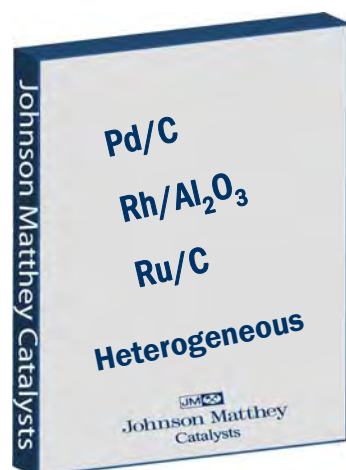


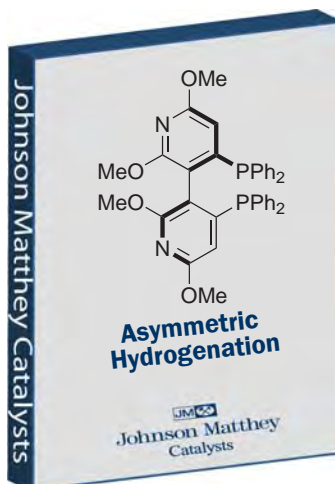


Johnson Matthey Catalysts

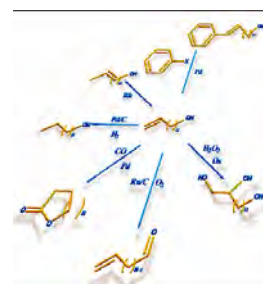
Catalysis and Chiral Technologies Kits



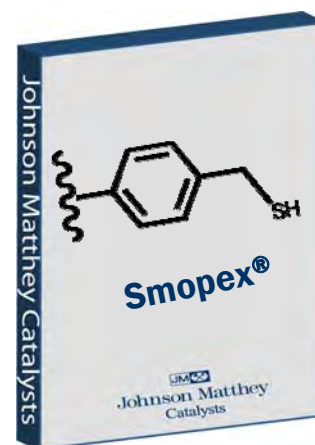
Heterogeneous Kits
Deprotection-Debenzylation



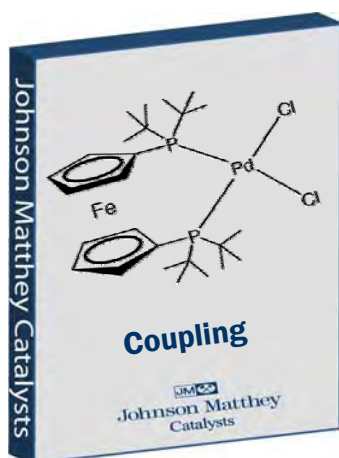
Asymmetric Hydrogenation



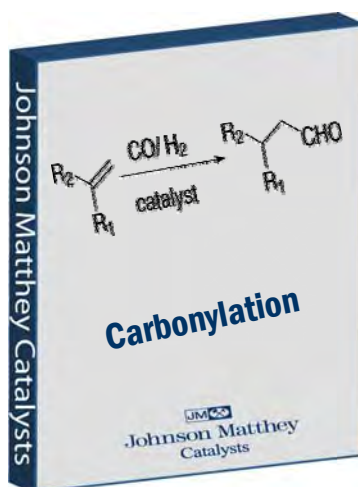
be selective



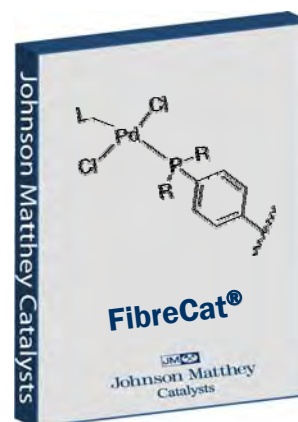
Smopex[®]
Metal Scavengers



Coupling Kits



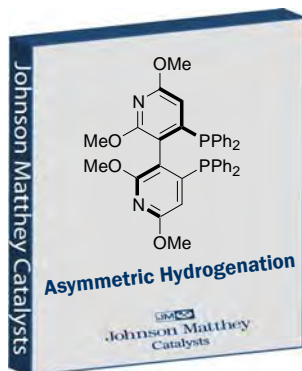
Carbonylation Kit



FibreCat[®]
Anchored Homogeneous Catalysts

Providing researchers with a collection of novel catalysts, ligands and metal scavenging products

