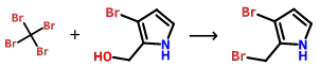
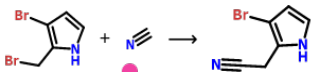
Path #1

Score: 16.00 Estimated cost ($/g): 546.81

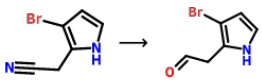
Reaction name: Appel reaction with primary alcohol
Reaction conditions: PPh3, CBr4
Alternative conditions: NBS, PPh3
Solvent: DCM or THF
Alternative Solvent: t-Butyl ethyl ether
Literature reference: 10.1021/ja9101503 and 10.1016/j.bmcl.2009.11.105 and 10.1021/op050137f (industrial application) and 10.1021/op0000733 (industrial application) and 10.1021/op9002455 (industrial application) and 10.1021/op9002455 (industrial application) and 10.1021/acs.oprd.5b00313 (industrial application)



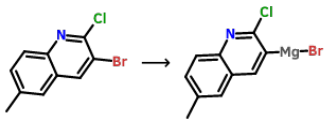
Reaction name: Sn2 cyanide
Reaction conditions: heating, KCN
Solvent: water
Literature reference: 10.1016/j.tet.2012.05.013 and 10.1016/j.tetlet.2016.08.054



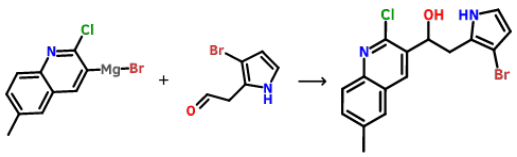
Reaction name: Reduction of nitriles to aldehydes
Reaction conditions: DIBAL, toluene
Solvent: toluene or DCM or THF or hexane
Literature reference: 10.1002/anie.200704095 and 10.1002/ejoc.200390130



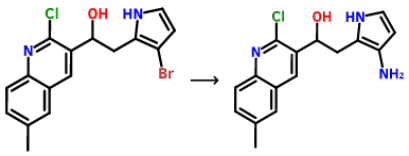
Reaction name: Synthesis of Grignard Reagents
Reaction conditions: Mg, Et2O or Mg, THF
Solvent: Et2O or THF
Alternative Solvent: t-Butyl ethyl ether
Literature reference: 10.1021/ol5018273 (Supplementary, page 3) and 10.1021/ol035846x and 10.1021/jacs.6b03384 (Supplementary, page 3)



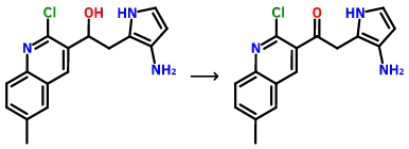
Reaction name: Addition of aryl Grignard reagent to aldehyde
Reaction conditions: THF, cooling
Solvent: THF
Alternative Solvent: t-Butyl ethyl ether
Literature reference: 10.1021/ja039076w and 10.1016/j.bmcl.2006.05.041



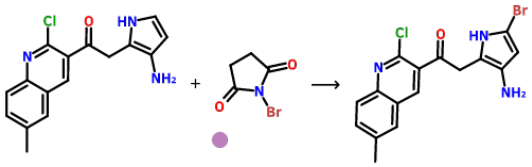
Reaction name: Buchwald Hartwig Amination
Reaction conditions: NH3, Pd[(o-tol)3P]2, NaOtBu, CyPF-t-Bu, dioxane
Solvent: dioxane
Alternative Solvent: CPME
Literature reference: 10.1021/ja903049z and 10.1021/ol401612c and 10.1021/ol501739g and 10.1021/op8000146 and WO2008133459 (Preparation Examples 9-14) and EP2149555 (Synthesis Example 7)



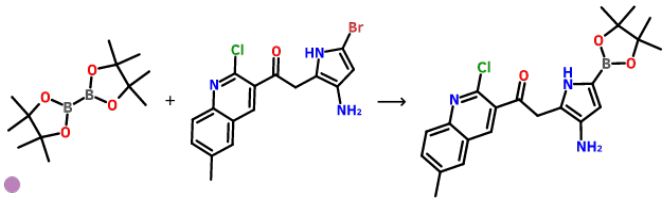
Reaction name: Dess-Martin Oxidation
Reaction conditions: Dess-Martin periodinane
Solvent: DCM or THF
Alternative Solvent: t-Butyl ethyl ether
Literature reference: 10.1016/j.steroids.2012.03.010 and 10.1002/adsc.201400702



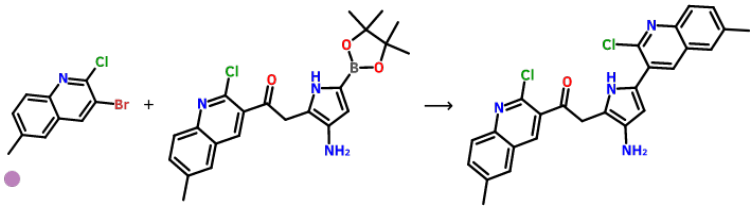
Reaction name: Electrophilic aromatic bromination
Reaction conditions: NBS
Solvent: DCM or DMF
Alternative Solvent: DMSO
Literature reference: 10.1016/j.tetlet.2003.08.069 and 10.1016/j.ejmech.2017.06.006



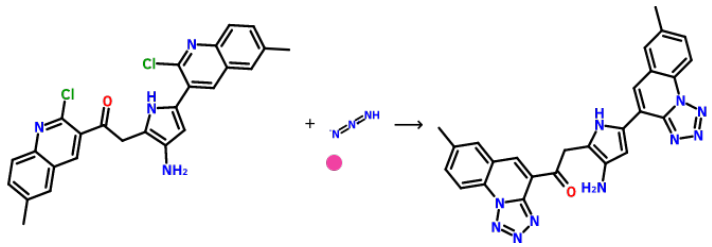
Reaction name: Pinacoloboranes synthesis
Reaction conditions: KOAc, [Pd]-catalyst, DMSO
Solvent: dioxane
Alternative Solvent: CPME
Literature reference: 10.1021/jm051065l and 10.1021/ol203216h (SI p.3) and 10.1021/acs.oprd.2c00350 (industrial application)



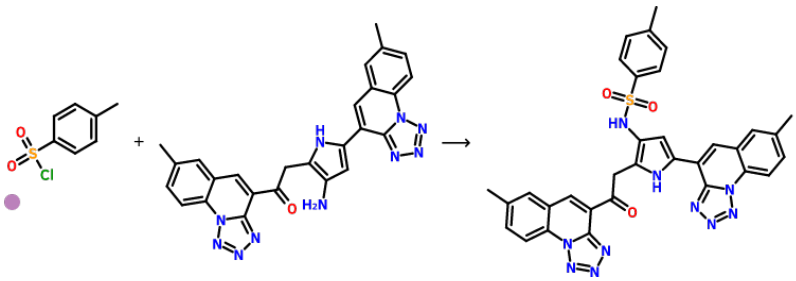
Reaction name: Suzuki Aryl-Aryl Coupling
Reaction conditions: [Pd]-catalyst, ligand, base
Solvent: dioxane
Alternative Solvent: CPME
Literature reference: 10.1126/science.aaa5414 and 10.1021/cr100346g



Reaction name: Formation of tetrazole
Reaction conditions: sodium azide, N,N-dimethyl-formamide
Solvent: N,N-dimethyl-formamide
Literature reference: 10.1021/jm049499o

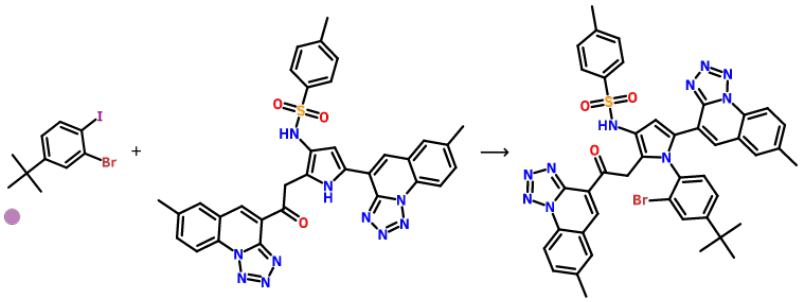


Reaction name: N-sulfonylation
Reaction conditions: NEt3
Solvent: DCM or THF
Alternative Solvent: t-Butyl ethyl ether
Literature reference: 10.1021/jo5011334 (experimental) NS 10.1016/j.tetlet.2007.11.044

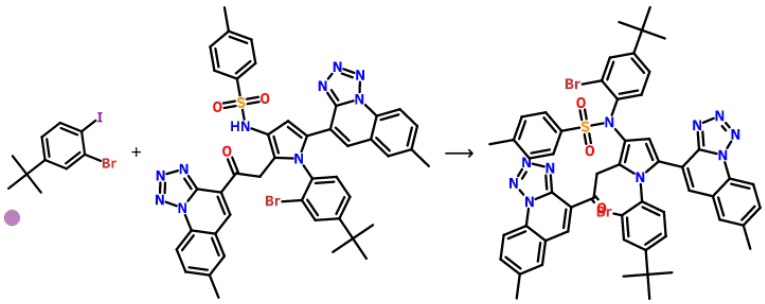


Reaction name: C-N Coupling with NH-heterocycles
Reaction conditions: CuI, Cs2CO3
Solvent: DMF
Alternative Solvent: DMSO
Literature reference: 10.1021/acs.joc.7b01192 and 10.1002/ejoc.201100112 and 10.1002/anie.200804427 and US10957859 (Preparation of 4-bromo-9-phenyl-9H-carbazole 3a; industrial

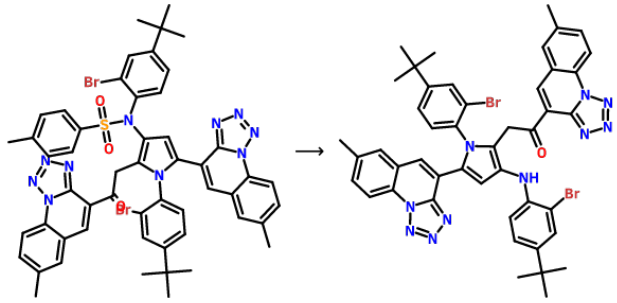
application: MERCK KGAA)



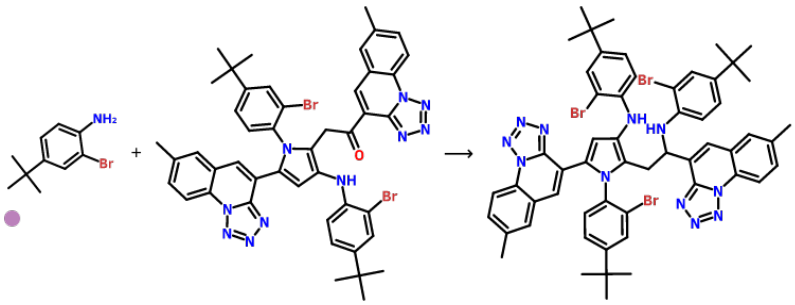
Reaction name: C-N Coupling with sulfonamides
Reaction conditions: CuI, K2CO3
Solvent: DMF
Alternative Solvent: DMSO
Literature reference: 10.1016/j.tetlet.2005.08.149 and 10.1002/anie.200802187



Reaction name: Hydrolysis of sulfonamides
Reaction conditions: HBr, AcOH, PhOH, rt or H2SO4, TFA, heat
Solvent: AcOH or H2O
Literature reference: 10.1055/s-0029-1217392 and 10.1021/jm070191h



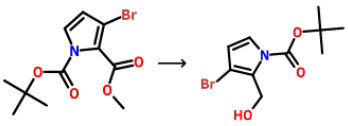
Reaction name: Reductive Amination
Reaction conditions: NaBH3CN or NaBH(OAc)3, AcOH or Cu(OAc)2, H2 then H2O quench
Solvent: MeOH or DCM
Literature reference: 10.1039/C3GC40359A and 10.1039/C2GC35565E and 10.1021/jm960158n and 10.1021/jm00156a023 and industrial application: WO2015057859 ([087])



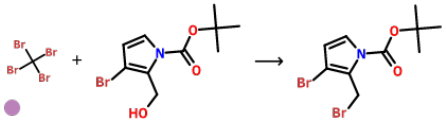
Path #2

Score: 21.50 Estimated cost ($/g): 193.53

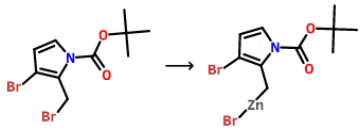
Reaction name: Reduction of Esters to Alcohols
Reaction conditions: LiAl(OtBu)3H
Solvent: Et2O or THF
Alternative Solvent: t-Butyl ethyl ether
Literature reference: 10.1002/anie.200704093



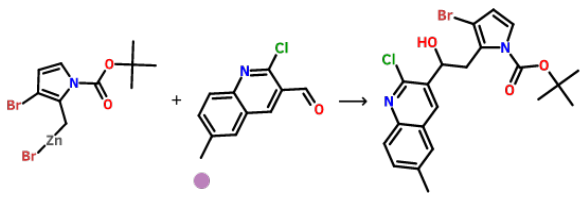
Reaction name: Appel reaction with primary alcohol
Reaction conditions: PPh3, CBr4
Alternative conditions: NBS, PPh3
Solvent: DCM or THF
Alternative Solvent: t-Butyl ethyl ether
Literature reference: 10.1021/ja9101503 and 10.1016/j.bmcl.2009.11.105 and 10.1021/op050137f (industrial application) and 10.1021/op0000733 (industrial application) and 10.1021/op9002455 (industrial application) and 10.1021/op9002455 (industrial application) and 10.1021/acs.oprd.5b00313 (industrial application)



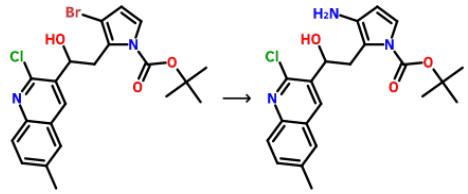
Reaction name: Organozinc compounds synthesis
Reaction conditions: Zn, LiCl
Solvent: THF
Alternative Solvent: t-Butyl ethyl ether
Literature reference: 10.1021/ol500790p and 10.1002/anie.201603923 (SI p.4)



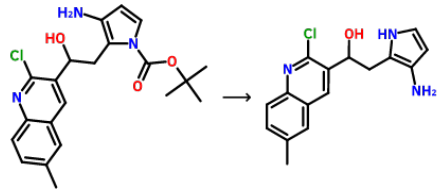
Reaction name: Zincoorganic compound addition to aldehyde
Reaction conditions: THF
Solvent: THF
Alternative Solvent: t-Butyl ethyl ether
Literature reference: 10.1039/C3OB41931B and 10.1021/jo0202233



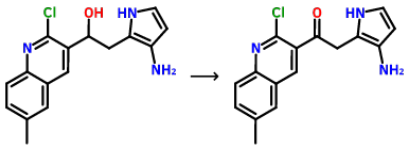
Reaction name: Buchwald Hartwig Amination
Reaction conditions: NH3, Pd[(o-tol)3P]2, NaOtBu, CyPF-t-Bu, dioxane
Solvent: dioxane
Alternative Solvent: CPME
Literature reference: 10.1021/ja903049z and 10.1021/ol401612c and 10.1021/ol501739g and 10.1021/op8000146 and WO2008133459 (Preparation Examples 9-14) and EP2149555 (Synthesis Example 7)



