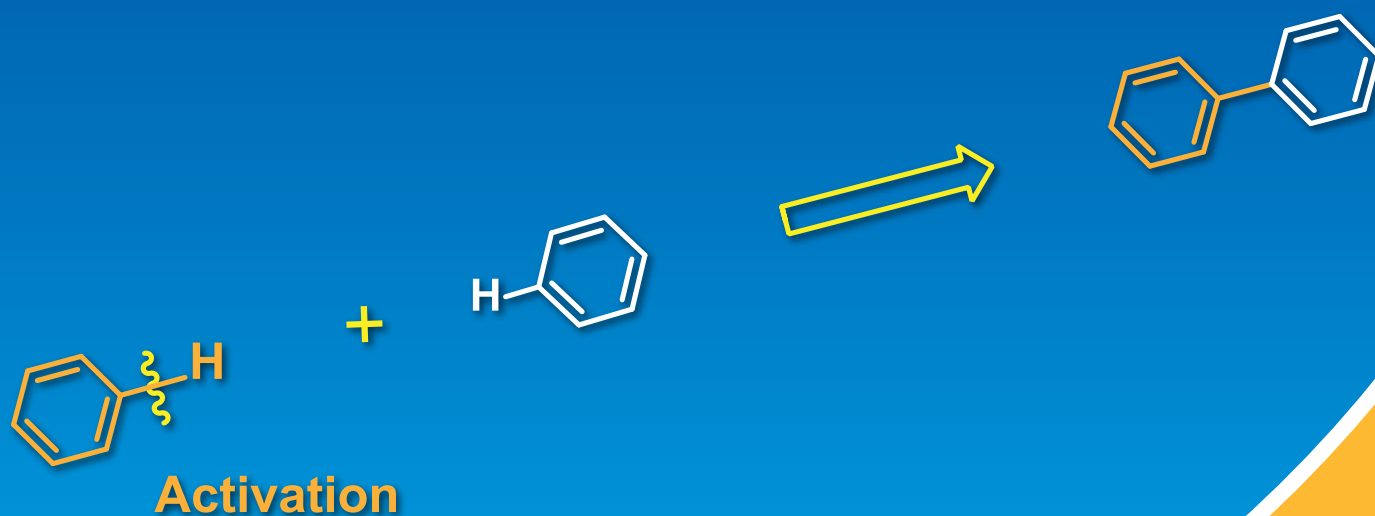


C-H Bond Activation Reaction



Metal Catalysts

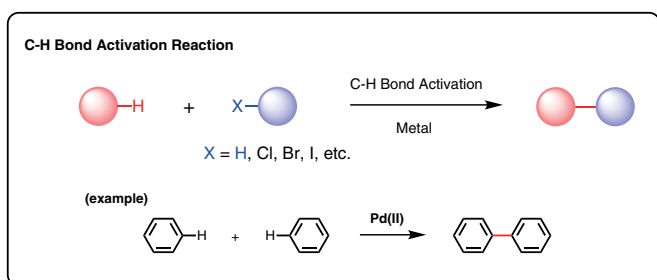
Ligands

Directing Group Introducing Agents

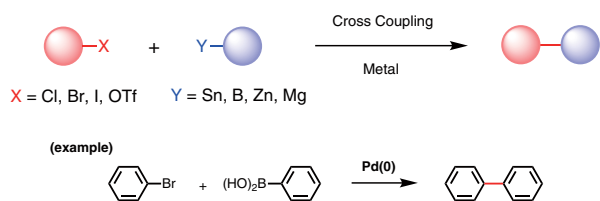
Additives

C-H Bond Activation Reaction

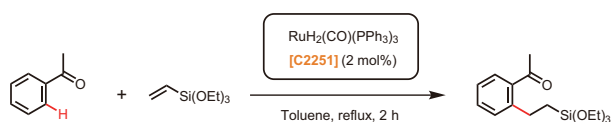
Recently, there have been a large number of reports on "C-H bond activation reaction". C-H bond activation is a methodology for directly forming carbon-carbon bonds by activating a carbon-hydrogen bond, which is the most fundamental linkage in organic chemistry. Traditional cross coupling reactions have been one of the most useful synthetic methods for the formation of carbon-carbon bonds. However, the cross coupling reaction requires extra procedures for preparing organic halides (or triflates) compounds, and organic boron or metal compounds. On the other hand, the C-H bond activation can reduce these procedures, thus making this reaction a cost-effective and eco-friendly system.



cf. Traditional Cross Coupling Reaction



C-H bonds generally have relatively high energy; therefore, the formation of a carbon-carbon or carbon-heteroatom bond by dissecting C-H bonds has been believed to be difficult. In 1993, Murai *et al.* reported the direct addition of C-H bonds of aromatic ketones to olefins in the presence of a catalytic amount of carbonyl(dihydrido)tris(triphenylphosphine)ruthenium(II) (**C2251**).¹⁾ Since then, numerous examples of C-H bond activation have been reported.



The reaction above proceeds without using halogenated compounds and organic boron or organic metal compounds. Thus, this system is cost-effective and eco-friendly.

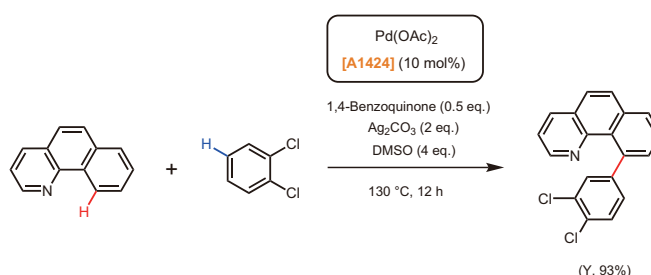
In general, palladium(II), rhodium(I), iridium(I), ruthenium(II), copper(II), and iron(II) are widely used in C-H bond activation. There are a number of reports on C-H bond activation using these catalysts in the presence of appropriate ligands and activating reagents. In this brochure, some examples of C-H bond activation using palladium catalysts, iridium catalysts, and iron catalysts are

shown as below.