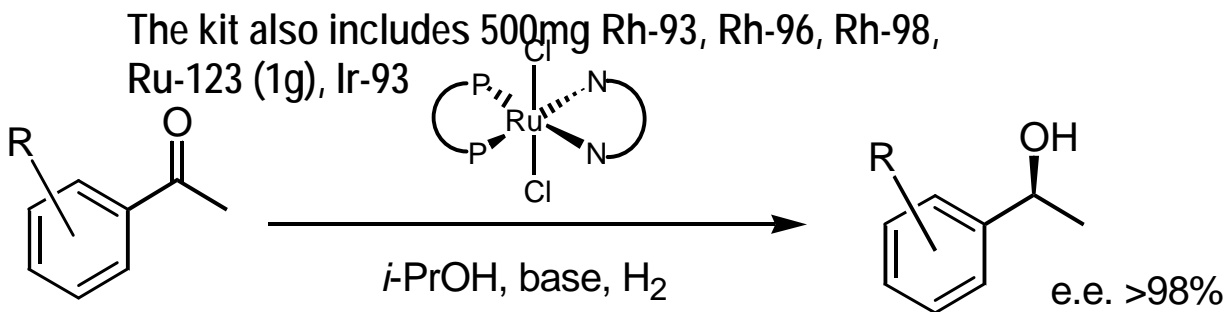
Asymmetric Hydrogenation Kit



This 20 sample kit contains 5 fully formed catalysts, 10 ligands and 5 metal precursors which are suited to a wide variety of transformations. It includes general application recommendations. Additional custom development is available from Johnson Matthey.

Kit includes 200 mg of the following catalysts:

- [(R)-Xyl-PPhos RuCl₂ (R,R)-DPEN]
- [(S)-Xyl-PPhos RuCl₂ (S)-Daipen]
- [Rh cod (R)-Phanephos] BF₄
- (R)-[Rh cod TCFP]BF₄
- (S)-Xyl-PPhos Ru(acac)₂
- (R)-PPhos / (S)-PPhos
- (R)-XylPPhos / (S)-XylPPhos
- (R)-An-Phanephos / (S)-An-Phanephos
- (R)-Me-Bophoz / (S)-Me-Bophoz

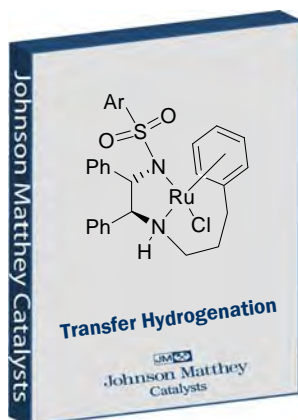


Asymmetric hydrogenation using a Noyori Ru Diamine Catalyst

Above materials may be handled and weighed in air but are best stored under inert conditions. Controlled reaction conditions are required, i.e. degassed solvents. It is recommended that the catalysts are studied in a selection of solvents. The Ru-diamine catalysts are to be tested under anhydrous conditions with a selection of bases in isopropanol.



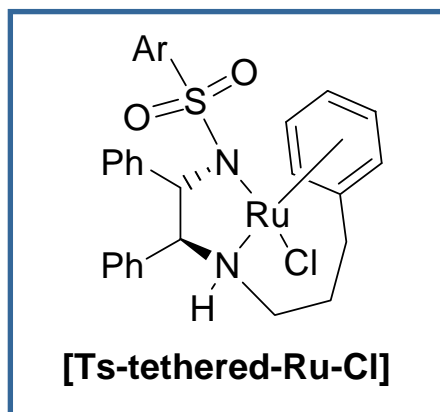
Transfer Hydrogenation Kit



Asymmetric transfer hydrogenation of prochiral ketones and imines is a powerful methodology for the preparation of chiral alcohols and amines in high enantiomeric purity.