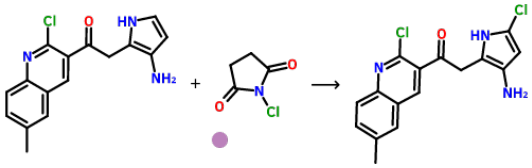
Reaction name: N-Boc deprotection
Reaction conditions: TFA
Solvent: DCM or dioxane or AcOEt
Literature reference: 10.1021/jo070460b and 10.1016/j.bmcl.2012.02.104 and 10.1016/j.bmc.2014.07.025



Reaction name: Dess-Martin Oxidation
Reaction conditions: Dess-Martin periodinane
Solvent: DCM or THF
Alternative Solvent: t-Butyl ethyl ether
Literature reference: 10.1016/j.steroids.2012.03.010 and 10.1002/adsc.201400702

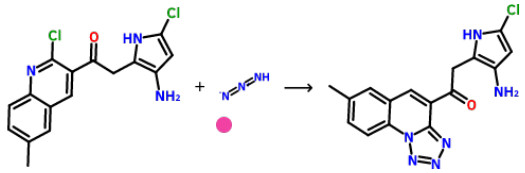


Reaction name: Electrophilic aromatic chlorination
Reaction conditions: NCS
Solvent: DCM or DMF
Alternative Solvent: DMSO
Literature reference: 10.1016/j.ejmech.2017.02.063 and 10.1002/adsc.200303229

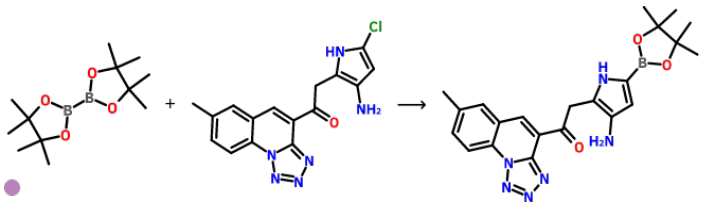


Reaction name: Formation of tetrazole
Reaction conditions: sodium azide, N,N-dimethyl-formamide

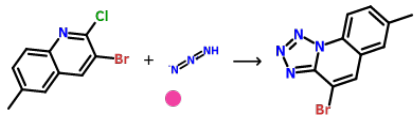
Solvent: N,N-dimethyl-formamide
Literature reference: 10.1021/jm049499o



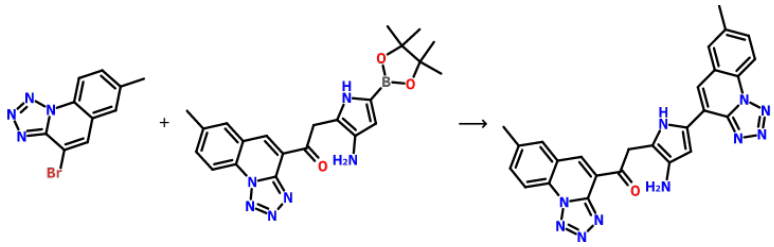
Reaction name: Coupling of B2(pin)2 with aryl halide
Reaction conditions: Pd-cat, AcOK, 1,4-dioxane, 70-110 deg C
Solvent: dioxane or THF or DMF or toluene or DMSO
Literature reference: 10.1021/ol0171463 and 10.1021/jo202472k and 10.1021/jm051065l and 10.1021/acs.oprd.2c00057 (industrial application)



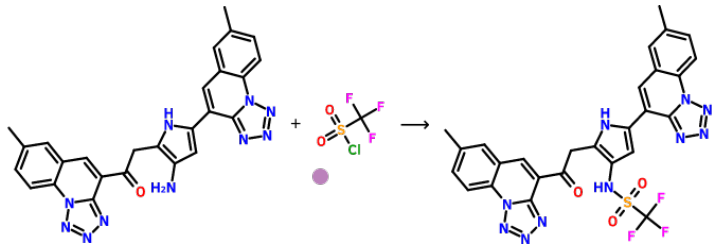
Reaction name: Formation of tetrazole
Reaction conditions: sodium azide, N,N-dimethyl-formamide
Solvent: N,N-dimethyl-formamide
Literature reference: 10.1021/jm049499o



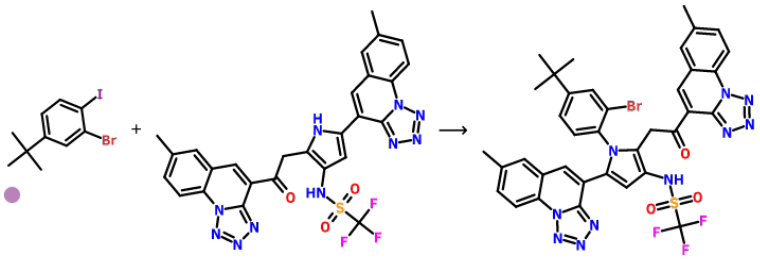
Reaction name: Suzuki Aryl-Aryl Coupling
Reaction conditions: [Pd]-catalyst, ligand, base
Solvent: dioxane
Alternative Solvent: CPME
Literature reference: 10.1126/science.aaa5414 and 10.1021/cr100346g



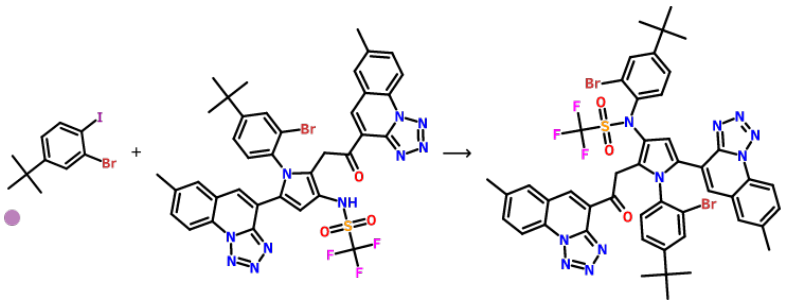
Reaction name: N-sulfonylation
Reaction conditions: NEt3
Solvent: DCM or THF
Alternative Solvent: t-Butyl ethyl ether
Literature reference: 10.1021/jo5011334 (experimental) NS 10.1016/j.tetlet.2007.11.044



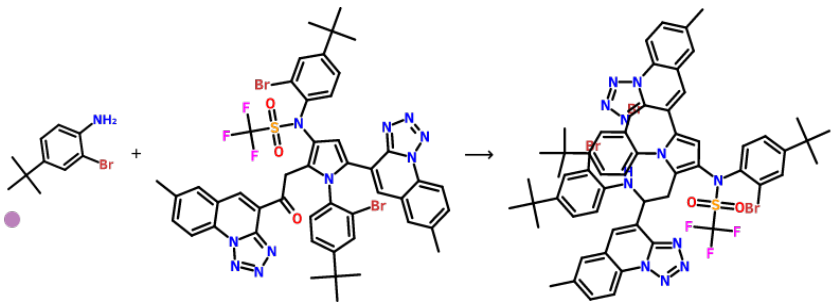
Reaction name: C-N Coupling with NH-heterocycles
Reaction conditions: CuI, Cs2CO3
Solvent: DMF
Alternative Solvent: DMSO
Literature reference: 10.1021/acs.joc.7b01192 and 10.1002/ejoc.201100112 and 10.1002/anie.200804427 and US10957859 (Preparation of 4-bromo-9-phenyl-9H-carbazole 3a; industrial application: MERCK KGAA)



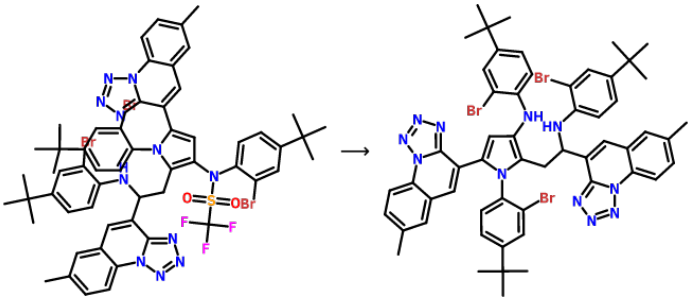
Reaction name: C-N Coupling with sulfonamides
Reaction conditions: CuI, K2CO3
Solvent: DMF
Alternative Solvent: DMSO
Literature reference: 10.1016/j.tetlet.2005.08.149 and 10.1002/anie.200802187



Reaction name: Reductive Amination
Reaction conditions: NaBH3CN or NaBH(OAc)3, AcOH or Cu(OAc)2, H2 then H2O quench
Solvent: MeOH or DCM
Literature reference: 10.1039/C3GC40359A and 10.1039/C2GC35565E and 10.1021/jm960158n and 10.1021/jm00156a023 and industrial application: WO2015057859 ([087])



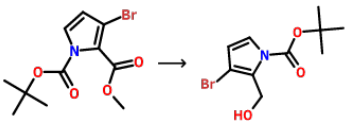
Reaction name: Reductive desulfoamidation
Reaction conditions: LAH, THF
Solvent: THF or Et2O
Alternative Solvent: t-Butyl ethyl ether
Literature reference: 10.1021/ja901352k and 10.1055/s-0036-1558973 and WO2005080402 (intermediate amine 27; industrial application: ASTRAZENECA PLC)



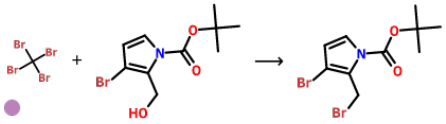
Path #3

Score: 21.50 Estimated cost ($/g): 193.53

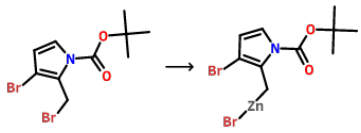
Reaction name: Reduction of Esters to Alcohols
Reaction conditions: LiAl(OtBu)3H
Solvent: Et2O or THF
Alternative Solvent: t-Butyl ethyl ether
Literature reference: 10.1002/anie.200704093



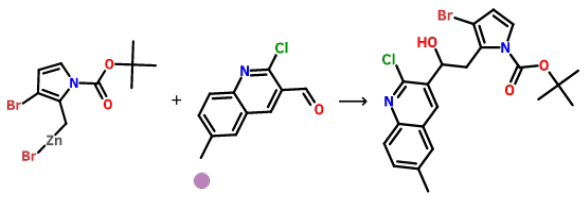
Reaction name: Appel reaction with primary alcohol
Reaction conditions: PPh3, CBr4
Alternative conditions: NBS, PPh3
Solvent: DCM or THF
Alternative Solvent: t-Butyl ethyl ether
Literature reference: 10.1021/ja9101503 and 10.1016/j.bmcl.2009.11.105 and 10.1021/op050137f (industrial application) and 10.1021/op0000733 (industrial application) and 10.1021/op9002455 (industrial application) and 10.1021/op9002455 (industrial application) and 10.1021/acs.oprd.5b00313 (industrial application)



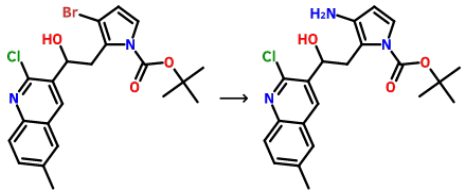
Reaction name: Organozinc compounds synthesis
Reaction conditions: Zn, LiCl
Solvent: THF
Alternative Solvent: t-Butyl ethyl ether
Literature reference: 10.1021/ol500790p and 10.1002/anie.201603923 (SI p.4)



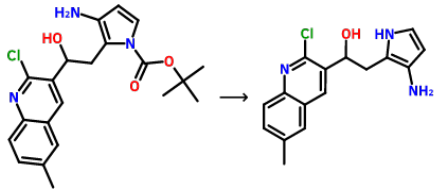
Reaction name: Zincoorganic compound addition to aldehyde
Reaction conditions: THF
Solvent: THF
Alternative Solvent: t-Butyl ethyl ether
Literature reference: 10.1039/C3OB41931B and 10.1021/jo0202233



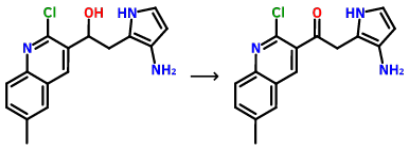
Reaction name: Buchwald Hartwig Amination
Reaction conditions: NH3, Pd[(o-tol)3P]2, NaOtBu, CyPF-t-Bu, dioxane
Solvent: dioxane
Alternative Solvent: CPME
Literature reference: 10.1021/ja903049z and 10.1021/ol401612c and 10.1021/ol501739g and 10.1021/op8000146 and WO2008133459 (Preparation Examples 9-14) and EP2149555 (Synthesis Example 7)



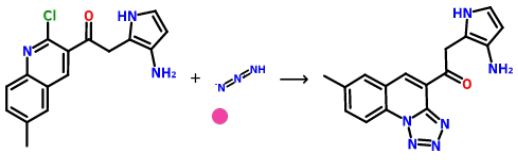
Reaction name: N-Boc deprotection
Reaction conditions: TFA
Solvent: DCM or dioxane or AcOEt
Literature reference: 10.1021/jo070460b and 10.1016/j.bmcl.2012.02.104 and 10.1016/j.bmc.2014.07.025



Reaction name: Dess-Martin Oxidation
Reaction conditions: Dess-Martin periodinane
Solvent: DCM or THF
Alternative Solvent: t-Butyl ethyl ether
Literature reference: 10.1016/j.steroids.2012.03.010 and 10.1002/adsc.201400702

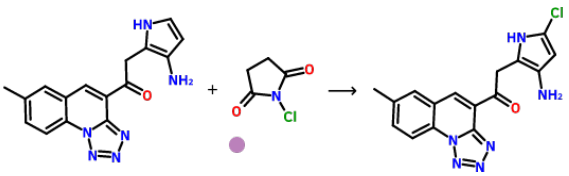


Reaction name: Formation of tetrazole
Reaction conditions: sodium azide, N,N-dimethyl-formamide
Solvent: N,N-dimethyl-formamide
Literature reference: 10.1021/jm049499o

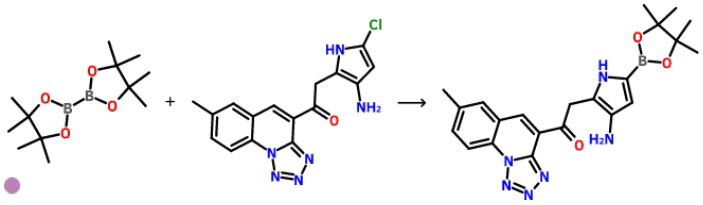


Reaction name: Electrophilic aromatic chlorination
Reaction conditions: NCS
Solvent: DCM or DMF
Alternative Solvent: DMSO

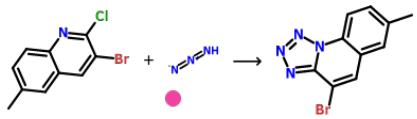
Literature reference: 10.1016/j.ejmech.2017.02.063 and 10.1002/adsc.200303229



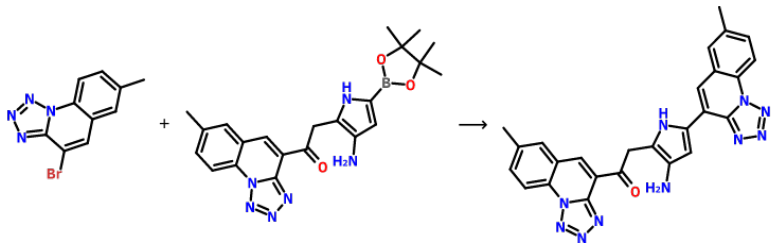
Reaction name: Coupling of B2(pin)2 with aryl halide
Reaction conditions: Pd-cat, AcOK, 1,4-dioxane, 70-110 deg C
Solvent: dioxane or THF or DMF or toluene or DMSO
Literature reference: 10.1021/ol0171463 and 10.1021/jo202472k and 10.1021/jm051065l and 10.1021/acs.oprd.2c00057 (industrial application)