● Pd(II) Catalysts

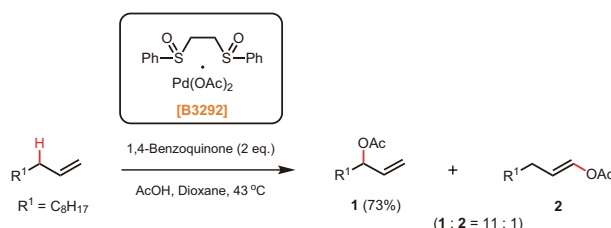
1) Regio-selective Coupling Reaction of 7,8-Benzoquinoline and Arene Compounds

Sanford *et al.* have reported the direct coupling reaction of 7,8-benzoquinoline and arene compounds using palladium acetate(II) (**A1424**).²⁾ In this reaction, a nitrogen atom of 7,8-benzoquinoline functions as a directing group to allow it to selectively introduce arenes at the C-10 position. Moreover, arene compounds also react with 7,8-benzoquinoline at the least sterically hindered positions. In this reaction system, 1,4-benzoquinone functions as a reaction promoter, and silver(I) carbonate oxidizes the generated Pd(0) species, which forms the Pd(II) / Pd(0) catalytic cycle.

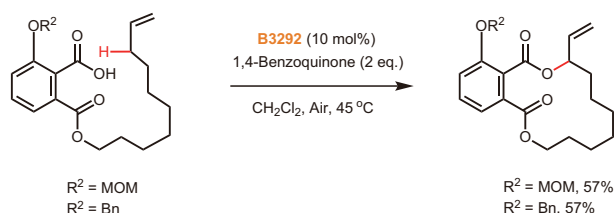


2) Allylic C-H Oxidation using "White Catalyst"

1,2-Bis(phenylsulfinyl)ethane palladium(II) diacetate (**B3292**) is a palladium catalyst, which was developed by M. C. White *et al.*, and named "White catalyst" after the developer. For an example of its characteristic reactivity differing from other homogeneous palladium catalysts, the allylic C-H oxidation reaction has been reported, in which an acetoxy group is introduced regioselectively into the allylic position.³⁾

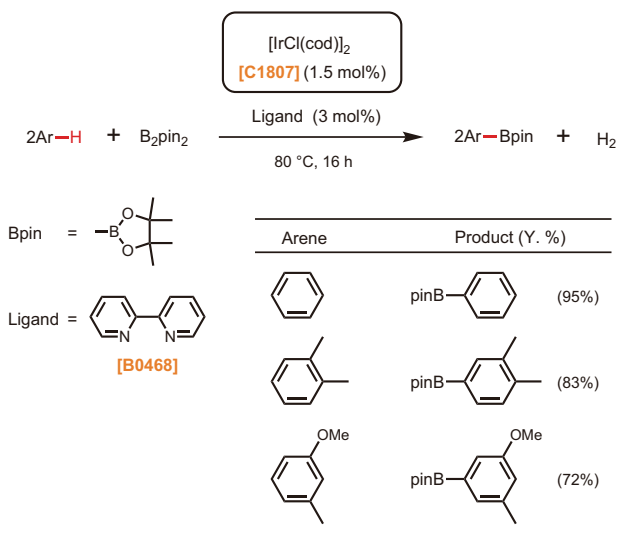


Moreover, White *et al.* have also reported the macrolactonization reaction of ortho-substituted salicylic acid substrates, applying the reaction into intramolecular allylic C-H oxidation, in which the corresponding 14-membered ring macrolides are obtained in moderate yields.⁴⁾



● Ir(I) Catalyst

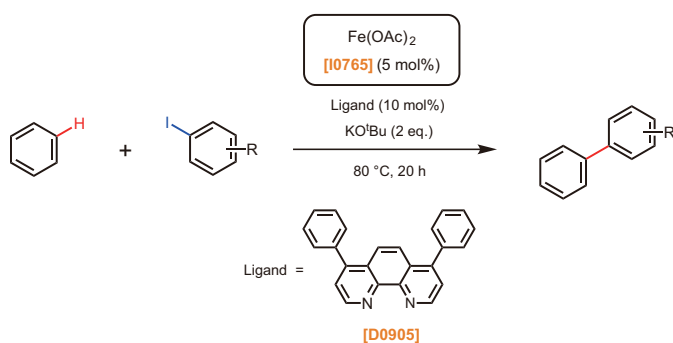
Miyaura, Ishiyama and Hargwig *et al.* have reported the direct C-H borylation in 2002.⁵⁾ This reaction is the most famous and practical example of C-H bond activation using iridium catalysts. Aryl borates had been synthesized by the reaction of aryl lithium or magnesium reagents with trialkyl borates so far, however, their method allowed a one-step preparation of alkyl borates in a simple manner.