Kit includes the following catalysts:

Compound*	Catalog ID	Quantity
[(R,R)-TsDpen-Ru(p-cymene)Cl]	C1-000	500 mg
[(S,S)-TsDpen-Ru(p-cymene)Cl]	C1-010	500 mg
[(R,R)-MsDpen-Ru(p-cymene)Cl]	C1-001	500 mg
[(S,S)-MsDpen-Ru(p-cymene)Cl]	C1-011	500 mg
[(R,R)-TsDACH-RuCl (p-cymene)]	C1-100	500 mg
[(S,S)-TsDACH-RuCl (p-cymene)]	C1-110	500 mg
[(R,R)-teth-TsDpen-RuCl]	C1-300	250 mg
[(S,S)-teth-TsDpen RuCl]	C1-310	250 mg



The research group of Prof. Martin Wills has recently developed new ‘tethered’ catalysts where the covalent linkage from the diamine to the n⁶-arene unit provides additional stability and a significant increase in the reaction rate relative to ‘untethered’ analogues.

Johnson Matthey has successfully scaled up these catalysts during our R&D program.

References: Wills et al. *J.Am.Chem.Soc.* **2005**, 127, 7318 ; Wills et al. *Organic Letters* **2007**, 9 , 4659; Wills et al *Organic Letters* **2009**, 11, 847

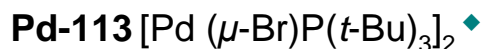
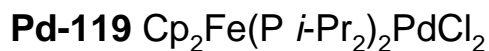
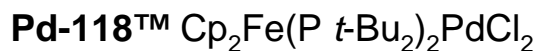


Johnson Matthey Catalysts

Advanced Coupling Kit



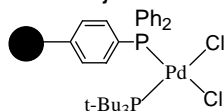
Designed for challenging C-C coupling reactions, amination, alpha ketone arylation, etc., using sterically hindered substrates, aryl chlorides and electron rich substrates. This kit is provided with a Catalytic Reaction & Coupling Reference Guide and contains one gram each of:



* Pd catalyst must be used in conjunction with ligand

♦ Must be dispensed and stored under nitrogen

■ Anchored Pd catalyst



Kits are available for purchase through Johnson Matthey Catalysis and Chiral Technologies

Please contact your local sales representative for additional details or Connie Schlegel at schlecx@jmusa.com.

References:

- Anil S. Guram *et al.*, *Org. Lett.*, **2006**, 8, 9, 1787-1789
- Chenyi Yi and Ruimao Hua, *J. Org. Chem.*, **2006**, 71, 2535-2537
- T. Colacot *et al.*, *Org. Lett.* **2004**, 6 (21), 3731-3734
- D. Sauer *et al.*, *Org. Lett.*, **2004**, 6(6), 2793-96
- M. Prashad *et al.*, *J. Org. Chem.*, **2003**, 68, 1163-1164
- J. Hartwig *et al.*, *J. Org. Chem.*, **2003**, 68, 2861
- Fu *et al.* *Angew. Chem., Int. Ed. Engl.* **2002**, 41, 4176-4211
- T. Colacot *et al.*, *Organometallics*, **2002**, 21, 3301-3304
- T. Colacot, *Platinum Metals Rev.*, **2001**, 45(1), 22-30

Catalog Part #C7050



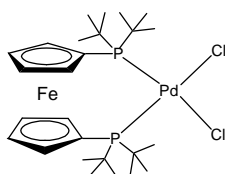
Johnson Matthey Catalysts

Mini Advanced Coupling Kit

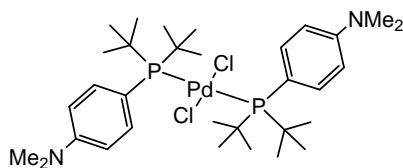


This scaled down version of our Advanced Coupling kit contains our **most active catalysts** and is designed for challenging C-C coupling reactions, amination, alpha ketone arylation, etc., using sterically hindered substrates, aryl chlorides and electron rich substrates.

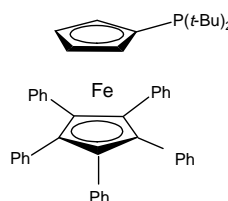
Pd-118™
(d^tbpf)PdCl₂



Pd-132
[(Me₂N-C₆H₄)t-Bu₂P]₂ PdCl₂

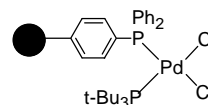


Pd-111 [Pd(OAc)₂]₃
/ **Q Phos***



Q- Phos Ligand

FC-1032 ■



* Pd catalyst must be used in conjunction with ligand

■ Anchored Pd catalyst

References:

