

Index

a

- (*R*)-(1-acetamido-2-phenylethyl)boronic acid 329
- acetophenone, enantioselective OXB-catalyzed reduction 414, 416
- acetylacetonato ligand 177
- α,β -acetylenic ketones, enantioselective OXB-catalyzed reduction 424
- 2-acetylfuran, OXB-catalyzed reduction 417
- N*-acetylphenyl alanine, boronic acid analogue 330
- 2-acetylpyridine, OXB-catalyzed reduction 417
- 2-acetylthiophene, OXB-catalyzed reduction 417
- acid chlorides, in preparation of allylboronates 248
- acrolein, Diels-Alder reaction 390
- acrylate ester 338
- radical addition with (α -chloroalkyl)boronic ester 338
- acrylate, α -boronyl-substituted 353
- (α -acylaminoalkyl)boronic acid 18, 328
- cleavage 18
 - enzyme inhibitor 54
- (acyloxy)borane catalyst $\text{RCO}_2\text{BR}'_2$ 23, 389
- in Diels-Alder reaction 389
- N*-acylurea 387
- alcohol 73, 226, 411
- coupling with boronic acid 73
 - coupling with trifluoroborate salt 226
 - intermediate and chiral auxiliary 411
- aldehyde 71, 73, 241, 256
- reaction with allylboronate 71, 241, 256
 - Rh-catalyzed reaction with boronic acid 73
- aldol reaction 191, 379
- catalyzed by arylboronic acid 379
- aliphatic boronic acid, reductive coupling 63
- aliphatic C-H borylation of alkanes 35, 105, 106
- mechanism 106
 - Re-catalyzed photochemical reaction 106
- alizarin red S (ARS), saccharide detection 23, 470
- alkanes, direct borylation 35, 105
- 1,2,6-alkatrienal, preparation 273
- alkene cross metathesis 46
- chemo- and E/Z selectivity 46
 - in preparation of alkenylboronic acids (esters) 46
- alkene dihydroxylation 78
- with $\text{PhB}(\text{OH})_2$ as additive 78
- alkenes
- asymmetric hydroboration 48
 - bromoboronolactonization 76
 - preparation 46
 - Rh-catalyzed addition of boronic acid 171, 73
- alkenyl halide (triflate) 67
- coupling with diboronyl reagent 38
 - borylation with pinacolborane 104
 - from alkenylboronic acids (ester) 67, 343
- alkenyl selenide 344
- alkenyl tris(boronate), preparation 371
- alkenyl(phenyl)iodonium salts, preparation 344
- alkenylaluminum reagents 245
- alkenylamines 222
- from alkenylboronic acids 222
- alkenylboron derivatives, coupling with alkenyl halides 123
- alkenylboronic acid derivatives 345
- alkenylboronic acids (esters)
- addition to *N*-acyliminium ions 297
 - addition to imines and iminium ions 72, 280

- B-C π conjugation 6
- ^{13}C NMR shift effect 6
- Cu-mediated C-O and C-N cross-coupling 206, 222
- 2,2-disubstituted 47
- Eschenmoser's reaction 283
- halogenation 343
- hydrohalogenation 343
- in boron-heteratom exchange 344
- microwave-assisted Suzuki coupling 160
- oxidation into enol acetates 64
- Petasis reaction 285, 289
- preparation 37–48, 102
- reaction with bromine to give bromoalkenes 343
- reaction with iodine to give iodoalkenes 343
- Rh-catalyzed addition to aldehydes, imines and alkenes 73, 195, 201
- Rh-catalyzed conjugate addition 172
- Suzuki coupling 69
- alkenylboronic esters
 - 2-alkoxycarbonyl-substituted 353
 - allylic rearrangement 346
 - as dipolarophiles 363
 - asymmetric Diels-Alder reaction 354
 - boron-tethered Diels-Alder reaction 353
 - carbene additions 350
 - catalytic asymmetric hydroboration 370
 - cyclic derivatives 362
 - cycloaddition with azomethyne ylides 366
 - cycloaddition with diazoalkanes 363
 - cycloaddition with nitrile oxides 364
 - [3+2] cycloaddition with methylenecyclopropanes 367
 - cyclopropanation 350
 - dialkylzinc-promoted addition to nitrones 301
 - diastereoselective hydrogenation 370
 - dienophile in [4+2] cycloadditions 351
 - (+)-diethyltartrate derivatives 354
 - dipolar cycloadditions with nitrones 365
 - Dötz annulation with Fischer carbenes 367
 - [2+2] enone-olefin photocycloaddition 367
 - epoxidation 50
 - free-radical additions 337
 - hydrogenation 48
 - hydrostannation 347
 - hydrozirconation 370
 - in preparation of allylboronates 250
 - isomerization to allylboronates 55, 252
 - intermolecular haloetherification 344
 - Petasis borono-mannich reaction 286
 - pinacol boronates 368
 - preparation 37–48, 368–370
 - protonolysis with AcOH 14
 - radical additions with xanthates 347
 - reaction with allylic zinc reagents 372
 - reaction with carbon radical 347
 - reaction with hydrogen bromide 344
 - reaction with organometallics to give borinic esters 345
 - reaction with sulfonyl halides 348
 - reaction with thiols 347
 - reactivity in Diels-Alder reaction 352
 - sensitivity to hydrolysis 343
 - [3,3]-sigmatropic rearrangement 252
 - stability to air and moisture 343
 - sulfonyl-substituted 347, 353
 - synthesis of epothilones 368
 - tartramide-derived 350
 - tetrasubstituted 38
 - transformation into organomercurial 62
 - transmetalation with dimethylzinc 301
 - α -trialkylstannyl-substituted 349
- alkenylcatecholboronates 174
 - Rh-catalyzed conjugate additions 174
- alkenylcopper reagents 245
- alkenyldichloroborane, Diels-Alder reaction 355
- alkenyldioxazaborocines, Michael addition 346
- alkenylmercuric halides 344
- alkenylmetal (Li, Mg) reagents 38, 244
 - configurational stability 244
 - preparation of allylboronates 244
 - trapping with borates 38
- alkenylphosphonates 184
- alkenylstannanes, α -boronyl 349
- alkenyltrifluoroborate salts 27, 298
 - epoxidation 27
 - Petasis borono-mannich reaction 298
- alkenyltrimethylsilanes, transmetalation to boronic acids 38
- alkoxide nucleophiles, in Matteson homologation 317
- alkoxy substituted boronic esters, Matteson homologation 316
 - (β -alkoxyalkyl)boronic esters 316
 - stability to elimination 316
 - in Matteson homologation 316
 - (α -alkoxyalkyl)boronic esters 336
 - Matteson homologation 322
 - preparation from (dialkoxyethyl)lithium 336

- (*E*)- γ -alkoxyallyl α -substituted boronates, preparation 346
- (*Z*)- γ -alkoxyallylboronates 246
- 1-alkoxycarbonyl alkenylcopper, in preparation of allylboronates 245
- 2-alkoxycarbonyl allylboronates 250, 272
- Lewis acid catalyzed addition to aldehydes 272
 - preparation 250
- 3-(alkoxymethyl)alkenylboronic esters 252
- alkylboronic acids
- α -acylamino-substituted 328
 - α -amino-substituted 328
 - by Re-catalyzed C-H activation/boronylation 48
 - Cu-promoted N-alkylation 227
 - halogenation 66
 - oxidation 63
 - preparation 48
 - stability in aqueous acid 14
 - Suzuki coupling 70
- alkylboronic esters 48, 106
- as tartrate-derived catalysts 392
 - compatibility with DDQ oxidation 318
 - compatibility with dichromate 321
 - compatibility with enolate formation 321
 - compatibility with other reactions 55
 - direct deprotonation 51
 - α -hydroxy substituted 318
 - oxidation 13, 63
 - preparation by asymmetric hydroboration 48, 333
 - preparation from α -trimethylstannyl derivatives 53
 - stereoselective preparation 370
 - α -zincated 372
- alkyldichloroboranes, see dichloroalkylborane
- 2-alkylthio-1-alkenylboronic esters 45
- β -alkylthioboronic esters 347
- alkyne diboration, mechanism 47
- alkynes
- bromoboration 314
 - cis-hydroboration 42
 - cyanoboration 47
 - diboration 47
 - hydroboration 43–46
 - hydrozirconation/boronylation 38
 - pinacolboration 45
 - Rh-catalyzed addition with boronic acids 192
 - silaboration 47
- alkynyl bromides 44
- hydroboration 44
 - in Suzuki coupling 123
- alkynylboronic acids
- addition to iminium ions 281
 - oxidation to alcohols 48
 - preparation 48
 - sensitivity to hydrolysis 47
 - transmetallation 48
- alkynylboronic esters 46, 74 f, 254, 355 f, 364, 368 ff, 370 f
- annulation by enyne metathesis 46, 369
 - as precursors of alkenylboronic esters 46
 - Co-catalyzed Diels-Alder reactions 356
 - [4+2] cycloadditions 355
 - cycloaddition with nitrile oxides 364
 - hydrogenation to Z-alkenylboronic esters 46, 370
 - in preparation of allylboronates 254
 - Ru-catalyzed enyne metathesis 368
 - nucleophilic addition to enones 74
 - Pt(0)-catalyzed diboration 371
- alkynyl dibromoboranes, Diels-Alder reaction 355
- alkynyltrifluoroborate salts, Petasis reaction 298
- allenes
- diborylation to give allylboronates 248
 - Pt(dba)₂-catalyzed pinacolboration 45
 - silaboration 47
- allenylboronic esters, preparation 45
- L-allose 465
- recognition by diboronic acid sensor 465
- allyl- and crotyltrifluoroborate salts, addition to imines 280
- allyl-Li, -K, -Mg reagents, preparation of allylboronates 243
- allylsilation of aldehydes, CAB-catalyzed 405
- allylation of aldehydes/ketones with allylboronates
- coulombic repulsion in transition state 262
 - diastereospecificity 257
 - electronic effects 256
 - enantioselective variants 259, 271
 - tandem alkene cross-metathesis/allylation 268
 - tandem hydroformylation/allylation 267
 - intramolecular variant 257, 267, 271
 - Lewis acid-catalyzed 257
 - Sc(OTf)₃-catalyzed, with camphordiols allylboronates 261

- stereoselectivity and mechanism 256
- tandem [4+2] cycloaddition/allylboration 357, 360
- using α -chloroallylboronates 262
- using crotylboronates 257
- using cyclohexenylboronates 357
- using tartrate allylboronates 259
- with ketones 263
- allylation of imine derivatives with allylboronates 264
- allylboronates (allylboronic esters)
 - activation with Lewis acids 258
 - addition to aldehydes 71, 241, 256, 260
 - addition to imine derivatives 264, 280
 - addition to ketones 263, 271
 - α -alkyl-substituted 245
 - allylboronic acids 49
 - α -alkoxycarbonyl 272
 - 2-alkoxycarbonyl (carboxyester) 245, 256, 258, 264
 - γ -alkoxy 244, 253, 256, 346
 - B-chiral 259
 - ^{11}B NMR shift 241, 256
 - binaphthol-derived 263
 - bis(sulfonamide) derivatives 260
 - borotropic rearrangement 241
 - camphordiol derivatives 261
 - C-chiral 259, 262, 271
 - α -chloro 245, 251
 - compared to allylboranes 241
 - γ,γ -disubstituted 245, 269, 270
 - electrophilicity 256
 - enantioselective addition to ketones 263 f
 - in ammonia fixation of aldehydes 265
 - Lewis acid-catalyzed additions to carbonyls 71, 242, 257
 - mechanism of addition to aldehydes 256
 - mesomeric effect of oxygen 241
 - one-pot cycloaddition/allylboration 357
 - oxidation to allylic alcohol 359
 - pinacol esters 242
 - preparation 72, 104, 241–271, 345, 357, 360
 - Ru-catalyzed cross-metathesis/allylboration 369
 - α - or γ -substituted 254, 273, 345
 - α -sulfonamido 25
 - γ -sulfonamido 267
 - stereochemical integrity 241
 - synthesis of leucasdandrolide A 244
 - synthesis of palustrine alkaloids 266
 - tandem allylation processes 242, 266–273
 - tartrate derivatives 260, 270
 - transmetalation to allylcopper 264
 - (*E*)- γ -trialkylsilyl 244, 264
 - tri- and tetrasubstituted 248
 - use in multicomponent reaction 266
- allylboronic acid, immobilization to ROMPgel 60
- allylic acetates
 - coupling with diboronyl reagents 104
 - one-pot borylation/allylation of sulfonylimines 265
 - preparation of allylboronates 249, 271
- allylic alcohols
 - borinic acid-catalyzed oxidation 380
 - boronate-promoted cyclopropanation 407
 - chiral, by OXB-catalyzed reduction 424
 - Suzuki coupling 70
- allylic amines, synthesis using Petasis reaction 281
- allylic halides, in preparation of allylboronates 249
- allylic zinc reagents, reaction with ethyleneboronate 372
- allylmetal reagents, addition to carbonyl and imines 242
- allylsilanes, CAB-catalyzed addition to aldehydes 40
- allylsilation of aldehydes, Pt-catalyzed 270
- aliphatic CH-borylation, Rh-catalyzed 107
- aluminium BINOL catalyst 259
 - in addition of allylboronates to aldehydes 259
- amide formation, boronic acid-catalyzed 383
- amides, Cu-catalyzed coupling with boronic acids 73
- (α -amidoalkyl)boronic acids, preparation 337
- amination, of arylboronic acids 65
- amine-functionalized phosphine, in Suzuki coupling 14
- amine-boranes, in OXB-catalyzed reductions 414
- amines
 - as optically active intermediates and chiral auxiliaries 411
 - chiral, preparation by OXB-catalyzed reduction of imines 431
 - Cu-catalyzed coupling with boronic acids 73
 - Petasis borono-mannich reaction 285
 - preparation 279, 411

- α -amino acids
 - as precursors of oxazaborolidines 413
 - boron analogues 50
 - complexes with boronic acids 24
 - N-methylated 333
 - preparation using Matteson homologation 331
 - preparation using Petasis reaction 72, 289
- amino alcohols, preparation 331
- 1,2-amino alcohols 413, 426
 - as components of drugs 418
 - preparation of chiral oxazaborolidines 413
 - preparation by OXB-catalyzed reduction 426
 - preparation by Petasis reaction 72, 290
- amino sugars 465
 - recognition by a tetraboronic acid sensor 465
- 2-amino-3-boronopropionic acid 55
- (2S)-amino-6-boronohexanoic acid (ABH) 491
 - as boron analogue of arginine 491
 - X-ray crystal structure of arginase complex 491
- (α -aminoalkyl)boronic acids (esters) 331
 - as boron analogues of aminoacids 82
 - as enzyme inhibitors 82
 - decomposition 329
 - instability 319, 333
 - preparation using Matteson homologation 328
 - rearrangement 50
- o-aminomethyl-arylboronic acids
 - as PET fluorescent sensors for saccharides 447, 449
 - dissociation in water (pKa) 444
 - effect of saccharide and pH on fluorescence 450
 - role of B-N coordination on sensor response 447, 449, 462, 503
 - spiropyran-conjugated 464
 - saccharide binding, requirement for rigid cis-diol 455
- 3-aminophenylboronic acid
 - component of polyaniline film for saccharide sensing 474
 - component of glucose-sensitive insulin release system 501
 - synthesis of a boronic acid azo dye 461
- aminopyrimidines, Suzuki coupling 135
- ammonia fixation, using allylboronates 265
- amphiphilic resin-supported ligand, in Suzuki coupling 155
- amphoteric boronic acids 59
- analytical methods, for boronic acid derivatives 61
- anhydrides, Rh-catalyzed addition with boronic acids 200
- anthracenyl diboronic acid, sensor for saccharides 451
- anthracene derivative, preparation 129
- anthrylboronic acid, sensor for saccharides 445
- anti- α -(difluoromethyl)- β -amino alcohols 291
- anti-difluorothreonine, preparation by Petasis reaction 291
- antifungal agent naftifine, synthesis by Petasis reaction 281
- aramids, preparation using 3,4,5- $F_3C_6H_2B(OH)_2$ 386
- arene borylation/cross-coupling 115
- arene borylation/oxidation, in preparation of phenols 115
- arginase, inhibition with boronic acids 490 f
- aromatic C-H borylation 109 ff
 - catalytic cycle with Ir catalysts 116
 - Ir-catalyzed reaction 110
 - mechanism of Rh-catalyzed reaction 109
 - mechanistic studies by 1H NMR 116
 - Re-catalyzed photochemical reaction 109
 - regioselectivity (orientation) 109, 113
 - with pinacolborane or catecholborane 116
- aromatic-aromatic Suzuki coupling 123
- arsine ligand, in borylation of allylic acetates 271
- aryl- and alkenyltrifluoroborates salts 197
 - Rh-catalyzed addition to aldehydes and imines 197
- aryl azides, from arylboronic acids 65
- aryl chlorides 17, 102
 - activation with Pd complexes 159
 - coupling with diboronyl esters 35
 - Suzuki coupling 71, 144, 156
- aryl ethers and anilines, preparation using boronic acids 205
- aryl fluorides, preparation with boronic acids and $CsSO_4F$ 66
- aryl halides (triflates) 102
 - coupling with pinacolborane 35
 - reaction with diboronyl reagents 34, 102
- aryl sulfonium salts, Suzuki coupling 71