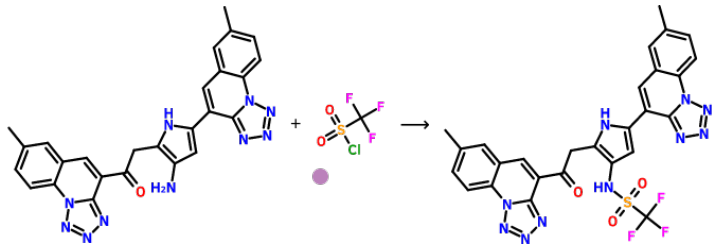
Reaction name: Formation of tetrazole
Reaction conditions: sodium azide, N,N-dimethyl-formamide
Solvent: N,N-dimethyl-formamide
Literature reference: 10.1021/jm049499o



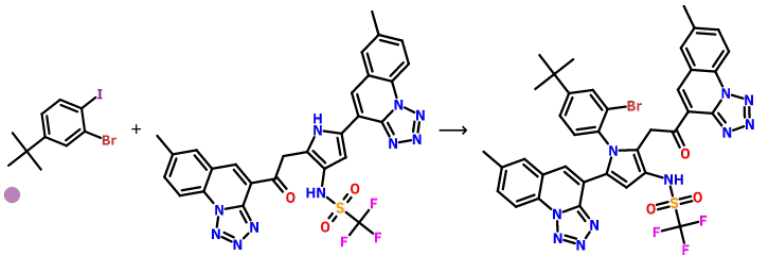
Reaction name: Suzuki Aryl-Aryl Coupling
Reaction conditions: [Pd]-catalyst, ligand, base
Solvent: dioxane
Alternative Solvent: CPME
Literature reference: 10.1126/science.aaa5414 and 10.1021/cr100346g



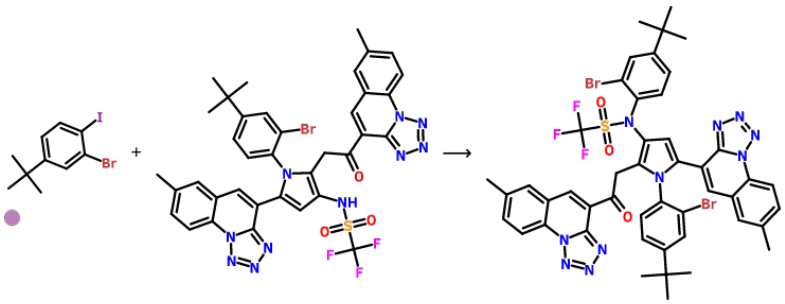
Reaction name: N-sulfonylation
Reaction conditions: NEt3
Solvent: DCM or THF
Alternative Solvent: t-Butyl ethyl ether
Literature reference: 10.1021/jo5011334 (experimental) NS 10.1016/j.tetlet.2007.11.044



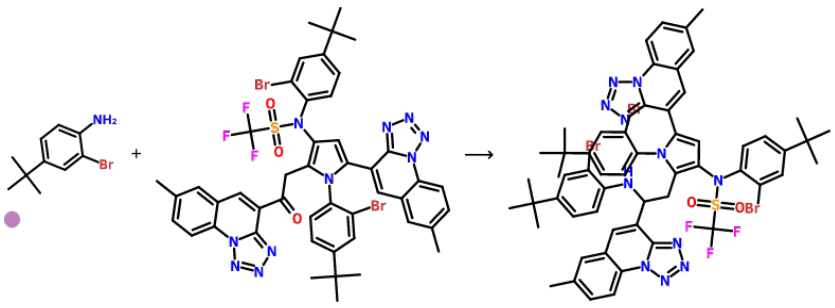
Reaction name: C-N Coupling with NH-heterocycles
Reaction conditions: CuI, Cs2CO3
Solvent: DMF
Alternative Solvent: DMSO
Literature reference: 10.1021/acs.joc.7b01192 and 10.1002/ejoc.201100112 and 10.1002/anie.200804427 and US10957859 (Preparation of 4-bromo-9-phenyl-9H-carbazole 3a; industrial application: MERCK KGAA)



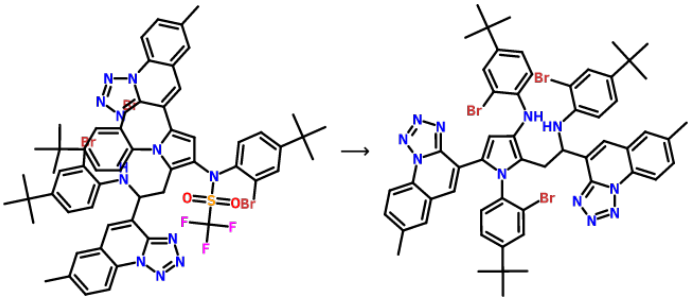
Reaction name: C-N Coupling with sulfonamides
Reaction conditions: CuI, K2CO3
Solvent: DMF
Alternative Solvent: DMSO
Literature reference: 10.1016/j.tetlet.2005.08.149 and 10.1002/anie.200802187



Reaction name: Reductive Amination
Reaction conditions: NaBH3CN or NaBH(OAc)3, AcOH or Cu(OAc)2, H2 then H2O quench
Solvent: MeOH or DCM
Literature reference: 10.1039/C3GC40359A and 10.1039/C2GC35565E and 10.1021/jm960158n and 10.1021/jm00156a023 and industrial application: WO2015057859 ([087])



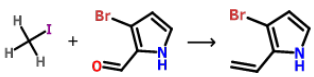
Reaction name: Reductive desulfoamidation
Reaction conditions: LAH, THF
Solvent: THF or Et2O
Alternative Solvent: t-Butyl ethyl ether
Literature reference: 10.1021/ja901352k and 10.1055/s-0036-1558973 and WO2005080402 (intermediate amine 27; industrial application: ASTRAZENECA PLC)



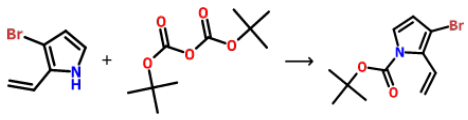
Path #4

Score: 22.00 Estimated cost ($/g): 381.14

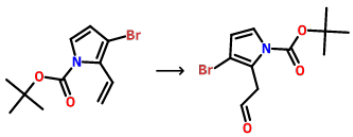
Reaction name: Wittig olefination
Reaction conditions: methyltriphenyl phosphonium bromide, KOtBu
Solvent: THF
Alternative Solvent: t-Butyl ethyl ether
Literature reference: 10.1016/j.dyepig.2015.01.009 and 10.1021/ja905652w and 10.1021/ja00196a042 and 10.1021/acs.joc.7b02030 and 10.1021/op800059y (industrial application)



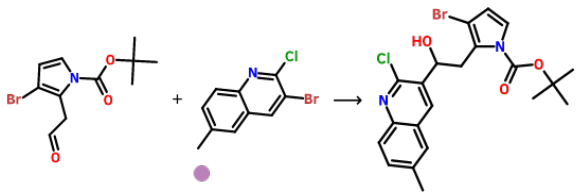
Reaction name: Carbamate synthesis
Reaction conditions: K2CO3
Solvent: THF
Alternative Solvent: t-Butyl ethyl ether
Literature reference: 10.1021/jm501758q and 10.1021/jm9801915



Reaction name: Wacker-type oxidation
Reaction conditions: [Pd]-catalyst, CuCl2, O2, water, NaNO2, tBuOH, nitromethane
Solvent: DMF
Alternative Solvent: DMSO
Literature reference: 10.1021/ja411749k and 10.1002/anie.201306756 and 10.1021/acs.orglett.6b01165 and 10.1039/D0SC03227A

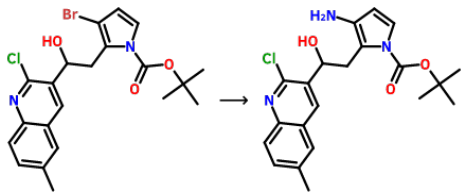


Reaction name: Addition of organolithium reagents to aldehydes
Reaction conditions: THF, -78 deg C
Solvent: THF
Alternative Solvent: t-Butyl ethyl ether
Literature reference: 10.1016/S0040-4039(00)78337-7 and 10.1021/jo070082a and 10.1021/ja806183r and 10.1021/acs.oprd.7b00187

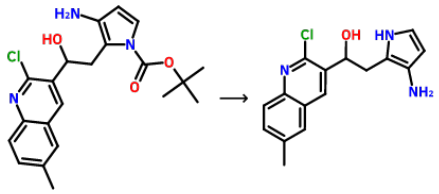


Reaction name: Buchwald Hartwig Amination
Reaction conditions: NH3, Pd[(o-tol)3P]2, NaOtBu, CyPF-t-Bu, dioxane
Solvent: dioxane

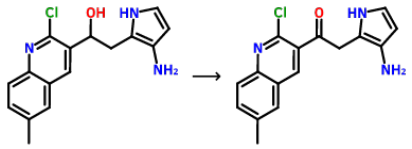
Alternative Solvent: CPME
Literature reference: 10.1021/ja903049z and 10.1021/ol401612c and 10.1021/ol501739g and 10.1021/op8000146 and WO2008133459 (Preparation Examples 9-14) and EP2149555 (Synthesis Example 7)



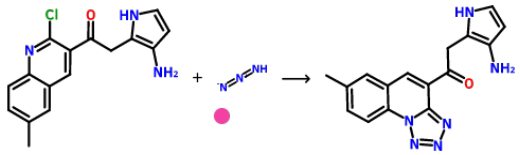
Reaction name: N-Boc deprotection
Reaction conditions: TFA
Solvent: DCM or dioxane or AcOEt
Literature reference: 10.1021/jo070460b and 10.1016/j.bmcl.2012.02.104 and 10.1016/j.bmc.2014.07.025



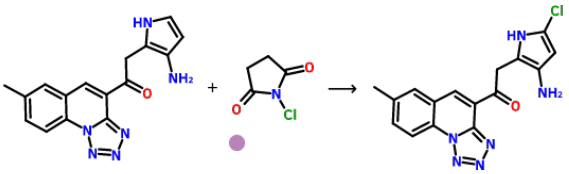
Reaction name: Dess-Martin Oxidation
Reaction conditions: Dess-Martin periodinane
Solvent: DCM or THF
Alternative Solvent: t-Butyl ethyl ether
Literature reference: 10.1016/j.steroids.2012.03.010 and 10.1002/adsc.201400702



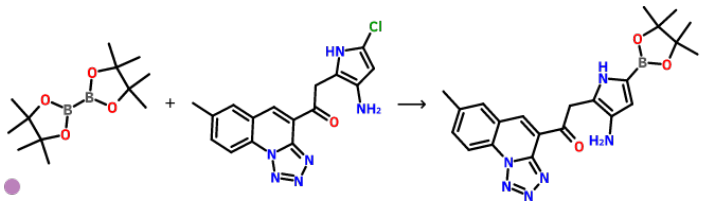
Reaction name: Formation of tetrazole
Reaction conditions: sodium azide, N,N-dimethyl-formamide
Solvent: N,N-dimethyl-formamide
Literature reference: 10.1021/jm049499o



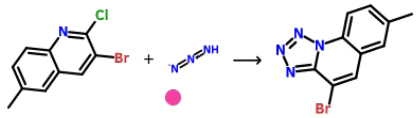
Reaction name: Electrophilic aromatic chlorination
Reaction conditions: NCS
Solvent: DCM or DMF
Alternative Solvent: DMSO
Literature reference: 10.1016/j.ejmech.2017.02.063 and 10.1002/adsc.200303229



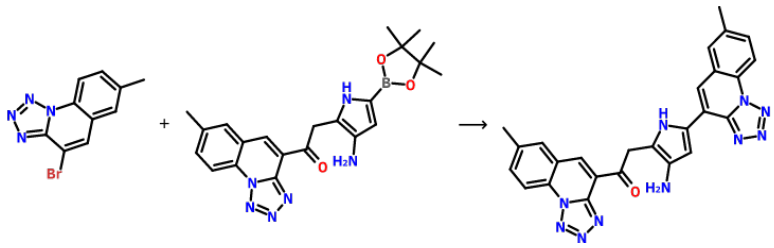
Reaction name: Coupling of B2(pin)2 with aryl halide
Reaction conditions: Pd-cat, AcOK, 1,4-dioxane, 70-110 deg C
Solvent: dioxane or THF or DMF or toluene or DMSO
Literature reference: 10.1021/ol0171463 and 10.1021/jo202472k and 10.1021/jm051065l and 10.1021/acs.oprd.2c00057 (industrial application)



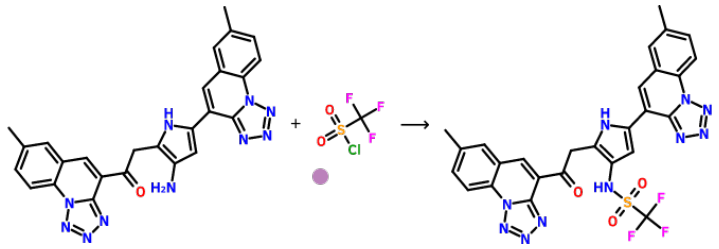
Reaction name: Formation of tetrazole
Reaction conditions: sodium azide, N,N-dimethyl-formamide
Solvent: N,N-dimethyl-formamide
Literature reference: 10.1021/jm049499o



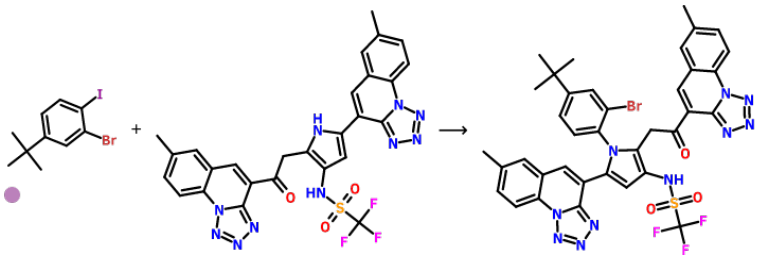
Reaction name: Suzuki Aryl-Aryl Coupling
Reaction conditions: [Pd]-catalyst, ligand, base
Solvent: dioxane
Alternative Solvent: CPME
Literature reference: 10.1126/science.aaa5414 and 10.1021/cr100346g



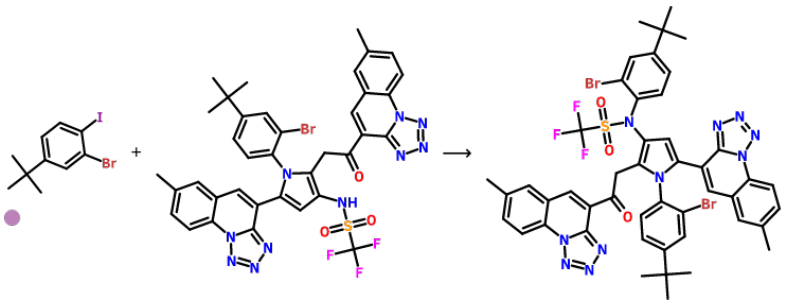
Reaction name: N-sulfonylation
Reaction conditions: NEt3
Solvent: DCM or THF
Alternative Solvent: t-Butyl ethyl ether
Literature reference: 10.1021/jo5011334 (experimental) NS 10.1016/j.tetlet.2007.11.044



