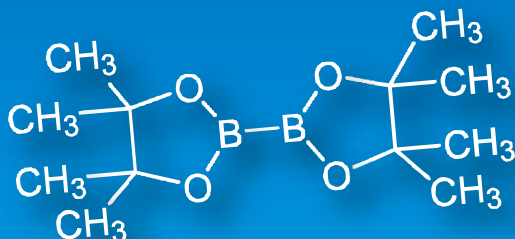
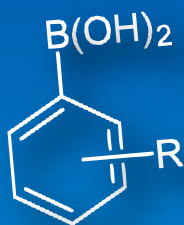


鈴木-宮浦

クロスカップリング反応

Suzuki-Miyaura Cross Coupling Reaction

TCI® 東京化成工業株式会社



ボロン酸

ボロン酸エステル

ジボロンエステル

パラジウム触媒

ニッケル触媒

ホスフィン配位子

N-複素環カルベン配位子

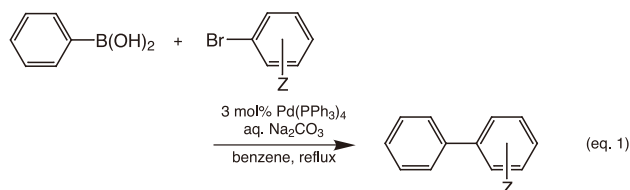
その他

塩基・添加剤

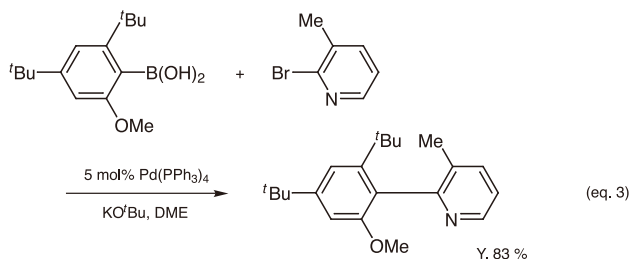
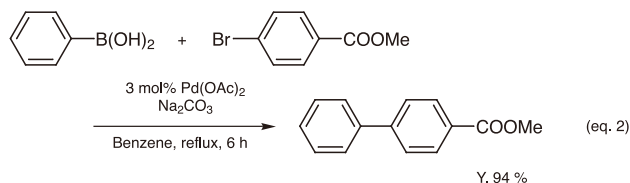
鈴木ー宮浦クロスカップリング反応

ビアリールは生理活性物質、液晶を始めとする機能性材料などの重要な基本骨格として用いられています。例えば、鎮痛、抗炎症作用を有するジフルニサル、液晶材料4-アルキル4'-シアノビフェニルは、ビアリールが基本骨格となっています。従来、ビアリールの形成にはウルマン反応、ゴンバーグーバツハマンーヘイ反応などが利用されてきましたが、反応の選択性に乏しく、また、その収率も決して高くありませんでした。

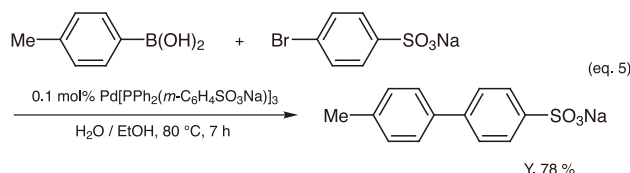
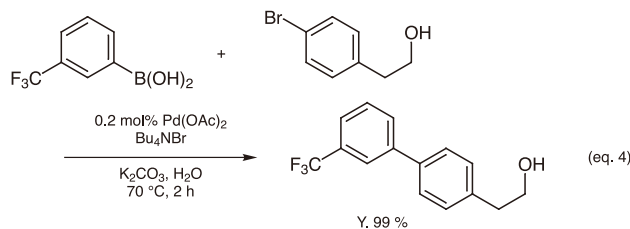
1981年、鈴木、宮浦らは、均一系パラジウム触媒と塩基の存在下、アリールボロン酸とアリールプロミドから高い収率でビアリールを合成する画期的な方法を報告しました (eq. 1)¹⁾。



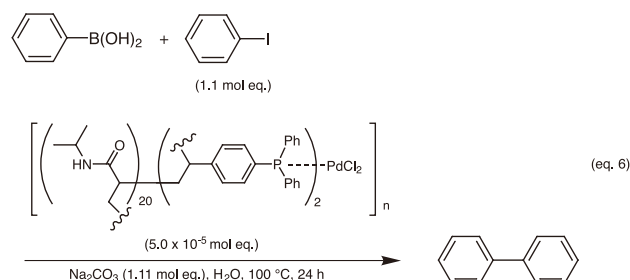
この反応は、温和な条件下、高い選択性と高い収率でビアリールを得ることができます。しかも官能基による制約が少なく、例えば、水酸基やカルボキシ基、ホルミル基など、様々な置換基を有するビアリールを合成することができます (eq. 2)。また、高度な立体障害を有するピリジルフェノール誘導体も合成することが可能です (eq. 3)²⁾。この有用なカップリング反応は、発明者の名を冠して「鈴木ー宮浦クロスカップリング反応」と呼ばれています。この鈴木ー宮浦クロスカップリング反応は極めて有用なため、様々な改良が行われています。



近年、グリーンケミストリーの観点から、水を溶媒として用いる鈴木ー宮浦クロスカップリング反応が次々と開発されています。例えば、テトラブチルアンモニウムプロミドを用いた反応では、水中でアリールボロン酸と $\text{ArB(OH)}_3 \cdot \text{Bu}_4\text{N}^+$ を形成し、クロスカップリング反応を促進します (eq. 4)³⁾。また、水溶性のPd(0)触媒を用いたクロスカップリング反応が報告されています (eq. 5)⁴⁾。

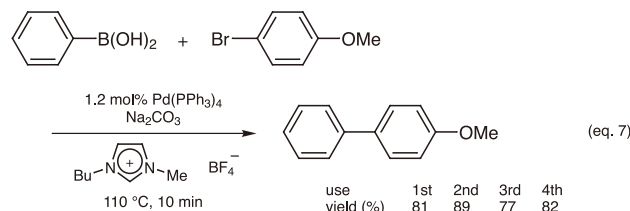


ごく最近では、両親媒性ポリマー担持Pd触媒を用いたクロスカップリング反応が報告されています。このPd触媒はネットワーク状の超分子を形成しており、水、有機溶媒に不溶であり、反応系からの回収が容易です。そして、Pdはコポリマーのホスフィノ基に強く担持されているため、反応に際して溶出することなく、繰り返し利用することができます (eq. 6)⁵⁾。

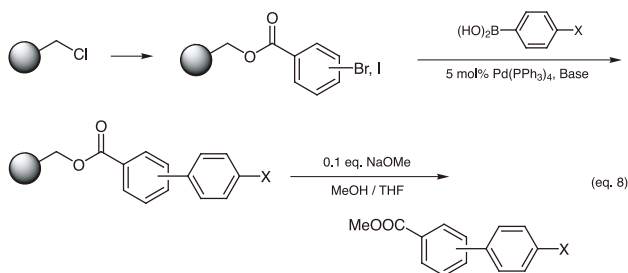


entry	catalyst	Y. (%)
1	1st use	95
2	10th use	93
3	1st ~ 10th consecutive use	av. 95

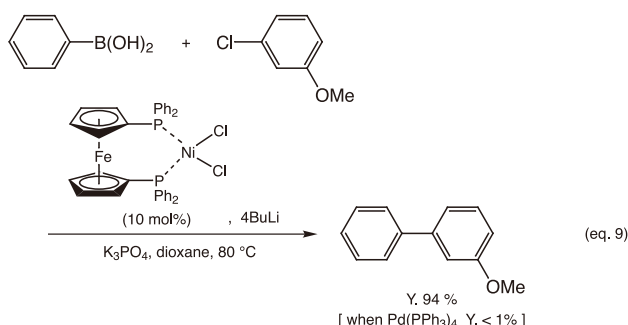
イオン液体を鈴木ー宮浦クロスカップリング反応の溶媒として用いる試みもなされています。それによると、反応終了後、生成物は有機溶媒で容易に抽出することができ、触媒はイオン液体中に保持されます。イオン液体および触媒はそのまま再利用することが可能です (eq. 7)⁶⁾。