- aryl tosylates, Suzuki coupling 71
- 2-aryl-(2-butadienyl)boronates 47
- aryl(phenyl)iodonium, from arylboronic acids 66
- 6-aryl-2,4-diaminopyrimidines/triazines, preparation by Suzuki coupling 133
- 3-aryl-5-isoxazoline boronic acids 364
- arylammonium salts, Suzuki coupling 71
- N-9 arylation, of chloropurines with boronic acids 219 f
- N-Arylation, of azoles with arylboronic acids 217 f
- Imidazoles, Cu-promoted N-arylation with arylboronic acids 217, 218
- arylborate salts, Rh-catalyzed addition to enoates 181
- arylboronic acids, as catalysts 378 f, 379
- arylboronic acids (esters)
 - addition to imines and iminium ions 72, 280, 297
 - amination 65
 - amine interaction in saccharide sensors 462
 - as
 - antimicrobial agents and enzyme inhibitors 81
 - catalyst for hydrolysis of haloalkanols 381
 - catalyst in biphasic amidation 384
 - catalysts in organic synthesis 377
 - catalyst in the hydrolysis of imines 76, 388
 - components of colorimetric sensors for saccharides 463, 466
 - components of electrochemical sensors for saccharides 467, 474
 - component of insulin release system 501
 - components of TM complexes for saccharide sensing 465
 - inhibitors of serine proteases 81, 482
 - inhibitors of subtilisin and chymotrypsin 485
 - receptors and sensors for saccharides 81, 441
 - B-C conjugation 6
 - binding process with diols 483
 - binding to erythrocytes 85
 - bipyridine-derived 457
 - BODIPY-substituted 446
 - bromination 55, 67
 - brominolysis, mechanism 66
 - catalytic activity in direct amide condensation 384
 - C-C bond insertion/functionalization 74
 - C-N (non-heteroarene) Cu-promoted cross-coupling 212, 215
 - colored derivatives 85
 - conversion into dihaloboranes 334
 - conversion into trifluoroborate salts 334
 - commercial availability 205, 233
 - coupling with acid chlorides 69
 - coupling with anhydrides 69
 - crown-ether containing 457
 - Cu-promoted N-arylation with phthalimides 226
 - Cu-promoted cross-coupling with phenols 207
 - Cu-promoted coupling with chloropurines 219
 - Cu-promoted coupling with imidazoles 217
 - Cu-promoted coupling with nucleosides 219
 - Cu-promoted coupling with O- and N-functionalities 73, 206
 - Cu-promoted coupling with N-hydroxyphthalimide 208
 - cyclobutanones 74
 - dansyl-labeled 85
 - DEAM-PS supported 295
 - decomposition with $\text{Cu}(\text{OAc})_2$ and triethylamine 232
 - diazotization/hydrolysis 55
 - diethanolamine adducts 33 f
 - direct amide condensation, catalytic cycle 384
 - dissociation in water (pKa) 9, 444, 481
 - dye-containing 461
 - equilibrium with oligomeric anhydrides and boroxines 383, 394
 - ferrocene-substituted 467
 - functionalization 35
 - guanidinium-containing 458
 - halogenation 66 f
 - homocoupling 69
 - immobilization with DEAM-PS 59
 - in bioconjugation/labeling of proteins and cell surface 84
 - in solid-phase synthesis 102
 - intramolecular C-O cross-coupling with phenols 210
 - iodination 67
 - ipso-nitration 65
 - mechanism of aqueous protodeboronation 63
 - metal-catalyzed protodeboronation 62
 - nitration 55

- nitrophenol derived 465
- nucleophilic aromatic substitutions 55
- *ortho*-aminomethyl-substituted 444, 447, 449
- *ortho*-alkylation of phenols 76
- O vs N-arylation in Cu-promoted couplings 221
- oxydation 63
- perfluoroalkylated 383
- Petasis borono-mannich reaction 73, 285, 289
- phospholipid-conjugated 85
- pK_a 9, 444
- porphyrin-containing 449
- preparation 28–36
- preparation by aromatic C-H borylation 35, 105, 109
- preparation using diboronol reagents 35, 102
- protolytic deboronation 13, 55, 62
- quinolium-substituted 459
- reaction with 1,3-dicarbonyl compounds 74
- Rh-catalyzed addition to aldehydes and alkenes 73, 171
- Rh-catalyzed addition to imine derivatives 199
- Rh-catalyzed addition to ketones 199
- Rh-catalyzed addition to N-sulfonylimines 299
- Rh-catalyzed addition to 2-oxanorbornenes 190
- Rh-catalyzed addition with enones and enals 171
- Rh-catalyzed asymmetric conjugate addition-aldol 191
- Rh-catalyzed hydroarylation of alkynes 192
- Rh-catalyzed reaction with anhydrides 201
- saccharide binding with cis-diols 455
- salicylhydroxamic acid adducts 25
- spiropyran-conjugated 464
- stability to dilute acids 62
- substituent effect on acidity 9,
- Suzuki coupling 69, 124
- transformation into arylthallium derivatives 63
- transmetallation with copper 232
- Wang-resin supported 296
- zinc-promoted addition to aldehydes 74
- arylboronic acids, electron-poor
 - catalyst in amidation of carboxylic acids 382
 - catalyst in reactions of carboxylic acids 387, 388
 - preparation of BLA catalysts 393
 - preparation of chiral OXB catalysts 402
- arylbaboronic esters (boronates)
 - as chiral Lewis acid catalysts 389
 - as weak internal Lewis acid 399
 - carbocyclization, Rh-catalyzed 115, 188
 - catalyst in enantioselective Diels-Alder reaction 389, 399
 - catalyst in enantioselective ketone reduction 406
 - Cu-promoted coupling with phenols and amines 224
 - *N,N,N',N'*-tetramethyltartaric acid diamide-derived 407
 - Pd-catalyzed cross-coupling reactions 115
 - preparation 28–36
 - preparation by *ortho* lithiation/in situ boration 125
 - promoter of enantioselective cyclopropanation 407
 - Ru-catalyzed *ortho*-arylation of aromatic ketones 74
 - tartaric acid-derived 406
- arylborexines, Rh-catalyzed addition to N-sulfonylimines 300
- arylchlorides, Suzuki coupling 71, 148
- aryldichloroboranes, as asymmetric catalysts 397
- arylmatal intermediates, trapping with borates 28
- O-aryloxyamines, preparation using boronic acids 209
- arylpiperidazinones, preparation by Suzuki coupling 134
- aryltrifluoroborate salts 27, 130f
 - Petasis borono-mannich reaction 298
 - Suzuki coupling 27, 131
- β -arylvinyliamminium salts, preparation by Suzuki coupling 158
- asymmetric cyclopropanation, of allylic alcohols 77, 407
- asymmetric hydroboration 48, 63, 65
- asymmetric reduction
 - of prochiral ketimines 25, 411, 430
 - of prochiral ketones 25, 411
- asymmetric Suzuki coupling, atropisomeric biaryls 143
- asymmetric synthesis, with (α -haloalkyl)boronic esters 305
- azaborolidines 23

- α -azido ketones, OXB-catalyzed reduction 426
- azides, reaction with alkylchloroboranes 65, 332
- azido substituents, in Matteson homologation 331
- α -azidoacetophenones, OXB-catalyzed reduction 426
- (α -azidoalkyl)boronic esters, in Matteson homologation 331f, 332
- azobenzene boronic acid, colorimetric detection of saccharides 462
- azomethyne ylides, dipolar cycloaddition with alkenylboronates 366
- azulene oligomers/polymers, preparation by Suzuki coupling 128
- b**
- B_2cat_2 23
- B_2neop_2 47
- B_2pin_2 (see bis(pinacolato)diboron)
- baclofen, preparation using boronic acid 181
- Barton radical chain 347
- B-B bond energy 108
- 9-Borabicyclononane (9-BBN) 43
- B-C π -bonding 6
 - in α -boryl radicals 337
- B-C conjugation, in boronyl-substituted carbanions 52
- BCl_3 , reaction with boronic esters 26
- (benzamidomethyl)boronic acid, preparation 329
- benzene, borylation with B_2pin_2 109
- benzenediboronic acids, preparation 36
- benzhydrols, preparation by OXB-catalyzed reduction 416
- benzoboroxole 25
- benzodioxaboroles, as sterilants of house flies 82
- benzodiazaboroles 23 f
 - as sterilants of house flies 82
 - partial aromatic character 24
- benzodioxaborinanes, thermolysis 76
- 1,3,2-benzodioxaborole (catecholborane) 23
- benzophenoneboronic acid, in photoaffinity labeling 85
- 1,4-Benzoquinones, in OXB-catalyzed Diels-Alder reaction 397
- benzopyrans, by Suzuki coupling 138
- N*-benzylimine derivatives, reaction with allylboronates 264
- benzylamine derivatives, preparation by OXB reduction 432
- benzylic boronic esters 109, 118
 - preparation by TM-catalyzed borylation 118
- benzylboronic acid 62
- benzylic C-H borylation 118
- $BF_3 \cdot Et_2O$, in the borono-mannich reaction 298
- biaryl compounds 69
 - chiral, preparation 143
 - enantioselective preparation by OXB reduction 429
 - importance in many areas 124, 159
 - preparation by arene borylation/cross-coupling 115
 - preparation by Suzuki coupling 69, 159, 164
- biaryl esters, preparation using boronic acids 206
- biaryl ethers, preparation using boronic acids 73, 207
- biaryl lactones, OXB-catalyzed reduction 429
- bicyclic annelated tetrahydropyrans 267
- binap, ligand, in Rh-catalyzed additions of boronic acids 172, 179, 191, 197
- 1,1'-binaphthol-based diphosphinite 174, 184
 - ligand in Rh-catalyzed additions of boronic acids 184
- binaphthyl derived boronic acid 451
 - chiral recognition of saccharides and sugar acids 451
 - structure of complexes with sugars in aqueous solutions 451
- binaphthyl-derived diboronic acid, sensor for saccharides 460
- binaphthyl-dichloroboranes, preparation 398
- binding constants, boronic acid-diol 22
- biosensors, for saccharides 460
- biphasic amidation, with 3,5- $(C_{10}F_{21})_2C_6H_3B(OH)_2$ 386
- biphenylphosphine Pd ligands, in Suzuki coupling 70 f, 142
- bipyridine, component of boronic acid saccharide sensors 457
- bipyridine ligands 111
- bipyridinyliron (II) boronic acid, electrochemical sensor for saccharides 467
- bipyridyl-based diphosphine 174
- bis(allylboronates) 247
- bis(diisopropylamino)boron chloride 33

- 1,4-bis(diphenylphosphino)butane (dppb)
171
– Rh-catalyzed additions with boronic acids
171
- 3,5-bis(fluoroalkyl)phenylboronic acid (3,5-
(C₁₀F₂₁)₂C₆H₃B(OH)₂) 385 f
– catalyst in amide condensation 386
– fluorous amidation 385
- bis(octaethyldiphosphaferrocene) Pd(0)
complex 144
- bis(pentafluorophenyl)boronic acid
(C₆F₅)₂BOH 380
- bis(phosphinite) ligands, in Suzuki coupling
146
- bis(pinacolato)diboron (B₂pin₂) 24 f, 35,
38, 44, 47, 102, 106 f, 111
– in
– aliphatic CH borylation 106
– benzylic CH borylation 118
– direct borylation of arenes 35, 109
– Pt(0)-catalyzed diboration of alkynyl-
boronates 174
– Rh-catalyzed conjugate addition to α , β -
unsaturated ketones 174
- 3,5-bis(trifluoromethyl)phenylboronic acid
(3,5-(CF₃)₂C₆H₃B(OH)₂) 377, 395
– BLA catalysts 393
– catalyst in amidation of carboxylic acids
with amines 382
– chiral OXB catalysts 402
– direct polycondensation with 2-imidazoli-
done 388
– HOREO₃ complex, one-pot synthesis of
nitriles 388
- BLA catalysts 392 ff
– enantioselective Diels-Alder reactions
392–394
– preparation from chiral triol and 3,5-
(CF₃)₂C₆H₃B(OH)₂ 394
- ¹¹BNMR 61
- B-N bond interaction, in o-aminoalkyl aryl-
boronic acids 503
- borane reagents, in OXB-catalyzed reduction
414
- borane-dimethyl sulfide (BMS), hydride
source in OXB reductions 414
- boranes 1
- borane-THF (BH₃·THF), hydride source in
OXB reductions 414
- borate esters, BLA catalysts in Diels-Alder
reactions 392
- borax 1
- boric acid 1, 8 f
– acidity of 9
– low toxicity 8
- borinic acids, as catalysts in organic synthe-
sis 377
- borinic esters
– as side product of Matteson homologation
308
– electrophilic amination 65
– facile air oxidation 308
- boro-L-arginine derivatives, inhibition of ni-
tric oxide synthase 493
- boroles 3
- (α -boroalkyl)boronates, conversion into zin-
cated derivatives 339
- α -bromoalkylboronate 347
– by radical addition of bromotrichloro-
methane 347
- boron
– biomimicry design 481
– isotopic pattern 61
- boron (¹¹B) 61
– spin state (3/2) 61
– quadrupole moment 61
- boron enolates 322, 379
– generation by Si-B exchange with
Ph₂BOH 379
– synthesis of stegobinone 322
- boron halides, in transmetalation of allyltin
compounds 244
- boron heterocycles 23
- boron neutron capture therapy (BNCT) 82,
347, 482, 461, 499
- boron trichloride 18, 26, 44
– in cleavage of pinanediol boronates 18,
26, 334
– in transmetalation of aryl silanes/stan-
nanes 34
- boron(III) compounds, Lewis acidic charac-
ter 377
- boronate activation, with Lewis acids 258
- boronate anion
– intermediacy in Petasis reaction 283
– structure 8
- boronate group
– alpha effect 5
– electron-withdrawing behavior 7
– inductive effect 5
– weak stabilizing effect 52
- α -boronyl radicals 348
– structures and energetics by DFT meth-
ods 348
- boron-dipyrromethene (BODIPY), sensor
for saccharides 447
- boronic acid azo dyes 461, 464