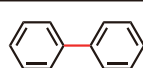

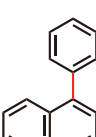
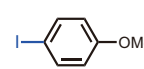
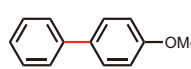
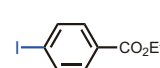
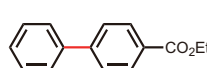

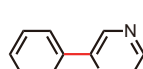


● Fe(II) Catalyst

Including palladium catalysts, which are frequently used for the Suzuki-Miyaura coupling reaction, transition metal catalysts, such as nickel or platinum, have been widely used for organic synthesis. However, the percentages of these metals in the earth's crust are extremely small, and their prices are rather expensive.⁶⁾ On the other hand, iron is abundant and less expensive, and therefore, more and more chemists have focused their attention to organic synthesis using iron compounds as a catalyst. Cross coupling reactions using iron catalysts have been reported.⁷⁾

For an example of C-H activation using iron catalysts, Charette *et al.* have reported the direct coupling reaction of benzene with aryl iodides using iron(II) acetate (**10765**).⁸⁾ This reaction is highly cost-effective and environmentally friendly in the sense of using an iron catalyst, which is less expensive, and therefore, further development and applications are expected from the point of green chemistry.



| Aryl Iodide | Product (Y. %) |
|--|---|
|  |  (89%) |
|  |  (60%) |
|  |  (93%) |
|  |  (40%) |
|  |  (79%) |

Thus, C-H bond activation has been widely studied as a new methodology of carbon-carbon and carbon-heteroatom bond formations, following a cross coupling reaction and olefin metathesis.

TCI offers a variety of transition metal catalysts, ligands, and activating reagents readily available for C-H bond activation as below.

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- 2) K. L. Hull, M. S. Sanford, *J. Am. Chem. Soc.* **2007**, 129, 11904.
- 3) M. S. Chen, N. Prabakaran, N. A. Labenz, M. C. White, *J. Am. Chem. Soc.* **2005**, 127, 6970.
- 4) K. J. Fraunhofer, N. Prabakaran, L. E. Sirois, M. C. White, *J. Am. Chem. Soc.* **2006**, 128, 9032.
- 5) T. Ishiyama, J. Takagi, K. Ishida, N. Miyaura, N. R. Anastasi, J. F. Hartwig, *J. Am. Chem. Soc.* **2002**, 124, 390.
- 6) J. Emsley, in *The Elements*, 3rd ed., Oxford Univ. Press, New York, **1998**.
- 7) T. Nagano, T. Hayashi, *Org. Lett.* **2004**, 6, 1297; K. G. Dongo, H. Koh, M. Sau, C. L. L. Chai, *Adv. Synth. Catal.* **2007**, 349, 1015; T. Hatakeyama, M. Nakamura, *J. Am. Chem. Soc.* **2007**, 129, 9844.
- 8) F. Vallée, J. J. Mousseau, A. B. Charette, *J. Am. Chem. Soc.* **2010**, 132, 1514,

Metal Catalysts

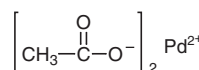
Palladium Catalysts

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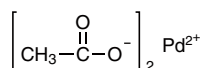
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A1424 1g 5g



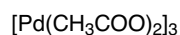
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P2161 1g



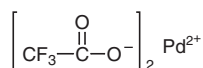
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P2106 1g 5g



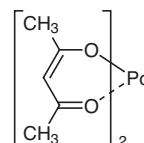
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P1870 1g 5g



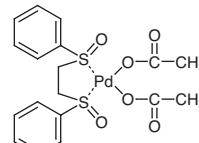
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B2018 1g 5g



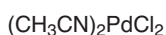
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B3292 200mg 1g



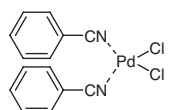
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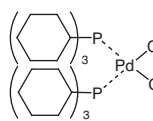
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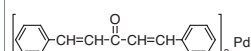
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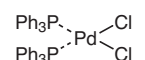
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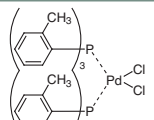
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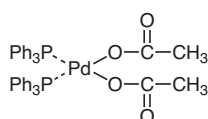
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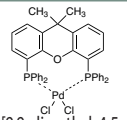
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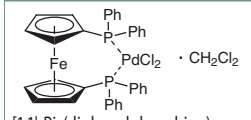
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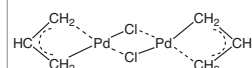
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B2064 1g 5g 25g



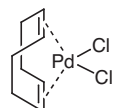
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A1479 500mg 1g



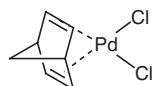
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Dimer
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D2604 1g 5g



Dichloro(1,5-cyclooctadiene)-
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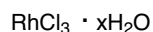
N0842 1g



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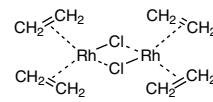
Rhodium Catalysts

R0244 250mg 1g



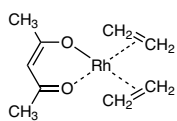
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C2461 200mg



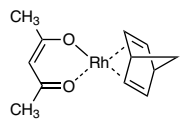
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CAS RN: 12081-16-2

A2100 200mg



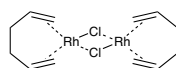
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A2761 200mg 1g



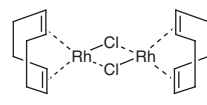
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C3194 100mg



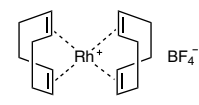
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B1045 100mg 1g



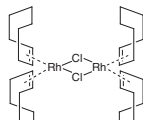
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B3961 100mg 1g



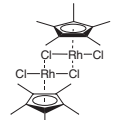
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C2253 100mg 500mg



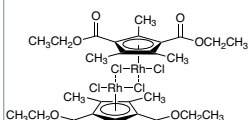
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P1788 200mg 1g



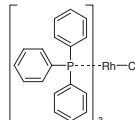
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B6169 200mg



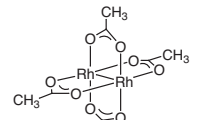
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T0931 1g 5g



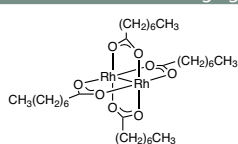
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R0069 100mg 1g