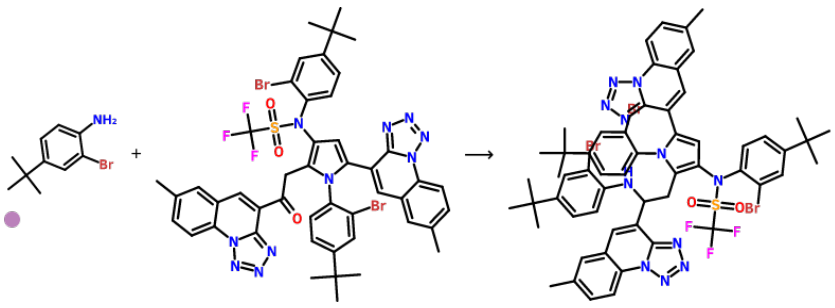
Reaction name: C-N Coupling with NH-heterocycles
Reaction conditions: CuI, Cs2CO3
Solvent: DMF
Alternative Solvent: DMSO
Literature reference: 10.1021/acs.joc.7b01192 and 10.1002/ejoc.201100112 and 10.1002/anie.200804427 and US10957859 (Preparation of 4-bromo-9-phenyl-9H-carbazole 3a; industrial application: MERCK KGAA)



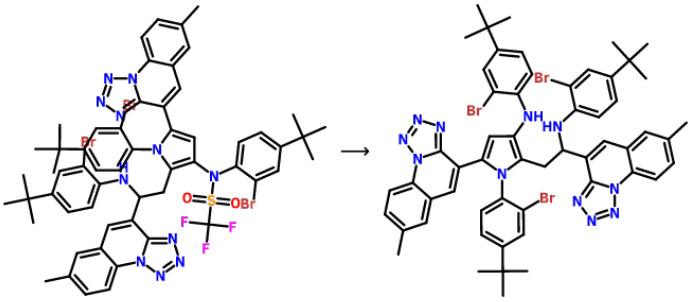
Reaction name: C-N Coupling with sulfonamides
Reaction conditions: CuI, K2CO3
Solvent: DMF
Alternative Solvent: DMSO
Literature reference: 10.1016/j.tetlet.2005.08.149 and 10.1002/anie.200802187



Reaction name: Reductive Amination
Reaction conditions: NaBH3CN or NaBH(OAc)3, AcOH or Cu(OAc)2, H2 then H2O quench
Solvent: MeOH or DCM
Literature reference: 10.1039/C3GC40359A and 10.1039/C2GC35565E and 10.1021/jm960158n and 10.1021/jm00156a023 and industrial application: WO2015057859 ([087])



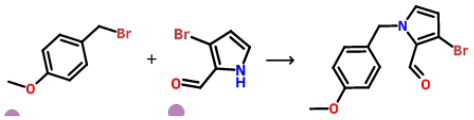
Reaction name: Reductive desulfoamidation
Reaction conditions: LAH, THF
Solvent: THF or Et2O
Alternative Solvent: t-Butyl ethyl ether
Literature reference: 10.1021/ja901352k and 10.1055/s-0036-1558973 and WO2005080402 (intermediate amine 27; industrial application: ASTRAZENECA PLC)



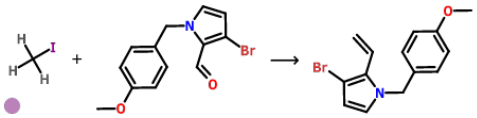
Path #5

Score: 27.00 Estimated cost ($/g): 388.34

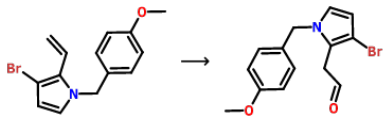
Reaction name: N-heterocycle alkylation
Reaction conditions: K2CO3
Solvent: DMF
Alternative Solvent: DMSO
Literature reference: 10.1021/jo00185a023 and 10.1080/00397910903226166



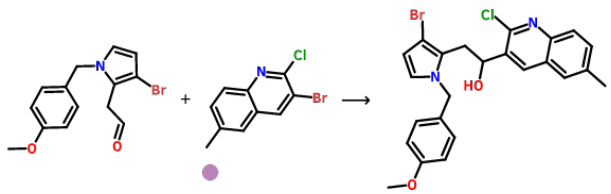
Reaction name: Wittig olefination
Reaction conditions: methyltriphenyl phosphonium bromide, KOtBu
Solvent: THF
Alternative Solvent: t-Butyl ethyl ether
Literature reference: 10.1016/j.dyepig.2015.01.009 and 10.1021/ja905652w and 10.1021/ja00196a042 and 10.1021/acs.joc.7b02030 and 10.1021/op800059y (industrial application)



Reaction name: Wacker-type oxidation
Reaction conditions: [Pd]-catalyst, CuCl2, O2, water, NaNO2, tBuOH, nitromethane
Solvent: DMF
Alternative Solvent: DMSO
Literature reference: 10.1021/ja411749k and 10.1002/anie.201306756 and 10.1021/acs.orglett.6b01165 and 10.1039/D0SC03227A

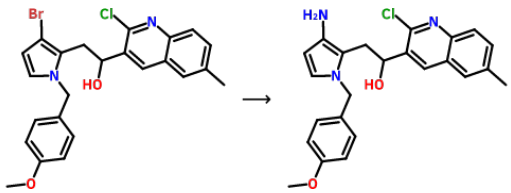


Reaction name: Addition of organolithium reagents to aldehydes
Reaction conditions: THF, -78 deg C
Solvent: THF
Alternative Solvent: t-Butyl ethyl ether
Literature reference: 10.1016/S0040-4039(00)78337-7 and 10.1021/jo070082a and 10.1021/ja806183r and 10.1021/acs.oprd.7b00187

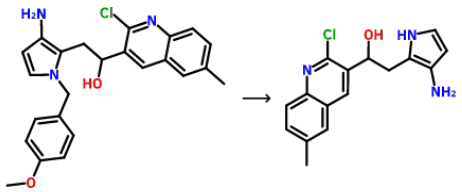


Reaction name: Buchwald Hartwig Amination
Reaction conditions: NH3, Pd[(o-tol)3P]2, NaOtBu, CyPF-t-Bu, dioxane

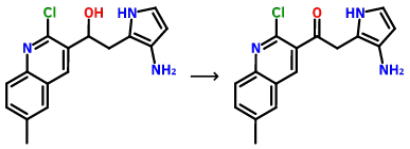
Solvent: dioxane
Alternative Solvent: CPME
Literature reference: 10.1021/ja903049z and 10.1021/ol401612c and 10.1021/ol501739g and 10.1021/op8000146 and WO2008133459 (Preparation Examples 9-14) and EP2149555 (Synthesis Example 7)



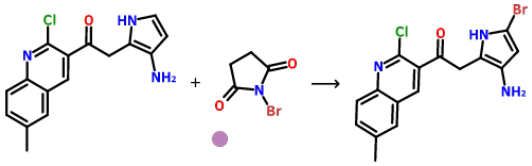
Reaction name: Removal of PMB group from N-H heterocycle
Reaction conditions: TFA, DCM
Solvent: DCM, anisole or water or THF
Literature reference: 10.1016/j.bmc.2006.02.018



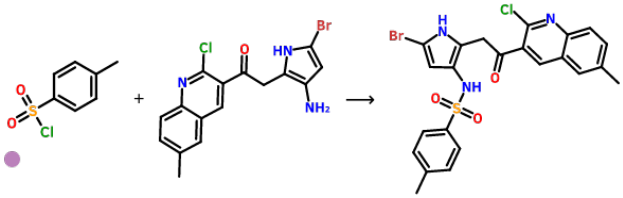
Reaction name: Dess-Martin Oxidation
Reaction conditions: Dess-Martin periodinane
Solvent: DCM or THF
Alternative Solvent: t-Butyl ethyl ether
Literature reference: 10.1016/j.steroids.2012.03.010 and 10.1002/adsc.201400702



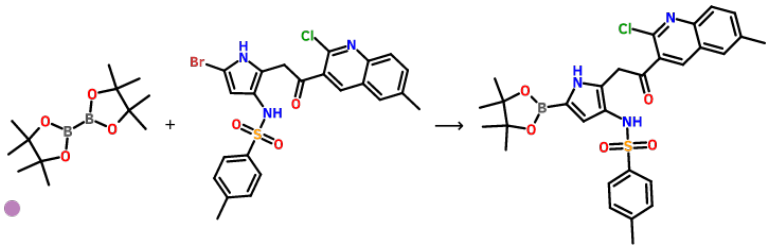
Reaction name: Electrophilic aromatic bromination
Reaction conditions: NBS
Solvent: DCM or DMF
Alternative Solvent: DMSO
Literature reference: 10.1016/j.tetlet.2003.08.069 and 10.1016/j.ejmech.2017.06.006



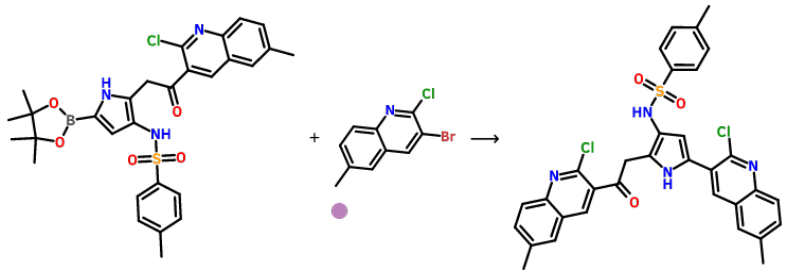
Reaction name: N-sulfonylation
Reaction conditions: NEt3
Solvent: DCM or THF
Alternative Solvent: t-Butyl ethyl ether
Literature reference: 10.1021/jo5011334 (experimental) NS 10.1016/j.tetlet.2007.11.044



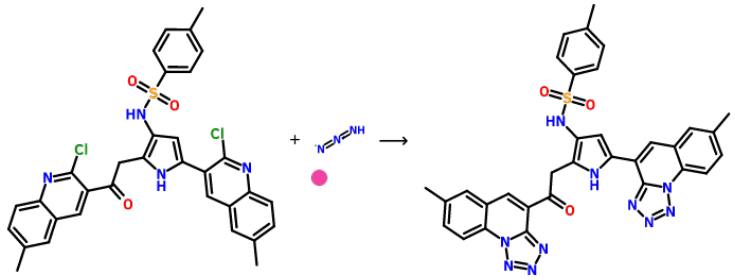
Reaction name: Pinacoloboranes synthesis
Reaction conditions: KOAc, [Pd]-catalyst, DMSO
Solvent: dioxane
Alternative Solvent: CPME
Literature reference: 10.1021/jm051065l and 10.1021/ol203216h (SI p.3) and 10.1021/acs.oprd.2c00350 (industrial application)



Reaction name: Suzuki Aryl-Aryl Coupling
Reaction conditions: [Pd]-catalyst, ligand, base
Solvent: dioxane
Alternative Solvent: CPME
Literature reference: 10.1126/science.aaa5414 and 10.1021/cr100346g

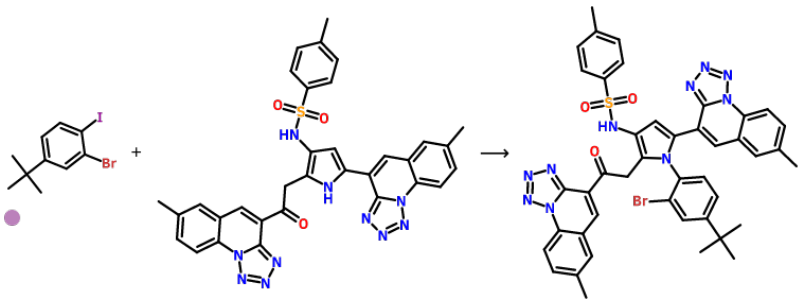


Reaction name: Formation of tetrazole
Reaction conditions: sodium azide, N,N-dimethyl-formamide
Solvent: N,N-dimethyl-formamide
Literature reference: 10.1021/jm049499o

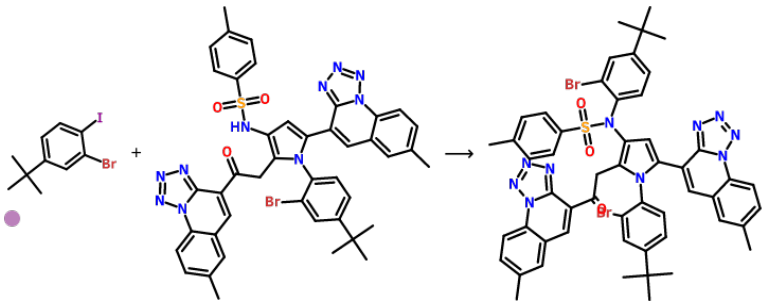


Reaction name: C-N Coupling with NH-heterocycles
Reaction conditions: CuI, Cs2CO3
Solvent: DMF

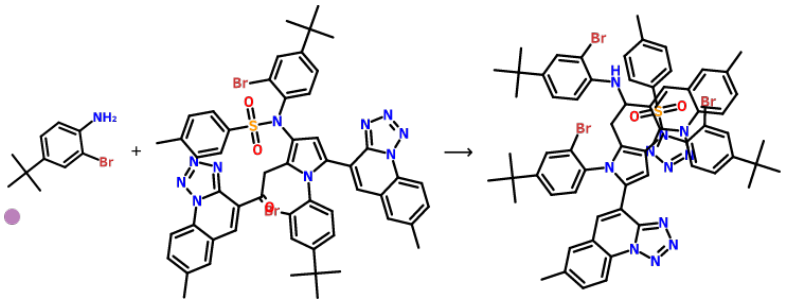
Alternative Solvent: DMSO
Literature reference: 10.1021/acs.joc.7b01192 and 10.1002/ejoc.201100112 and 10.1002/anie.200804427 and US10957859 (Preparation of 4-bromo-9-phenyl-9H-carbazole 3a; industrial application: MERCK KGAA)



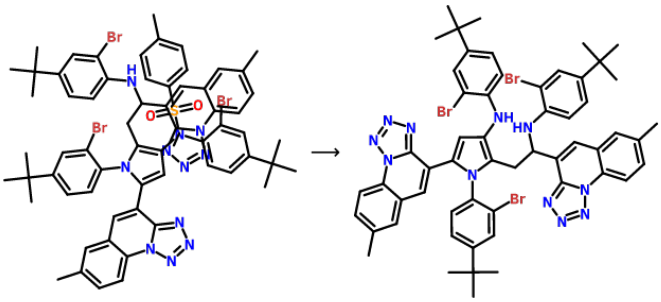
Reaction name: C-N Coupling with sulfonamides
Reaction conditions: CuI, K2CO3
Solvent: DMF
Alternative Solvent: DMSO
Literature reference: 10.1016/j.tetlet.2005.08.149 and 10.1002/anie.200802187



Reaction name: Reductive Amination
Reaction conditions: NaBH3CN or NaBH(OAc)3, AcOH or Cu(OAc)2, H2 then H2O quench
Solvent: MeOH or DCM
Literature reference: 10.1039/C3GC40359A and 10.1039/C2GC35565E and 10.1021/jm960158n and 10.1021/jm00156a023 and industrial application: WO2015057859 ([087])