- effect of substituents on saccharide binding 464
- use in BNCT 461
- use for D-glucose monitoring 461
- boronic acid based assays for saccharide detection 23, 468
- boronic acid derivatives 14, 62, 76, 297
 - additions to C=N compounds 279
 - additions to N-acyliminium ions 297
 - metallation 62
 - reaction promoters and catalysts 76
- boronic acid supports 79
 - derivatization and purification of diols, sugars, and proteins 79
- boronic acids (esters)
 - additions to imines and iminiums 72
 - advantages for biological applications 481
 - advantages vs other organometallics 201, 372
 - amination 65
 - amine complexes 11
 - amine interaction in saccharide sensors 462
 - amino acid complexes 24
 - amphiphilic character 8, 57
 - (α -amidoalkyl) 331
 - analogue of alanine and phenylalanine 330
 - anthracenyl-derived 446
 - apparent stability constant (K_{app}) with diols 443
 - as
 - antimicrobial agents and enzyme inhibitors 81
 - antifungal agents 82
 - bidirectional enzyme inhibitors 488
 - BNCT agents 82, 481, 499
 - carriers for monosaccharides 83
 - catalysts in organic synthesis 76, 377
 - CEST contrast agents 474
 - colorimetric diagnostic tests for D-glucose 461
 - ditopic fluorescence sensors for charged saccharides 457
 - drug (insulin) delivery devices 500
 - enzyme inhibitors 81, 481, 484
 - inhibitors of arginase and NO synthase 347, 490
 - inhibitors of glycosidases 493
 - inhibitors of HIV protease 494
 - lectin mimics 481
 - nucleoside derivatives 494, 499
 - polymeric complex sensitive to glucose 501
 - protease inhibitors 81, 484
 - protecting groups for diols and diamines 78
 - purine analogues 25
 - receptors and sensors for saccharides 81, 441
 - receptor for α -glucopyranose 460
 - saccharide sensors based on fluorescence 44
 - thrombin inhibitors 488
 - transition state analogs of hydrolytic enzymes 482, 484
 - transmembrane transporters 83, 481, 484
 - atmospheric oxidation 7, 13
 - autoxidation 7, 13
 - B-C/B-O bond metatheses 13
 - B-C bond energy 4
 - B-C bond length 4
 - B-C pi-conjugation 5
 - binding constants with diols 22
 - binding equilibria with diols and sugars 21, 443
 - binding selectivity towards saccharides 442
 - bioactivity measurements 9
 - biological and medicinal applications 481
 - bipyridine-derived 457
 - B-O bond lengths 4
 - B-O conjugation 5
 - BODIPY-derived 446
 - boronate formation with cis-diols of saccharides 442
 - bromo-boronolactonization of olefins 76
 - Brønsted acidity 8, 10
 - chalcone-derived 446
 - characterization 7, 57
 - chemical stability 13
 - chemoselective transformations 50
 - chromatography 57
 - combustion analysis 61
 - compatibility with hydrogenation
 - compatibility with oxidative methods 50
 - compatibility with reductive methods 51
 - component of azo-dye sensors for saccharides 463
 - component of displacement assay for saccharides 23, 468, 470
 - component of biosensor for oligosaccharides 460

- component of electrochemical sensors for saccharides 467
- components of chiral Lewis acids 77
- component of non-azo dye sensors for saccharides 466
- component of polymer and surface sensors for saccharides 471
- conjugate with a EuDOTA-tetraamide ligand 502
- conversion into anionic tetrahedral boronate 481
- coordination with Lewis bases 10, 443
- coordination of water or hydroxide ions 9
- Cu-catalyzed coupling with O- and N-functionalities 73, 205
- crown-ether containing 457
- cyclic thiourea-based 499
- diethanolamine adducts 5, 59
- diol (sugar) equilibrium in water 21
- disproportionation, stability to 7, 12
- dissociation in water (pKa) 9, 444
- electronegativity differences 6
- electronic effects on saccharide binding 454
- enhanced acidity of cyclic boronates 443
- extended hydrogen-bonded network 4
- ferrocene-substituted 464, 467
- first preparation of 1
- fluorescent 505
- fluorescent sensors for saccharides 458
- fluoroalkyl-tagged 60
- formation of complexes with buffer components 23, 443, 470
- for protein immobilization 481
- GC-MS, ortho substituent analysis 61
- guanidinium-containing 458
- handling 7
- heats of reaction 13
- Heck-type coupling to alkenes and alkynes 73
- heteroarene-heteroarene Cu-promoted cross-coupling 220
- heterocyclic 3
- hydration 443
- iminodiacetic acid derivatives 17
- immobilization with DEAM-PS 59
- immobilization with diol resins 60
- in
 - bioconjugation and protein labeling 84, 481
 - biomimicry desing 481
 - resin-to-resin transfer reactions (RRTR) 59
 - Suzuki coupling 68, 123
 - the recognition of cell surface saccharides 503
- indirect proton transfer 9
- ionization equilibrium in water 8
- IR spectroscopy 62
- isolation 57
- isolation from aqueous work-up 32
- Lewis acidity 8, 21, 481
- ligand exchange with 13
- long-term preservation 7
- low toxicity 8
- macrocyclic peptidyl derivatives 490
- mass spectrometric analysis 61
- measurement of binding constants with saccharides 482
- melting points 61
- mono vs diboronic acids as saccharide sensors 448
- monosaccharide complexes 21
- naphthalene-substituted 446
- Ni-catalyzed coupling with alkynes and imines 75, 301
- NMR spectroscopy, ¹¹B chemical shifts 61
- nomenclature 2
- oligosaccharide detection and sensing 81, 444
- ortho-anilide derivatives 25
- oxazaborolidine derivatives 411
- oxidation 13, 63
- Pd-catalyzed three-component reaction 75
- peptidyl 484
- pKa 9, 444
- pharmaceutical applications 331
- 1,2-phenylenediamine adducts 24
- physical properties 7
- polar character 8, 57
- polyol complexes 9, 21
- porous solids 4
- preparation 28–49, 101
- preparation from trialkylboranes 27
- presence in certain food 484
- protolytic deboronation 14
- quantitative binding constant with sugars in water 442
- quartz crystal microbalance (QCM) sensors 474
- 8-quinolinyl 505
- reactivity 2
- recrystallization 57, 61
- resorcinol-derived 465

- reversible boronate formation with vicinal diols 21, 442, 482, 500
- Rh-catalyzed addition to α,β -unsaturated esters 181
- Rh-catalyzed additions to α,β -unsaturated ketones 171
- Rh-catalyzed additions to aldehydes and alkenes 73, 171
- Rh-catalyzed additions to N-sulfonylimines 299
- saccharide binding, requirement for a cis-1,2-diol 455
- safety considerations 8
- secondary interactions in saccharide binding 445
- shelf-stability 7
- slow oxidation into boric acid 8
- solid supports for immobilization 58
- solubility 8, 57
- sources 1, 305
- spiropyran-conjugated 464
- stability in organic acids 14
- stability to oxygen and moisture 1, 13, 172
- storage 7
- structure of complexes with sugars in aqueous solutions 21, 442
- structure 3, 8
- sub-types 2
- supramolecular assemblies 4
- ternary complex with serine protease 489
- tetracoordinated (tetrahedral) adducts 4, 8, 20f
- therapeutics 2
- toxicity and stability issues 8, 482
- transformation into trifluoroborate salts 27
- transmetallation to hydroxorhodium 179
- transmetallation with Ni(II) 301
- transmetallation with Pd(II) 69
- transmetallation with Rh(I) 300
- trigonal geometry 3
- use for in vivo glucose imaging by MRI 502
- UV spectroscopy 62
- vacant p orbital 1, 5, 8, 377
- X-ray crystal structure bound to thrombin 484
- boronic anhydrides 8, 15, 62
 - IR spectroscopy 62
- boronic esters
 - α,α -dimethyl substituted 326
 - amine complexes 10
 - amino and amido-substituted 328
 - angle strain 18, 21
 - annulation by enyne metathesis 369
 - as
 - chiral Lewis acid catalysts 389
 - enzyme inhibitors 493
 - masked boronic acids 14
 - promoter of enantioselective cyclopropanation 77, 407
 - protecting groups 15, 78
 - tartrate-derived catalysts in Diels-Alder reaction 392
 - tethers in intramolecular radical additions 337
 - bimolecular Lewis acid-base complexes 10
 - camphordiol-derived 18
 - catechol derived 17
 - chain extension with (dialkoxymethyl)lithium 336
 - chiral C₂-symmetrical 306
 - chiral OXB derivatives in Diels-Alder reaction 391
 - cleavage with NaIO₄ 19, 210
 - cyclobutyl-substituted 326
 - cyclopropyl-substituted 328, 350
 - DICHED derivatives 18, 319
 - fluoride complexation 12
 - formation from saccharides 16, 21, 442
 - formation from boronic acids, mechanism 22
 - halogen-substituted 315
 - hydrolysis and cleavage 18
 - hypercoordinated 6
 - in Petasis borono-mannich reaction 286
 - instability of direct acyl linkages 323
 - neighboring group effect 21
 - Lewis acidity 10
 - liquid state 15
 - oxidative amination 26, 65
 - pinacol derived 18
 - pinanediol derived 18
 - preparation 28–49
 - preparation by transesterification of smaller esters 16
 - preparation from trialkylboranes 16, 28
 - protection as dialkoxylamine adducts 346
 - rearrangement of α -acyl derivatives 323
 - replacement in (α -chloroalkyl)boronates 334
 - Rh-catalyzed additions to N-sulfonylimines 299

- silica gel chromatography 18
- stoichiometric formation 16
- tartrate derived 17
- thermodynamic hydrolysis 19
- *trans*-1,4-dimethoxy-1,1,4,4-tetraphenyl-2,3-butanediol 18
- transesterification with diethanolamine 21
- transformation into monoalkylboranes 26
- transformation into dichlorides 26
- two-phase transesterification 19
- water complexation 18, 20 f
- boronic ester annulation 254
- boronic ester chemistry, brief history 305
- boronic ester derivatives, hemi-heterocyclic 25
- boronic ester hydrolysis, entropic and thermodynamic factors 20
- borono-*N*-methylpyridinium iodides, amidation catalysts 387
- 1-borono-2,3-butadienes, in [4+2] cycloadditions 253, 356
- 3-boronoacrolein pinacolate, in [4+2] cycloaddition/allylboration 266, 361
- 2-(2-boronobenzyl)benzimidazole, catalyst for etherification 76, 382
- (*S*)-(2-boronoethyl)-L-cystein (BEC), arginase inhibitor 491
- 4-boronohydrasonodienes, heterodienes in [4+2] cycloadditions 266, 360
- boronolactins 505
 - recognition of cell surface saccharides 482, 503
- borono-mannich reaction 59, 73, 279
- 4-boronophenylalanine 82
 - dimerization 24
 - preparation 35, 50
- 1,1-boronozircono-alkanes and alkenes 370
- boron-tethered radical cyclizations 349
- boron-to-copper transmetallation 47
- boron-to-oxygen migration 64
- N*-boronyl 2-pyrazoline, from a 1,3-migration of boron 363
- 3-boronyl allylborane reagent 271
- boronyl group, protection as diethanolamine ester 55
- 2-boronylbutadiene 54
- 3-boronylpropenoic acid derivatives, in Diels-Alder reactions 354
- α -boronyl-substituted carbanions and radicals 51, 53
- boropeptides 61
- boroxines 1, 11, 15, 158, 174, 208, 224, 395
 - amine complexes 11
 - as reaction substrates 15
 - autoxidation 15
 - BLA-catalyzed Diels-Alder reaction 395
 - Cu-promoted couplings with phenols and amines 208, 224
 - distribution of oligomeric anhydrides in water 395
 - equilibrium formation in water 15
 - from acetylenic aldehydes 395
 - formation, entropic drive 15
 - formation in gas phase 61
 - in Suzuki coupling 158
 - preparation by dehydration of boronic acids 15
 - structure 15
 - thermodynamic parameters 15
- bortezomib – see Velcade
- borylcopper reagents (CuBpin) 47
 - preparation of allylboronates 250
- β -boryl ketones 174
- α -boryl radicals, synthetic applications 337
- borylations with diboronyl reagents 24, 101
 - of
 - allylic acetates 249, 271
 - alkenylhalides and triflates 42, 103
 - aromatic halides and triflates 35, 102
 - mechanism and reaction conditions 102
 - microwave activation 102
- borylations with pinacolborane 104
- borylcyclobutane 326
- borylmethylzinc reagent, preparation of allylboronates 249
- bpfa 174
- bromination 55, 66, 344
 - of
 - alkenyl boronic acids (esters) 66, 344
 - arylboronic acids (esters) 55, 66
 - N*-bromo- and *N*-iodosuccinimides 66
 - 2-bromo(chloro) acetophenone, OXB-catalyzed reduction 418
 - 2-bromoacrolein, in Diels-Alder reaction 390
 - (*Z*)-1-bromo-alkenyldibromoboranes 44
 - (α -bromoalkyl)boronic esters 48, 54
 - dehalodeboration 316
 - preparation from α -zirconated derivative 371
 - reaction with alkoxides 318
 - reaction with azide ion 331
 - reaction with sodium trityloxide 319
 - reduction with KDB (*o*-iPr)₃ 319

- bromoboration, of 1-butyne 314
- bromodeboronation 67
- 2-bromoethaneboronic acid, debromoboration 50, 316
- (bromomethyl)boronic esters 48, 54
 - preparation from dibromomethane 315
 - reaction with sodium trityloxiide 319
 - reaction with tert-butyl lithioacetate 324
- (bromomethyl)phenylboronic acids, preparation 50
- bromotrichloromethane, radical addition to dibutyl vinylboronate 347
- Brønsted acid-assisted chiral Lewis acids (BLA) 392
- B-Si exchange, in Mukaiyama aldol catalyzed by Ph₂BOH 379
- Buchwald-Hartwig N- and C-arylation chemistry 233
- butadienes, preparation of allylboronates 246
- (2-butadienyl)boronates, preparation by enyne metathesis 46, 254
- butadienylboronic esters, polysubstituted 46
- c**
- CAB-catalyzed allylsilation of aldehydes 406
- cyclopropylboronates, preparation from alkenylboronic esters 350
- Cadogan reaction, compared to Suzuki reaction 125
- calixarene-derived diboronic acid, as saccharide sensor 451
- camphordiols allylboronates 72, 259, 261
 - Sc(OTf)₃ catalyzed additions to aldehydes 72, 261
- carbanions, boronyl-substituted 51
- carbene ligands, in Suzuki coupling 71, 145
- carbohydrates
 - enzymatic detection 441
 - immobilization with polystyryl boronic acid 80
 - Petasis reaction 291
 - protection with boronic acids 78
 - recognition and sensing, with boronic acids 81, 441
- carbon-centered nucleophiles, additions to C=N compounds 279
- carbonyl compounds
 - α-boryl substituted 323
 - allylation 71
 - Rh-catalyzed addition with boronic acids 171
- carbonyl substituents, in Matteson homologation 323
- 4-carboxy-3-nitrophenylboronic acid, pKa 444
- 2-carboxyester allylboronates
 - preparation from alkenylcopper reagents 245
 - synthesis of gamma-lactones 257
- carboxylic acids, amidation catalyzed by boronic acids 76, 383
- carboxylic ester, β-boryl substituted 323
- p-carboxyphenylboronic acid 13, 59
 - immobilization with DEAMPS 59
- carboxy-substituted arylboronic acids, via permanganate oxidation 50
- catalysts and ligands, for Suzuki coupling 71
- catalytic cycle
 - aromatic CH borylation with dialkoxyboranes 116
 - OXB-catalyzed ketone reduction 415
- catechol 15
- catechol boronic esters
 - Lewis acidity 18
 - quaternization with CsF 358
- catechols, analysis/separation using boronic acid supports 80
- catecholamines, analysis/separation using boronic acid supports 80
- catecholborane 17, 23 f, 44, 48, 116, 174
 - hydride source in OXB-catalyzed reductions 414
- catecholamine transport 83
- cedranediolborane, coupling with aryl halides (triflates) 35
- cell surface carbohydrates, recognition with boronic acids 503
- cesium carbonate, in Rh-catalyzed conjugate addition 181
- cesium fluoroxysulfate (CsSO₄F) 66
- 3,3'-(CF₃)₂-BINOL allylboronate 263
- C-H borylation of hydrocarbons
 - catalytic cycle 102
 - preparation of boronic acids (esters) 35
 - regioselectivity 35
 - with B₂pin₂ 102
 - with pinacolborane 102
- chalcone boronic acids, as saccharide sensor 447
- chiral (acyloxy)borane (CAB) complexes 77
 - in