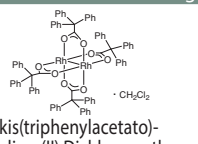
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R0161 200mg 1g



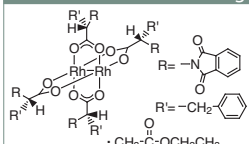
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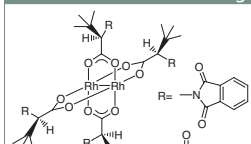
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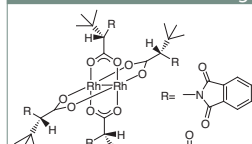
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T2054 100mg

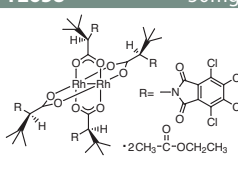
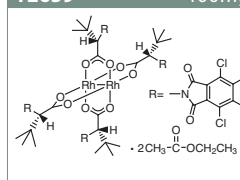
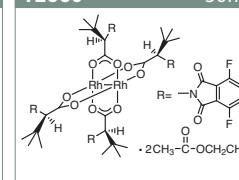
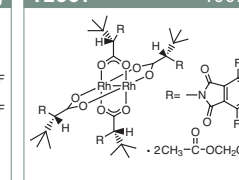
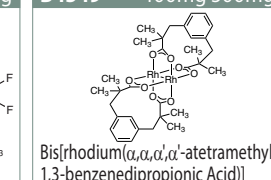
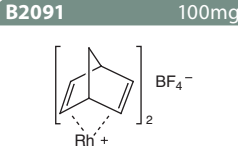
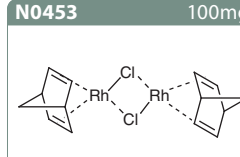
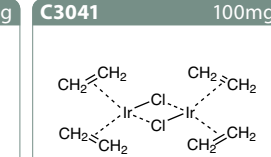
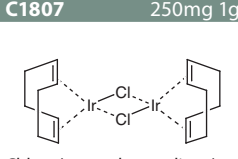
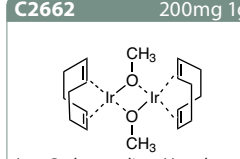
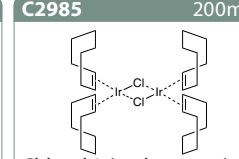
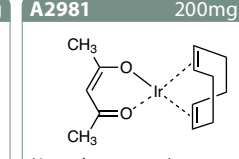
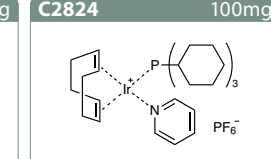
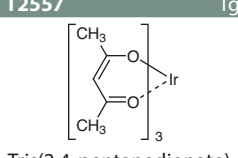
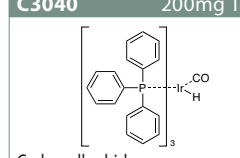
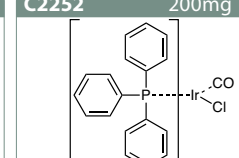
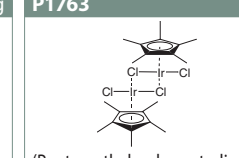
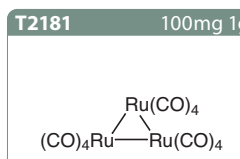
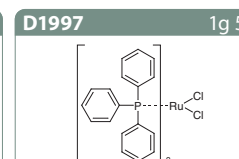
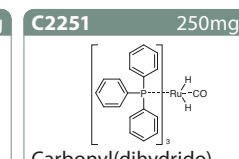
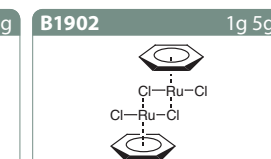
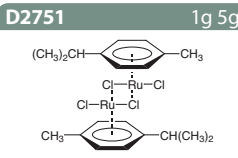
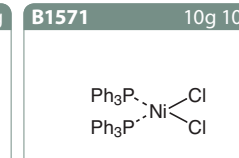
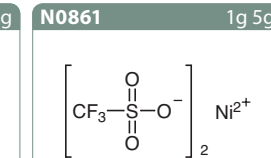
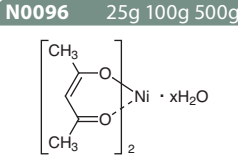
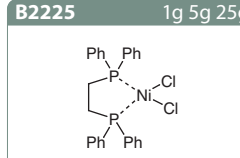
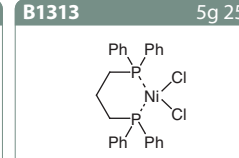
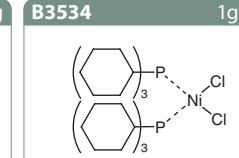
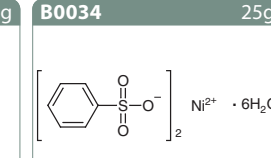
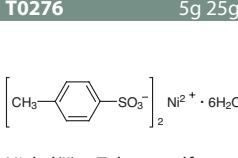
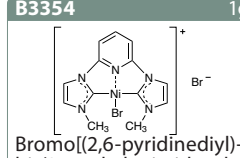
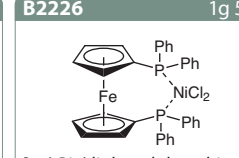
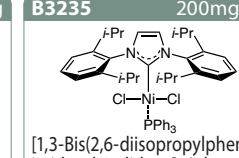
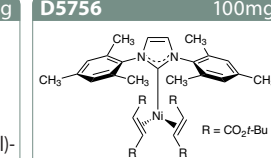