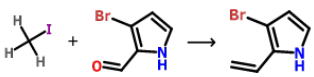
Reaction name: Hydrolysis of sulfonamides
Reaction conditions: HBr, AcOH, PhOH, rt or H2SO4, TFA, heat
Solvent: AcOH or H2O
Literature reference: 10.1055/s-0029-1217392 and 10.1021/jm070191h



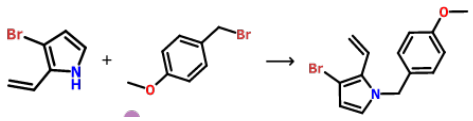
Path #6

Score: 27.00 Estimated cost ($/g): 388.34

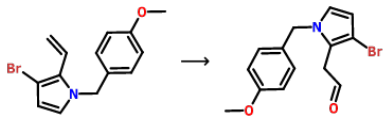
Reaction name: Wittig olefination
Reaction conditions: methyltriphenyl phosphonium bromide, KOtBu
Solvent: THF
Alternative Solvent: t-Butyl ethyl ether
Literature reference: 10.1016/j.dyepig.2015.01.009 and 10.1021/ja905652w and 10.1021/ja00196a042 and 10.1021/acs.joc.7b02030 and 10.1021/op800059y (industrial application)



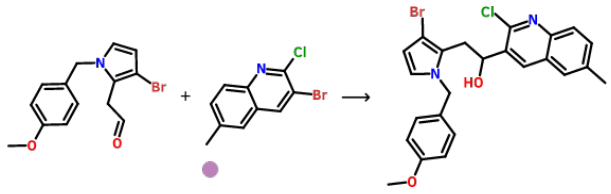
Reaction name: N-heterocycle alkylation
Reaction conditions: K2CO3
Solvent: DMF
Alternative Solvent: DMSO
Literature reference: 10.1021/jo00185a023 and 10.1080/00397910903226166



Reaction name: Wacker-type oxidation
Reaction conditions: [Pd]-catalyst, CuCl2, O2, water, NaNO2, tBuOH, nitromethane
Solvent: DMF
Alternative Solvent: DMSO
Literature reference: 10.1021/ja411749k and 10.1002/anie.201306756 and 10.1021/acs.orglett.6b01165 and 10.1039/D0SC03227A

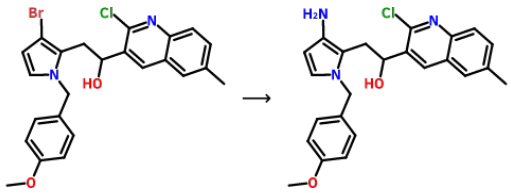


Reaction name: Addition of organolithium reagents to aldehydes
Reaction conditions: THF, -78 deg C
Solvent: THF
Alternative Solvent: t-Butyl ethyl ether
Literature reference: 10.1016/S0040-4039(00)78337-7 and 10.1021/jo070082a and 10.1021/ja806183r and 10.1021/acs.oprd.7b00187

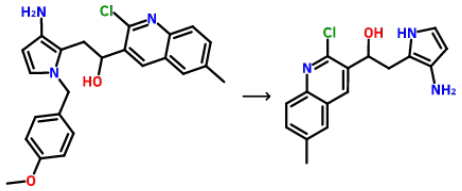


Reaction name: Buchwald Hartwig Amination
Reaction conditions: NH3, Pd[(o-tol)3P]2, NaOtBu, CyPF-t-Bu, dioxane
Solvent: dioxane

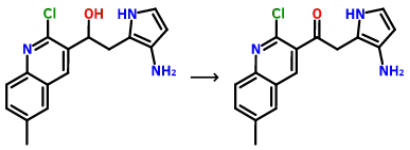
Alternative Solvent: CPME
Literature reference: 10.1021/ja903049z and 10.1021/ol401612c and 10.1021/ol501739g and 10.1021/op8000146 and WO2008133459 (Preparation Examples 9-14) and EP2149555 (Synthesis Example 7)



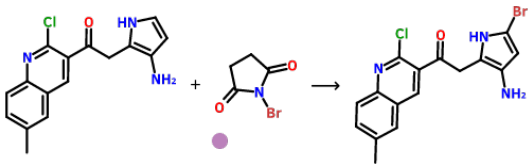
Reaction name: Removal of PMB group from N-H heterocycle
Reaction conditions: TFA, DCM
Solvent: DCM, anisole or water or THF
Literature reference: 10.1016/j.bmc.2006.02.018



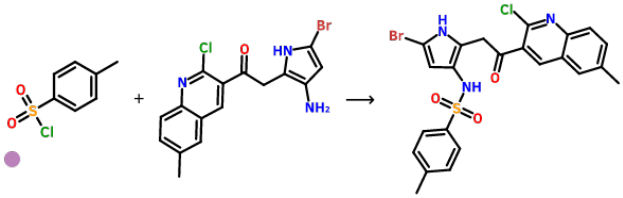
Reaction name: Dess-Martin Oxidation
Reaction conditions: Dess-Martin periodinane
Solvent: DCM or THF
Alternative Solvent: t-Butyl ethyl ether
Literature reference: 10.1016/j.steroids.2012.03.010 and 10.1002/adsc.201400702



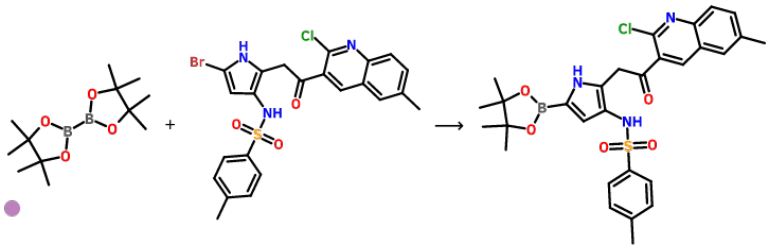
Reaction name: Electrophilic aromatic bromination
Reaction conditions: NBS
Solvent: DCM or DMF
Alternative Solvent: DMSO
Literature reference: 10.1016/j.tetlet.2003.08.069 and 10.1016/j.ejmech.2017.06.006



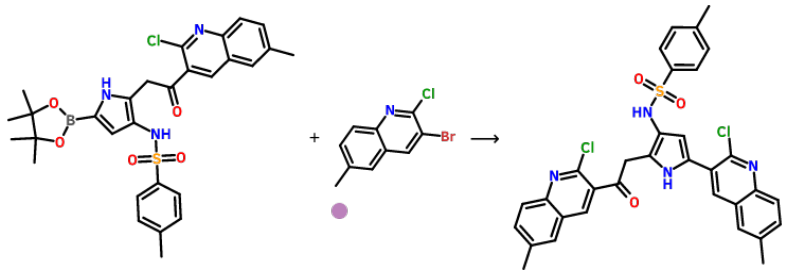
Reaction name: N-sulfonylation
Reaction conditions: NEt3
Solvent: DCM or THF
Alternative Solvent: t-Butyl ethyl ether
Literature reference: 10.1021/jo5011334 (experimental) NS 10.1016/j.tetlet.2007.11.044



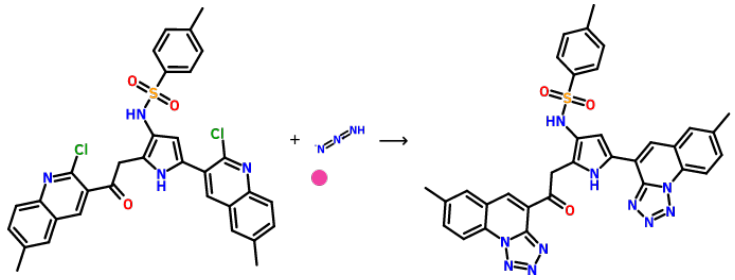
Reaction name: Pinacoloboranes synthesis
Reaction conditions: KOAc, [Pd]-catalyst, DMSO
Solvent: dioxane
Alternative Solvent: CPME
Literature reference: 10.1021/jm051065l and 10.1021/ol203216h (SI p.3) and 10.1021/acs.oprd.2c00350 (industrial application)



Reaction name: Suzuki Aryl-Aryl Coupling
Reaction conditions: [Pd]-catalyst, ligand, base
Solvent: dioxane
Alternative Solvent: CPME
Literature reference: 10.1126/science.aaa5414 and 10.1021/cr100346g

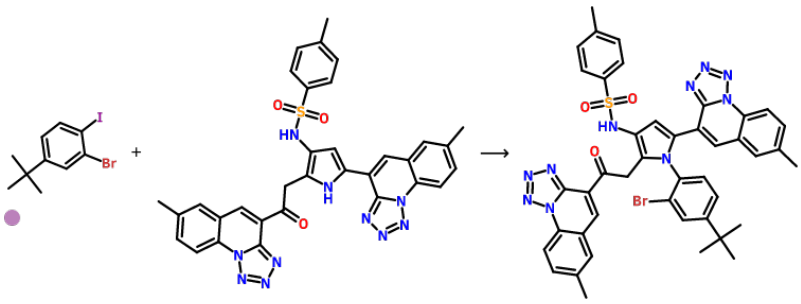


Reaction name: Formation of tetrazole
Reaction conditions: sodium azide, N,N-dimethyl-formamide
Solvent: N,N-dimethyl-formamide
Literature reference: 10.1021/jm049499o

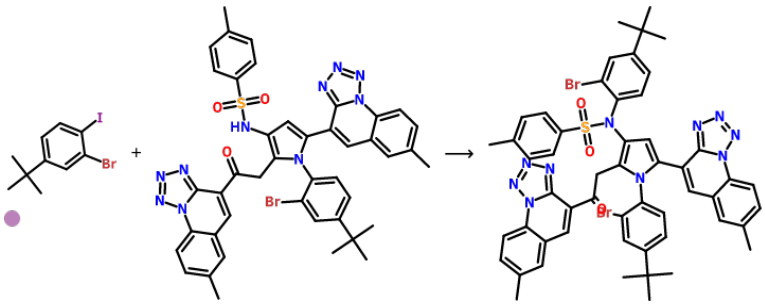


Reaction name: C-N Coupling with NH-heterocycles
Reaction conditions: CuI, Cs2CO3
Solvent: DMF

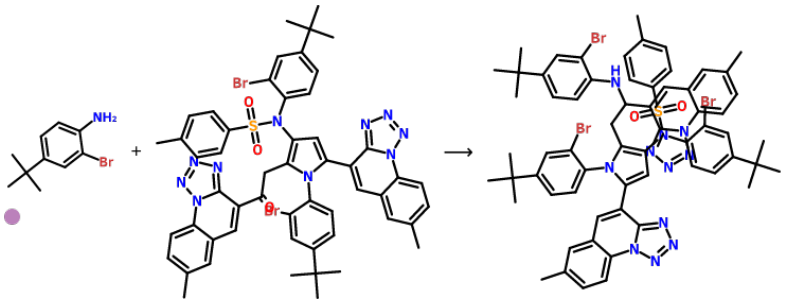
Alternative Solvent: DMSO
Literature reference: 10.1021/acs.joc.7b01192 and 10.1002/ejoc.201100112 and 10.1002/anie.200804427 and US10957859 (Preparation of 4-bromo-9-phenyl-9H-carbazole 3a; industrial application: MERCK KGAA)



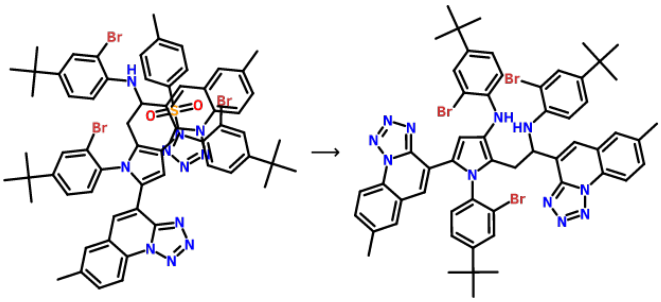
Reaction name: C-N Coupling with sulfonamides
Reaction conditions: CuI, K2CO3
Solvent: DMF
Alternative Solvent: DMSO
Literature reference: 10.1016/j.tetlet.2005.08.149 and 10.1002/anie.200802187



Reaction name: Reductive Amination
Reaction conditions: NaBH3CN or NaBH(OAc)3, AcOH or Cu(OAc)2, H2 then H2O quench
Solvent: MeOH or DCM
Literature reference: 10.1039/C3GC40359A and 10.1039/C2GC35565E and 10.1021/jm960158n and 10.1021/jm00156a023 and industrial application: WO2015057859 ([087])



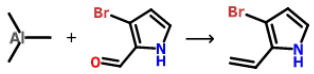
Reaction name: Hydrolysis of sulfonamides
Reaction conditions: HBr, AcOH, PhOH, rt or H2SO4, TFA, heat
Solvent: AcOH or H2O
Literature reference: 10.1055/s-0029-1217392 and 10.1021/jm070191h



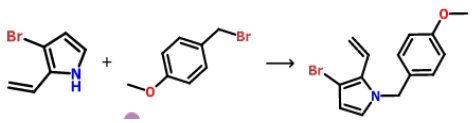
Path #7

Score: 28.00 Estimated cost ($/g): 388.49

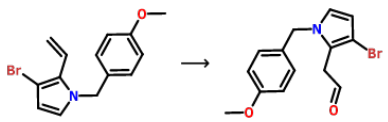
Reaction name: Tebbe olefination of aldehydes
Reaction conditions: Tebbe's reagent, THF
Solvent: THF
Alternative Solvent: t-Butyl ethyl ether
Literature reference: 10.1002/047084289X.rb126.pub3 and 10.1002/ejoc.201701219 and 10.1021/jacs.6b04781 and 10.1016/j.bmcl.2018.09.007 and WO2005123757 (Example 4; industrial application: Pfizer) and 10.1021/op034180j (industrial application)



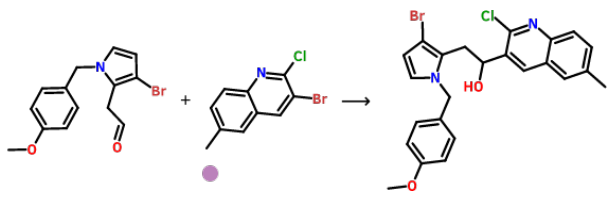
Reaction name: N-heterocycle alkylation
Reaction conditions: K2CO3
Solvent: DMF
Alternative Solvent: DMSO
Literature reference: 10.1021/jo00185a023 and 10.1080/00397910903226166



Reaction name: Wacker-type oxidation
Reaction conditions: [Pd]-catalyst, CuCl2, O2, water, NaNO2, tBuOH, nitromethane
Solvent: DMF
Alternative Solvent: DMSO
Literature reference: 10.1021/ja411749k and 10.1002/anie.201306756 and 10.1021/acs.orglett.6b01165 and 10.1039/D0SC03227A

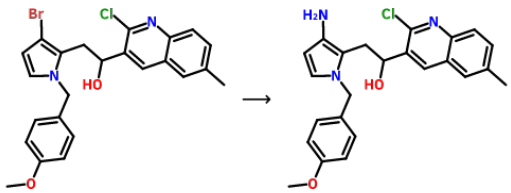


Reaction name: Addition of organolithium reagents to aldehydes
Reaction conditions: THF, -78 deg C
Solvent: THF
Alternative Solvent: t-Butyl ethyl ether
Literature reference: 10.1016/S0040-4039(00)78337-7 and 10.1021/jo070082a and 10.1021/ja806183r and 10.1021/acs.oprd.7b00187