- enantioselective Diels-Alder reaction 389, 390, 399
- enantioselective Sakurai-Hosomi allylation 405
 - with bulky arylboronic acids 399
- chiral α -chloroallylboronates, addition to aldehydes 262
- chiral 1,3-dienylboronates 360
- chiral alkenylboronates, in [4+2] cycloadditions 355
- α -chiral alkylboronates, oxidation 63
- α -chiral (C-chiral) allylboronates 71
 - addition to aldehydes 271
 - catalytic enantioselective preparation 267
 - preparation by Johnson-Claisen rearrangement 252
 - synthesis of complex natural products 261
- chiral allylboronates 254 f, 259 f
 - by
 - desymmetrization of prochiral alcohols 255
 - kinetic resolution of allylic alcohols 254
 - stereoselective addition to aldehydes 259
- chiral amidophosphanes, in Rh-catalyzed additions 300
- chiral amines, in Petasis reaction 289
- chiral benzodiazepine drug, by OXB-catalyzed reduction 434
- chiral biaryls
 - configurational stability 143
 - preparation by Suzuki coupling 143
- chiral boron enolates 190
- chiral boronic esters 16
 - in Petasis reaction 289
 - neighboring group participation 76
 - reduction of ketones 76
- chiral diazaborolidine salts, in enantioselective protonation 77
- chiral drugs, preparation by OXB-catalyzed reductions 419
- chiral ligands, in Rh-catalyzed conjugate additions 174, 190
- chiral oxazaborolidines (OXB) 77
- chiral salen-Co(II) diboronic acid, recognition of saccharides 465
- chiral titanium catalyst, Diels-Alder reaction of alkenylboronates 354
- chiral vinylidioxazaborocine, nitrene cycloadditions 366
- chiraphos 174
- circular dichroism (CD) spectroscopy, to monitor saccharide binding 465
- chiro*-inositol 17
- chloridazon, [5-amino-4-chloro-2-phenyl-3(2*H*)-pyridazinone] 132
- chloroanisoles, in Suzuki coupling 124
- α -chloro-(*E*)-crotylboronate 251, 372
 - by rearrangement of γ -silyloxyvinylboronate 372
 - preparation by allylic chlorination 251
- chloroalkanols, hydrolysis catalyzed by boronic acid 381
- (α -chloroalkyl)boronic esters 54, 334 f, 338, 371
 - conversion into a (α -chloroalkyl)dichloroborane 335
 - conversion into α -alkyl allylboronates 245
 - optically pure 54, 245
 - oxidation to carboxylic acid 332
 - preparation using Matteson asymmetric homologation 306
 - reaction with alkoxide nucleophiles 317
 - reaction with chiral α -lithioalkylether 339
 - reaction with chromous chloride and acrylate ester 338
 - reaction with silicon tetrachloride 335
 - reaction with lithiohexamethyldisilazane 329
 - replacement of boronate group 334
- (α -chloro)allylboronates
 - as precursors of other α -chiral allylboronates 261
 - enantioselective additions to aldehydes 262
 - preparation from dichloromethylboronic esters 245
- chloroarenes, in Suzuki coupling 71, 139, 156
- chlorocinnoline, in Suzuki coupling 139
- chlorocoumarine, in Suzuki coupling 139
- chloroethanol, hydrolysis catalyzed by boronic acid 381
- chloroisoquinoline, in Suzuki coupling 139
- (chloromethyl)lithium,
 - from chloriodomethane and butyllithium 314
 - in the preparation of allylboronates 251
- (α -chloromethyl)boronic esters 48, 54
 - in the preparation of allylboronates 244
 - preparation from (chloromethyl)lithium 48, 315

- (3-chloroprop-1-enyl)boronates, reaction with Grignard reagents 345
- chloropurines, in Suzuki coupling 139, 140
- chloropyridazines, in Suzuki coupling 139
- chloropyridines, in Suzuki coupling 139
- chloropyrimidines, in Suzuki coupling 139
- chloroquinazoline, in Suzuki coupling 139
- chloroquinoline, in Suzuki coupling 139
- N-chlorosuccinimide 66
- chlorosulfonyl arylboronic acids, preparation 55
- chlorothiophenes, in Suzuki coupling 139
- chlorotriazines, in Suzuki coupling 139
- cholanyl 3-pyridiniumboronic acid 83
- 2*H*-chromenes, preparation by Petasis reaction 292
- chromium(III) chiral complex, in Diels-Alder reaction 361
- 4-chromnone, OXB-catalyzed reduction 417
- chymotrypsin 328 f, 485
 - inhibition by boronic acids 329, 485
 - inhibition by ternary boronic acid complex 489
- cis*-2,2-diboronylalkenes 47
- cis*-alkenylboronic acids 45
- clerodin, Diels-Alder/allylboration approach 257
- cobalt catalysts, in Diels-Alder reaction of alkynylboronates 356
- colorimetric sensors for saccharides 461, 464
- combinatorial chemistry 17, 153, 213
 - using Suzuki coupling 153
 - using the Petasis reaction 288
- concanavalin A (ConA), semi-synthetic biosensor for oligosaccharides 460
- conducting polymers 124
- copper(I) oxide, co-catalyst in Suzuki coupling 164
- copper(II) acetate, in C–O coupling of boronic acids 73, 207
- copper catalyst, in allylboration of ketones 264
- copper-promoted C-heteroatom coupling of boronic acid derivatives 73, 205 ff
 - advantages and disadvantages 205, 233
 - application in pharmaceutical and crop protection 234
 - applications in solid-phase synthesis 214
 - catalytic $[\text{Cu}(\text{OH})\text{TMEDA}]_2\text{Cl}_2$ conditions 217
 - catalytic conditions 222, 226
 - catalytic cycle 230
 - catalytic variant for N-arylation 212
 - compared to Barton's bismuth arylation 206
 - compared to Buchwald-Hartwig N-arylation 215, 233
 - comparison to Ullmann coupling 205, 233
 - competing processes 231
 - competing phenol formation 231
 - competing protodeboration 211, 231
 - competition between C–O and C–N coupling 221
 - C–S cross-coupling 224
 - effect
 - of adventitious water 231
 - of base 229
 - of ligand 229
 - of molecular sieves 205, 221
 - of oxygen 205
 - ether formation as side reaction 210
 - electronic effects 227
 - historical background 73, 206
 - homocoupling as competing process 231
 - intramolecular variant for biaryl ethers 210
 - involvement of Cu (II) species 231
 - mechanistic considerations 227, 230
 - microwave-assisted 215, 224
 - of carboxylate-containing substrates 216
 - $\text{PhB}(\text{OH})_2$ vs PhBF_3K 226
 - preparation of factor Xa inhibitors 217
 - preparation of fungicidal biaryl ethers 208
 - S-arylation 224
 - synthesis of natural products 73, 208
 - synthesis of chloropeptin 210
 - rate-limiting step 227
 - role of amine base 213
 - role of boroxine equilibrium 225
 - scope of copper source 205
 - solubility of the Cu(II) salt 228
 - solvent effects 228
 - use of molecular sieves 231
 - use of other organometalloids 233
 - using DMAP as base 211
 - using solid-supported Cu catalyst 214
 - with
 - 2-mercaptopyridine 224
 - aliphatic amines 226, 237
 - aliphatic primary and secondary alcohols 226
 - alkenylboronic acids 222

- alkylboronic acids 227
 - amides 236
 - amino acids 237
 - amino-substituted heterocycles 212
 - anilines 212, 217, 221, 237
 - benzimidazole 228
 - boronic esters 224
 - boroxines 224
 - heteroarenes 235
 - heterocyclic boronic acid 220
 - imidazoles 215, 217
 - imides 236
 - indoles 215
 - N-hydroxybenzotriazole 210
 - N-hydroxyphthalinimide 207
 - nucleosides 219
 - phenols 207, 236
 - phenylalanine 216
 - phthalimides 227
 - purines 219
 - pyrazoles 215, 217
 - pyrroles 215
 - sulfonamides 217, 236
 - tetrazoles 215
 - triazoles 215
 - trifluoroborate salts 224, 226
 - tri-vinylboroxine-pyridine 223
 - ureas 236
 - coumarine boronic acid, saccharide sensor 447
 - coumarins, by Suzuki coupling 166
 - $\text{Cp}^*\text{Re}(\text{CO})_3$, in photochemical CH borylation 106
 - $\text{Cp}^*\text{Rh}(\eta^4\text{-C}_6\text{Me}_6)$
 - in aliphatic CH borylation 107
 - in direct borylation of arenes 109
 - m*-CPBA 27
 - Cr-mediated benzannulation, for quinone boronic esters 368
 - crotylboronates
 - addition to imines 265
 - addition to ketones 263
 - camphordiol-substituted 261
 - addition to aldehydes, diastereoselectivity 257
 - diisopropyl tartrate (DIPT) derivatives 243
 - preparation from crotylpotassium 243
 - stability to borotropic rearrangement 242
 - crown ethers, components of saccharide sensors 457
 - CsF, base in Suzuki coupling 143
 - Curtis rearrangement 54
 - with β -boronyl carboxylates 354
 - cyanine diboronic acid, saccharide sensor 459
 - 4-cyano-(α -chloroalkyl)boronic ester, cyclization 325
 - cyanoboronation of alkynes 48
 - cyclic 1,3-dienylboronic esters
 - in Diels-Alder reaction 363, 368
 - preparation by enyne metathesis 368
 - [3+2] cycloaddition, of alkenylboronic esters 367
 - [4+2] cycloaddition, of alkenylboronic esters 7, 351
 - cycloalkenones, [2+2] photocycloadditions with alkenylboronic esters 367
 - (cyclobutyl)boronic esters, asymmetric synthesis 326
 - β -cyclodextrin, component of saccharide sensor 459
 - cis*-1,2-cyclohexanediol 17
 - 1,2-cyclohexanediol 80
 - isomer separation with polystyrylboronic acid 80
 - cyclohexylboronic acid 227
 - 1,5-cyclooctadiene (cod), ligand in the Rh-catalyzed additions 179
 - cis*-1,2-cyclopentanediol 17
 - cyclopentanols, by oxidation of cyclopentylboronates 367
 - cyclophane atropisomers 126
 - cyclopropanation 350 f
 - of alkenylboronic esters 350
 - of dienylboronic esters using diazoalkanes 351
 - cyclopropanes, in organic synthesis 350
 - cyclopropanation, chiral boronate-promoted 77, 407
 - cyclopropylboronic esters 49, 328, 350 f
 - asymmetric synthesis 328
 - in cross coupling chemistry 351
 - oxidation to cyclopropanols 350
 - preparation by enantioselective hydroboration 49
 - cyclopropylboronic acids, in Suzuki coupling 71
 - L-cysteine, radical addition to vinylboronic esters 347
- d**
- Danishesky's diene, in CAB-catalyzed Diels-Alder reaction 399
 - dansyl-labeled arylboronic acid 85
 - DEAM-PS – see diethanolaminomethyl polystyrene 59

- deboronation 50, 329, 364
 - of (aminoalkyl)boronic esters 50, 329
 - of boronyl-substituted isoxazolines 364
- debromoboronation 50
- 6-deoxycastanospermine, synthesis using alkenylboronate 297
- DFT calculations, of α -boryl radicals 348
- di(isopropylprenyl)borane 44
- diabetes 441, 461
- diacetoxiodobenzene 64, 66
- diadamantyl-*n*-butylphosphane (BuPAD₂), ligand in Suzuki coupling 156
- dialkoxyamine alkenylboronate, chiral 346
- (dialkoxyethyl)lithium 336
- 3,3-dialkylallylboronates 250
- diamines, in Petasis reaction 286
- diaryl ethers, preparation from arylboronic acids 73, 207
- diaryl ketones, OXB-catalyzed reduction 416
- diarylboronic acids 377, 380, 394
 - chiral BLA catalysts for Diels-Alder reactions 394
 - catalyst for the Oppenauer oxidation 380
 - catalysts in Mukaiyama aldol 377
 - conversion into arylboronic acids 380
- diarylmethanol derivatives, preparation 198
- diazaborinanes 3
- diazaborines 82
 - as
 - estrogen mimic 82
 - enzyme inhibitors 82
 - prostaglandin mimetic 82
- diazaborolidines 3, 24
- diazo dye, component of boronic acid sensor 462
- diazoalkanes, dipolar cycloaddition with alkenylboronic esters 363
- diboration 47
 - of alkynes 47
 - of allenes 47
 - of symmetrical dienes 247
- diboronic acids 36
 - anthracene-derived 452
 - allosteric saccharide sensor 453
 - as fluorescence sensor for saccharides 459
 - as modular sensor for saccharides 453, 455
 - as PET fluorescent sensors 452
 - as sensors/receptors for saccharides 85, 448, 462
 - binaphthyl derived 452, 460
 - binding selectivity for monosaccharides 450
 - binding selectivity to D-glucose 453
 - bipyridine-derived 452, 458
 - calixarene-derived 452
 - conjugated with a EuDOTA-tetraamide 502
 - crown-ether containing 452
 - cyanine-derived 459
 - effect of fluorophore on saccharide binding 454
 - effect of spacer and substituents on saccharide binding 453
 - in recognition of cell surface saccharides 85, 503
 - mixed phenanthrene-pyrene saccharide sensor 456
 - modular solid-phase synthesis 454
 - preparation 36
 - saccharide binding vs monoboronic acid 454, 456
 - square derived 450
 - stilbene-derived 459
 - structure of sugar complexes in water 451
 - use for in vivo glucose imaging by MRI 502
 - alkaline phosphatase conjugate 84
 - as receptor for α -glucopyranose 460
 - component of assay for D-glucose 472
 - in dye displacement assay for saccharides 471
 - azobenzene derived 462
 - chiral recognition of saccharides 465
 - comprising a Re(I) complex 465
 - cross-coupling with aryl halides (triflates) 35
 - ferrocene-substituted 467
 - for agglutination of erythrocytes 85
 - porphyrin-derived 460
 - pyridinium-derived 460
 - viologen derived 470
- diboronyl esters (reagents) 24, 35, 47, 102, 265
 - cross-coupling with aryl halides (triflates) 35
 - preparation of allylboronates 265
 - preparation of arylboronic acids (esters) 35, 102
- diborylation of dienes, to give allylboronates 270
- 1,3-dibromo-5,5-dimethylhydantoin (DB-DMH) 66
- dibromoborane 44

- dibutyl acetyleneboronate 48
dibutyl ethyleneboronate 37
- bromination 343
 - cycloaddition with ethyl diazoalkanes 363
 - Diels-Alder reaction 351
- dicarbonyltitanocene 45
DICHED allylboronate, α -chloro 262
DICHED boronic esters 16, 19 f, 334
- basic hydrolysis 19
 - cleavage to amine haloborane 334
- (*R*)-DICHED ethylboronate, in Matteson homologation 320
dichloroalkylboranes 26, 44
- preparation by hydroboration 44, 326
 - electrophilic amination 65
 - reaction with pinacol 42
 - chiral catalyst in Diels-Alder reaction 390
 - intramolecular reaction with azides 334, 355
 - preparation from trifluoroborate salts 27, 334
 - as powerful chiral Lewis acids 397
- dichlorodicyanoquinone (DDQ), compatibility with alkylboronic esters 318
dichloromethylboron pinacolate (Cl_2CHBpin) 46
(dichloromethyl)lithium 54, 306
- effect of ZnCl_2 on boronate insertion 306
 - in Matteson homologation 54
 - reaction with boronic esters 306
- dichloromethylboronic esters, preparation of α -chloroallylboronates 245
(*R,R*)-1,2-dicyclohexyl-1,2-ethanediol [„(*R*)-DICHED“] 18, 319
- transesterification of pinacol boronates 319
- dicyclohexylborane 43
dicyclophane imidazolium carbene 174
Diels-Alder dimerization/allylboration 362
Diels-Alder reaction of 1,3-dienylboronic esters 253, 356
- asymmetric variants 359
 - boron-tethered variant 359
 - preparation of cyclohexenols 359
- Diels-Alder reaction 7, 351 ff, 360 f, 389 ff
- boron-tethered intramolecular variant 353
 - catalyzed by chiral boronate 389
 - catalyzed by chiral alkyldichloroborane 390
 - enantioselective, CAB-catalyzed 389
 - enantioselective, catalyzed by OXB 391
 - of
 - alkenylboronic esters 7, 351, 353 f, 355
 - alkynyl dibromoboranes 355
 - 1,2-bis(catecholboronyl)ethylene 352
 - 3-boronoacrolein as diene 361
 - dibutyl acetyleneboronate 355
 - dibutyl ethyleneboronate 352
 - 1,3-dienylborate fluoride salt 358
 - 1,3-dienylboronic esters 253, 356, 359, 361
 - heteroboronodienes 266, 360
 - propynals, catalyzed by BLA 396
 - semi-empirical and ab initio calculations 358
 - stereochemical induction with chiral dioxaborolane 392
 - tandem [4+2] cycloaddition/allylboration 266
- (*2R,3R*)-1,4-dimethoxy-1,1,4,4-tetraphenyl-2,3-butanediol 350
- as chiral director and protecting group for boronic esters 18, 55, 350
- dienyldiboronic esters 371
1,3-dienyl-2-boronic acid (ester) 369
- [4+2] cycloaddition with acrolein 361
 - isolation 361
 - preparation by enyne metathesis 369
 - propensity to dimerize 361
- 1,3-dienyl-1-boronic esters 254, 356 ff, 369
- boron-tethered Diels-Alder reaction 359
 - cyclopropanation with diazoalkanes 351
 - Diels-Alder reaction with an azo dienophile 259
 - fluoride salt 358
 - heterodienes in [4+2] cycloadditions 360
 - influence of ether substituents 358
 - in tandem [4+2] cycloaddition/allylboration 357
 - intramolecular Diels-Alder reaction 359
 - in [4+2] cycloadditions 253, 356
 - precursors of allylboronates 353, 357
 - preparation by ring-closing metathesis 369
 - sensitivity to hydrolysis 343
 - stability to air and moisture 343
 - 3-triethylsiloxy-substituted 358
 - tartrate derivatives, in Diels-Alder reaction 359
- diethanolamine boronic esters 3 f, 16 f, 17, 24, 59, 61, 334
- B-O bond strength 5
 - bond distances 5
 - for boronic acid protection 55

