanol carbonylation 172
- rhodium-catalyzed carbonylations 149–185, 337, 398
- room-temperature
- phosphine-functionalized polyether guanidinium ionic liquids (RTP-PolyGILs) 155
- $\text{Ru}_3(\text{CO})_{12}$ -catalyzed [2+2+1+1] cyclization 136
- $\text{Ru}_3(\text{CO})_{12}/\text{PCy}_3$ catalytic system 128
- RuhrShemie /Rhône-Poulenc process 157
- ruthenium-based carbonylations 398
- ruthenium-catalyzed carbonylations
- of amines and alcohols 132–133
 - CH activation of nitrogen-containing arene derivatives 116–122
 - cyclocarbonylations 133–138
 - hydroformylations and alkoxy carbonylations 115
 - of nitroarenes 129
 - of olefins
 - alkoxy carbonylation 126–128
 - hydroformylation 123–126
 - oxo products from H_2 and CO_2 142–143
 - $\text{Ru}_3(\text{CO})_{12}$ cluster 115
 - syngas
 - Fischer–Tropsch synthesis (FTS) 138–139
 - oxo products 140–142
- S**
- S_EAr palladation 240, 241
- Schiff bases 37, 354
- second-row transition metals 7, 295–328, 398
- silver-doped Nafion 308
- single-electron transfer (SET) 71, 92, 369
- sodium 3-mercapto-1-propanesulfonate (SMPS) 138
- Sonogashira cross-coupling reaction 69
- sp^3 -hybridized CH bond 121, 122
- spirooxindole γ - and δ -lactones/lactams 201
- Stanley's catalyst 20
- sterically hindered
- phosphabicyclononane ligands 18, 19
- Stille coupling 65, 327
- substituted *N*-aryl-2-aminopyridines 310
- 3-substituted 4-aryloisoquinolines 217, 219
- 2-substituted 3-aryloquinolin-4(1*H*)-ones 220
- 2-substituted-4*H*-3,1-benzoxazin-4-one 198
- substitutive carbonylation process 5, 263, 273
- sulfonyl isocyanate 321
- sulfoxantphos 156, 159, 160
- supercritical carbon dioxide (scCO_2) 22
- supported ionic liquid-phase (SILP) 142, 155
- Suzuki carbonylation 61
- Suzuki–Miyaura coupling 84, 104
- synergistic copper-catalyzed reductive aminocarbonylation of nitroarenes 103
- syngas 1, 16–19, 115, 138–142, 159–162, 165–167, 169–171, 313, 314
- synthetic fuels 15
- t**
- tandem hydroformylation 124, 126, 164–169, 347
- tandem hydroformylation–acetylation reaction to acetals 126
- tetrabutylammonium cyanoborohydride 366, 392
- 1-tetralone 300

- 2,3,4,5-tetrahydro-1*H*-2,4-benzodiazepine-1,3-dione derivatives 212
- tetramethylphosphonium bromide 140
- TFA–cyclohexane–MeOH mixture 236
- ThaxPhos ligand 26
- thermoreponsive hydrogels 154
- thiadiazafuorenone 231
- thiocarbonylation 65, 225
- 2,2'-(thiophene-3,4-diyl)diacetate derivatives 257
- third row transition metals 398
- alkoxycarbonylation of alkenes 352–353
- alkynes 353
- hydroformylation
- iridium catalysts 346–349
 - osmium catalysts 351
 - platinum catalysts 349–351
- methanol carbonylation
- acetic acid production 336–337
 - iridium catalysts 339–345
 - Rh catalyst 337–339
 - migratory CO insertion 335, 336
 - oxidative carbonylations 354–355
- thunberginol A 198–200
- N*-tosyl allylpropargylamines 271
- N*-tosylhydrazone 213
- N*-tosylpentenamines 251, 252
- transition metal-catalyzed carbonylative reactions 197
- transition metal-catalyzed direct carbonylation 220
- transition metal-free carbonylation processes
- acids and anhydrides 386–388
 - acyl chlorides and alcohols 388–392
 - aldehydes and ketones
 - alk-4-enyl iodides 366
 - alkylamines with styrenes 370
 - aryl boronic acid 373
 - gem*-dihalocyclopropane derivatives with CO 365
 - N*-formylsaccharin 375
 - free-radical carbonylation 364
 - visible-light-induced radical carbonylation 368, 369
 - β , γ -unsaturated ketones 369
 - amides 385–386
 - esters and lactones 375–384
 - organic electronic devices 363
 - residual metal contamination 363
 - transmetalation mechanism 4, 5
 - trapping efficiency (TE) 58
 - trialkylphosphine ligand 18
 - tributyltin hydride 369
 - bis(*o*-trifluoroacetamidophenyl)acetylene 217
 - 6-trifluoromethyl-12-acylindolo[1,2-*c*]quinazolines 217
 - trimethylsilylacetonitrile 218, 220, 221
 - trimethyl(tetradecyl)ammonium bromide (TTAB) 138
 - triphenylphosphine (TPP) 29, 127, 150, 153, 349
 - bis(triphenylphosphine)iminium iodide ([PPN]I) 29
 - tris(*p*-sulfonatophenyl)phosphine (TPPTS) ligand 21
 - tris(trimethylsilyl)silane (TTMS) 369
 - 2D-layered clay mineral vermiculite (2D-VT) 61
- U**
- γ , δ -unsaturated aromatic oxime esters 91, 93
 - β , γ -unsaturated esters 5, 238, 244, 250, 277
 - α , β -unsaturated γ -lactones 137
 - α , β -unsaturated olefins 137
- V**
- vapor-phase carbonylation of methanol 52, 63, 365
 - vapor-phase methanol carbonylation 52, 172
 - vinylallenyl esters 197, 203
 - vinyl aziridine 210
 - 2-vinylbenzylamines 254
 - visible-light-initiated photocatalysis 366, 368

W

- Wacker process 241, 336
water–gas shift (WGS) reaction 16, 142,
143, 171, 337

X

- Xantphos ligand 90

Y

- 2-ynamides 256, 261, 266, 267, 270
3-yne-1,2-diols 268, 269
2-ynoate esters 256, 260, 261

Z

- Ziegler-type low pressure polyethylene
138

- zirconacycles carbonylation 300
zirconacyclopentadienes 303–305
zirconacyclopentadienones 306
zirconacyclopentane 303
zirconacyclopentene 303
zirconaindane 299
zirconindane 300
zirconium-mediated intramolecular
coupling–carbonylation 306
zirconocene complexes 295, 299–307,
328
zirconocene-promoted
bicyclization–carbonylation of
dienes 302, 304
zwitterionic hydrophilic phosphines
159