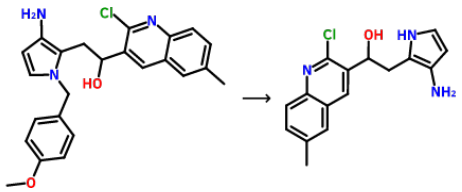


Reaction name: Buchwald Hartwig Amination
Reaction conditions: NH3, Pd[(o-tol)3P]2, NaOtBu, CyPF-t-Bu, dioxane

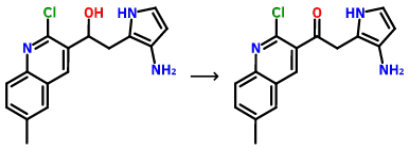
Solvent: dioxane
Alternative Solvent: CPME
Literature reference: 10.1021/ja903049z and 10.1021/ol401612c and 10.1021/ol501739g and 10.1021/op8000146 and WO2008133459 (Preparation Examples 9-14) and EP2149555 (Synthesis Example 7)



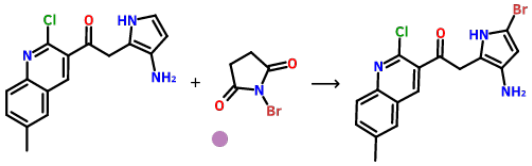
Reaction name: Removal of PMB group from N-H heterocycle
Reaction conditions: TFA, DCM
Solvent: DCM, anisole or water or THF
Literature reference: 10.1016/j.bmc.2006.02.018



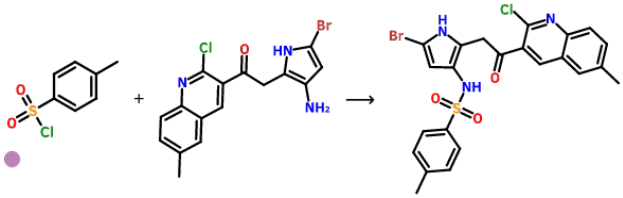
Reaction name: Dess-Martin Oxidation
Reaction conditions: Dess-Martin periodinane
Solvent: DCM or THF
Alternative Solvent: t-Butyl ethyl ether
Literature reference: 10.1016/j.steroids.2012.03.010 and 10.1002/adsc.201400702



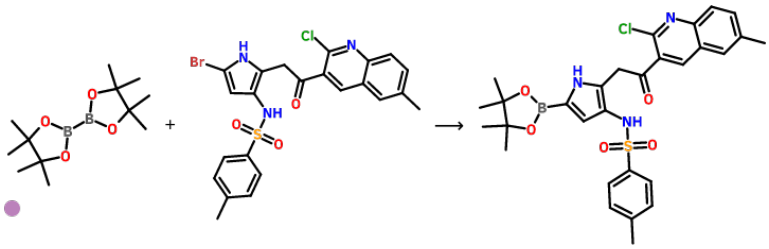
Reaction name: Electrophilic aromatic bromination
Reaction conditions: NBS
Solvent: DCM or DMF
Alternative Solvent: DMSO
Literature reference: 10.1016/j.tetlet.2003.08.069 and 10.1016/j.ejmech.2017.06.006



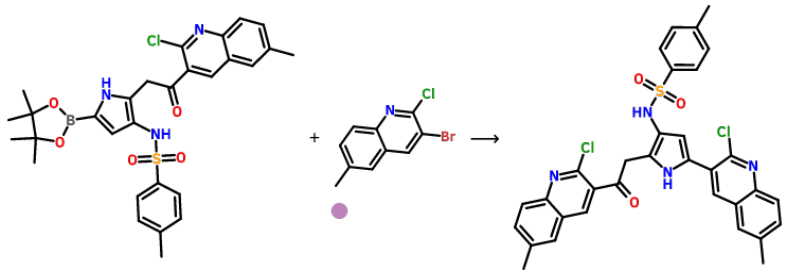
Reaction name: N-sulfonylation
Reaction conditions: NEt3
Solvent: DCM or THF
Alternative Solvent: t-Butyl ethyl ether
Literature reference: 10.1021/jo5011334 (experimental) NS 10.1016/j.tetlet.2007.11.044



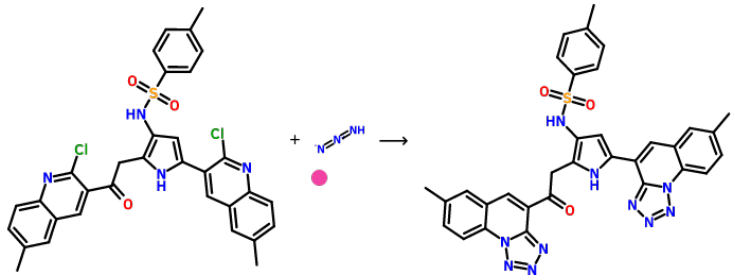
Reaction name: Pinacoloboranes synthesis
Reaction conditions: KOAc, [Pd]-catalyst, DMSO
Solvent: dioxane
Alternative Solvent: CPME
Literature reference: 10.1021/jm051065l and 10.1021/ol203216h (SI p.3) and 10.1021/acs.oprd.2c00350 (industrial application)



Reaction name: Suzuki Aryl-Aryl Coupling
Reaction conditions: [Pd]-catalyst, ligand, base
Solvent: dioxane
Alternative Solvent: CPME
Literature reference: 10.1126/science.aaa5414 and 10.1021/cr100346g

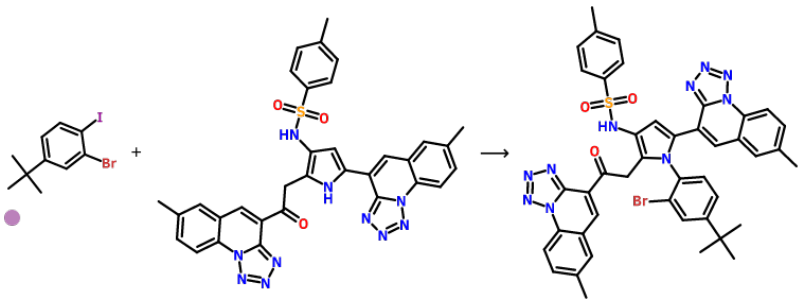


Reaction name: Formation of tetrazole
Reaction conditions: sodium azide, N,N-dimethyl-formamide
Solvent: N,N-dimethyl-formamide
Literature reference: 10.1021/jm049499o

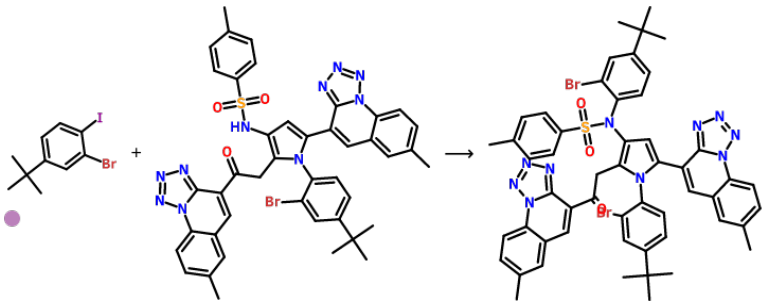


Reaction name: C-N Coupling with NH-heterocycles
Reaction conditions: CuI, Cs2CO3
Solvent: DMF

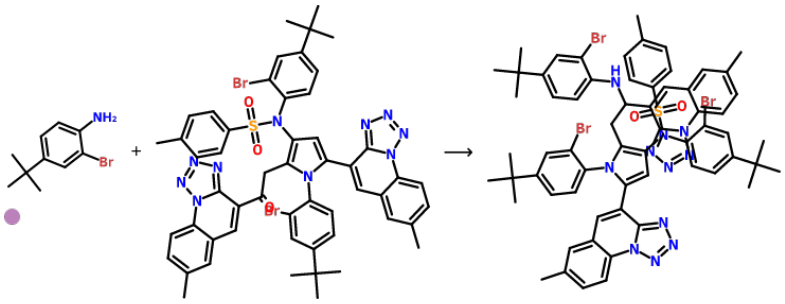
Alternative Solvent: DMSO
Literature reference: 10.1021/acs.joc.7b01192 and 10.1002/ejoc.201100112 and 10.1002/anie.200804427 and US10957859 (Preparation of 4-bromo-9-phenyl-9H-carbazole 3a; industrial application: MERCK KGAA)



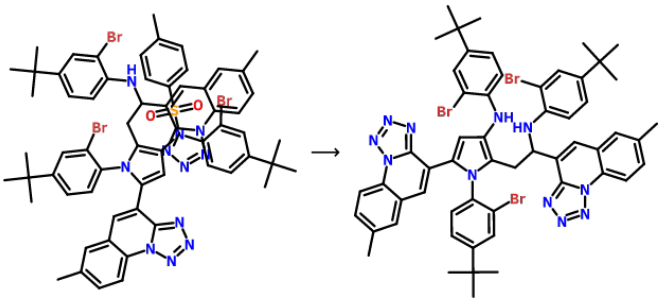
Reaction name: C-N Coupling with sulfonamides
Reaction conditions: CuI, K2CO3
Solvent: DMF
Alternative Solvent: DMSO
Literature reference: 10.1016/j.tetlet.2005.08.149 and 10.1002/anie.200802187



Reaction name: Reductive Amination
Reaction conditions: NaBH3CN or NaBH(OAc)3, AcOH or Cu(OAc)2, H2 then H2O quench
Solvent: MeOH or DCM
Literature reference: 10.1039/C3GC40359A and 10.1039/C2GC35565E and 10.1021/jm960158n and 10.1021/jm00156a023 and industrial application: WO2015057859 ([087])



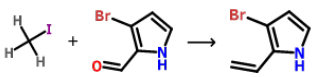
Reaction name: Hydrolysis of sulfonamides
Reaction conditions: HBr, AcOH, PhOH, rt or H2SO4, TFA, heat
Solvent: AcOH or H2O
Literature reference: 10.1055/s-0029-1217392 and 10.1021/jm070191h



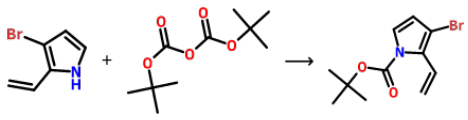
Path #8

Score: 28.50 Estimated cost ($/g): 378.98

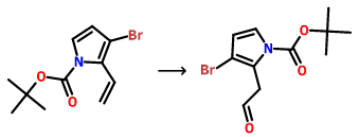
Reaction name: Wittig olefination
Reaction conditions: methyltriphenyl phosphonium bromide, KOtBu
Solvent: THF
Alternative Solvent: t-Butyl ethyl ether
Literature reference: 10.1016/j.dyepig.2015.01.009 and 10.1021/ja905652w and 10.1021/ja00196a042 and 10.1021/acs.joc.7b02030 and 10.1021/op800059y (industrial application)



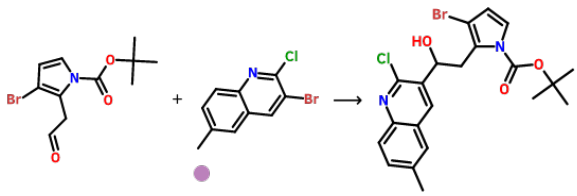
Reaction name: Carbamate synthesis
Reaction conditions: K2CO3
Solvent: THF
Alternative Solvent: t-Butyl ethyl ether
Literature reference: 10.1021/jm501758q and 10.1021/jm9801915



Reaction name: Wacker-type oxidation
Reaction conditions: [Pd]-catalyst, CuCl2, O2, water, NaNO2, tBuOH, nitromethane
Solvent: DMF
Alternative Solvent: DMSO
Literature reference: 10.1021/ja411749k and 10.1002/anie.201306756 and 10.1021/acs.orglett.6b01165 and 10.1039/D0SC03227A

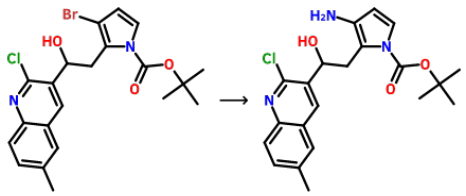


Reaction name: Addition of organolithium reagents to aldehydes
Reaction conditions: THF, -78 deg C
Solvent: THF
Alternative Solvent: t-Butyl ethyl ether
Literature reference: 10.1016/S0040-4039(00)78337-7 and 10.1021/jo070082a and 10.1021/ja806183r and 10.1021/acs.oprd.7b00187

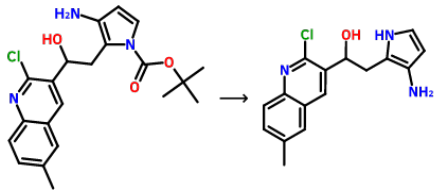


Reaction name: Buchwald Hartwig Amination
Reaction conditions: NH3, Pd[(o-tol)3P]2, NaOtBu, CyPF-t-Bu, dioxane
Solvent: dioxane

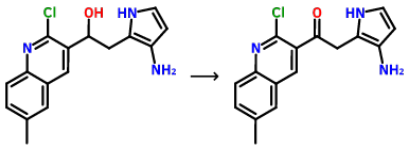
Alternative Solvent: CPME
Literature reference: 10.1021/ja903049z and 10.1021/ol401612c and 10.1021/ol501739g and 10.1021/op8000146 and WO2008133459 (Preparation Examples 9-14) and EP2149555 (Synthesis Example 7)



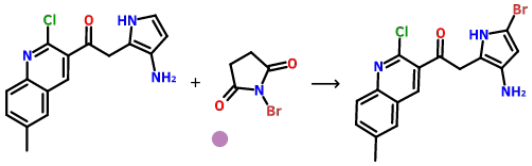
Reaction name: N-Boc deprotection
Reaction conditions: TFA
Solvent: DCM or dioxane or AcOEt
Literature reference: 10.1021/jo070460b and 10.1016/j.bmcl.2012.02.104 and 10.1016/j.bmc.2014.07.025



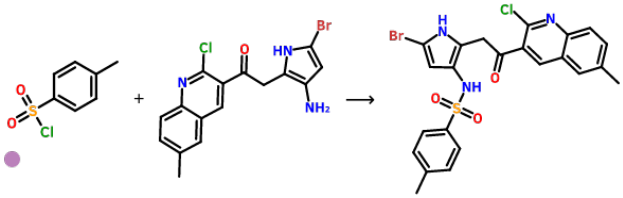
Reaction name: Dess-Martin Oxidation
Reaction conditions: Dess-Martin periodinane
Solvent: DCM or THF
Alternative Solvent: t-Butyl ethyl ether
Literature reference: 10.1016/j.steroids.2012.03.010 and 10.1002/adsc.201400702



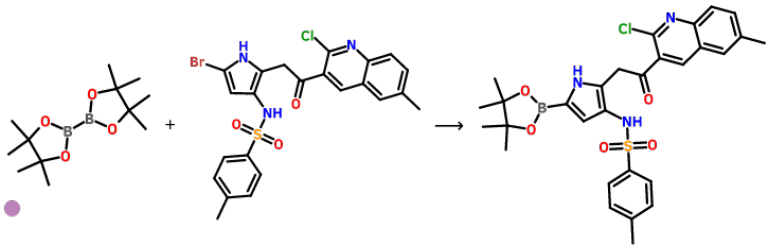
Reaction name: Electrophilic aromatic bromination
Reaction conditions: NBS
Solvent: DCM or DMF
Alternative Solvent: DMSO
Literature reference: 10.1016/j.tetlet.2003.08.069 and 10.1016/j.ejmech.2017.06.006