- formation 17
 - hydrolysis 17
 - hypervalent 5
 - melting points 61
 - $N^{\delta+}$ - $B^{\delta-}$ dipole 5
 - pentacoordinated 5
 - transannular B-N bridge 4, 17
 - diethanolaminomethyl polystyrene (DEAMP-PS) 59
 - in resin-to-resin Suzuki coupling 156
 - in Petasis reaction 295
 - difluoroboranes 298, 334
 - (*R*)-digm-binap 174
 - dihaloboranes 26, 48
 - oxidative amination 26
 - preparation from boronic esters 26
 - (dihalomethyl)lithium, reaction with boronic esters 305
 - 3,4-dihydronaphthalene-2-boronic acid, Petasis reaction 285
 - dihydropyrene derivatives, preparation using CAB catalyst 399
 - diisopinocampheylallylboranes 271
 - diisopinocampheylborane 43, 48, 65
 - diisopropyl (bromomethyl)boronate, preparation 48, 315
 - 1,2-diisopropyl-1,2-ethanediol (DIPED), in Matteson asymmetric homologation 312
 - diketones, OXB-catalyzed reduction 421
 - diketopiperazines, preparation using Petasis reaction 295
 - 1-*N,N*-dimethylamino-8-borononaphthalene 382
 - dimethylphenylsilyl(pinacolato)borane 44
 - (dimethylphenylsilyl)pinacolborane 247
 - diol immobilization, with boronic acid supports 79
 - 1,2-diol monosulfonates, preparation by OXB reduction 420
 - diols, binding equilibria with boronic acids 21, 443, 483
 - 1,2-diols, optically active by OXB reduction 421
 - diop 174
 - dioxaborinanes 3
 - dioxaborolanes 3
 - promoter of enantioselective cyclopropanation 407
 - tartrate-derived 392
 - dioxazaborocines, cycloaddition with nitrones 365
 - dioxene thermolysis 273
 - 1,3-dioxolanes, OXB-catalyzed cleavage 404
 - (*S*)-DIPED (*R*)-(α -bromoalkyl)boronate 324
 - reaction with tert-butyl lithiopropionate 324
 - DIPED (1-chloroethyl)boronate, in Matteson homologation 313
 - DIPED boronic esters, in Matteson asymmetric homologation 312
 - dipeptide amides, preparation using Petasis reaction 287
 - dipeptidyl peptidases, inhibition by boronic acids 485, 497
 - diphenylborinic acid, catalyst for Mukaiyama aldol 379
 - 1,3-dipolar cycloadditions, of alkenylboronic esters 363 f, 364, 365
 - direct Ir-cat-borylation of arenes with dialkoxyboranes 116
 - direct catalytic borylation of heteroarenes 112
 - directed ortho-metallation, preparation of arylboronic acids 33
 - disaccharides
 - pyranose to furanose isomerization 442
 - recognition by diboronic acid sensors 459, 461
 - disiamylborane 43
 - 3,3-disubstituted allylboronates 255, 269 f
 - 2,3-disubstituted thiophenes, preparation by Suzuki coupling 136
 - diversity-oriented organic synthesis 369
 - DMAP, base in Cu-promoted coupling of boronic acids 211
 - π - π interaction, in BLA-catalyzed Diels-Alder reaction 393
 - L-DOPA, analysis/separation using boronic acid supports 80
 - Dötz cycloaddition, of alkynylboronic esters 36
 - double allylation strategy, using allylboronates 271
 - DuPHOS 264
 - Dyes, boronic acid-containing 461
- e**
- elastase, inhibition with boronic acids 496
 - electrochemical sensors for saccharides 467
 - 6 π -electrocyclization 292
 - β -elimination, as side-reaction in Matteson homologation 308
 - elimination of α -haloboronic esters 316
 - α,β -enals, in BLA-catalyzed Diels-Alder reaction 393

enamines, preparation from alkenylboronic acids 222

ene-yne metathesis 46, 368

α,β -enones 378, 424

- OXB-catalyzed reduction 424
- formation by boronic acid catalyzed dehydration 378

enyne, Pd(PPh₃)₄-catalyzed catecholboration 45

enzyme inhibitors 82, 328

epothilone analogues 46

epoxides 27, 418, 420

- from 1-alkenyltrifluoroborate salts 27
- preparation by OXB-catalyzed reduction 418, 420

ethyl vinyl ether 266, 361

- hetero-Diels-Alder reaction 266, 361

ethylboronic acid 78

ethylene and (-1-propenyl) pinacol boronic esters 46

ethyleneboronic acid 37

ethylene boronic esters, as dienophiles 7

ethylene glycol arylboronic esters 33

ethynylbis(diisopropylamino)boranes 349

- radical additions to give alkenylboronic esters 349

α -exomethylene butyrolactones 257, 272

- preparation using 2-alkoxycarbonyl allylboronates 257, 272

f

factor I, inhibition using dipeptidyl boronic acids 487

factor Xa inhibitors, preparation using boronic acids 217

ferrocene boronic acid

- carbohydrate binding 464, 467

ferrocene diboronic acid 467

- as electrochemical sensor for saccharides 467

Fischer carbene complexes 36, 367

- Dötz annulation with alkenylboronic esters 36, 367

fluorescence energy transfer 456

- in saccharide sensing with boronic acids 456

fluorescence lifetime based sensors 451

- in saccharide sensing with boronic acids 451

fluorinated (α -aminoalkyl)boronic ester 337

fluoroarenes, preparation by Suzuki coupling 126

4-fluorophenylboroxine, Rh-catalyzed conjugate addition 183

fluorous biphasic technique, boronic acid-catalyzed amidation 383, 385

fluorous borane complex, hydride source in OXB reductions 414

fluorous boronates 60

FMO theory, Diels-Alder reaction of alkenylboronic esters 7, 352

formaldehyde, in Petasis reaction 298

2-formylphenylboronic acid 26, 134

- in Suzuki coupling 134

formylphenylboronic acids, preparation 50

D-fructose 22, 83, 441f, 448, 451, 468, 472, 505

- complexes with diboronic acids 448
- importance in biological systems 441
- pyranose to furanose isomerization 442
- recognition by boronic acid sensor 441, 451, 472
- recognition by 8-quinolineboronic acid 505
- transmembrane transport with boronic acids 83

functionalized ketones, OXB-catalyzed reduction 418

furans, TM-catalyzed borylation 111

1-furylboronic acid, Cu-promoted coupling with imidazole 220

2-furylboronic acid, in Petasis reaction 281, 284

g

D-galactose isomerization 442

β -galactosidase, inhibition with borono-aminosugars 493

gem-bis(borono)zinc reagent, (BrZn)₂CHB(O₂C₂Me₄) 339

gem-boronozirconocenes, preparation from 1-alkynylboronates 370

gem-dialkyl effect 272

D-glucarate, recognition by ditopic boronic acid sensor 458

D-glucosamine, recognition by ditopic boronic acid sensor 457

D-glucose

- complexation by boronic acid receptors/sensors 22, 81, 441
- control of blood sugar level 472
- enzymatic biosensors 467
- importance in biological systems 441
- insulin delivery with boronic acid polymer 500

- MRI with EuDOTA-tetraamide diboronic acid 502
 - physiological concentration 472
 - pyranose to furanose isomerization 442, 451, 460
 - recognition by diboronic acid sensors 448, 451
 - recognition using colorimetric boronic acid sensors 461
 - recognition using polyboronic acid sensors 472
 - selective recognition of α -pyranose form 460
 - D-glucose phosphates, recognition by tetra-boronic acid sensor 465
 - D-glucose-6-phosphate, selective recognition 468
 - D-glucuronic acid, recognition by ditopic boronic acid sensor 457 f
 - glutamic acid, preparation using Matteson homologation 332
 - glycosidase enzymes, inhibition with borono-iminosugars 493
 - C-glycoside, preparation using Rh-catalyzed addition of boronic acid 183
 - glycosides 22
 - glycosylated hemoglobin 84
 - analysis with boronic acid supports 80
 - glyoxylic acid, in Petasis reaction 284 f
 - goniodiol, synthesis using [4+2] cycloaddition/allylboration 361
 - Grignard reagents 305 f
 - in Matteson asymmetric homologation 306
 - preparation of boronic acids (esters) 28
 - Grubbs catalyst 46, 254, 268
 - in tandem alkene cross-metathesis/allylation 268
 - preparation of allylboronates 254, 268
 - guanidinium, component of boronic acid glucarate sensor 458
- h**
- Hafner's azulene synthesis 128
 - α -halo ketones, in OXB-catalyzed reductions 420 f, 421
 - (α -haloalkyl)boronic esters 48, 54, 305 f, 324 f, 333, 337 f
 - dehalodeboronation 316
 - displacement with $\text{LiN}(\text{SiMe}_3)_2$ 328
 - first synthesis using radical addition 306
 - halide displacement 54, 305
 - metallation 338
 - preparation by radical additions to alkenylboronic esters 337
 - preparation using Matteson asymmetric homologation 306
 - reaction with lithioacetonitrile 325
 - reaction with tert-butyl lithiopropionate 324
 - 1,2-rearrangement 54
 - haloetherification, of alkenylboronic esters 344
 - halogenation
 - of alkenylboronic acids (esters) 66
 - of arylboronic acids (esters) 66
 - halogenation and hydrohalogenation, of alkenylboronic esters 343
 - halogen-metal exchange, of (α -haloalkyl)boronic esters 53, 338
 - halohydrins, preparation by OXB-catalyzed reduction 418
 - α -halo-ketones, OXB-catalyzed reduction 418
 - halomethaneboronates, in preparation of allylboronates 244, 249
 - halophenols, in Suzuki coupling 160
 - halosuccinimides (NCS, NBS or NIS)
 - reaction with alkenylboronic acids 68, 344
 - Hantzsch process, preparation of thiazoles 137
 - Heck coupling 47, 73, 186
 - preparation of 2-substituted alkenylboronic acids (esters) 47
 - with boronic acids 73, 186
 - heparin, recognition with boronic acid sensors 81, 468
 - herbicide metolachlor, preparation by OXB-catalyzed reduction 434
 - herbicides 124
 - hetero Diels-Alder reaction, CAB-catalyzed 399
 - heteroarenes 214 f
 - N-arylation by Cu-promoted coupling with boronic acids 215
 - direct TM-catalyzed borylation with B_2pin_2 112
 - preparation using solid-phase Cu-promoted coupling 214
 - heteroarene-heteroarene C-N Cu-promoted coupling of boronic acids 221
 - heteroaryl chlorides, in Suzuki coupling 159
 - heteroarylboronic acids, in Petasis reaction 285
 - heterocycles

- boron functionalized 363
 - derivatization by Cu-promoted coupling of boronic acids 212
 - heterocyclic boronic acids, preparation 37
 - N*-heterocyclic carbenes 102, 197
 - ligand in the Rh-catalyzed addition of arylboronic acids 197
 - heterocyclic ketones, OXB-catalyzed reduction 417
 - heterogeneous palladium catalysts, in Suzuki coupling 147
 - 2-hexanone, enantioselective OXB-catalyzed reduction 416
 - high-throughput synthesis 295
 - hindered biaryls, preparation by Suzuki coupling 142
 - HIV-1 protease, inhibition by peptidyl boronic acids 494
 - homomallylic alcohols
 - from CAB-catalyzed allylsilation of aldehydes 406
 - in olefin cross metathesis/allylboration 268
 - preparation by additions of allylboronates to aldehydes 256
 - synthesis from (3-chloroprop-1-en-1-yl)boronic ester 346
 - (*S*)-homophenylalanine, preparation using Petasis reaction 73, 290
 - human EP3 prostanoid receptors, preparation by Suzuki coupling 154
 - human immunodeficiency virus, HIV-1, inhibition by boronyl-nucleosides 494
 - hydrazides, in Petasis reaction 293
 - hydrazones, in Petasis reaction 293
 - hydrazonobutadienes, in tandem aza [4+2] cycloaddition/allylboration 266
 - β -hydride elimination 70
 - hydroboration 43, 305
 - of 1-acetoxy-but-3-yne 297
 - of alkynes to give alkenylboronic acids (esters) 43–47
 - of dienes to give allylboronates 246, 269
 - transition-metal catalyzed 45
 - with catecholborane 333
 - hydroformylation of alkenes 267
 - hydrogen bond interaction, in allylboration transition state 257
 - hydrogen peroxide 63
 - hydrolysis
 - of alkynylboronic acids (esters) 48
 - of boronic esters 18
 - of haloalkanols catalyzed by 8-quinolineboronic acid 381
 - of salicylaldehyde imines catalyzed by arylboronic acids 389
 - hydroxorhodium intermediate 176, 188 f, 193, 198
 - active species in Rh-catalyzed addition of boronic acids to aldehydes 198
 - in Rh-catalyzed Heck-type reaction with boronic acids 188
 - transmetallation with boronic acids 176
 - β -hydroxy carbonyl compounds, boronic acid-catalyzed dehydration 378
 - β -hydroxy esters, from OXB-catalyzed Mukaiyama aldol 403
 - hydroxy esters, preparation by OXB-catalyzed reduction 423
 - hydroxy lactams, preparation by OXB-catalyzed reduction 423
 - 4-hydroxy-2-isoxazolines, synthesis from alkenylboronic esters 364
 - α -hydroxyaldehydes, in Petasis reaction 73, 290
 - α -hydroxyalkyl pyrans, preparation by [4+2] cycloaddition/allylboration 266, 361
 - (α -hydroxyalkyl)boronic esters 318
 - preparation 318
 - stability to deboronation 319
 - α -hydroxyalkylpiperidines, preparation by [4+2] cycloaddition/allylboration 266
 - hydroxybenzeneboronic acids, preparation 33
 - N*-hydroxybenzotriazole, Cu-promoted coupling with arylboronic acids 210
 - hydroxyboronate anion 9, 21, 62
 - hydroxycarboxylic acid, binding with boronic acid sensors 81
 - α -hydroxyketones, reaction with allylboronates 263
 - hydroxylamine-*O*-sulfonic, in electrophilic amination 65
 - hydroxylamines, in Petasis reaction 293
 - hydroxyphosphonates, preparation by OXB-catalyzed reduction 427
 - N*-hydroxyphthalimide, Cu-promoted coupling with arylboronic acids 208
 - hydrozirconation 42, 46, 370
 - of alkenylboronic esters 370
 - hypervalent boronic acid derivatives 5
- i**
- imides, enantioselective OXB-catalyzed reduction 423
 - imine derivatives 73, 199, 264, 279, 388, 430, 433