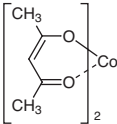

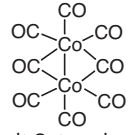
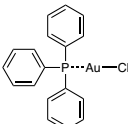
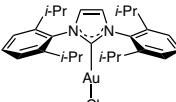
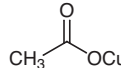
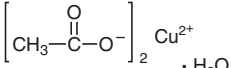
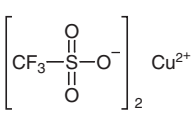
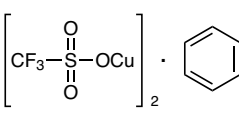
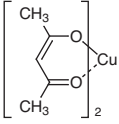
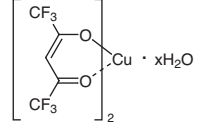
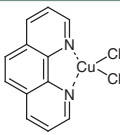
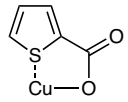
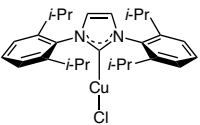
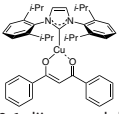
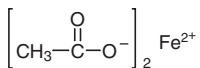
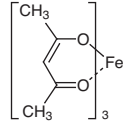
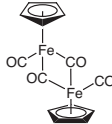
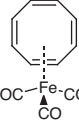
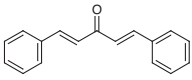
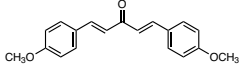
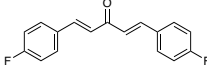
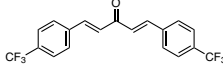
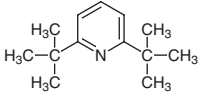
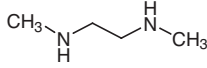


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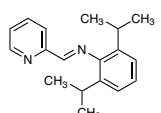
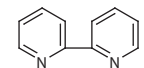
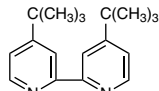
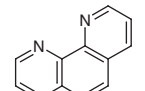
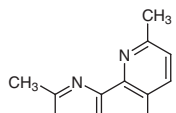
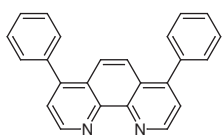
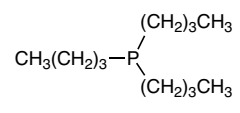
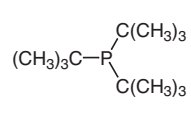
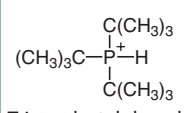
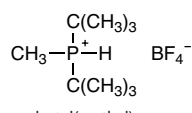
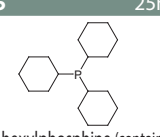
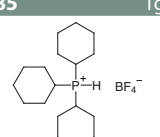
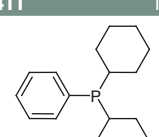
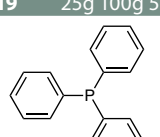
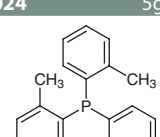
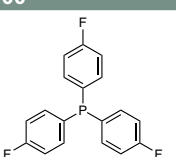
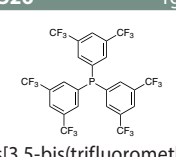
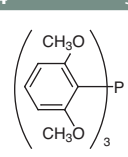
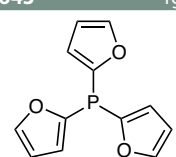
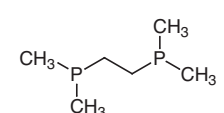
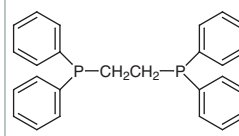
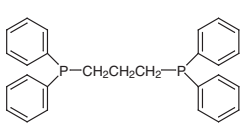
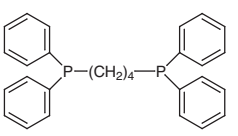
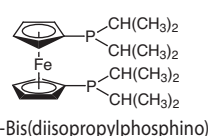
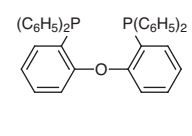
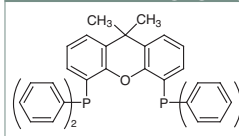
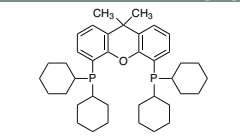
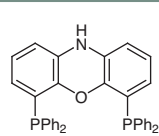
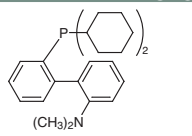

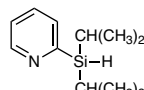
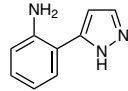
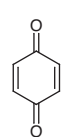
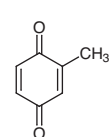
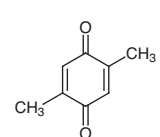
T2055 100mg



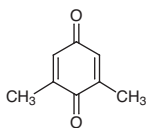
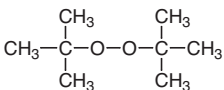
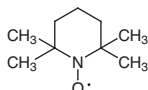
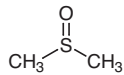
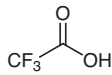
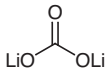
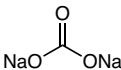
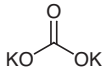
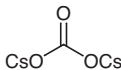
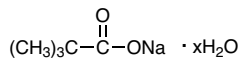
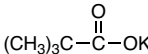
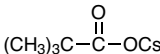
$\text{Rh}_2(\text{S-PTTL})_4 2\text{EtOAc}$