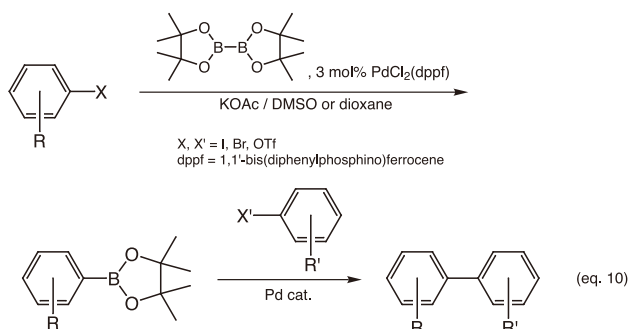
1994年に鈴木ー宮浦クロスカップリング反応の固相合成への応用が初めて報告されて以来⁷⁾、多くの合成例が報告されています。例えば、メリフィールド樹脂に連結したアリールヨードおよびアリールプロミドは種々のアリールボロン酸と反応し、高収率でビアリールを与えます (eq. 8)。



アリールハライドおよびアリールトリフラートの反応性は、 $\text{Ar-I} > \text{Ar-Br} > \text{Ar-OTf} \gg \text{Ar-Cl}$ の順となっています。アリールクロリドはPdに対する酸化付加が遅いため、アリール部位がヘテロ環である場合や電子吸引基を有する場合を除き、通常は十分に反応が進行しません。Pd触媒の代わりにNi触媒を用いることにより、アリールクロリドとアリールボロン酸から良好な収率でビアリールを得られることが報告されています (eq. 9)⁸⁾。



アリールボロン酸の製法は、グリニャール試薬またはリチウム試薬とアルキルボラートを反応させるのが一般的です。しかしながら、低温で反応を行わなければならないこと、置換基によってはボロン酸の収率が低下するという問題点がありました。宮浦らは、ジボロンエステル類とアリールハライドあるいはアリールトリフラートから得られるアリールボロナートが、鈴木-宮浦クロスカップリング反応に利用可能であることを報告しています (eq.10)⁹⁾。このアリールボロナートは、クロスカップリング反応に直接利用することができる有用な化合物です。



鈴木-宮浦クロスカップリング反応は、炭素-炭素結合形成のための最も強力な手法の1つであり、様々な目的化合物の炭素骨格を構築するための有用な方法です。

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総 説

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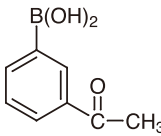
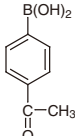
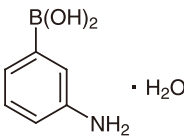
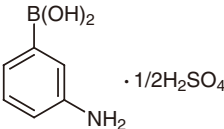
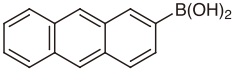
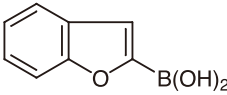
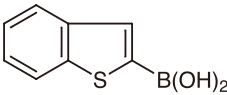
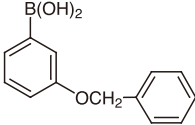
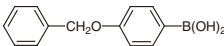
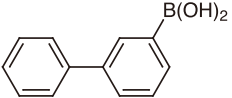
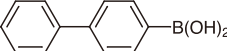
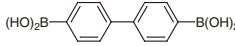
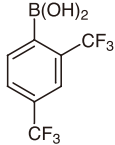
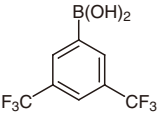
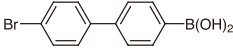
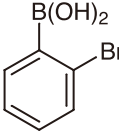
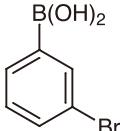
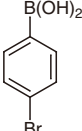
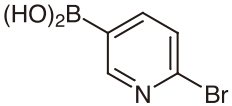
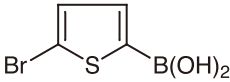
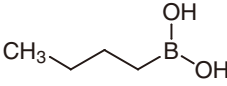
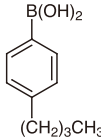
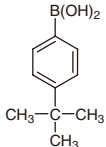
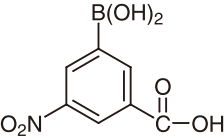
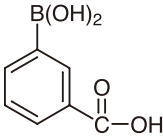
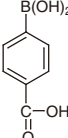
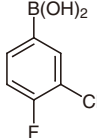
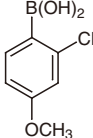
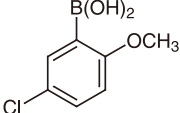
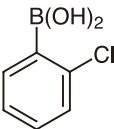
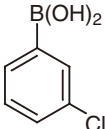
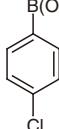
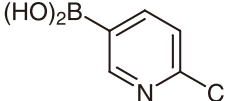
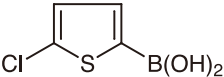
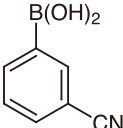
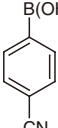
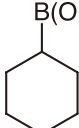
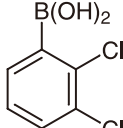
アリール-アリール結合形成反応