- enantioselective OXB-catalyzed reduction 430
 - reaction with boronic acid derivatives 73, 279
 - Rh-catalyzed addition with boronic acids 199
 - hydrolysis catalyzed by PhB(OH)₂ 388
 - N-substituted, enantioselective reduction 433
 - reaction with allylboronates 264
 - iminium ions 279, 283
 - intermediacy in Petasis reaction 283
 - reaction with boronic acid derivatives 279
 - α-imino ketones, OXB-catalyzed reduction 426
 - iminolactone, in Petasis reaction 289
 - indanes, preparation by carbocyclization of arylboronic esters 189
 - indolylboronic acids 36, 139, 285, 289
 - in Petasis reaction 285, 289
 - in Suzuki coupling 139
 - 5-indolylboronic acid, as a sensor for saccharides 445
 - inhibitors of TACE enzyme, preparation using boronic acid 221
 - insect pheromones, synthesis using (α-haloalkyl)boronic esters 305, 320
 - insulin delivery using boronic acid polymer 500
 - internal charge transfer (ICT) fluorescence 446
 - internal charge transfer (ICT) sensing 462
 - colorimetric detection of sugars 462
 - intramolecular allylboration 257, 267
 - intramolecular Cu-promoted C-O coupling of arylboronic acids 211
 - inverse electron demand Diels-Alder cycloaddition 266
 - 1-iodoalkenes, preparation from 1-alkenylboronic acids 344
 - 1-iodoalkenylboronic pinacol esters 54
 - (α-iodoalkyl)boronic esters 54, 336, 344
 - radical reduction with Bu₃SnH 345
 - furan/pyran-substituted 344
 - (α-iodomethyl)boronic ester 48, 328
 - 3-iodopropynal, in BLA-catalyzed Diels-Alder reaction 396
 - ionic additions to alkenylboronic esters 343
 - ionic liquids 298
 - as solvent in Petasis reaction 298
 - as solvent in Suzuki coupling 162
 - ipc₂BH 43, 48, 65
 - ip-phox 174
 - Ir(η⁵-C₉H₇)(cod) 116
 - iridium(V) intermediates, in direct borylation of arenes 117
 - iridium-catalyzed borylation of arenes with pinacolborane 117
 - iridium catalyst, for isomerization of alkenylboronic esters 252
 - iridium complexes, in aromatic CH borylation 110
 - iridium(I)- and iridium(III)-boryl species, aromatic C-H borylation 116
 - iridium-catalyzed trans-hydroboration 45
 - isotopic distribution of boron 61
 - isoxazoleboronic esters 364
 - in Suzuki coupling 364
 - preparation by dipolar cycloadditions of alkynylboronic esters 364
 - isoxazolidines, boronyl-substituted 365
- j**
- Jacobsen's chiral Cr(III) catalyst 266
 - japanese beetle pheromone, synthesis 324
- k**
- kainic acid, attempted synthesis 320
 - ketene silyl acetals, in OXB-catalyzed Mukaiyama aldol 403
 - ketimines, enantioselective OXB-catalyzed reduction 411, 430, 433
 - α-keto acetals, OXB-catalyzed reduction 422
 - keto esters, OXB-catalyzed reduction 423
 - α-, β- and γ-keto phosphates, OXB-catalyzed reduction 427
 - β-keto sulfides and sulfones, OXB-catalyzed reduction 428
 - ketones 199 f, 263, 271, 293, 406, 411, 414
 - enantioselective reduction using oxazaborolidines 411, 414
 - enantioselective reduction with boronate catalyst 406
 - in the Petasis reaction 293
 - preparation by Rh-catalyzed reaction of anhydrides and boronic acids 200
 - reaction with allylboronates 263, 271
 - Rh-catalyzed addition with boronic acids 199
 - ketoxime, OXB-catalyzed reduction 430
- l**
- lactamases, inhibition with boronic acids 485, 496
 - D-lactulose 442, 454, 460

- pyranose to furanose isomerization 442
- recognition by a diboronic acid sensor 454, 460
- LDA (lithium diisopropylamide) 326
- leucasdandrolide, synthesis using allylboronates 244
- D-leucrose 442
- Lewis acid-catalyzed allylboration of aldehydes 257 f, 261, 272
 - diastereoselectivity 257 f
 - mechanism 258
 - using camphor diol allylboronates 261
- Lewis acidity, of boronic acids 8
- B-N Lewis acid-Lewis base interaction 449, 462
 - bond distance and energy 449
 - in boronic acid sensors for saccharides 449, 462
- Lewis acids, in additions of boronic acids to N-acyliminium 297
- LiAlH₄, reaction with boronic esters 26
- liquid crystals 124
- α-lithioalkyl ether, preparation from (α-chloroalkyl)boronic esters 339
- lithiohexamethyldisilazane, LiN(SiMe₃)₂
 - in the synthesis of (α-aminoalkyl)boronic acids 328
- lithium acetylides 48
- losartan 34, 70
- L-ribose, synthesis using Matteson homologation 317

- m**
- magnesium bromide, in (cyclobutyl)boronic ester synthesis 326
- magnesium sulfate 380
- maleic anhydride, [4+2] cycloaddition with 1,3-dienylboronates 356
- D-maltose, isomerization 442
- mandelic acid derivatives, preparation by Suzuki coupling 160
- Mannich reaction 279
- D-mannose, isomerization 442
- mass spectrometry of boronic acids 61
- Matteson asymmetric homologation 54
 - acope of nucleophile 306
 - diastereoselectivity 306
 - directing effect of boron 308, 316
 - β-elimination as side reaction 308
 - elimination of β-haloboronic esters 316
 - evidence for second diastereoselection 308
 - features and observations 307
 - mechanism of stereinduction 306
 - minimization of epimerization with ZnCl₂ 308
 - oxygenative migration as side reaction 309
 - preparation of aminoalcohols and amino acids 331
 - preparation of deuterated compounds 319
 - synthesis of
 - african pheromone 323
 - α-amino alkylboronic esters 328
 - cyclobutylboronic esters 326
 - cyclopropylboronic esters 326
 - insect pheromones 312
 - japonilure 324
 - L-ribose 317
 - serriconin 314
 - tautomycin 322
 - quantum mechanical calculations 308
 - with
 - α-alkoxy boronic esters 322
 - alkoxy-substituted boronic esters 316
 - azido-substituted boronic esters 331
 - carbonyl-containing boronic esters 323
 - cyano-substituted boronic esters 325
 - DICHD ethylboronic ester 320
 - halogen-substituted boronic esters 316
 - pinanediol (α-chloroalkyl)boronic esters 311
 - pinanediol boronates 309
 - simple boronic esters 311
 - using
 - lithioalkyne 324
 - lithium enolates of esters 324
 - lithioacetonitrile 325
 - oxazolidinone enolate 324
 - role of ZnCl₂ as promoter 306
 - scope of nucleophile 306
- Matteson homologation 63, 250
 - preparation of allylboronates 250
- mechanism 227, 415
 - Cu-promoted coupling of boronic acids 227
 - OXB-catalyzed ketone reduction 415
- D-melibiose 442, 455, 459
 - isomerization 442
 - recognition by a diboronic acid sensor 455, 459
- melting points of boronic acids 61
- (S)-MeO-mop, ligand in Rh-catalyzed additions 197
- meso-imides, enantioselective OXB-catalyzed reduction 423

- (α -metallated)alkylboronic esters, preparation and application 53, 339
- γ -(*N*-methallyl)-amido-substituted allylboronate 267
- methallylboronates, camphordiol derived 250, 261
- 3-methoxycarbonyl-5-nitro-phenylboronic acid 9, 470
- in dye displacement assay for saccharide detection 470
- 2-methoxyphenol, in Rh-catalyzed addition of boronic acids 184
- p*-methoxyphenyl boronic acid, X-ray crystal structure 3
- 4-methyl-3-heptanol, synthesis using Matteson homologation 312
- α -methylbenzylamine, in Petasis reaction 289
- methylboronic acid 13, 22
- pK_a 10
 - heats of reaction 13
- methylboronic esters, preparation 48
- methylenecyclopropanes, cycloaddition with alkenylboronic esters 367
- α -methylene- γ -butyrolactones, preparation by allylboration 250
- methylenecyclopentanes, from alkenylboronic esters 367
- methyl-substituted arylboronic acids, bromination 50
- microencapsulated Ph_3P -Pd catalysts, in Suzuki coupling 149
- microwave heating 102, 286, 292
- in Petasis reaction 286, 292
 - in Suzuki coupling 160, 165
- molecular wires 124
- molybdenum metathesis catalyst, in preparation of allylboronates 254
- monoalkylboranes 26, 65
- H_8 -monophos 174
- monosaccharides 21, 83, 442, 459
- fluorescence sensing with diboronic acids 459
 - pyranose to furanose isomerization 442
 - transmembrane transport with boronic acids 83
- morpholine, Cu-promoted coupling with boronic acids 229
- mosquito oviposition pheromone, synthesis 267, 361
- motuporin, synthesis using Matteson homologation 332
- Mukaiyama aldol reaction 379, 400, 404
- catalyzed by arylboronic acids 379
 - enantioselective OXB-catalyzed 400
 - scope of OXB-catalyzed variant 404
- multicomponent reactions 74, 266, 283, 368
- cyclotrimerization/Suzuki coupling 368
- n**
- naphthaldehyde 199
- naphthalene based boronic acid, as saccharide sensor 447
- naphthalene boronic acid, amidation catalyst 382
- natural products, synthesis using [4+2] cycloaddition/allylboration 216, 361
- Negishi coupling 141, 249
- compared to Suzuki coupling 141
 - preparation of allylboronates 249
 - of 1-iodozincalkenylboronates 53
- (neopentyl glycolate)diboron, Rh-catalyzed conjugate addition 174
- $Ni(acac)_2$, in silaboration of dienes 247
- nickel catalysts 253
- in isomerization of alkenylboronic esters 253
 - in coupling of boronic acids with alkynes and imines 75, 301
- $NiCl_2(PCy)_2$, catalyst for Suzuki coupling 153
- nitration, of arylboronic acids 55, 65
- nitric oxide synthase, inhibition with boronic acids 490
- nitrile oxides, dipolar cycloaddition with alkenylboronic esters 364
- nitrile substituent, in Matteson homologation 325
- nitroalkenes, in Rh-catalyzed conjugate addition of boronic acids 184
- nitrogen heterocycles, preparation by borono-Mannich reaction 288
- nitrones 301, 365
- dipolar cycloaddition with alkenylboronic esters 365
 - reaction with dialkylzinc and boronic acids 301
- nitrophenylboronic acids, in detection of saccharides 462, 465
- 3-nitrophenylboronic acid (3-(NO_2) $C_6H_4B(OH)_2$) 388
- catalyst for reduction of carboxylic acids 388
 - catalyst in the synthesis of oxazolines/thiazolines 388
- N*-methyl aminoacids, preparation using $ClCH_2Bpin$ 333

- ^{13}C NMR 62
- ^{11}B NMR spectroscopy 22, 61
- 2-Norbornene, Rh-catalyzed multialkylation with arylboronic acids 188
- norbornodiene derivatives 189, 396
- in Rh-catalyzed carbocyclization of arylboronates 189
- nucleic acid derivatives, analysis/separation using boronic acid supports 80
- nucleosides 78, 219, 461
- binding with boronic acid dye 461
 - N-1 arylation by Cu-promoted coupling of arylboronic acids 219
 - protection with boronic acids 78
- nucleoside derivatives, preparation by Suzuki coupling 140
- o**
- olefin cross-metathesis 46, 254, 268
- tandem cross-metathesis/allylation 268
 - preparation of allylboronates 254
- olefin metathesis 46, 291, 368
- in preparation of functionalized alkenylboronic esters 46, 368
- oligosaccharide binding and sensing with boronic acids 22, 81, 441, 444
- components 444
 - industrial applications 441
- oligosaccharides 441 f, 451, 461
- chiral recognition using boronic acids 451
 - enzymatic detection 441
 - importance to living systems 441
 - inefficiency of hydrogen bonding receptors 441
 - pyranose to furanose isomerization 442
 - recognition by diboronic acid sensors 451
 - recognition by boronic acid receptors 22, 81, 441
 - recognition using semi-synthetic biosensor 461
- Oppenauer oxidation of allylic alcohols, catalyzed by $(\text{C}_6\text{F}_5)_2\text{BOH}$ 380
- organocuprates, conjugate addition to alkenyldioxaborocines 346
- organolithium reagents 28
- preparation of boronic acids (esters) 28–34
 - in Matteson homologation 306
- ortho*-aminomethyl arylboronic acid 9, 33, 453
- as component of modular design of saccharide sensors 453
 - preparation 33
- ortho*-bromobenzenboronic esters, metalation 74
- ortho*-carboxamido-arylboronic acids, preparation 33
- ortho*-quinone methides 76
- osmium tetroxide, dihydroxylation of α -pinene 309
- (*oxa*- π -allyl)rhodium intermediate 176, 184, 191
- hydrolysis 184
 - in Rh-catalyzed conjugate addition-aldol 191
 - in catalytic cycle of boronic acid conjugate addition 176
- oxaborolidinium triflylimide, catalyst in Diels-Alder reaction 77, 397
- oxanorbornenes, Rh-catalyzed addition with phenylboronic acid 190
- oxazaborolidine (OXB or OAB) catalysts 25, 411, 413 ff, 421 ff, 427 ff, 434
- as chiral catalysts for reduction of prochiral ketones and imines 414
 - borane sources as co-reductant 414
 - catalytic cycle of enantioselective reduction 415
 - complexation of borane to the nitrogen 415
 - in kinetic resolution of ketones and lactones 429
 - in reduction of
 - diaryl ketones 416
 - α,β -enones and ynones 424
 - functionalized ketones 418
 - α -halo(tosyloxy) ketones 418
 - heterocyclic ketones 417
 - of imine derivatives 430
 - of α -imino ketones 427
 - α -keto acetals and thioketals 422
 - keto-esters 423
 - α -silyloxy ketones 421
 - unfunctionalized ketones 416
 - polymer-supported 413, 431
 - preparation from 1,2-aminoalcohols 413
 - proline derived 413
 - scope of substrates for ketone reduction 434
 - X-ray crystal structure of BH_3 adduct 415
- oxazaborolidinones 23, 25
- oxazaborolidinone (OXB) catalysts 23, 25, 391, 397, 400 ff, 404 f
- cationic 397

- from 3,5-(CF₃)₂C₆H₃B(OH)₂, in Mukaiyama aldol 402
 - in desymmetrization of meso-1,2-diols 405
 - in Diels-Alder reactions 391, 397
 - in enantioselective Mukaiyama aldol 400
 - in hetero-Diels-Alder reaction of enals 401
 - in ring-cleavage of 1,3-dioxolanes 404
 - *N-p*-nitrobenzenesulfonyl-derived 401
 - oxazoles, by Suzuki coupling 137
 - oxidation of boronic acids (esters), mechanism 64
 - oxime derivatives
 - enantioselective OXB-catalyzed reduction 430
 - reaction with allylboronates 264
 - oxone 64
 - oxygen-containing heterocycles, by intramolecular allylboration 253
- P**
- D-palatinose, recognition by diboronic acid sensor 460
 - palladacycles, catalysts in Suzuki coupling 159
 - palladium acetate, in cyclopropanation of alkenylboronic esters 351
 - palladium catalysts 123, 161
 - in Suzuki coupling 123
 - ligand-free 161
 - in addition of organoboron to alkenes/alkynes 201
 - palladium *N*-heterocyclic carbene complexes, catalysts in Suzuki coupling 159
 - palladium powder, catalyst in Suzuki coupling 161
 - palladium nanoparticles, in Suzuki coupling 152, 161
 - palladium-on-carbon
 - catalyst for Suzuki coupling 160
 - in borylation of benzylic CH bonds 118
 - palustrine alkaloids, synthesis using allylboronates 266
 - palytoxin 47
 - paraformaldehyde 281
 - in Petasis reaction 281
 - paroxetine, preparation using Rh-catalyzed addition of boronic acid 183
 - PCy₃ 102
 - Pd(dba)₂ 35
 - PdCl₂(dppf) 34, 102
 - PdCl₂(SEt₂)₂ 152
 - pentaerythrol 20
 - pentafluorophenylborinic acid (C₆F₅)₂BOH 380
 - 1,2,2,5,5-pentamethylpiperidine, base in Cu-promoted couplings 229
 - peptide mimetics, preparation by Petasis reaction 294
 - peptidyl boronates 493
 - inhibitors of BVDV NS3 protease 493
 - inhibitors of thrombin 493
 - peptidyl boronic acids
 - as enzyme inhibitors 81
 - as inhibitors of HIV protease 494
 - as proteasome inhibitors 494
 - as thrombin inhibitors 486
 - in protease inhibition 81, 485
 - importance of Lewis acidity in enzyme inhibition 487
 - molecular interactions in thrombin complex 487
 - ternary complex with enzyme 489
 - perfluorodecalin, solvent 384
 - perfluoro-tagged Pd complexes, catalysts for Suzuki coupling 145
 - permanganate oxidation 50
 - Petasis borono-mannich reaction 73, 281 ff, 286, 290, 291 ff, 296, 298, 302
 - advantages 282, 302
 - applications in combinatorial chemistry 288
 - combined with a Pd(0)-catalyzed reaction 288
 - diastereoselectivity 281, 289, 295
 - discovery of the reaction 281
 - effect of neighboring heteroatoms 284
 - enantioselective additions 289
 - functional group tolerance 282
 - incomplete conversions 292
 - in ionic liquids as solvent 298
 - in resin-to-resin transfer reactions 295
 - intermediacy of iminium ions 283
 - intermediacy of tetracoordinate boronate anion 283
 - limited scope of aldehyde 284
 - mechanistic considerations 283
 - microwave assisted 286, 292
 - NMR observations 284
 - polymer-supported 294
 - preparation of piperazinones and benzopiperazinones 286
 - with
 - aldehydes possessing heteroatoms 284
 - alkenylboronic acids 292
 - 3-alkoxy-*N,N*-dimethylaniline 287