| | | | | | |
|---|--|--|--|--|---|
| <p>T2658 50mg</p>  <p>Rh₂(R-TCPTTL)₄ 2EtOAc</p> | <p>T2659 100mg</p>  <p>Rh₂(S-TCPTTL)₄ 2EtOAc</p> | <p>T2660 50mg</p>  <p>Rh₂(R-TFPTTL)₄ 2EtOAc</p> | <p>T2661 100mg</p>  <p>Rh₂(S-TFPTTL)₄ 2EtOAc</p> | <p>B4549 100mg 500mg</p>  <p>Bis(rhodium(α,α,α',α'-tetramethyl-1,3-benzenedipropionic Acid)) CAS RN: 819050-89-0</p> | |
| <p>B2091 100mg</p>  <p>Bis[η-(2,5-norbornadiene)]-rhodium(I) Tetrafluoroborate CAS RN: 36620-11-8</p> | <p>N0453 100mg</p>  <p>Norbornadiene Rhodium(I) Chloride Dimer CAS RN: 12257-42-0</p> | <p>Iridium Catalysts</p> | | <p>I0616 1g 5g</p> <p>IrCl₃ · xH₂O</p> <p>Iridium(III) Chloride Hydrate CAS RN: 14996-61-3</p> | <p>C3041 100mg</p>  <p>Chlorobis(ethylene)iridium(I) Dimer CAS RN: 39722-81-1</p> |
| <p>C1807 250mg 1g</p>  <p>Chloro(1,5-cyclooctadiene)-iridium(I) Dimer CAS RN: 12112-67-3</p> | <p>C2662 200mg 1g</p>  <p>(1,5-Cyclooctadiene)(methoxy)-iridium(I) Dimer CAS RN: 12148-71-9</p> | <p>C2985 200mg</p>  <p>Chlorobis(cyclooctene)-iridium(I) Dimer CAS RN: 12246-51-4</p> | <p>A2981 200mg 1g</p>  <p>(Acetylacetonato)-(1,5-cyclooctadiene)iridium(I) CAS RN: 12154-84-6</p> | <p>C2824 100mg</p>  <p>Crabtree's Catalyst CAS RN: 64536-78-3</p> | |
| <p>T2557 1g</p>  <p>Tris(2,4-pentanedionato)-iridium(III) CAS RN: 15635-87-7</p> | <p>C3040 200mg 1g</p>  <p>Carbonylhydrido-tris(triphenylphosphine)iridium(I) CAS RN: 17250-25-8</p> | <p>C2252 200mg 1g</p>  <p>Vaska's Catalyst CAS RN: 14871-41-1</p> | <p>P1763 1g</p>  <p>(Pentamethylcyclopentadienyl)-iridium(III) Dichloride Dimer CAS RN: 12354-84-6</p> | <p>Ruthenium Catalysts</p> | |
| <p>R0074 1g 5g</p> <p>RuCl₃</p> <p>Ruthenium(III) Chloride CAS RN: 10049-08-8</p> | <p>T2181 100mg 1g</p>  <p>Triruthenium Dodecacarbonyl CAS RN: 15243-33-1</p> | <p>D1997 1g 5g</p>  <p>Tris(triphenylphosphine)-ruthenium(II) Dichloride CAS RN: 15529-49-4</p> | <p>C2251 250mg 1g</p>  <p>Carbonyl(dihydro)-tris(triphenylphosphine)-ruthenium(II) CAS RN: 25360-32-1</p> | <p>B1902 1g 5g</p>  <p>Benzeneruthenium(II) Chloride Dimer CAS RN: 37366-09-9</p> | |
| <p>D2751 1g 5g</p>  <p>Dichloro(<i>p</i>-cymene)ruthenium(II) Dimer CAS RN: 52462-29-0</p> | <p>Nickel Catalysts</p> | | <p>N0850 25g 500g</p> <p>NiCl₂</p> <p>Nickel(II) Chloride Anhydrous CAS RN: 7718-54-9</p> | <p>B1571 10g 100g</p>  <p>Bis(triphenylphosphine)-nickel(II) Dichloride CAS RN: 14264-16-5</p> | <p>N0861 1g 5g</p>  <p>Nickel(II) Triflate CAS RN: 60871-84-3</p> |
| <p>N0096 25g 100g 500g</p>  <p>Bis(2,4-pentanedionato)-nickel(II) Hydrate CAS RN: 120156-44-7</p> | <p>B2225 1g 5g 25g</p>  <p>[1,2-Bis(diphenylphosphino)ethane]nickel(II) Dichloride CAS RN: 14647-23-5</p> | <p>B1313 5g 25g</p>  <p>[1,3-Bis(diphenylphosphino)propane]dichloronickel(II) CAS RN: 15629-92-2</p> | <p>B3534 1g 5g</p>  <p>Bis(tricyclohexylphosphine)-nickel(II) Dichloride CAS RN: 19999-87-2</p> | <p>B0034 25g</p>  <p>Nickel(II) Benzenesulfonate Hexahydrate CAS RN: 39819-65-3</p> | |
| <p>T0276 5g 25g</p>  <p>Nickel(II) <i>p</i>-Toluenesulfonate Hexahydrate CAS RN: 6944-05-4</p> | <p>B3354 1g</p>  <p>Bromo[(2,6-pyridinediyl)-bis(3-methyl-1-imidazolyl-2-ylidene)]nickel Bromide CAS RN: 894102-11-5</p> | <p>B2226 1g 5g</p>  <p>[1,1'-Bis(diphenylphosphino)-ferrocene]nickel(II) Dichloride CAS RN: 67292-34-6</p> | <p>B3235 200mg 1g</p>  <p>[1,3-Bis(2,6-diisopropylphenyl)-imidazol-2-ylidene]triphenylphosphine Nickel(II) Dichloride CAS RN: 903592-98-3</p> | <p>D5756 100mg</p>  <p>Ni(Imes)(Di-<i>tert</i>-butyl Fumarate)₂ CAS RN: 2230140-59-5</p> | |