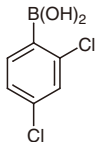
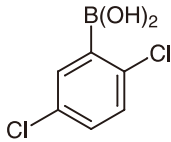
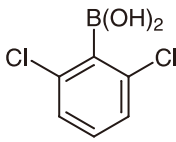
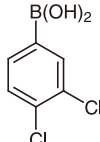
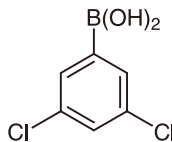
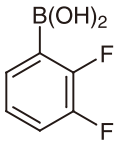
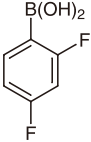
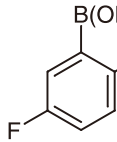
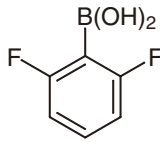
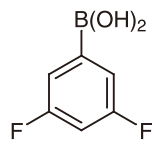
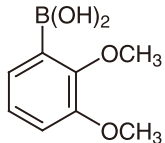
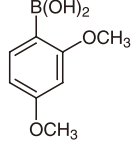
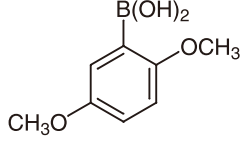
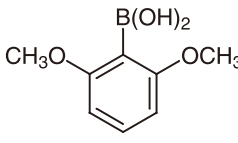
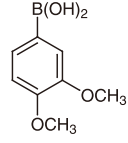
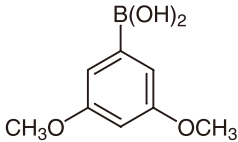
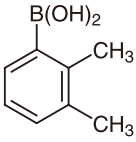
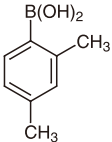
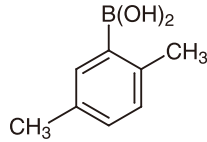
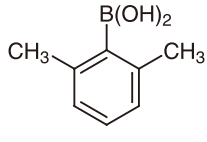
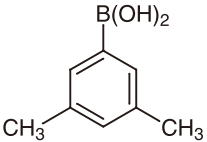
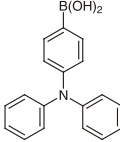
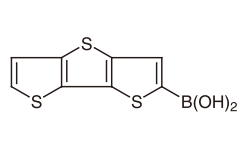
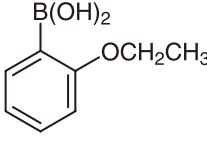
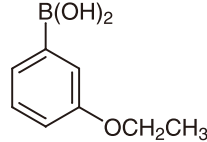
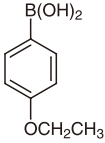
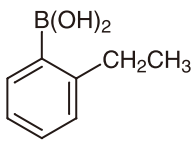
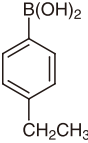
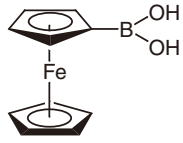
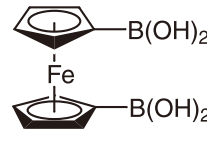
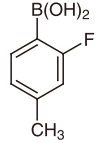
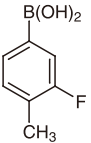
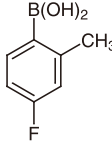
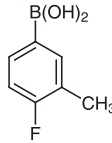
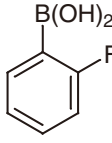
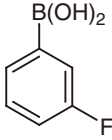
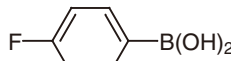
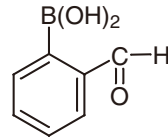
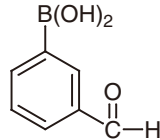
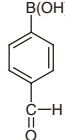
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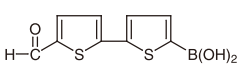
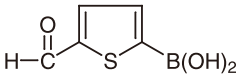
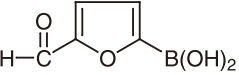
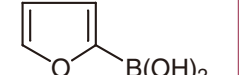
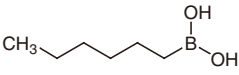
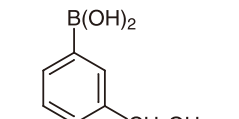
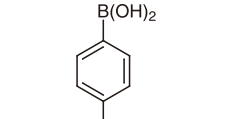
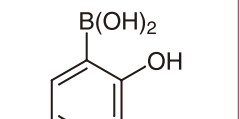
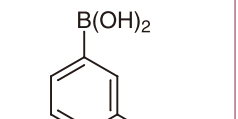
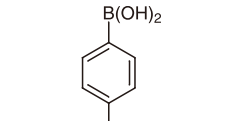
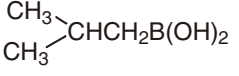
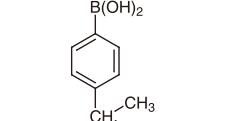
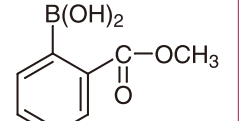
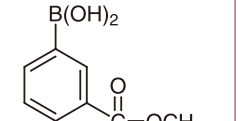
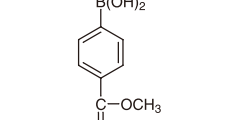
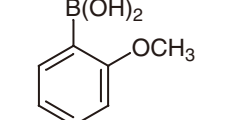
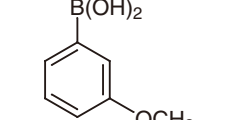
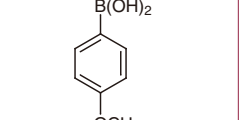
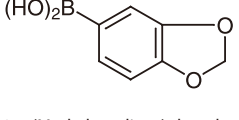
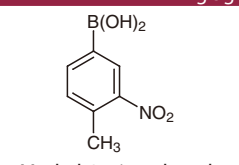
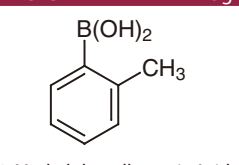
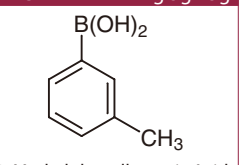
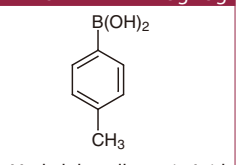
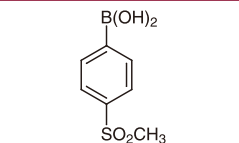
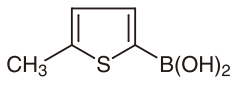
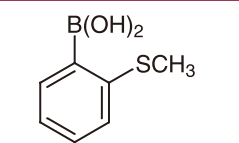
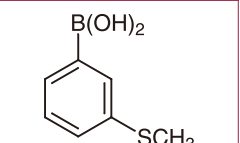
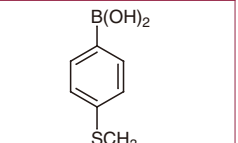
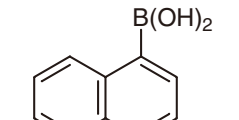
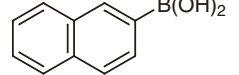
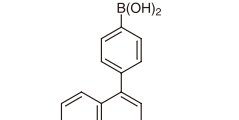
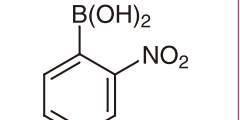
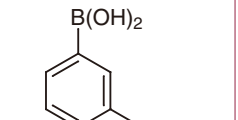
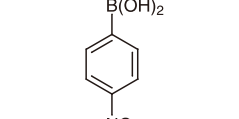
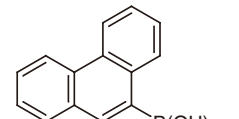
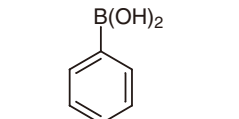
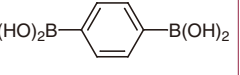
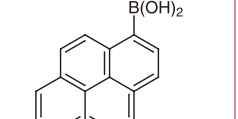
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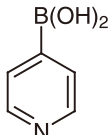
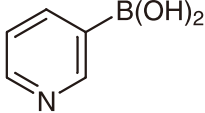
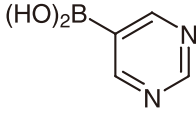
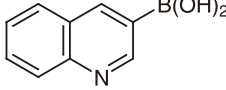
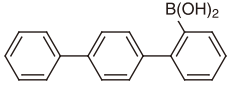
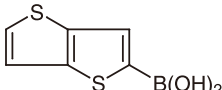
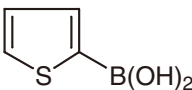
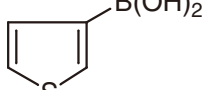
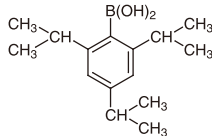
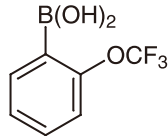
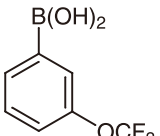
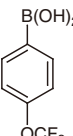
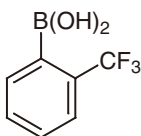
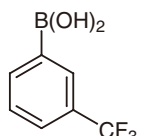
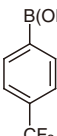
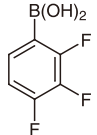
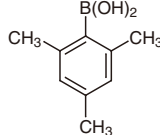
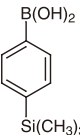
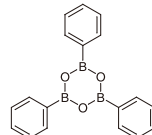
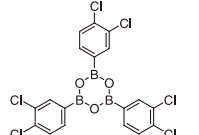
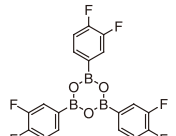
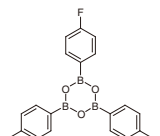
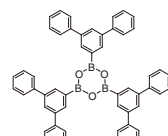
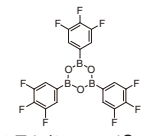
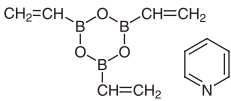
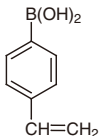
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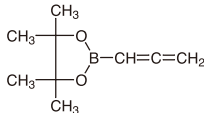
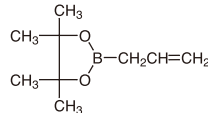
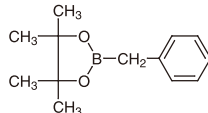
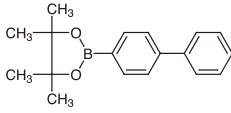
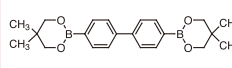
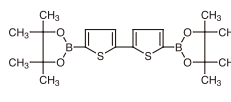
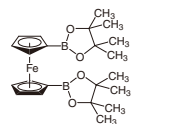
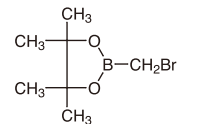
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A17741g 5g 25g  3-Aminophenylboronic Acid Hemisulfate [66472-86-4]	A1843250mg 1g  2-Anthraceneboronic Acid [141981-64-8]	B29781g  Benzofuran-2-boronic Acid [98437-24-2]	B28931g 5g  Benzo[b]thiophene-2-ylboronic Acid [98437-23-1]	B30565g  3-Benzyloxyphenylboronic Acid [156682-54-1]
B21451g 5g  4-Benzyloxyphenylboronic Acid [146631-00-7]	B24895g  3-Biphenylboronic Acid [5122-95-2]	B22945g 25g  4-Biphenylboronic Acid [5122-94-1]	B24901g  4,4'-Biphenyldiboronic Acid [4151-80-8]	B30221g 5g  2,4-Bis(trifluoromethyl)phenylboronic Acid [153254-09-2]
B18861g 5g  3,5-Bis(trifluoromethyl)phenylboronic Acid [73852-19-4]	B28601g  4'-Bromo-4-biphenylboronic Acid [480996-05-2]	B28895g  2-Bromophenylboronic Acid [244205-40-1]	B28901g 5g 25g  3-Bromophenylboronic Acid [89598-96-9]	B18581g 5g 25g  4-Bromophenylboronic Acid [5467-74-3]
B33071g 5g  2-Bromo-5-pyridineboronic Acid [223463-14-7]	B28621g 5g  5-Bromo-2-thiopheneboronic Acid [162607-17-2]	B05291g 5g 25g  Butylboronic Acid [4426-47-5]	B25891g 5g  4-Butylphenylboronic Acid [145240-28-4]	B22515g 25g  4-tert-Butylphenylboronic Acid [123324-71-0]
C23851g 5g  3-Carboxy-5-nitrophenylboronic Acid [101084-81-5]	C20281g 5g  3-Carboxyphenylboronic Acid [25487-66-5]	C13531g 5g  4-Carboxyphenylboronic Acid [14047-29-1]	C17601g 5g  3-Chloro-4-fluorophenylboronic Acid [144432-85-9]	C23861g 5g  2-Chloro-4-methoxyphenylboronic Acid [219735-99-6]
C22925g 25g  5-Chloro-2-methoxyphenylboronic Acid [89694-48-4]	C17051g 5g  2-Chlorophenylboronic Acid [3900-89-8]	C16135g 25g  3-Chlorophenylboronic Acid [63503-60-6]	C14735g 25g  4-Chlorophenylboronic Acid [1679-18-1]	C22881g 5g  2-Chloro-5-pyridineboronic Acid [444120-91-6]
C20661g 5g  5-Chloro-2-thiopheneboronic Acid [162607-18-3]	C20315g 25g  3-Cyanophenylboronic Acid [150255-96-2]	C17781g 5g 25g  4-Cyanophenylboronic Acid [126747-14-6]	C21881g 5g  Cyclohexylboronic Acid [4441-56-9]	D34345g 25g  2,3-Dichlorophenylboronic Acid [151169-74-3]