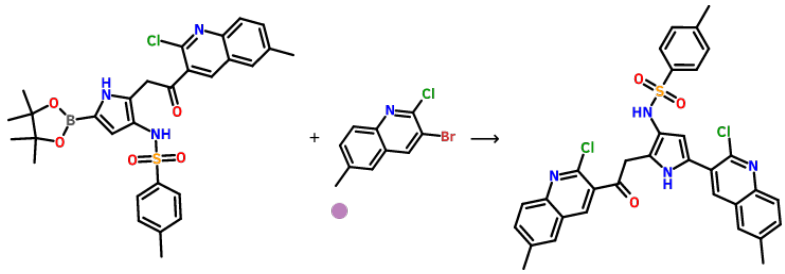
Reaction name: N-sulfonylation
Reaction conditions: NEt3
Solvent: DCM or THF
Alternative Solvent: t-Butyl ethyl ether
Literature reference: 10.1021/jo5011334 (experimental) NS 10.1016/j.tetlet.2007.11.044



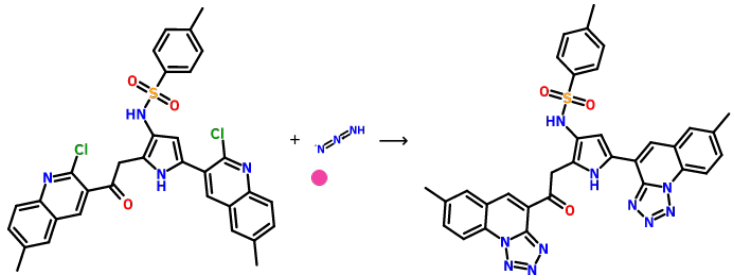
Reaction name: Pinacoloboranes synthesis
Reaction conditions: KOAc, [Pd]-catalyst, DMSO
Solvent: dioxane
Alternative Solvent: CPME
Literature reference: 10.1021/jm051065l and 10.1021/ol203216h (SI p.3) and 10.1021/acs.oprd.2c00350 (industrial application)



Reaction name: Suzuki Aryl-Aryl Coupling
Reaction conditions: [Pd]-catalyst, ligand, base
Solvent: dioxane
Alternative Solvent: CPME
Literature reference: 10.1126/science.aaa5414 and 10.1021/cr100346g

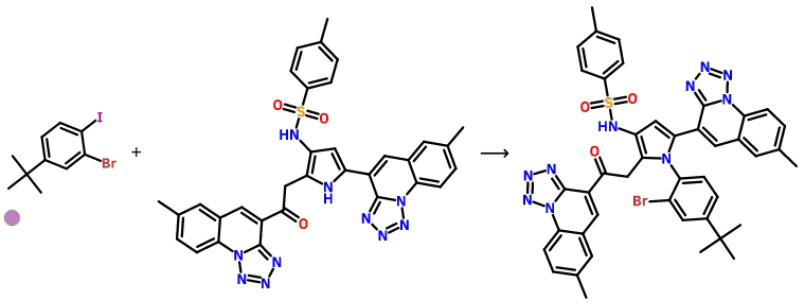


Reaction name: Formation of tetrazole
Reaction conditions: sodium azide, N,N-dimethyl-formamide
Solvent: N,N-dimethyl-formamide
Literature reference: 10.1021/jm049499o

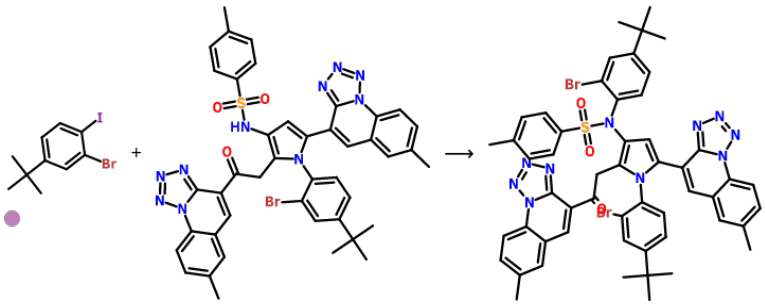


Reaction name: C-N Coupling with NH-heterocycles
Reaction conditions: CuI, Cs2CO3
Solvent: DMF

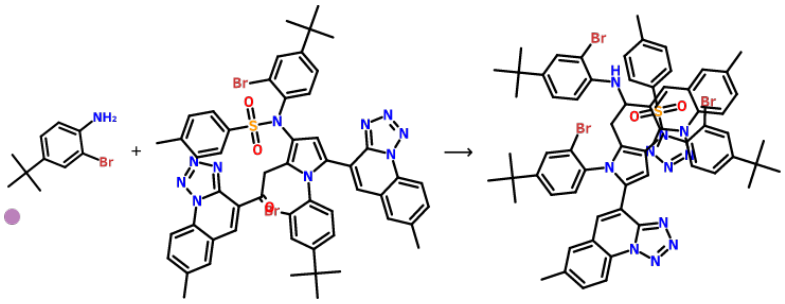
Alternative Solvent: DMSO
Literature reference: 10.1021/acs.joc.7b01192 and 10.1002/ejoc.201100112 and 10.1002/anie.200804427 and US10957859 (Preparation of 4-bromo-9-phenyl-9H-carbazole 3a; industrial application: MERCK KGAA)



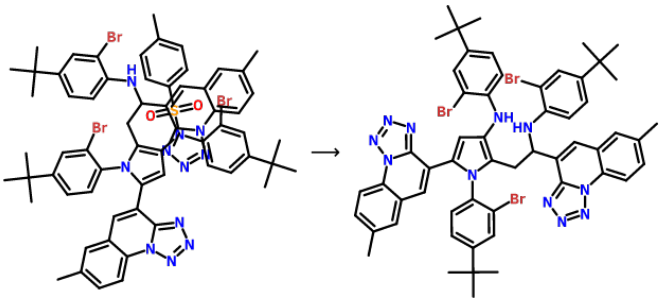
Reaction name: C-N Coupling with sulfonamides
Reaction conditions: CuI, K2CO3
Solvent: DMF
Alternative Solvent: DMSO
Literature reference: 10.1016/j.tetlet.2005.08.149 and 10.1002/anie.200802187



Reaction name: Reductive Amination
Reaction conditions: NaBH3CN or NaBH(OAc)3, AcOH or Cu(OAc)2, H2 then H2O quench
Solvent: MeOH or DCM
Literature reference: 10.1039/C3GC40359A and 10.1039/C2GC35565E and 10.1021/jm960158n and 10.1021/jm00156a023 and industrial application: WO2015057859 ([087])



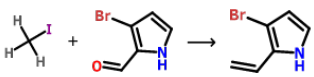
Reaction name: Hydrolysis of sulfonamides
Reaction conditions: HBr, AcOH, PhOH, rt or H2SO4, TFA, heat
Solvent: AcOH or H2O
Literature reference: 10.1055/s-0029-1217392 and 10.1021/jm070191h



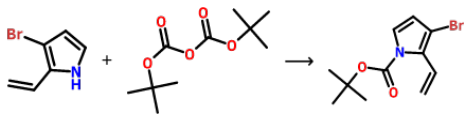
Path #9

Score: 39.00 Estimated cost ($/g): 380.54

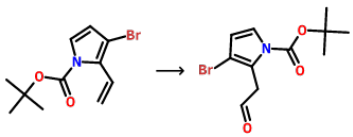
Reaction name: Wittig olefination
Reaction conditions: methyltriphenyl phosphonium bromide, KOtBu
Solvent: THF
Alternative Solvent: t-Butyl ethyl ether
Literature reference: 10.1016/j.dyepig.2015.01.009 and 10.1021/ja905652w and 10.1021/ja00196a042 and 10.1021/acs.joc.7b02030 and 10.1021/op800059y (industrial application)



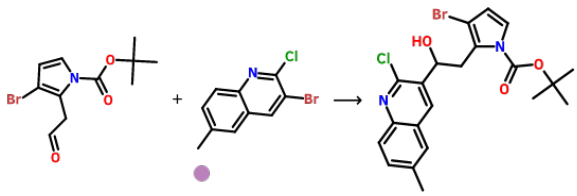
Reaction name: Carbamate synthesis
Reaction conditions: K2CO3
Solvent: THF
Alternative Solvent: t-Butyl ethyl ether
Literature reference: 10.1021/jm501758q and 10.1021/jm9801915



Reaction name: Wacker-type oxidation
Reaction conditions: [Pd]-catalyst, CuCl2, O2, water, NaNO2, tBuOH, nitromethane
Solvent: DMF
Alternative Solvent: DMSO
Literature reference: 10.1021/ja411749k and 10.1002/anie.201306756 and 10.1021/acs.orglett.6b01165 and 10.1039/D0SC03227A

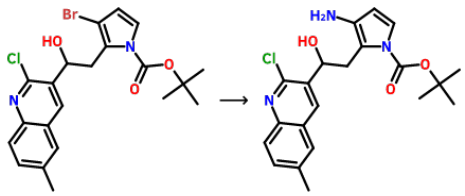


Reaction name: Addition of organolithium reagents to aldehydes
Reaction conditions: THF, -78 deg C
Solvent: THF
Alternative Solvent: t-Butyl ethyl ether
Literature reference: 10.1016/S0040-4039(00)78337-7 and 10.1021/jo070082a and 10.1021/ja806183r and 10.1021/acs.oprd.7b00187

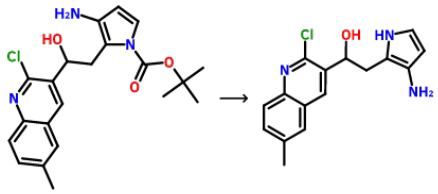


Reaction name: Buchwald Hartwig Amination
Reaction conditions: NH3, Pd[(o-tol)3P]2, NaOtBu, CyPF-t-Bu, dioxane
Solvent: dioxane

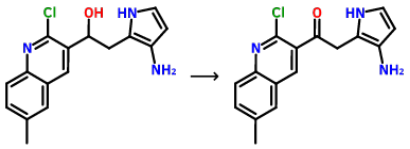
Alternative Solvent: CPME
Literature reference: 10.1021/ja903049z and 10.1021/ol401612c and 10.1021/ol501739g and 10.1021/op8000146 and WO2008133459 (Preparation Examples 9-14) and EP2149555 (Synthesis Example 7)



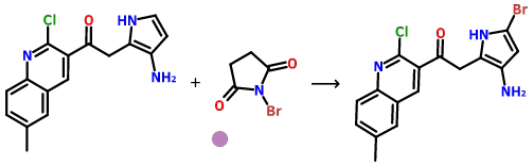
Reaction name: N-Boc deprotection
Reaction conditions: TFA
Solvent: DCM or dioxane or AcOEt
Literature reference: 10.1021/jo070460b and 10.1016/j.bmcl.2012.02.104 and 10.1016/j.bmc.2014.07.025



Reaction name: Dess-Martin Oxidation
Reaction conditions: Dess-Martin periodinane
Solvent: DCM or THF
Alternative Solvent: t-Butyl ethyl ether
Literature reference: 10.1016/j.steroids.2012.03.010 and 10.1002/adsc.201400702

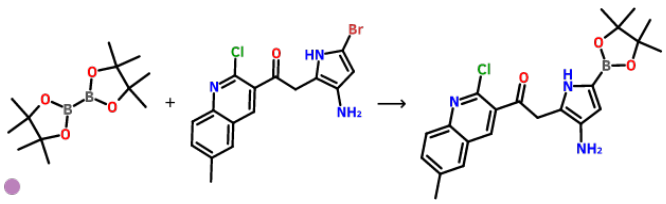


Reaction name: Electrophilic aromatic bromination
Reaction conditions: NBS
Solvent: DCM or DMF
Alternative Solvent: DMSO
Literature reference: 10.1016/j.tetlet.2003.08.069 and 10.1016/j.ejmech.2017.06.006

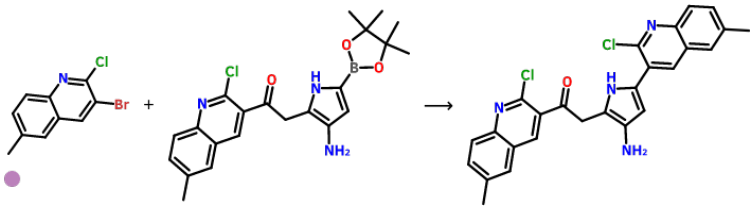


Reaction name: Pinacoloboranes synthesis
Reaction conditions: KOAc, [Pd]-catalyst, DMSO
Solvent: dioxane
Alternative Solvent: CPME
Literature reference: 10.1021/jm051065l and 10.1021/ol203216h (SI p.3) and 10.1021/

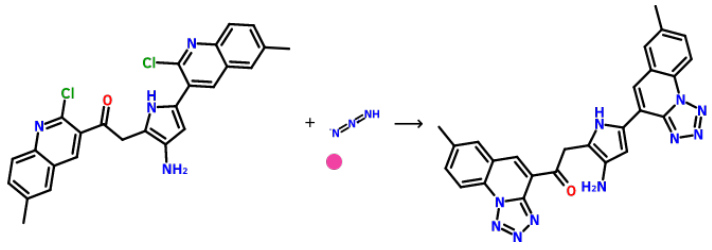
acs.oprd.2c00350 (industrial application)



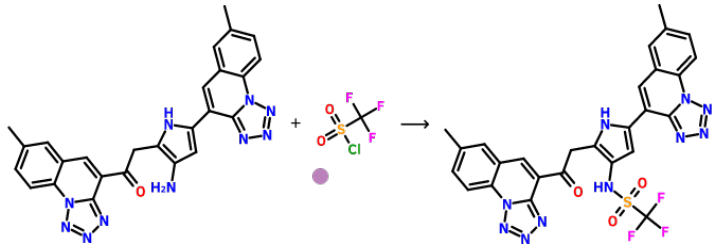
Reaction name: Suzuki Aryl-Aryl Coupling
Reaction conditions: [Pd]-catalyst, ligand, base
Solvent: dioxane
Alternative Solvent: CPME
Literature reference: 10.1126/science.aaa5414 and 10.1021/cr100346g



Reaction name: Formation of tetrazole
Reaction conditions: sodium azide, N,N-dimethyl-formamide
Solvent: N,N-dimethyl-formamide
Literature reference: 10.1021/jm049499o

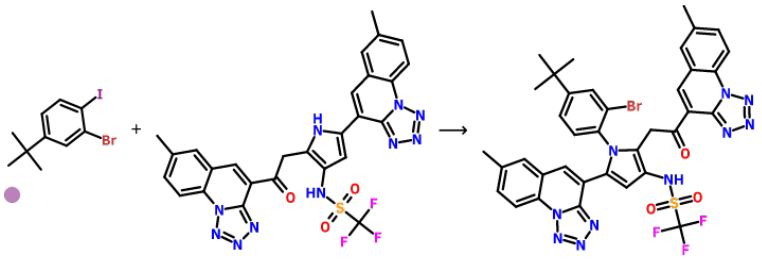


Reaction name: N-sulfonylation
Reaction conditions: NEt3
Solvent: DCM or THF
Alternative Solvent: t-Butyl ethyl ether
Literature reference: 10.1021/jo5011334 (experimental) NS 10.1016/j.tetlet.2007.11.044