T. Colacot, *Dichloro[1,1'-bis(di-tert-butylphosphino)-ferrocene]palladium(II)*; **2009**, Encyclopedia of Reagents for Organic Synthesis DOI:10.1002/047084289X.rn01062, John Wiley & Sons. Ltd., www.mrw.interscience.wiley.com/eros/, March 15, 2009

T. Colacot, *FibreCat (polypropylene-supported Pd-phosphine complexes)*; **2009**, Encyclopedia of Reagents for Organic Synthesis DOI:10.1002/047084289X.rn00968, John Wiley & Sons. Ltd., www.mrw.interscience.wiley.com/eros/, March 15, 2009

G. Grasa et al., *Org. Process Res. Dev.*, **2008**, 12 (3), 522-29

T. Colacot, *Top Catal*, **2008**, 48, 91-98

A. Guram et al., *Org. Lett.*, **2006**, 8, 9, 1787-1789

C. Yi et al., *J. Org. Chem.*, **2006**, 71, 2535-2537

T. Colacot et al., *Org. Lett* **2004**, 6 (21), 3731-3734

D. Sauer et al., *Org. Lett.*, **2004**, 6(6), 2793-96

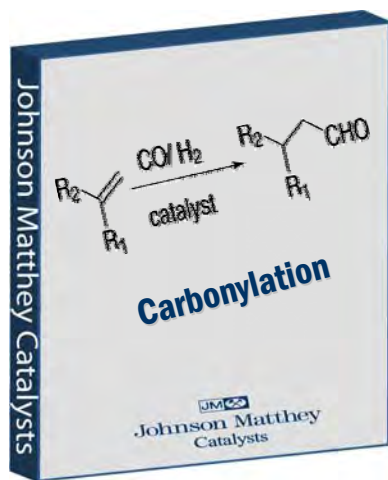
M. Prashad et al., *J. Org. Chem.*, **2003**, 68, 1163-1164

Kits are available for purchase through Johnson Matthey Catalysis and Chiral Technologies. Please contact your local sales representative for additional details. Kit is supplied with one gram of each catalyst.

Catalog Part #C7053



Carbonylation Catalyst Kit



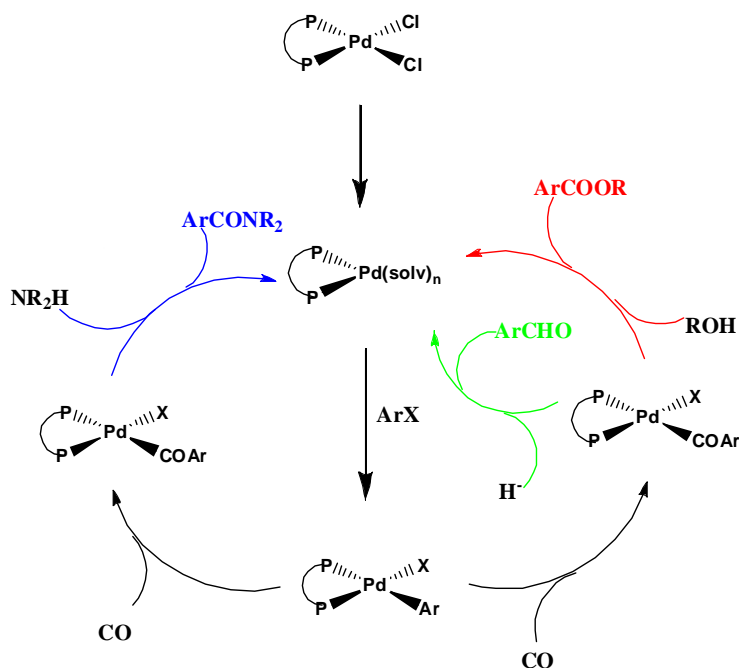
Due to the wide-ranging reactivity of -CHO functionality, step (and atom) economical methodologies for the preparation of aldehydes are extremely useful in route development for organic synthesis in the Pharmaceutical and Fine Chemical sectors.

Johnson Matthey has developed very practical methodologies in this area. This kit contains a variety of catalysts for the carbonylation of aryl halides, triflates, mesylates and even tosylates to aldehydes, acids, esters and amides under relatively mild conditions.