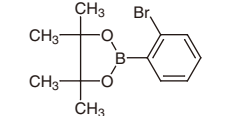
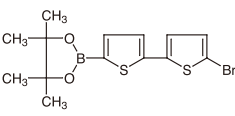
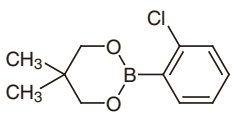
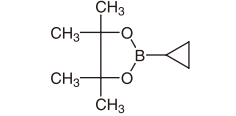
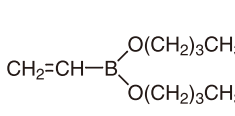
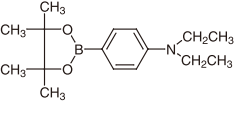
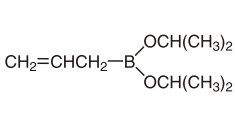
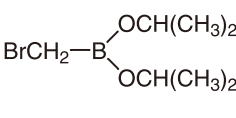
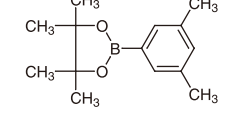
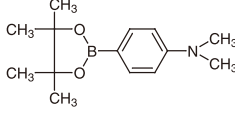
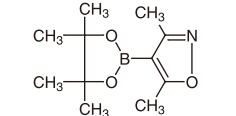
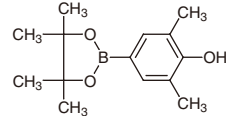
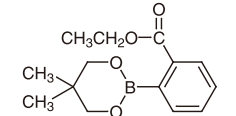
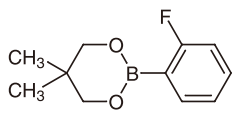
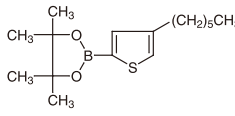
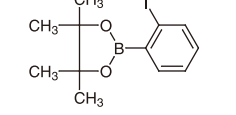
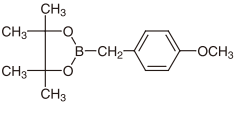
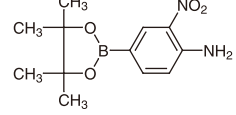
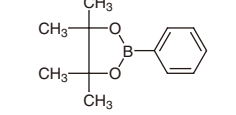
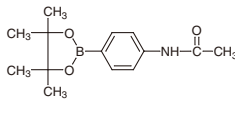
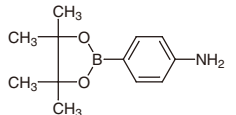
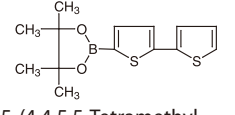
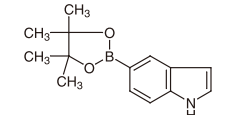
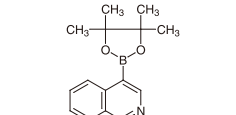
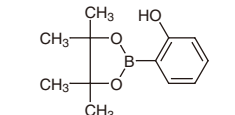
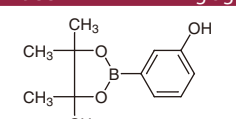
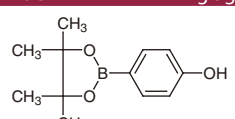
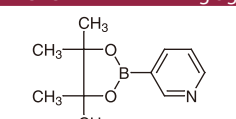
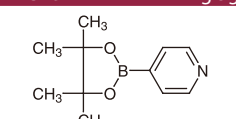
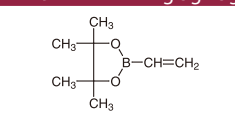
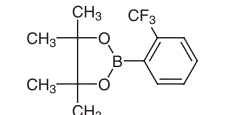
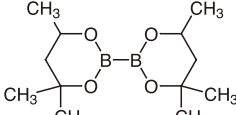
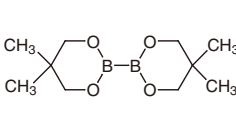
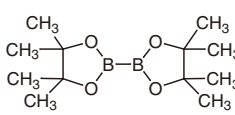
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D3523 5g 25g  2,3-Difluorophenylboronic Acid [121219-16-7]	D3391 5g 25g  2,4-Difluorophenylboronic Acid [144025-03-6]	D3436 5g 25g  2,5-Difluorophenylboronic Acid [193353-34-3]	D3087 1g 5g  2,6-Difluorophenylboronic Acid [162101-25-9]	D3081 5g 25g  3,5-Difluorophenylboronic Acid [156545-07-2]
D3853 5g  2,3-Dimethoxyphenylboronic Acid [40972-86-9]	D3521 1g 5g  2,4-Dimethoxyphenylboronic Acid [133730-34-4]	D3522 1g 5g  2,5-Dimethoxyphenylboronic Acid [107099-99-0]	D3861 5g 25g  2,6-Dimethoxyphenylboronic Acid [23112-96-1]	D3512 5g 25g  3,4-Dimethoxyphenylboronic Acid [122775-35-3]
D3513 1g 5g 25g  3,5-Dimethoxyphenylboronic Acid [192182-54-0]	D3516 5g  2,3-Dimethylphenylboronic Acid [183158-34-1]	D3514 1g 5g  2,4-Dimethylphenylboronic Acid [55499-44-0]	D3517 1g 5g  2,5-Dimethylphenylboronic Acid [85199-06-0]	D3633 1g 5g  2,6-Dimethylphenylboronic Acid [100379-00-8]
D3396 5g 25g  3,5-Dimethylphenylboronic Acid [172975-69-8]	D3537 1g  4-(Diphenylamino)phenylboronic Acid [201802-67-7]	D3823 200mg 1g  Dithieno[3,2-b:2',3'-d]thiophene-2-boronic Acid [183960-95-4]	E0723 1g 5g  2-Ethoxyphenylboronic Acid [213211-69-9]	E0724 1g 5g  3-Ethoxyphenylboronic Acid [90555-66-1]
E0725 5g  4-Ethoxyphenylboronic Acid [22237-13-4]	E0818 5g  2-Ethylphenylboronic Acid [90002-36-1]	E0720 5g 25g  4-Ethylphenylboronic Acid [63139-21-9]	F0280 100mg 1g  Ferroceneboronic Acid [12152-94-2]	F0664 1g  1,1'-Ferrocenediboronic Acid [32841-83-1]
F0683 1g 5g  2-Fluoro-4-methylphenylboronic Acid [170981-26-7]	F0712 1g 5g  3-Fluoro-4-methylphenylboronic Acid [168267-99-0]	F0666 1g 5g  4-Fluoro-2-methylphenylboronic Acid [139911-29-8]	F0697 5g 25g  4-Fluoro-3-methylphenylboronic Acid [139911-27-6]	F0407 1g 5g 25g  2-Fluorophenylboronic Acid [1993-03-9]
F0404 5g 25g  3-Fluorophenylboronic Acid [768-35-4]	F0361 5g 25g  4-Fluorophenylboronic Acid [1765-93-1]	B1873 1g 5g  2-Formylphenylboronic Acid [40138-16-7]	F0445 1g 5g 25g  3-Formylphenylboronic Acid [87199-16-4]	F0446 1g 5g  4-Formylphenylboronic Acid [87199-17-5]