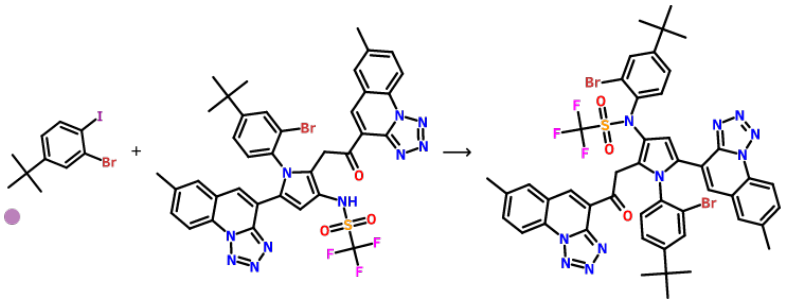


Reaction name: C-N Coupling with NH-heterocycles
Reaction conditions: CuI, Cs2CO3
Solvent: DMF
Alternative Solvent: DMSO

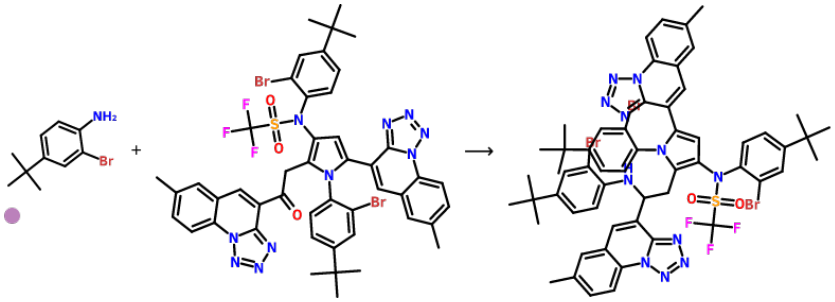
Literature reference: 10.1021/acs.joc.7b01192 and 10.1002/ejoc.201100112 and 10.1002/anie.200804427 and US10957859 (Preparation of 4-bromo-9-phenyl-9H-carbazole 3a; industrial application: MERCK KGAA)



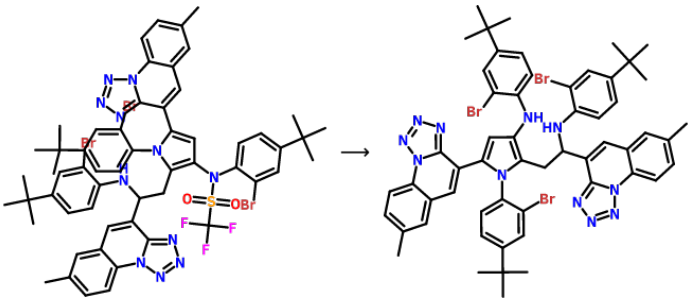
Reaction name: C-N Coupling with sulfonamides
Reaction conditions: CuI, K2CO3
Solvent: DMF
Alternative Solvent: DMSO
Literature reference: 10.1016/j.tetlet.2005.08.149 and 10.1002/anie.200802187



Reaction name: Reductive Amination
Reaction conditions: NaBH3CN or NaBH(OAc)3, AcOH or Cu(OAc)2, H2 then H2O quench
Solvent: MeOH or DCM
Literature reference: 10.1039/C3GC40359A and 10.1039/C2GC35565E and 10.1021/jm960158n and 10.1021/jm00156a023 and industrial application: WO2015057859 ([087])



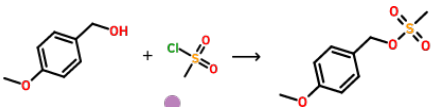
Reaction name: Reductive desulfoamidation
Reaction conditions: LAH, THF
Solvent: THF or Et2O
Alternative Solvent: t-Butyl ethyl ether
Literature reference: 10.1021/ja901352k and 10.1055/s-0036-1558973 and WO2005080402 (intermediate amine 27; industrial application: ASTRAZENECA PLC)



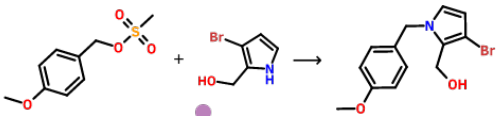
Path #10

Score: 39.00 Estimated cost ($/g): 415.15

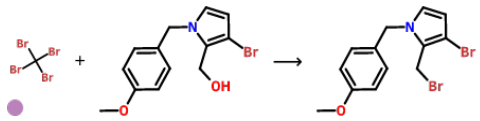
Reaction name: O-sulfonylation
Reaction conditions: NEt3
Solvent: DCM or THF
Alternative Solvent: t-Butyl ethyl ether
Literature reference: 10.1016/j.bmcl.2007.01.090 and 10.1021/ja963944q (experimental)



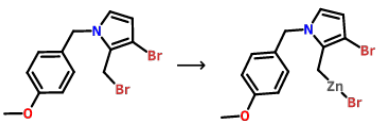
Reaction name: Sn2 n-heterocycles
Reaction conditions: NaH
Solvent: DMF
Alternative Solvent: DMSO
Literature reference: 10.1134/S1070363217070337 and 10.1021/jm500073h



Reaction name: Appel reaction with primary alcohol
Reaction conditions: PPh3, CBr4
Alternative conditions: NBS, PPh3
Solvent: DCM or THF
Alternative Solvent: t-Butyl ethyl ether
Literature reference: 10.1021/ja9101503 and 10.1016/j.bmcl.2009.11.105 and 10.1021/op050137f (industrial application) and 10.1021/op0000733 (industrial application) and 10.1021/op9002455 (industrial application) and 10.1021/op9002455 (industrial application) and 10.1021/acs.oprd.5b00313 (industrial application)

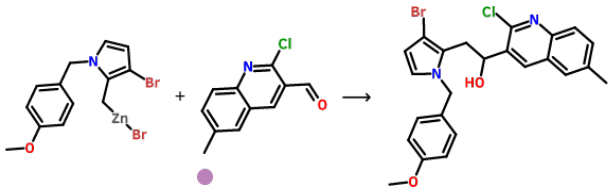


Reaction name: Organozinc compounds synthesis
Reaction conditions: Zn, LiCl
Solvent: THF
Alternative Solvent: t-Butyl ethyl ether
Literature reference: 10.1021/ol500790p and 10.1002/anie.201603923 (SI p.4)

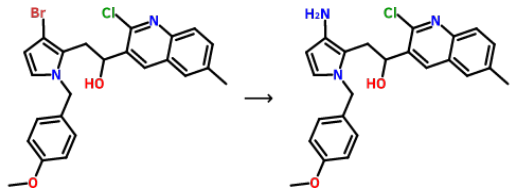


Reaction name: Zincoorganic compound addition to aldehyde
Reaction conditions: THF
Solvent: THF

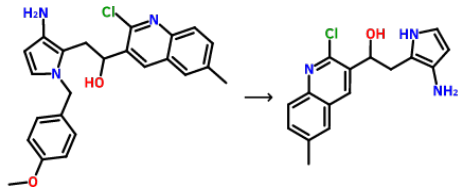
Alternative Solvent: t-Butyl ethyl ether
Literature reference: 10.1039/C3OB41931B and 10.1021/jo0202233



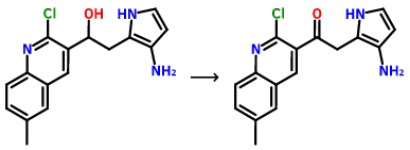
Reaction name: Buchwald Hartwig Amination
Reaction conditions: NH3, Pd[(o-tol)3P]2, NaOtBu, CyPF-t-Bu, dioxane
Solvent: dioxane
Alternative Solvent: CPME
Literature reference: 10.1021/ja903049z and 10.1021/ol401612c and 10.1021/ol501739g and 10.1021/op8000146 and WO2008133459 (Preparation Examples 9-14) and EP2149555 (Synthesis Example 7)



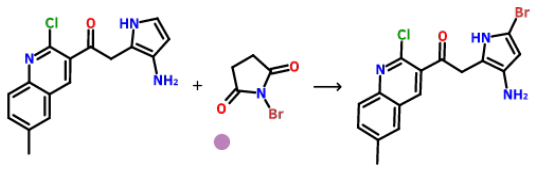
Reaction name: Removal of PMB group from N-H heterocycle
Reaction conditions: TFA, DCM
Solvent: DCM, anisole or water or THF
Literature reference: 10.1016/j.bmc.2006.02.018



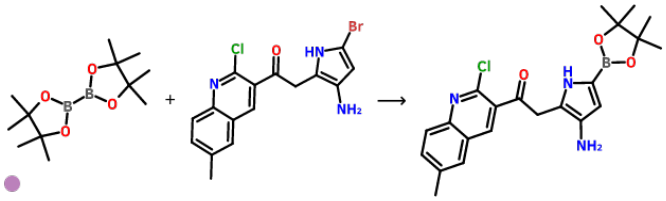
Reaction name: Dess-Martin Oxidation
Reaction conditions: Dess-Martin periodinane
Solvent: DCM or THF
Alternative Solvent: t-Butyl ethyl ether
Literature reference: 10.1016/j.steroids.2012.03.010 and 10.1002/adsc.201400702



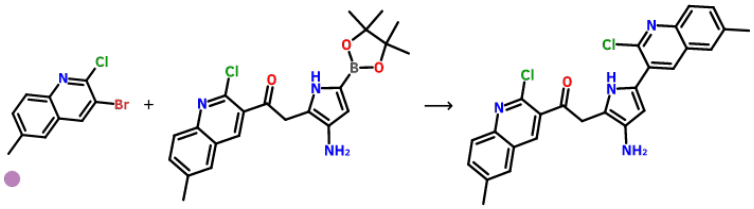
Reaction name: Electrophilic aromatic bromination
Reaction conditions: NBS
Solvent: DCM or DMF
Alternative Solvent: DMSO
Literature reference: 10.1016/j.tetlet.2003.08.069 and 10.1016/j.ejmech.2017.06.006



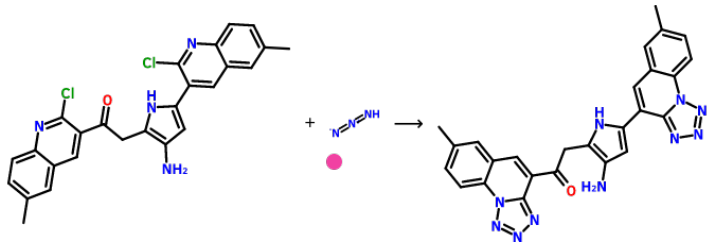
Reaction name: Pinacoloboranes synthesis
Reaction conditions: KOAc, [Pd]-catalyst, DMSO
Solvent: dioxane
Alternative Solvent: CPME
Literature reference: 10.1021/jm051065l and 10.1021/ol203216h (SI p.3) and 10.1021/acs.oprd.2c00350 (industrial application)



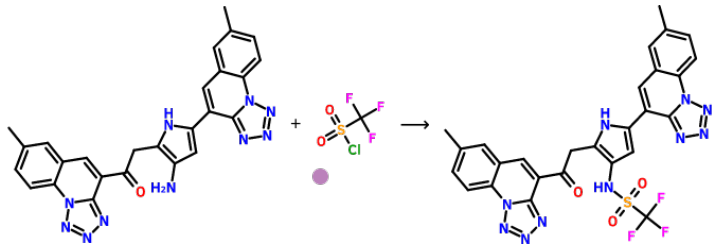
Reaction name: Suzuki Aryl-Aryl Coupling
Reaction conditions: [Pd]-catalyst, ligand, base
Solvent: dioxane
Alternative Solvent: CPME
Literature reference: 10.1126/science.aaa5414 and 10.1021/cr100346g



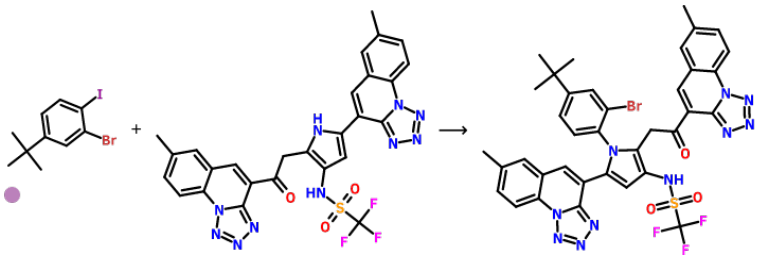
Reaction name: Formation of tetrazole
Reaction conditions: sodium azide, N,N-dimethyl-formamide
Solvent: N,N-dimethyl-formamide
Literature reference: 10.1021/jm049499o



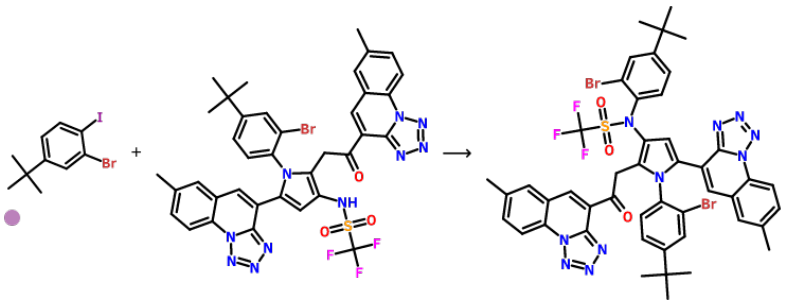
Reaction name: N-sulfonylation
Reaction conditions: NEt3
Solvent: DCM or THF
Alternative Solvent: t-Butyl ethyl ether
Literature reference: 10.1021/jo5011334 (experimental) NS 10.1016/j.tetlet.2007.11.044



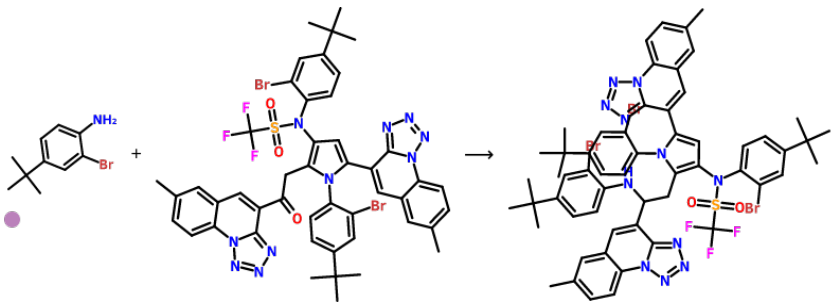
Reaction name: C-N Coupling with NH-heterocycles
Reaction conditions: CuI, Cs2CO3
Solvent: DMF
Alternative Solvent: DMSO
Literature reference: 10.1021/acs.joc.7b01192 and 10.1002/ejoc.201100112 and 10.1002/anie.200804427 and US10957859 (Preparation of 4-bromo-9-phenyl-9H-carbazole 3a; industrial application: MERCK KGAA)



Reaction name: C-N Coupling with sulfonamides
Reaction conditions: CuI, K2CO3
Solvent: DMF
Alternative Solvent: DMSO
Literature reference: 10.1016/j.tetlet.2005.08.149 and 10.1002/anie.200802187



Reaction name: Reductive Amination
Reaction conditions: NaBH3CN or NaBH(OAc)3, AcOH or Cu(OAc)2, H2 then H2O quench
Solvent: MeOH or DCM
Literature reference: 10.1039/C3GC40359A and 10.1039/C2GC35565E and 10.1021/jm960158n and 10.1021/jm00156a023 and industrial application: WO2015057859 ([087])



Reaction name: Reductive desulfoamidation
Reaction conditions: LAH, THF
Solvent: THF or Et2O
Alternative Solvent: t-Butyl ethyl ether
Literature reference: 10.1021/ja901352k and 10.1055/s-0036-1558973 and WO2005080402 (intermediate amine 27; industrial application: ASTRAZENECA PLC)