- arylboronic acids 292
- boronic esters 286
- DEAM-PS supported arylboronic acids 295
- diamines 286
- heteroarylboronic acids 291
- hydrazones 293
- α -hydroxy aldehydes 290
- hydroxylamines 293
- iminium ions derived from hydrazines, hydroxylamines, sulfinamides 293
- iminium ions possessing neighboring heteratoms 285
- pyruvic acid 293
- salicylaldehyde 291
- sulfinamides 293
- supported piperazine 295
- supported piperazine 294
- supported proline 294
- trifluoroborate salts 298
- Wang resin-supported arylboronic acids 296
- xylose as aldehyde 291
- reaction conditions and practical advantages 282
- sequence with Ugi 4-component coupling 287
- substrate scope 284, 302
- synthesis of *anti*-1,2-amino alcohols 290
- synthesis of enantiopure α -amino acids 289
- synthesis of fluorinated aminoalcohols 291
- synthesis of 2*H*-chromenes 292
- synthesis of peptide mimetics 294
- transition structure with α -hydroxy aldehydes 290
- pH depression method, quantification of diol-boronic acid complexation 21, 482
- pharmaceutical drugs and materials, using Suzuki coupling 69
- phenanthrene-based phosphine ligand 148
 - in Suzuki coupling 148
- phenanthroline, base in Cu-promoted coupling of boronic acids 219
- phenols 64, 73, 76, 115, 207, 226
 - Cu-promoted coupling with boronic acids 73, 207
 - Cu(II)-catalyzed coupling with trifluoroborate salts 226
 - orthoalkylation catalyzed by arylboronic acids 76
 - preparation by oxidation of arylboronic acids (esters) 64, 115
- N-phenyl maleimide 358
 - in Diels-Alder reaction of 1,3-dienylboronic esters 358
- phenylalanine 216, 332
 - asymmetrically deuterated 332
- phenylboronic acid 3, 9, 13, 15 f, 18, 28, 68, 76, 78, 224, 284, 382, 442 f, 483, 485
 - binding equilibria with diols and sugars 21, 443, 483
 - binding selectivity towards saccharides 442
 - binding selectivity with monosaccharides 443
 - competitive inhibitor of subtilisin and chymotrypsin 485
 - Cu-promoted S-arylation 224
 - cyclodimerization of D-glucosamine into a pyrazine 76
 - hydration 17, 443
 - in regiocontrol of Diels-Alder reaction 76
 - in opening of epoxy-sulfides 76
 - in Petasis reaction 284
 - in OsO₄ promoted dihydroxylation of alkenes 78
 - pK_a 9
 - preparation 28
 - Suzuki coupling with aryl bromides 68
 - X-ray crystal structure 3
- phenylboronic acid polymers, control of insulin release 474
- phenylboroxine, Rh-catalyzed additions to alkynes 194
- 1,2-phenylenediamine 24
- 1-phenylethenylboronic ester, asymmetric hydrogenation 370
- phenyliodonium zwitterions, in Suzuki coupling 166
- phenylmercuric chloride, from phenylboronic acid 62
- α -phenylthio alkylboronates, carbanions 52
- pheromones, synthesis using Matteson homologation 312, 313, 323
- phosphine (biphenyl) ligand, in Pd-catalyzed Suzuki coupling 142
- phosphine ligands, in Suzuki coupling 71
- phosphinite-based palladacycles, in Suzuki coupling 145
- phosphorylated saccharides, recognition by ditopic boronic acid sensor 458
- [2+2] photo-cycloaddition, of alkenylboronic esters 367

- photoinduced electron transfer (PET) fluorescence 446, 448
- photonic crystal sensing, of D-glucose 474
- pinacol 15, 17, 21, 43, 324
 - reaction with tert-butyl lithioacetate 324
- pinacol (1,3-butadien-2-yl)boronate, Diels-Alder reactions 362
- pinacol (bromomethyl)boronate 48, 319, 326
 - reaction with lithioacetonitrile 326
 - reaction with sodium trityloxide 319
- pinacol (chloromethyl)boronate 48, 333
 - in monomethylation of primary amines 333
- pinacol (dichloromethyl)boronate 48, 339
 - conversion into a dichromium derivative 339
- pinacol (iodomethyl)boronate 48, 339
 - conversion to $\text{IZnCH}_2\text{B}(\text{O}_2\text{C}_2\text{Me}_4)$ 339
- pinacol (phenylthiomethyl)boronate, preparation of (α -iodoalkyl)boronic esters 336
- pinacol 3-chloroallylboronate, vinylogous Matteson rearrangement 251
- pinacol alkenylboronic esters 55, 68, 104, 301, 350
 - asymmetric cyclopropanation 350
 - compatibility with other reactions 55
 - reaction with carbenes 350
 - reaction with dialkylzinc and nitrones 301
 - robustness 55
- pinacol allylboronate, cross-metathesis to other allylboronates 254
- pinacol allylboronic esters, stability and ease of handling 242
- pinacol benzylboronate, preparation 118
- pinacol boronic esters 18, 20, 35, 43, 55, 61, 319, 326, 335, 337, 493
 - Hydrolysis 18
 - mass spectrometric analysis 61
 - preparation of peptidyl boronic ester inhibitors 493
 - transesterification with DICHD 21, 319, 326
 - transesterification to pinanediol esters 335, 337
- pinacol esters of arylboronic acids 115
- pinacol ethyleneboronate 47, 348, 363, 372
 - reaction with allylic zinc reagents 372
 - cycloaddition with ethyl diazoalkanes 363
 - reaction with carbon-centered radicals 348
- pinacolborane 23, 35, 42, 44f, 48, 102, 104, 106, 109, 116, 246, 252
 - borylation of alkenyl halides 42
 - coupling with aryl halides (triflates) 35
 - direct borylation of arenes 35, 109
 - hydroboration of alkynes 44
 - hydroboration of allenes 246
 - hydroboration of propargyl ethers 252
 - in benzylic CH borylation 118
 - TM-catalyzed coupling with alkenyl halides (triflates) 104
- pinacolone, OXB-catalyzed reduction 416
- pinanediol 18, 306, 309
 - as chiral director in Matteson homologation 309
 - preparation by dihydroxylation of pinene 309
- (+)-pinanediol (chloroethyl)boronate, in Matteson homologation 322
- pinanediol (chloromethyl)boronate, reaction with alkoxides 317
- pinanediol (dichloromethyl)boronate, in Matteson homologation 310
- pinanediol (trityloxymethyl)boronate, X-ray structure 319
- (+)-pinanediol 1,3-dienylboronate, Diels-Alder reaction 359
- pinanediol alkylboronates, chain extension with (dialkoxymethyl)lithium 336
- pinanediol alkenylboronates, in Petasis reaction 289
- pinanediol boronic esters 19f, 306, 309, 310, 329, 334, 493
 - cleavage, difficulties 19, 309, 334
 - cleavage with boron trichloride 18, 329
 - diastereotopic faces 310
 - exceptional stability 18, 309
 - hydrolysis in two-phase system 19, 329
 - reaction with Cl_2CHLi 306
 - reduction with lithium aluminium hydride 18, 334
 - solid-phase synthesis 493
 - stability to trifluoroacetic acid 493
- α -pinene 43, 309
 - preparation of pinanediol 306, 309
- piperazinones and benzopiperazinones
 - preparation using Petasis reaction 286
- piperidines 355, 360
 - 2,6-disubstituted 361
 - from alkenyldichloroboranes 355
 - α -hydroxyalkyl-substituted 360
- platelet aggregation inhibitors, preparation by Suzuki coupling 133

- polyacrylamide-supported nitro-arylboronic acid 79f
- polyamides, synthesis catalyzed by 3,4,5- $F_3C_6H_2B(OH)_2$ 386
- polyaniline boronic acids, sensors 474
- polychlorinated biphenyls (PCBs), synthesis by Suzuki coupling 124
- polyene boronic acids, sensors for saccharides 446
- polyethylene glycol (PEG), medium for Suzuki coupling 162
- polyhydroxylated indolizidines, synthesis using boronates 291, 297
- polyimides, synthesis catalyzed by 3,4,5- $F_3C_6H_2B(OH)_2$ 386
- polymer support, in Petasis reaction 294
- polymer-supported base, in Petasis reaction 292
- polymer-supported phosphine-Pd catalyst, in Suzuki coupling 163
- polystyrene-bound pyridinium boronic acid, catalyst for amide condensation 387
- polystyrene-divinylbenzene resins, in Suzuki coupling 154
- polystyryl boronic acid resins 79
- porphyrin derived diboronic acid, fluorescence sensor for saccharides 460
- porphyrins and metalloporphyrins 140
- potassium carbonate, in Rh-catalyzed conjugate additions 181
- potassium fluoride, base in Suzuki coupling 161f
- potassium triisopropoxyborohydride (KIPBH) 45
- potassium triisopropoxyborodeuteride 319
- L-proline-based amidomonophosphine 174
- propanediol methyl bisboronate 52
- propargylic alcohols, chiral 424
- by OXB-catalyzed reduction 423
- propargylic ketones, OXB-catalyzed reduction 424
- prostaglandin endoperoxides PGH_2 and PGG_2 396
- prostaglandin synthesis 390
- HCV NS3 protease, inhibition with boronic acids 496
- protease enzymes, inhibition with boronic acids 82, 485
- proteasome 494, 497
- inhibition by boronic acids 497
- inhibition by the dipeptidyl boronic acid Velcade 494
- role in cellular pathways 494
- α -protected hydroxy ketones, OXB-catalyzed reduction 421
- protein labeling with boronic acid 84
- protolytic deboronation 14, 69, 143, 178, 183, 211
- kinetics and mechanism 14
- competitive process in Suzuki coupling 69, 143
- side-reaction in Cu-promoted coupling of boronic acids 211
- side-reaction in Rh-catalyzed conjugate additions 174, 183
- protodeboronation of arylboronic acids 62
- $Pt(CH_2=CH_2)(PPh_3)_2$, in diene silaboration 270
- $Pt(PPh_3)_4$, in diene diborylation 47, 247
- purine boron analogues 25
- purine derivatives
- preparation by Suzuki coupling 140
- N-arylation by Cu-promoted coupling of arylboronic acids 219
- pyrans, preparation via hetero-Diels-Alder/allylboration 361
- pyrazole phenyl ketones, OXB-catalyzed reduction 417
- pyrazoles, N-arylation 217
- pyridine 10
- pyridine derivatives, in TM-catalyzed borylation 114
- pyridine-2-carboxaldehyde, in Petasis reaction 298
- pyridineboronic acid isomers, preparation 37
- pyridines, complexation with 3-nitrophenylboronic acid 462
- pyridinium boronic acid salts, as catalysts 387
- pyridinium-substituted diboronic acid, saccharide sensor 460
- 3-pyridylboronic acid 9, 220
- acidity 9
- Cu-promoted coupling with benzimidazole 220
- 4-pyridylboronic acid, in Suzuki coupling 132
- pyrimidine boronic acid analogues 26
- pyroles, preparation by Suzuki coupling 138
- pyrones, by OXB-catalyzed hetero-Diels-Alder reaction 401
- pyrrole derivatives
- direct TM-catalyzed borylation 111, 114
- pyrrolidines 335, 366
- boronyl-substituted 366

- preparation from dichloroboranes 335
- pyrrolylboronic acids 36
- pyruvic acid, in Petasis reaction 285, 293

q

- quantum mechanical calculation, of Matteson homologation 308
- quaternary carbon centers 269 f
 - by allylboration of aldehydes 255
 - preparation using 3,3-disubstituted allylboronates 269 f
- quinine and quinidine, asymmetric total synthesis 339
- 8-quinolineboronic acid 76, 220, 381, 458, 505
 - catalyst for hydrolysis of haloalkanol 76, 381
 - Cu-promoted coupling with benzimidazole 220
 - fluorescence intensity upon fructose binding 505
 - fluorescence sensor for saccharides 458
- quinolium boronic acids, fluorescence sensor for saccharides 459
- quinoneboronic esters, preparation from alkynylboronic esters 36, 367

r

- radical additions 55, 337, 347
 - boron-tethered 337
 - to alkenylboronic esters 55, 347
 - to allylboronic esters 55
- radical chemistry, of α -boryl-radicals 337
- radical cyclizations of alkenylboronates 348
- receptors, for saccharides 441
- reduction, atropo-enantioselective using OXB 429
- regioselectivity (orientation) of aromatic C-H borylation 36, 113
- resin-to-resin transfer reactions 59, 295
 - Petasis borono-mannich reaction 295
- resorcinol-derived boronic acid, colorimetric detection of saccharides 465
- Rh(acac)(binap), in additions of boronic acids 177
- Rh(acac)(CO)₂, pre-catalyst in additions of boronic acids 171
- [Rh(acac)(GO)₂]/dppf, pre-catalyst in additions of boronic acids 195
- Rh(acac)C₂H₄)₂, pre-catalyst in conjugate additions of boronic acids 172
- Rh(acac)C₂H₄)₂/(S)-binap, catalyst in asymmetric conjugate additions 173
- [Rh(cod)₂]BF₄, in conjugate additions of boronic acids 183
- [Rh(OH)(binap)]₂ 177 f
 - catalyst in asymmetric conjugate additions of boronic acids 177, 178
- RhCl(CO)(PPh₃)₂ 47
- Rh₄(CO)₁₂, in the hydroboration of cyclohexadiene 246
- rhodium(I)-catalyzed addition of arylboronic acids to N-sulfonylimines 300
- rhodium(I)-catalyzed addition of boronic acids to anhydrides 200
- rhodium catalysts 45, 109, 171, 299
 - in asymmetric hydroboration 45
 - in addition of boronic acids to N-sulfonylimines 299
 - in additions of boronic acids to alkenes and carbonyls 73, 171
 - in direct borylation of arenes 109
- rhodium-catalyzed 1,4-addition to enones 115
- rhodium-catalyzed addition of boronic acids to aldehydes 73, 195, 197
 - asymmetric version 197
 - mechanism 198
 - substrate scope and optimal conditions 195
 - using trifluoroborate salts 197
- rhodium-catalyzed addition of arylboronic acids to aldimines 199
- rhodium-catalyzed addition of boronic acids to alkynes 192
- rhodium-catalyzed hydroarylation of heteroaromatic alkynes 194
- rhodium-catalyzed carbocyclization of arylboronic esters 188
- rhodium-catalyzed hydroarylation-cyclization of 3-hexyne with PhB(OH)₂ 194
- rhodium-catalyzed trans-hydroboration 46
- rhodium-catalyzed asymmetric additions of boronic acids to alkenes 172, 174, 178 ff, 184, 186, 188, 190
 - effect of
 - different chiral ligands 174
 - water 184
 - ligand exchange 179
 - reaction temperature 178
 - Heck-type reaction with α , β -unsaturated esters 186
 - intermediacy of hydroxyrhodium 176
 - inhibition by phosphine ligands 184
 - mechanism and NMR studies 176
 - multiple arylation of 2-norbornene 188