F0548 1g  5'-Formyl-2,2'-bithiophene-5-boronic Acid	F0549 1g 5g  5-Formyl-2-thiopheneboronic Acid [4347-33-5]	F0611 1g 5g  5-Formyl-2-furanboronic Acid [27329-70-0]	F0394 1g 5g  2-Furylboronic Acid [13331-23-2]	F0438 1g 5g  3-Furylboronic Acid [55552-70-0]
H0913 1g 5g  Hexylboronic Acid [16343-08-1]	H1244 1g 5g  3-(Hydroxymethyl)phenylboronic Acid [87199-15-3]	H1204 1g 5g  4-(Hydroxymethyl)phenylboronic Acid [59016-93-2]	H1184 1g 5g  2-Hydroxyphenylboronic Acid [89466-08-0]	H1185 1g 5g  3-Hydroxyphenylboronic Acid [87199-18-6]
H1228 1g 5g  4-Hydroxyphenylboronic Acid [71597-85-8]	I0597 5g 25g  Isobutylboronic Acid [84110-40-7]	I0620 5g  4-Isopropylphenylboronic Acid [16152-51-5]	M1905 1g 5g  2-(Methoxycarbonyl)phenylboronic Acid [374538-03-1]	M1906 1g 5g  3-(Methoxycarbonyl)phenylboronic Acid [99769-19-4]
M1907 1g 5g 25g  4-(Methoxycarbonyl)phenylboronic Acid [99768-12-4]	M1261 1g 5g 25g  2-Methoxyphenylboronic Acid [5720-06-9]	M1322 1g 5g  3-Methoxyphenylboronic Acid [10365-98-7]	M1252 5g 25g  4-Methoxyphenylboronic Acid [5720-07-0]	M1553 1g 5g  Methylboronic Acid [13061-96-6]
M2035 5g 25g  3,4-(Methylenedioxy)phenylboronic Acid [94839-07-3]	M1127 1g 5g  4-Methyl-3-nitrophenylboronic Acid [80500-27-2]	M1313 5g  2-Methylphenylboronic Acid [16419-60-6]	M1314 1g 5g 25g  3-Methylphenylboronic Acid [17933-03-8]	M1126 5g 25g  4-Methylphenylboronic Acid [5720-05-8]
M1972 1g 5g  4-(Methylsulfonyl)phenylboronic Acid [149104-88-1]	M1850 1g 5g  5-Methyl-2-thiopheneboronic Acid [162607-20-7]	M1570 1g 5g  2-(Methylthio)phenylboronic Acid [168618-42-6]	M1793 5g  3-(Methylthio)phenylboronic Acid [128312-11-8]	M1458 1g 5g  4-(Methylthio)phenylboronic Acid [98546-51-1]
N0630 1g 5g 25g  1-Naphthaleneboronic Acid [13922-41-3]	N0649 1g 5g 25g  2-Naphthaleneboronic Acid [32316-92-0]	N0798 1g 5g  4-(1-Naphthyl)phenylboronic Acid [870774-25-7]	N0811 1g 5g  2-Nitrophenylboronic Acid [5570-19-4]	N0563 5g 25g  3-Nitrophenylboronic Acid [13331-27-6]
N0812 1g  4-Nitrophenylboronic Acid [24067-17-2]	P1093 100mg 1g  9-Phenanthreneboronic Acid [68572-87-2]	B0857 5g 25g 250g  Phenylboronic Acid [98-80-6]	P1358 1g 5g  1,4-Phenylenediboronic Acid [4612-26-4]	P1625 1g 5g 25g  1-Pyreneboronic Acid [164461-18-1]

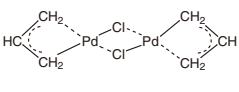
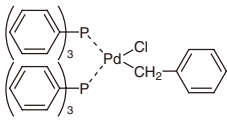
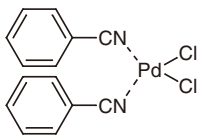
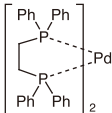
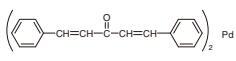
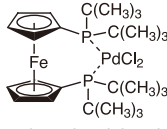
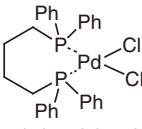
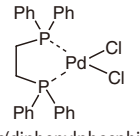
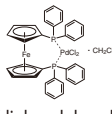
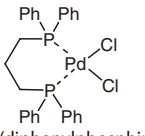
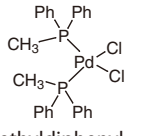
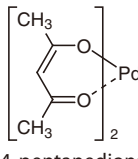
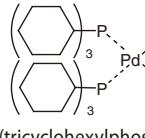
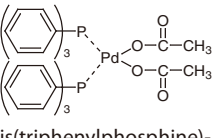
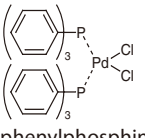
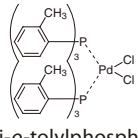
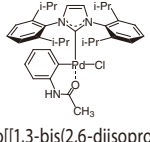
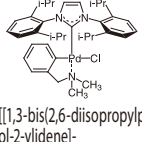
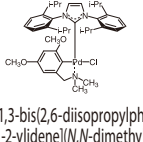
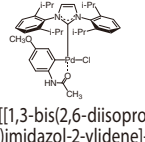
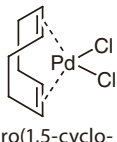
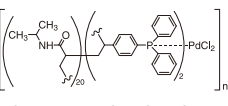
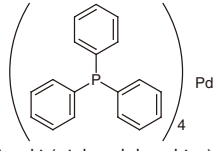
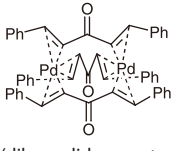
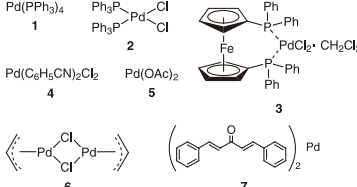
P1594 1g 5g  4-Pyridylboronic Acid [1692-15-5]	P1673 1g 5g 25g  3-Pyridylboronic Acid [1692-25-7]	P1759 100mg 1g  5-Pyrimidylboronic Acid [109299-78-7]	Q0080 1g 5g  Quinoline-3-boronic Acid [191162-39-7]	T2412 1g  2-p-Terphenylboronic Acid [663954-31-2]
T2621 1g  Thieno[3,2-b]thiophene-2-boronic Acid [160032-40-6]	T1772 1g 5g 25g  2-Thiopheneboronic Acid [6165-68-0]	T1975 1g 5g  3-Thiopheneboronic Acid [6165-69-1]	T2654 1g 5g  2,4,6-Triisopropylphenylboronic Acid [154549-38-9]	T2413 1g 5g  2-(Trifluoromethoxy)phenylboronic Acid [175676-65-0]
T2362 5g  3-(Trifluoromethoxy)phenylboronic Acid [179113-90-7]	T1773 5g 25g  4-(Trifluoromethoxy)phenylboronic Acid [139301-27-2]	T1800 1g 5g 25g  2-(Trifluoromethyl)phenylboronic Acid [1423-27-4]	T1793 1g 5g  3-(Trifluoromethyl)phenylboronic Acid [1423-26-3]	T1788 1g 5g  4-(Trifluoromethyl)phenylboronic Acid [128796-39-4]
T2574 5g  2,3,4-Trifluorophenylboronic Acid [226396-32-3]	T1960 1g 5g  2,4,6-Trimethylphenylboronic Acid [5980-97-2]	T2664 1g 5g  4-(Trimethylsilyl)phenylboronic Acid [17865-11-1]	T2640 5g 25g  2,4,6-Triphenylboroxin [3262-89-3]	D3435 5g 25g  2,4,6-Tris(3,4-dichlorophenyl)boroxin
T2430 5g 25g  2,4,6-Tris(3,4-difluorophenyl)boroxin	T1814 10g  2,4,6-Tris(4-fluorophenyl)boroxin [448-59-9]	T1887 100mg  2,4,6-Tris(m-terphenyl-5'-yl)boroxin [909407-14-3]	T1929 1g 5g  2,4,6-Tris(3,4,5-trifluorophenyl)boroxin [223440-94-6]	T2498 1g 5g  2,4,6-Trivinylboroxin-Pyridine Complex [95010-17-6]
V0075 1g 5g  4-Vinylphenylboronic Acid [2156-04-9]				