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|--|---|---|--|--|
| <h2 style="text-align: center;">Cobalt Catalysts</h2> | <p>B2681 25g</p>  <p>Acetylacetonate Cobalt(II) Salt CAS RN: 14024-48-7</p> | <p>D4940 2g</p>  <p>Dicarbonyl-cyclopentadienylcobalt(I) CAS RN: 12078-25-0</p> | <p>D3213 5g 25g</p>  <p>Dicobalt Octacarbonyl (stabilized with 1-5% Hexane) CAS RN: 10210-68-1</p> | <h2 style="text-align: center;">Gold Catalysts</h2> |
| <p>T2994 200mg 1g</p>  <p>(Triphenylphosphine)-gold(I) Chloride CAS RN: 14243-64-2</p> | <p>C2405 200mg</p>  <p>Chloro[1,3-bis(2,6-diisopropylphenyl)-imidazol-2-ylidene]gold(I) CAS RN: 852445-83-1</p> | <h2 style="text-align: center;">Silver Catalysts</h2> | <p>S0463 5g 25g</p> <p>AgSbF₆</p> <p>Silver Hexafluoroantimonate(V) CAS RN: 26042-64-8</p> | <p>S0898 1g 5g</p> <p>Ag⁺ (CF₃SO₂)₂N⁻</p> <p>Silver Triflimide CAS RN: 189114-61-2</p> |
| <h2 style="text-align: center;">Copper Catalysts</h2> | <p>T2666 1g 5g 25g</p> <p>(CH₃CN)₄Cu⁺ BF₄⁻</p> <p>Tetrakis(acetonitrile)copper(I) Tetrafluoroborate CAS RN: 15418-29-8</p> | <p>T2665 5g</p> <p>(CH₃CN)₄Cu⁺ PF₆⁻</p> <p>Tetrakis(acetonitrile)copper(I) Hexafluorophosphate CAS RN: 64443-05-6</p> | <p>A1540 5g 25g</p>  <p>Copper(I) Acetate CAS RN: 598-54-9</p> | <p>C2346 25g 500g</p>  <p>Copper(II) Acetate Monohydrate CAS RN: 6046-93-1</p> |
| <p>T1292 5g 25g</p>  <p>Copper(II) Trifluoromethanesulfonate CAS RN: 34946-82-2</p> | <p>T1442 1g 5g</p>  <p>Copper(I) Triflate Benzene Complex CAS RN: 42152-46-5</p> | <p>C0384 25g 250g</p>  <p>Bis(2,4-pentanedionato)-copper(II) CAS RN: 13395-16-9</p> | <p>H0554 1g 5g</p>  <p>Bis(hexafluoroacetylacetonato)-copper(II) Hydrate CAS RN: 14781-45-4</p> | <p>D3891 1g 5g</p>  <p>Dichloro(1,10-phenanthroline)copper(II) CAS RN: 14783-09-6</p> |
| <p>C2312 1g 5g</p>  <p>CuTC CAS RN: 68986-76-5</p> | <p>C2304 200mg 1g</p>  <p>Bis(2,4-pentanedionato)-copper(II) CAS RN: 578743-87-0</p> | <p>B3351 200mg 1g</p>  <p>[1,3-Bis(2,6-diisopropylphenyl)-imidazol-2-ylidene](1,3-diphenyl-1,3-propanedionato)copper(I) CAS RN: 920739-11-3</p> | <h2 style="text-align: center;">Iron Catalysts</h2> | <p>I0765 5g 25g</p>  <p>Iron(II) Acetate CAS RN: 3094-87-9</p> |
| <p>I0079 25g 100g 500g</p>  <p>Iron(III) Acetylacetonate CAS RN: 14024-18-1</p> | <p>C1592 5g</p>  <p>Cyclopentadienyliron Dicarbonyl Dimer CAS RN: 12154-95-9</p> | <p>T1775 1g</p>  <p>Tricarbonyl(cyclooctatetraene)-iron CAS RN: 12093-05-9</p> | | |
| <h2 style="text-align: center;">Ligands</h2> | | | | |
| <p>D0903 25g 250g</p>  <p><i>trans,trans</i>-Dibenzylideneacetone CAS RN: 35225-79-7</p> | <p>B4467 200mg 1g</p>  <p><i>trans,trans</i>-Bis(4-methoxybenzylidene)acetone CAS RN: 37951-12-5</p> | <p>B2283 5g 25g</p>  <p><i>trans,trans</i>-Bis(4-fluorobenzylidene)acetone CAS RN: 53369-00-9</p> | <p>B4468 200mg 1g</p>  <p><i>trans,trans</i>-Bis(4-(trifluoromethyl)benzylidene)acetone CAS RN: 103836-71-1</p> | <p>D1804 5g 25g</p>  <p>2,6-Di-<i>tert</i>-butylpyridine CAS RN: 585-48-8</p> |
| <p>D0720 5mL 25mL</p>  <p><i>N,N'</i>-Dimethylethylenediamine CAS RN: 110-70-3</p> | <p>N0166 25g 400g</p>  <p>2-Norbornene CAS RN: 498-66-8</p> | <p>N0346 25mL 100mL 500mL</p>  <p>2,5-Norbornadiene (stabilized with BHT) CAS RN: 121-46-0</p> | | |