- protodeboronation as competing process 174
- role of inorganic bases 179
- scope of the reaction 172
- with
- α , β -unsaturated esters and amides 181
- 2-alkenyl pyridines 184
- alkenylphosphates 184
- boroxines 183
- enones 178
- nitroalkenes 184
- oxanorbornenes 190
- [Rh(OH)(binap)]₂ 179
- styrene derivatives 186
- tandem conjugate addition-aldol reaction 191
- using 2-methoxyphenol as protic source 184
- ribonucleoside 5'-triphosphate, recognition by polymeric boronic acid 471
- ribose, binding with boronic acid dye 461
- ring-closing metathesis reaction, preparation of cyclic 1,3-dienyl-2-boronates 362
- ROMPgel diol, immobilization of allylboronates 60
- rutamycin 47
- ruthenium alkylidene catalyst
 - alkene metathesis to give alkenylboronic acids 46
 - preparation of allylboronates 254
- s**
- saccharides 21, 81, 441 f, 451, 461, 472
 - chiral recognition by boronic acid sensors 451
 - detection, industrial applications 441
 - effect on color of boronic acid dyes 461
 - enzymatic detection 441
 - inefficiency of hydrogen-bonding receptors 441
 - pyranose to furanose isomerization 442
 - recognition by
 - boronic acid-based receptors/sensors 21, 81, 441
 - colorimetric boronic acid sensors 461
 - diboronic acid sensors 451
 - polymeric boronic acid sensors 472
 - semi-synthetic biosensor 461
- Sakurai-Hosomi allylation 405
- salicylaldehyde, in Petasis reaction 284, 291 f, 292
- salicylhydroxamic acid-boronate interaction 84
- Sc(OTf)₃, in Lewis-acid catalyzed allyboration 258
- Schlosser's base 37
- Schlosser's conditions, preparation of allylboronates 243
- secondary alcohol, by oxidation of boronic ester 63, 311
- sensors, boronic acid 22, 81, 441, 444 f, 448, 457 f, 461, 467 f, 473, 504
 - based on
 - colorimetric detection 445, 461
 - combination of binding sites 457
 - competitive assay 468
 - electrochemical detection 445, 467
 - fluorescence 22, 445, 458
 - ICT fluorescence 445
 - PET fluorescence 448
 - diboronic acids, for cell surface carbohydrates 504
 - for saccharides 81, 441
 - using polymer and surface conjugated boronic acids 473
- serine, preparation using Matteson homologation 332
- serine proteases 82, 329, 482, 489
 - inhibition by boronic acids 82, 329, 482
 - ternary complex with boronic acid 489
- serricornin, synthesis using Matteson homologation 314
- sialic (N-acetylneuraminic) acid, recognition by boronic acid sensor 457, 472
- sialyl Lewis X (sLex) tetrasaccharide 85, 454, 503
 - selective recognition using diboronic acid sensors 454, 503
- silaboration 48, 247, 270
 - of allenes 48
 - of dienes 247, 270
 - preparation of allylboronates 247, 270
- silicon tetrachloride 27, 334
- (Z)-3-(siloxy)allylboronates 253
- γ -siloxyalkenylboronate, preparation of α -chloro(*E*)-crotylboronate 251
- silver carbonate, base in Suzuki coupling 143
- silver nitrate 63
- α -siloxy ketones, OXB-catalyzed reduction 421
- Simmons-Smith reaction, using alkenylboronic esters 350
- sodium chlorite, oxidation of (α -chloroalkyl)boronic esters 332
- sodium dodecyl sulfate (SDS) 189, 194

- sodium perborate, oxidation of boronic acids (esters) 64
- sodium phenoxide, base in Suzuki coupling 143
- solid supports for boronic acids 58
- solid-phase synthesis 59, 102, 153, 214, 294, 454
 - advantages 294
 - Cu-promoted C-heteroatom cross-coupling of boronic acids 214
 - of boronic acid sensors 454
 - Petasis borono-mannich reaction 294
 - Suzuki coupling 153
- solid-supported catalysts, for Suzuki coupling 147
- solid-supported diol resins 60
- sorbic alcohol, Diels-Alder reaction with alkenylboronic esters 353
- D-sorbitol, recognition by diboronic acid sensor 451
- spirobenzopyrans 138, 464
 - boronic acid appended 464
 - preparation by Suzuki coupling 138
- spiropyran-derived boronic acid, colorimetric detection of saccharides 464
- stegobinone, synthesis using Matteson homologation 320
- sterically hindered arylboronic esters, in Suzuki coupling 142
- sterically hindered biaryls 141
- stilbazolium boronic acids, colorimetric detection of saccharides 465
- stilbene, in diboronic acid sensor 446, 459
- Stille coupling 125, 136, 249, 349
 - compared to Suzuki coupling 125, 136
 - preparation of allylboronates 249
- styrene oxides, OXB-catalyzed reduction 418
- styrenyl olefins, in Rh-catalyzed conjugate addition of boronic acids 185
- styrylboronate, catalyzed diboration 371
- (*E*)-styrylboronic acid, in Petasis reaction 291
- styryltrifluoroborate, in Petasis reaction 298
- 3-substituted allylboronates, preparation 244
- α -substituted allylboronates 273, 345
 - tandem allylation/dioxene thermolysis 273
 - reaction with aldehydes 259, 345
- N*-substituted maleimides, in [4+2] cycloaddition/allylboration 266
- (*E*)-1-substituted-1-alkenylboronic esters 44
- subtilisin, inhibition with boronic acids 485
- sugar acids, binding with boronic acid sensors 81
- sugars 15, 22, 81, 291, 441, 451
 - recognition by boronic acid receptors/sensors 22, 81, 441
 - chiral recognition using boronic acid sensors 451
 - enzymatic detection 441
 - in Petasis reaction 291
 - recognition by diboronic acid sensors 451
- sulfenamides, in Petasis reaction 293
- α -sulfonamido allylboronates 251
- N*-sulfonyl aldimines, Rh-catalyzed reaction with boronic acids 199
- sulfonyl iodides, reaction with alkenylboronic esters 347
- N*-sulfonylated amino acids 25
- N*-sulfonylimines, Rh-catalyzed addition with arylboronic acid 299
- sulfonyl-imines, reaction with allylboronates 265
- α -sulfonyloxy ketones, OXB-catalyzed reduction 418
- supercritical carbon dioxide (scCO₂), Suzuki coupling 163
- Suzuki-Miyaura coupling 13, 33, 35, 37, 38, 47, 59, 61, 68 ff, 76, 115, 123, 125 ff, 129, 132, 135 ff, 139 ff, 141, 159 ff, 162 ff, 307, 339, 356, 367
 - advantages 166
 - asymmetric variants 143
 - atropisomer selective 143
 - biphasic 164
 - catalysts and ligands 71
 - compared to Negishi coupling 141
 - compared to Stille coupling 125, 132, 136
 - competitive protoboration 143
 - diastereoselective 130
 - effect of stronger bases 143
 - heteroaromatic-heteroaromatic couplings 131
 - fluororous biphasic system 145, 152
 - combinatorial library synthesis 71
 - in medicinal chemistry 71
 - in solid-phase chemistry 71, 153
 - in supercritical carbon dioxide 163
 - in water 151, 155, 159
 - ligand free 71, 130, 161, 164
 - mechanism of aqueous variant 69, 131

- mechanism of Ni(0)-catalyzed variant for aryltosylates 153
 - mechanism with trifluoroborate salts 131
 - microwave assisted 135, 160, 164 f
 - nickel-catalyzed 71, 153
 - of
 - alkenylboronic acids 155, 160
 - alkylboronic acids 70
 - alkenylboronic ester 339
 - aryl chlorides 71, 139, 144, 147, 148, 152, 156, 158, 164
 - aryl halides in water 155
 - aryl ammonium salts 71
 - arylboronic acids (esters) 123
 - arylboronic esters prepared by ortho-metalation 125
 - arylsulfonium salts 71
 - aryltosylates 71, 153
 - boronic anhydrides 158
 - chloroheteroarenes 139
 - co-catalysis by copper(I) oxide 164
 - cyclic alkenylboronic esters 356
 - cyclopropylboronic acids 70
 - electron-poor arylboronic acids 141
 - haloacetates 164
 - halophenols 160
 - hindered arylboronic acids 71, 141, 143
 - phenyliodonium zwitterions 166
 - phthalazine derivatives 140
 - potassium arylltrifluoroborates 130
 - resin-bound aryl halide 154
 - sterically hindered substrates 147
 - thioesters 71
 - optically active (*S*)-binaphthyl bromide 127
 - phosphine free systems 71, 130
 - phosphine ligands 71
 - preparation of
 - azulene oligomers 128
 - biaryls 159
 - chiral biaryls 142
 - hindered biaryls 141
 - polysubstituted oxazoles 137
 - porphyrin derivatives 140
 - purine derivatives 140
 - pyridazines 135
 - spiroyrans 138
 - substituted coumarins 138
 - substituted pyrroles 138
 - substituted thiazoles 136
 - thiophene derivatives 136
 - role of base 69
 - solvent-less 161
 - use in chemical tagging for combinatorial chemistry 154 ff
 - using
 - biphenyl-based phosphine ligands 142
 - DEAM-PS resin 156
 - heterogeneous Pd catalysts 147
 - ionic liquids as solvent 162
 - micro-encapsulated Pd catalyst 149
 - N-heterocyclic carbene ligands 71
 - Pd(0) nanoparticles as catalyst 152, 161
 - Pd/C as catalyst 160 f
 - phenanthrene based phosphine ligand 148
 - tetraphosphine ligand (tedicyp) 149
 - trialkylphosphine ligands 150
 - triarylphosphine ligands 150
 - modified catalysts and ligands 144
 - phosphine-free catalysts 147
 - phosphinite palladacycles as catalysts 145
 - solid supported catalysts 147
 - water-soluble catalysts 141, 151
 - C₂-symmetrical diols, chiral directors in Matteson homologation 307
 - synthesis of biaryls, by Suzuki coupling 69, 124
- t**
- Takai reaction 47
 - tandem
 - [4+2] cycloaddition/allylboration 253, 357
 - allylation/dioxene thermolysis 273
 - allylboration/allylboration 271
 - allylic borylation/intramolecular allylation 271
 - aza[4+2] cycloaddition/allylboration 266, 360
 - cross-metathesis/allylboration 254, 268 f, 269
 - hydroformylation/allylboration 267
 - oxa[4+2] cycloaddition/allylboration 361
 - reactions using allylboronates 266
 - substrate scope 268
 - tartrate, binding to boronic acid sensors 81
 - tartrate alkenylboronates 289
 - in Petasis reaction 289
 - tartrate allylboronates, addition to aldehydes 71, 260, 270
 - tartrate esters, exchange with 1,2-phenylene-diamine 24
 - tautomycin, synthesis using Matteson homologation 322
 - teicoplanin aglycon 73

- temperature-jump relaxation method 22
- tetraboronic acid, in saccharide detection 465, 469
- tetrabutylammonium bromide, phase-transfer in Suzuki coupling 164
- tetracoordinate boronate anion, in Suzuki coupling 69
- tetracoordinated boronate adducts, bond lengths 5
- tetraenal, preparation 273
- N,N,N,N*-tetramethylhexanediamine, base in Suzuki coupling 163
- 2,2,6,6-tetramethylpiperidine (LTMP), in ortho-lithiations 34
- tetra-ortho-substituted biaryls, by Suzuki coupling 142
- tetraphenyl dioxaborolane, allylboronate derivative 272
- tetraphosphine ligand (tedicyp), in Suzuki coupling 149, 150
- tetrasaccharide, recognition by diboronic acid sensors 503
- thallium hydroxide, base in Suzuki coupling 70, 143
- therapeutics, boronic acid based 2
- thexylborane 43
- thiazoles (substituted), preparation and applications 136 f, 137
- thiazolines, by boronic acid – catalyzed dehydration 388
- thienodiazaborine, as enzyme inhibitor 82
- thienylboronic acids 37
- thioalkynes, Ni-catalyzed catecholboration 45
- thioethers, preparation from boronic acids 224
- thioketals, OXB-catalyzed reduction 422
- thiols, Cu-catalyzed coupling with boronic acids 73
- thiophenes, TM-catalyzed borylation 111
- three-component borono-mannich reaction 282
- three-component process with allylboronates 253
- thrombin 485, 487
- inhibition by boronic acids 485
 - X-ray crystal structure with boronic acid 487
- thyroxine 73, 207
- preparation from arylboronic acid 207
- p*-tolylboronic acid, bromination 50
- triboronic acid, component of dye displacement assay 469
- α -*p*-tosyloxyketones, OXB-catalyzed reduction 420
- trans*-1-alkenylboronic esters RCH=CH-B(O₂C₂Me₄) 45, 339, 340
- by the reaction of (ClCr)₂CHBpin and aldehyde 339
 - from (BrZn)₂CHBpin and aldehyde 340
 - preparation by hydroboration 44
- trans*-cyclohexenediols 353
- synthesis from (*E*)-1,2-bis(catecholboryl)ethylene 353
- trans*-hydroboration 45 f
- using alkynyl bromides 45
 - TM-catalyzed 46
- transition state analogs for protease inhibition 485
- transition state assembly 394, 397, 400, 403
- BLA-catalyzed [4+2] cycloaddition 394, 397
 - CAB-catalyzed [4+2] cycloaddition 400
 - OXB-catalyzed Mukaiyama aldol 403
- transmetalation 34, 47, 300 f
- boron-to-copper 47
 - boron-to-silicon/tin 34
 - of alkenylboronic esters with dimethylzinc 301
 - of boronic acids with Ni(II) 301
 - of boronic acids with Rh(I) 300
- tri(*t*-butyl)phosphine 197
- tri(pentafluorophenyl)borane (C₆F₅)₃B 377
- trialkylboranes 28
- trialkylborates 28
- trialkylphosphines 151
- water-soluble 151
- triallylboranes, preparation of allylboronates 250
- triarylismuth reagents 206
- triarylphosphines, ligands in Suzuki coupling 150
- tributyltin hydride 337
- tricyclohexylphosphine, in active catalyst for Suzuki coupling 158
- trienylboronic acid 37, 58
- triethylamine, base in Cu-promoted couplings 207, 213, 230
- 3,3,3-trifluoroalanine, preparation using OXB reduction 434
- 3,4,5-trifluorobenzeneboronic acid (3,4,5-F₃C₆H₂B(OH)₂) 76, 382, 386, 388
- catalyst in polycondensation to produce polyamides 386
 - catalysts in the amidation of carboxylic acids with amines 76, 382

trifluoroborate salts 18

- additions to iminium ions 298
- preparation from boronic acids (esters) 27
- Cu-promoted coupling with alcohol and phenols 225
- Rh-catalyzed conjugate additions 27, 174
- stability 27
- Suzuki coupling 27
- transformation into dichloroboranes 27
- use in allylation of aldehydes 27

triisopropylborate, in preparation of boronic acids (esters) 32, 38

4,4,6-trimethyl-1,3,2-dioxaborinane, hydroboration of alkynes 44

trimethylamine *N*-oxide, oxidation of boronic acids (esters) 43, 64

trimethylborate, in preparation of boronic acids (esters) 28

trimethylsilyl enol ethers, in OXB-catalyzed aldol 402

(trimethylsilyl)oxide 319

α -trimethylsilylmethylboronic ester 47, 52

α -trimethylstannyl alkylboronate, lithiation 53

tri-*tert*-butylphosphine 46, 163

- use in Suzuki coupling 163

trivinylboroxine/pyridine complex, Cu-promoted coupling 223

tRNA, analysis/separation using boronic acid supports 80

tryptophan-derived OXB catalysts 391

u

Ugi 4-component reaction, with Petasis reaction 287

Ullmann coupling 205

ultraviolet and infrared spectroscopy 62

α,β -unsaturated aldehydes, in OXB-catalyzed Mukaiyama aldol 404

α,β -unsaturated carbonyl compounds

- in preparation of allylboronates 250
- Rh-catalyzed conjugate addition with boronic acids 181

α,β -unsaturated esters 69, 181

- preparation by Suzuki coupling 69
- Rh-catalyzed conjugate addition with boronic acids 181

α,β -unsaturated ketones, Rh-catalyzed addition with boronic acid 171

uronic (D-glucuronic and D-galacturonic) acids 457

v

vancomycin 73

Vaska's complex, rhodium analogue 198

Velcade (bortezomib) 2, 82, 305, 331, 482 f, 484, 494 ff

- as proteasome inhibitor for cancer therapy 331, 494 f
- plasma half-life 484
- synthesis using (α -haloalkyl)boronic esters 305
- target and mode of action 495
- toxicological studies 484

vinylboronic esters 352

- as formal hydroxyethylene equivalent in Diels-Alder reactions 352

vinylboronic acid (ethylene boronic acid) 223

vinylidioxaborocines, dipolar cycloaddition with nitrile oxides 364

vinyl-substituted nitrogen heteroarenes

- Rh-catalyzed conjugate addition of boronic acids 184

w

Wang resin 154, 294, 296

- in Petasis borono-mannich reaction 294, 296
- in solid-phase Suzuki coupling 154

water-soluble palladium catalysts and ligands, for Suzuki coupling 141, 151

water-soluble phosphine, in Rh-catalyzed addition of arylboronic acids 195

x

xanthates, radical additions to alkenylboronic esters 347

X-ray crystal structure 485

- of peptidyl boronic acid bound to thrombin 485

X-ray crystallographic analysis 3, 26

Xylose, in Petasis reaction 291

y

Yb(fod)₃, in hetero-Diels-Alder reaction 361

α,β -ynones, OXB-catalyzed reduction 424

z

zinc chloride (ZnCl₂), in Matteson homologation 54, 306, 318,

α -zincated alkylboronic ester, preparation 53, 372