ボロン酸エステル

ボロン酸エステル		A2086 1g 5g  2-Allenyl-4,4,5,5-tetramethyl-1,3,2-dioxaborolane [865350-17-0]	A2157 1g 5g  2-Allyl-4,4,5,5-tetramethyl-1,3,2-dioxaborolane [72824-04-5]	B3448 1g 5g  2-Benzyl-4,4,5,5-tetramethyl-1,3,2-dioxaborolane [87100-28-5]
B3019 5g  2-(4-Biphenyl)-4,4,5,5-tetramethyl-1,3,2-dioxaborolane [144432-80-4]	B3151 1g  4,4'-Bis(5,5-dimethyl-1,3,2-dioxaborinan-2-yl)-biphenyl [5487-93-4]	B3363 5g  5,5'-Bis(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)-2,2'-bithiophene [239075-02-6]	B3501 1g 5g  1,1'-Bis(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)-ferrocene [737776-93-1]	B3199 1g 5g  2-(Bromomethyl)-4,4,5,5-tetramethyl-1,3,2-dioxaborolane [166330-03-6]

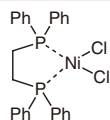
B2828 1g 5g  2-(2-Bromophenyl)-4,4,5,5-tetramethyl-1,3,2-dioxaborolane [269410-06-2]	B3200 1g  5-Bromo-5'-(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)-2,2'-bithiophene [578715-23-8]	C2004 1g  2-(2-Chlorophenyl)-5,5-dimethyl-1,3,2-dioxaborinane [346656-42-6]	C2276 1g 5g  2-Cyclopropyl-4,4,5,5-tetramethyl-1,3,2-dioxaborolane [126689-01-8]	D3596 1g 5g  Dibutyl Vinylboronate [6336-45-4]
D3601 1g  N,N-Diethyl-4-(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)aniline [920304-57-0]	D3738 1g 5g  Diisopropyl Allylboronate [51851-79-7]	D3649 1g 5g  Diisopropyl (Bromomethyl)boronate [137297-49-5]	D3533 5g  2-(3,5-Dimethylphenyl)-4,4,5,5-tetramethyl-1,3,2-dioxaborolane [325142-93-6]	D3832 1g 5g  N,N-Dimethyl-4-(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)aniline [171364-78-6]
D3772 1g 5g  3,5-Dimethyl-4-(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)isoxazole [832114-00-8]	D2853 1g 5g  2,6-Dimethyl-4-(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)phenol [269410-25-5]	E0667 1g  Ethyl 2-(5,5-Dimethyl-1,3,2-dioxaborinan-2-yl)benzoate [346656-34-6]	F0531 1g  2-(2-Fluorophenyl)-5,5-dimethyl-1,3,2-dioxaborinane [346656-39-1]	H1294 5g  2-(4-Hexyl-2-thienyl)-4,4,5,5-tetramethyl-1,3,2-dioxaborolane [883742-29-8]
I0653 1g  2-(2-Iodophenyl)-4,4,5,5-tetramethyl-1,3,2-dioxaborolane [857934-82-8]	M2071 5g  2-(4-Methoxybenzyl)-4,4,5,5-tetramethyl-1,3,2-dioxaborolane [475250-52-3]	N0824 1g  2-Nitro-4-(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)aniline [833486-94-5]	P1855 5g 25g  2-Phenyl-4,4,5,5-tetramethyl-1,3,2-dioxaborolane [24388-23-6]	T1950 1g  4'-(4,4,5,5-Tetramethyl-1,3,2-dioxaborolan-2-yl)-acetanilide [214360-60-8]
T1951 1g 5g  4-(4,4,5,5-Tetramethyl-1,3,2-dioxaborolan-2-yl)aniline [214360-73-3]	T2518 1g 5g  5-(4,4,5,5-Tetramethyl-1,3,2-dioxaborolan-2-yl)-2,2'-bithiophene [479719-88-5]	I0590 1g  5-(4,4,5,5-Tetramethyl-1,3,2-dioxaborolan-2-yl)-1H-indole [269410-24-4]	I0739 1g 5g  4-(4,4,5,5-Tetramethyl-1,3,2-dioxaborolan-2-yl)isoquinoline [685103-98-4]	T1952 1g 5g  2-(4,4,5,5-Tetramethyl-1,3,2-dioxaborolan-2-yl)phenol [269409-97-4]
T1953 1g 5g  3-(4,4,5,5-Tetramethyl-1,3,2-dioxaborolan-2-yl)phenol [214360-76-6]	T1954 1g 5g  4-(4,4,5,5-Tetramethyl-1,3,2-dioxaborolan-2-yl)phenol [269409-70-3]	T2345 1g 5g  3-(4,4,5,5-Tetramethyl-1,3,2-dioxaborolan-2-yl)pyridine [329214-79-1]	T2349 1g 5g  4-(4,4,5,5-Tetramethyl-1,3,2-dioxaborolan-2-yl)pyridine [181219-01-2]	T2297 1g 5g 25g  4,4,5,5-Tetramethyl-2-vinyl-1,3,2-dioxaborolane (stabilized with Phenothiazine) [75927-49-0]
T2428 5g  2-[2-(Trifluoromethyl)phenyl]-4,4,5,5-tetramethyl-1,3,2-dioxaborolane				
ジボロンエステル				
B2906 1g 5g  Bis(hexylene Glycolato)-diboron [230299-21-5]	B2254 1g  Bis(neopentyl Glycolato)-diboron [201733-56-4]	B1964 1g 5g 25g  Bis(pinacolato)diboron [73183-34-3]		