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|---|--|---|--|--|
| D4652 200mg 1g  <i>trans</i> -2,6-Diisopropyl- <i>N</i> -(2-pyridylmethylene)aniline CAS RN: 908294-68-8 | B0468 25g 100g 500g  2,2'-Bipyridyl CAS RN: 366-18-7 | D3134 1g 5g  4,4'-Di- <i>tert</i> -butyl-2,2'-bipyridyl CAS RN: 72914-19-3 | P0221 1g 25g  1,10-Phenanthroline Monohydrate CAS RN: 5144-89-8 | D0771 1g  Neocuproine Hemihydrate CAS RN: 34302-69-7 |
| D0905 1g 5g  Bathophenanthroline CAS RN: 1662-01-7 | T0361 25mL 100mL 500mL  Tributylphosphine CAS RN: 998-40-3 | T1912 5g  Tri- <i>tert</i> -butylphosphine CAS RN: 13716-12-6 | T2584 1g 5g  Tri- <i>tert</i> -butylphosphonium Tetrafluoroborate CAS RN: 131274-22-1 | D4731 1g 5g  Di- <i>tert</i> -butyl(methyl)-phosphonium Tetrafluoroborate CAS RN: 479094-62-7 |
| T1165 25mL  Tricyclohexylphosphine (contains Tricyclohexylphosphine Oxide) (ca. 18% in Toluene, ca. 0.60mol/L) CAS RN: 2622-14-2 | T2585 1g 5g  Tricyclohexylphosphonium Tetrafluoroborate CAS RN: 58656-04-5 | D2411 1g 5g  Dicyclohexylphenylphosphine CAS RN: 6476-37-5 | T0519 25g 100g 500g  Triphenylphosphine CAS RN: 603-35-0 | T1024 5g 25g  Tri(<i>o</i> -tolyl)phosphine CAS RN: 6163-58-2 |
| T2900 5g  Tris(4-fluorophenyl)phosphine CAS RN: 18437-78-0 | T2526 1g 5g  Tris[3,5-bis(trifluoromethyl)-phenyl]phosphine CAS RN: 175136-62-6 | T1614 5g 25g  Tris(2,6-dimethoxyphenyl)phosphine CAS RN: 85417-41-0 | T1643 1g 5g  Tri(2-furyl)phosphine CAS RN: 5518-52-5 | B1174 100mg 1g  1,2-Bis(dimethylphosphino)ethane CAS RN: 23936-60-9 |
| B1137 10g 25g  1,2-Bis(diphenylphosphino)ethane CAS RN: 1663-45-2 | B1138 5g 25g  1,3-Bis(diphenylphosphino)propane CAS RN: 6737-42-4 | B1246 5g 25g  1,4-Bis(diphenylphosphino)butane CAS RN: 7688-25-7 | B2710 100mg 1g  1,1'-Bis(diisopropylphosphino)ferrocene CAS RN: 97239-80-0 | B2867 5g 25g  DPEphos CAS RN: 166330-10-5 |
| B2709 1g 5g 25g  4,5-Bis(diphenylphosphino)-9,9-dimethylxanthene CAS RN: 161265-03-8 | B5239 200mg 1g  4,5-Bis(dicyclohexylphosphino)-9,9-dimethylxanthene CAS RN: 940934-47-4 | B2717 100mg 1g  4,6-Bis(diphenylphosphino)phenoazine CAS RN: 261733-18-0 | D3389 1g 5g  2-(Dicyclohexylphosphino)-2'-(dimethylamino)biphenyl CAS RN: 213697-53-1 | |
| <h2>Directing Group Introducing Agents</h2> | | | | |
| | A0419 5g 25g 100g  8-Aminoquinoline CAS RN: 578-66-5 | D4264 1g 5g  2-(Diisopropylsilyl)pyridine CAS RN: 1232692-92-0 | P1902 1g  2-(1 <i>H</i> -Pyrazol-5-yl)aniline CAS RN: 111562-32-4 | |
| <h2>Additives</h2> | | | | |
| | B0089 25g 100g 500g  <i>p</i> -Benzoquinone CAS RN: 106-51-4 | T1244 25g 500g  <i>p</i> -Toluquinone CAS RN: 553-97-9 | D0686 1g 5g 25g  <i>p</i> -Xyloquinone CAS RN: 137-18-8 | |

C-H Bond Activatin Reaction

| | | | | |
|--|---|---|--|--|
| D2234 1g 5g 25g  2,6-Dimethyl-1,4-benzoquinone CAS RN: 527-61-7 | D3411 100mL  Di-tert-butyl Peroxide CAS RN: 110-05-4 | T1560 5g 25g  TEMPO Free Radical CAS RN: 2564-83-2 | D0798 25g 500g  Dimethyl Sulfoxide CAS RN: 67-68-5 | T0431 25g 100g 500g  Trifluoroacetic Acid CAS RN: 76-05-1 |
| O0310 25g 500g 2KHSO ₅ · KHSO ₄ · K ₂ SO ₄ Potassium Peroxymonosulfate CAS RN: 37222-66-5 | L0224 25g 500g  Lithium Carbonate CAS RN: 554-13-2 | S0560 300g  Sodium Carbonate CAS RN: 497-19-8 | P1748 300g  Potassium Carbonate CAS RN: 584-08-7 | C2160 25g 100g  Cesium Carbonate CAS RN: 534-17-8 |
| T2052 100mL 500mL TiCl ₄ Titanium(IV) Chloride (14% in Dichloromethane, ca. 1.0mol/L) CAS RN: 7550-45-0 | T3238 100mL 500mL TiCl ₄ Titanium(IV) Chloride (ca. 19% in Toluene, ca. 1.0mol/L) CAS RN: 7550-45-0 | S0463 5g 25g AgSbF ₆ Silver Hexafluoroantimonate(V) CAS RN: 26042-64-8 | S0898 1g 5g Ag ⁺ (CF ₃ SO ₂) ₂ N ⁻ Silver Triflimide CAS RN: 189114-61-2 | S0978 5g 25g  Sodium Pivalate Hydrate CAS RN: 143174-36-1 |
| P2354 5g 25g  Potassium Pivalate CAS RN: 19455-23-3 | C3230 1g 5g  Cesium Pivalate CAS RN: 20442-70-0 | | | |

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