パラジウム触媒

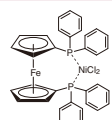
パラジウム触媒		A1479500mg 1g  Allylpalladium(II) Chloride Dimer [12012-95-2]	B2029100mg 1g  Benzylbis(triphenylphosphine)palladium(II) Chloride [22784-59-4]	B16761g 5g $(\text{CH}_3\text{CN})_2\text{PdCl}_2$ Bis(acetonitrile)palladium(II) Dichloride [14592-56-4]
B16681g 5g  Bis(benzonitrile)palladium(II) Dichloride [14220-64-5]	B32241g 5g  Bis[1,2-bis(diphenylphosphino)ethane]palladium(0) [31277-98-2]	B13741g 5g  Bis(dibenzylideneacetone) Palladium(0) [32005-36-0]	B31601g 5g  [1,1'-Bis(di-tert-butylphosphino)ferrocene]palladium(II) Dichloride [95408-45-0]	B20311g 5g  [1,4-Bis(diphenylphosphino)butane]palladium(II) Dichloride [29964-62-3]
B20161g 5g  [1,2-Bis(diphenylphosphino)ethane]palladium(II) Dichloride [19978-61-1]	B20641g 5g 25g  [1,1'-Bis(diphenylphosphino)ferrocene]palladium(II) Dichloride Dichloromethane Adduct [95464-05-4]	B21921g 5g  [1,3-Bis(diphenylphosphino)propane]palladium(II) Dichloride [59831-02-6]	B21611g 5g  Bis(methyldiphenylphosphine)palladium(II) Dichloride [52611-08-2]	B20181g 5g  Bis(2,4-pentanedionato)palladium(II) [14024-61-4]
B3161250mg 1g $[(\text{CH}_3)_3\text{C}]_3\text{P}-\text{Pd}-[(\text{CH}_3)_3\text{C}]_3\text{P}$ Bis(tri-tert-butylphosphine)palladium(0) [53199-31-8]	B20551g 5g  Bis(tricyclohexylphosphine)palladium(II) Dichloride [29934-17-6]	B20421g 5g  Bis(triphenylphosphine)palladium(II) Diacetate [14588-08-0]	B16671g 5g 25g  Bis(triphenylphosphine)palladium(II) Dichloride [13965-03-2]	B20261g  Bis(tri-o-tolylphosphine)palladium(II) Dichloride [40691-33-6]
C2387200mg 1g  Chloro[1,3-bis(2,6-diisopropylphenyl)imidazol-2-ylidene](acetanilide)palladium(II)]	C2372200mg 1g  Chloro[1,3-bis(2,6-diisopropylphenyl)imidazol-2-ylidene](N,N-dimethylbenzylamine)palladium(II)] [930796-10-4]	C2406200mg 1g  Chloro[1,3-bis(2,6-diisopropylphenyl)imidazol-2-ylidene](N,N-dimethyl-3,5-dimethoxybenzylamine)palladium(II)] [1093348-08-3]	C2407200mg 1g  Chloro[1,3-bis(2,6-diisopropylphenyl)imidazol-2-ylidene](4-methoxyacetanilide)palladium(II)]	D26041g 5g  Dichloro[1,5-cyclooctadiene]palladium(II) [12107-56-1]
P14905g 25g Pd Palladium 5% on Carbon (wetted with ca. 55% Water) [7440-05-3]	P14915g 25g Pd Palladium 10% on Carbon (wetted with ca. 55% Water) [7440-05-3]	P17855g 25g Pd Palladium 10% on Carbon (wetted with ca. 55% Water) [7440-05-3]	A14241g 5g $(\text{CH}_3\text{COO})_2\text{Pd}^{2+}$ Palladium(II) Acetate [3375-31-3]	P14891g 5g PdCl_2 Palladium(II) Chloride [7647-10-1]
P152810g 50g $\text{Pd}(\text{OH})_2$ Palladium Hydroxide 20% on Carbon (wetted with ca. 50% Water) [12135-22-7]	P1425100mg 1g  Poly[N-isopropylacrylamide-co-4-(diphenylphosphino)styrene] Palladium(II) Dichloride (ratio, acrylamide:phosphine=20:2)	S05401g Na_2PdCl_4 Sodium Tetrachloropalladate(II) [13820-53-6]	T13501g 5g 25g  Tetrakis(triphenylphosphine)palladium(0) [14221-01-3]	T21841g 5g  Tris(dibenzylideneacetone)dipalladium(0) [51364-51-3]
P14301set Palladium Catalyst Set Tetrakis(triphenylphosphine)palladium(0) (1) 1g Bis(triphenylphosphine)palladium(II) Dichloride (2) 1g [1,1'-Bis(diphenylphosphino)ferrocene]palladium(II) Dichloride Dichloromethane Adduct (3) 1g Bis(benzonitrile)palladium(II) Dichloride (4) 1g Palladium(II) Acetate (5) 1g Allylpalladium(II) Chloride Dimer (6) 500mg Bis(dibenzylideneacetone)palladium(0) (7) 1g 				

ニッケル触媒

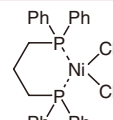
B2225 1g 5g 25g

[1,2-Bis(diphenylphosphino)-ethane]nickel(II) Dichloride
[14647-23-5]

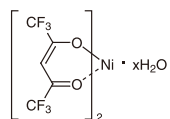
B2226 1g 5g

[1,1'-Bis(diphenylphosphino)-ferrocene]nickel(II) Dichloride
[67292-34-6]

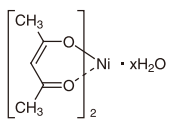
B1313 5g 25g

[1,3-Bis(diphenylphosphino)-propane]nickel(II) Dichloride
[15629-92-2]

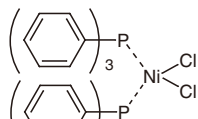
H0558 1g 5g

Bis(hexafluoroacetylacetonato)nickel(II) Hydrate
[14949-69-0]

N0096 25g 500g

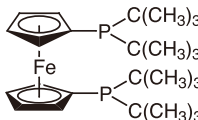
Bis(2,4-pentanedionato)nickel(II) Hydrate
[3264-82-2]

B1571 10g 100g

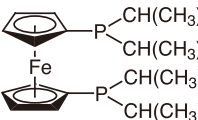
Bis(triphenylphosphine)nickel(II) Dichloride
[14264-16-5]

ホスフィン配位子

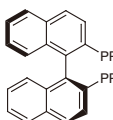
B2711 100mg 1g

1,1'-Bis(di-tert-butylphosphino)ferrocene
[84680-95-5]

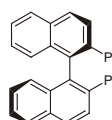
B2710 100mg 1g

1,1'-Bis(diisopropylphosphino)ferrocene
[97239-80-0]

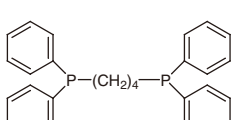
B1405 1g 5g

(S)-(-)-2,2'-Bis(diphenylphosphino)-1,1'-binaphthyl
[76189-56-5]

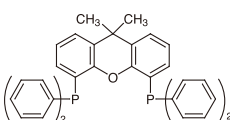
B1406 1g 5g

(R)-(+)-2,2'-Bis(diphenylphosphino)-1,1'-binaphthyl
[76189-55-4]

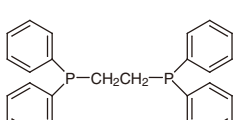
B1246 5g 25g

1,4-Bis(diphenylphosphino)butane
[7688-25-7]

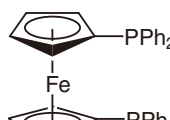
B2709 1g 5g

4,5-Bis(diphenylphosphino)-9,9-dimethylxanthene
[161265-03-8]

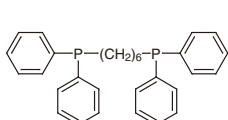
B1137 10g 25g

1,2-Bis(diphenylphosphino)ethane
[1663-45-2]

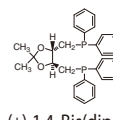
B2027 1g 5g 25g

1,1'-Bis(diphenylphosphino)ferrocene
[12150-46-8]

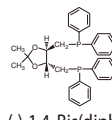
B1959 1g 5g

1,6-Bis(diphenylphosphino)hexane
[19845-69-3]

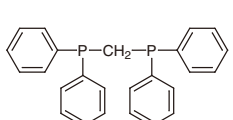
B1112 1g

(2S,3S)-(+)-1,4-Bis(diphenylphosphino)-2,3-O-isopropylidene-2,3-butanediol
[37002-48-5]

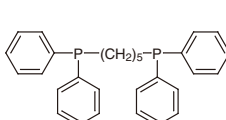
B1113 1g

(2R,3R)-(-)-1,4-Bis(diphenylphosphino)-2,3-O-isopropylidene-2,3-butanediol
[32305-98-9]

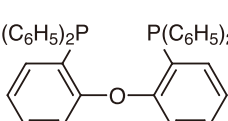
B1982 5g 25g

Bis(diphenylphosphino)methane
[2071-20-7]

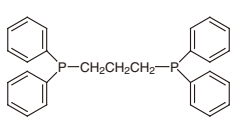
B1960 1g

1,5-Bis(diphenylphosphino)pentane
[27721-02-4]

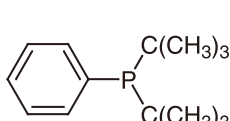
B2867 5g

Bis[2-(diphenylphosphino)phenyl] Ether
[166330-10-5]

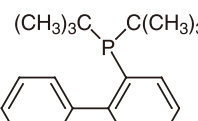
B1138 5g 25g

1,3-Bis(diphenylphosphino)propane
[6737-42-4]

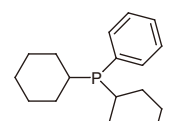
D3940 5g

Di-tert-butylphenylphosphine
[32673-25-9]

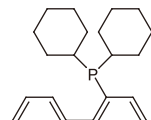
D3387 1g

2-(Di-tert-butylphosphino)biphenyl
[224311-51-7]

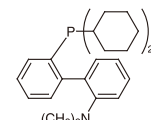
D2411 1g 5g

Dicyclohexylphenylphosphine
[6476-37-5]

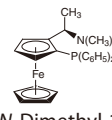
D3388 1g 5g

2-(Dicyclohexylphosphino)biphenyl
[247940-06-3]

D3389 1g 5g

2-(Dicyclohexylphosphino)-2'-(dimethylamino)biphenyl
[213697-53-1]

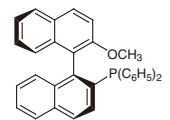
D2535 100mg

(R)-N,N-Dimethyl-1-[(S)-2-(diphenylphosphino)ferrocenyl]ethylamine
[55700-44-2]

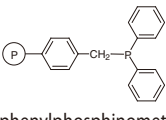
D2536 100mg

(S)-N,N-Dimethyl-1-[(R)-2-(diphenylphosphino)ferrocenyl]ethylamine
[55650-58-3]

D2775 100mg 1g

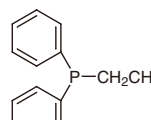
(S)-(-)-2-Diphenylphosphino-2'-methoxy-1,1'-binaphthyl
[134484-36-9]

D2766 5g

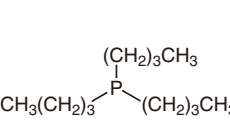


4-Diphenylphosphinomethyl Polystyrene Resin cross-linked with 2% DVB (200-400mesh) (0.5-1.0mmol/g)

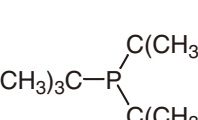
E0519 5g

Ethyldiphenylphosphine
[607-01-2]

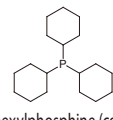
T0361 25ml 500ml

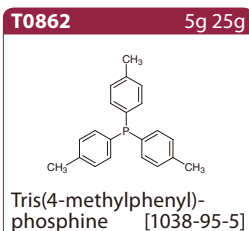
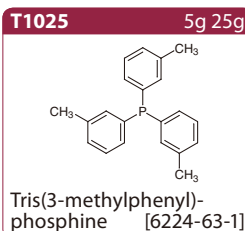
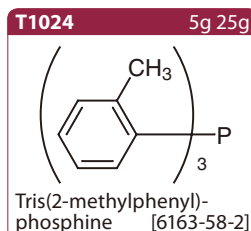
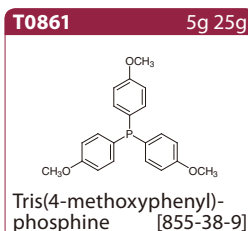
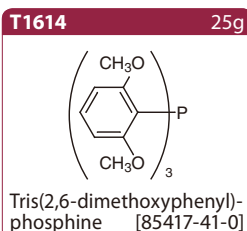
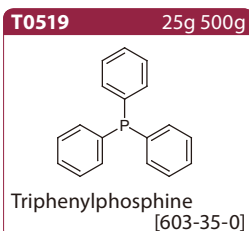
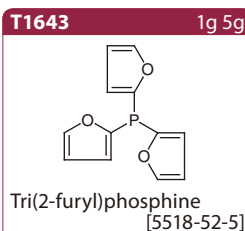
Tributylphosphine
[998-40-3]

T1912 5g

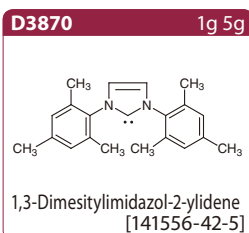
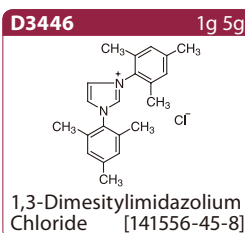
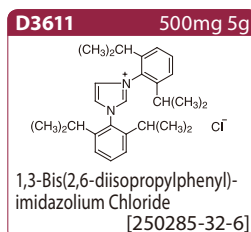
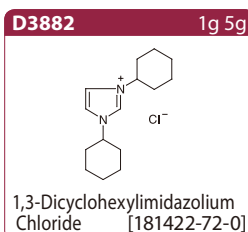
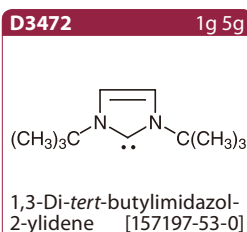
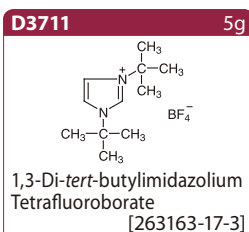
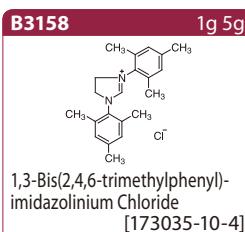
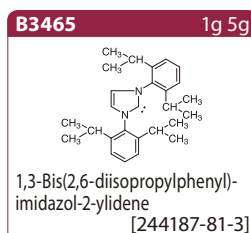
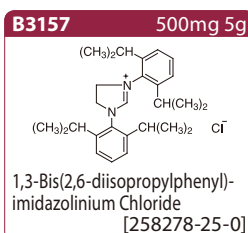
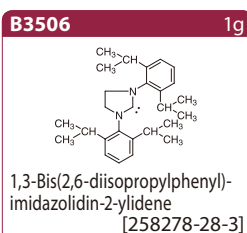
Tri-tert-butylphosphine
[13716-12-6]

T1165 25ml 500ml

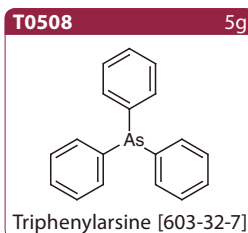
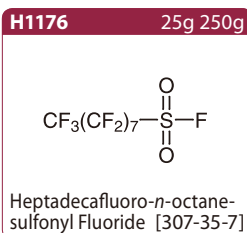
Tricyclohexylphosphine (contains Tricyclohexylphosphine Oxide) (ca. 18% in Toluene, ca. 0.60mol/L)
[2622-14-2]



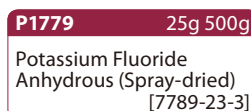
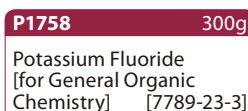
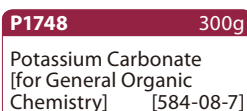
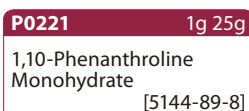
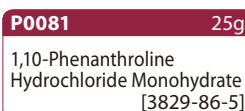
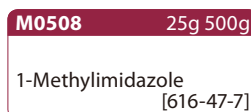
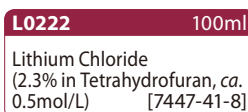
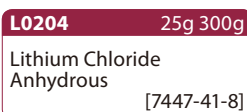
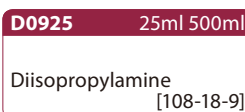
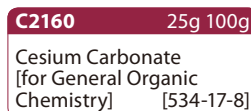
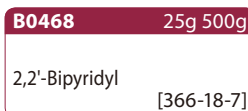
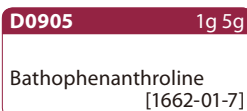
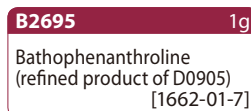
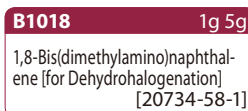
N-複素環カルベン配位子



その他



塩基・添加剤



S0485 100g 500g Sodium Methoxide [124-41-4]	S0560 300g Sodium Carbonate [for General Organic Chemistry] [497-19-8]	T0054 25g 500g Tetrabutylammonium Bromide [1643-19-2]	T0057 25g 500g Tetrabutylammonium Iodide [311-28-4]	Z0015 300g Zinc (Powder) [for General Organic Chemistry] [7440-66-6]
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