Kit includes the following catalysts:

Pd-105	PdCl ₂ dppb
Pd-107	PdCl ₂ dppf
Pd-124	Pd(Br) ₂ (BINAP)
Pd-126	PdCl ₂ dppp
Pd-133	PdCl ₂ dcpp
Pd-134	XantPhosPdCl ₂
FC-1032	FibreCat 1032

Mechanism for Reductive Carbonylation



References:

C. F. J. Barnard, *Organometallics* **2008**, 27, 5402-5422
Palladium-catalyzed carbonylation – a reaction come of age

C. F. J. Barnard, *Org. Process Res. Dev.* **2008**, 12, 566-574
Carbonylation of aryl halides: extending the scope of the reaction

L. Ashfield and C.F. J. Barnard, *Org. Process Res. Dev.* **2007**, 11, 39-43
Reductive carbonylation – an efficient and practical route for the conversion of aryl halides to aldehydes

Catalog Part #S7012

Kits are available for purchase through Johnson Matthey Catalysis and Chiral Technologies

Please contact your local sales representative for additional details or email your request to cct@jmtusa.com.

Kit is supplied with one gram of each catalyst.



Johnson Matthey Catalysts

Deprotection and Debenzylation Catalyst Kit

A New Series of Catalysts for Deprotection Reactions

Johnson Matthey Catalysts

Removal of Benzyloxycarbonyl (Cbz) Protecting Groups via Hydrogenation

In the manufacture of pharmaceuticals, protecting groups are used to prevent unwanted side reactions during synthesis. If the final product requires protection of sensitive functional groups, a change in these protecting groups is often required. Design for stability, hydrogenation, can be preferred, with good stability under mild conditions using homogeneous Palladium on Carbon (Pd/C) catalysts in the presence of hydrogen gas as a reagent. In this context, Johnson Matthey catalysts are an excellent choice for the removal of benzyloxycarbonyl (Cbz) protecting groups via hydrogenation.

Deprotection Model Reactions

The hydrogenation of N-benzyloxycarbonyl-L-phenylalanine and N-benzyloxycarbonyl-L-phenylalanine (see above) gives:

Reaction Conditions:
 Substrate: N-benzyloxycarbonyl-L-phenylalanine
 Temperature: 35°C
 Pressure: 1 bar H₂
 Catalyst Loading: 26 wt% (active Pd) on 10% H₂O catalyst
 Reaction Time: 11 hours
 Screening: 100% (active Pd) on 10% H₂O catalyst
 Reaction Yielding: 100% (active Pd) on 10% H₂O catalyst

N-benzyloxycarbonyl-L-phenylalanine:
 Temperature: 35°C
 Pressure: 1 bar H₂
 Catalyst Loading: 26 wt% (active Pd) on 10% H₂O catalyst
 Reaction Time: 70 hours
 Screening: 100% (active Pd) on 10% H₂O catalyst
 Reaction Yielding: 100% (active Pd) on 10% H₂O catalyst

Catalyst Activity and Selectivity

A series of catalysts (5R39, 5R338, 5R394, A405028-5, A405032-5, A503129-5, A402028-10, A501023-10, 10R39, 20R91) were tested for their activity and selectivity in the deprotection of N-benzyloxycarbonyl-L-phenylalanine. The results show that the 5R39 catalyst is the most active and selective, with a reaction time of 11 hours and a yield of 100%.

As part of our **Catalyst Innovation Program**, Johnson Matthey has recently developed a range of more active and selective catalysts with reduced metal loadings designed for the O-debenzylation of benzyl protected alcohols and acids, N-debenzylation of amines and amides and Cbz (carbamate) type protection of amines.

Kit includes 5gms dwb of the following catalysts:

- 5% Pd/C 5R39
- 5% Pd/C 5R338
- 5% Pd/C 5R394
- 5% Pd/C A405028-5
- 5% Pd/C A405032-5
- 5% Pd/C A503129-5
- 10% Pd/C A402028-10
- 10% Pd/C A501023-10
- 10% Pd/C 10R39
- 20% Pd/C 20R91

A New Series of Catalysts for Deprotection Reactions

Johnson Matthey Catalysts

Transfer Hydrogenation

In the manufacture of pharmaceuticals, the transfer of hydrogen from a donor to a substrate is a key step in many synthesis routes. This is often achieved using homogeneous catalysts, but the use of heterogeneous catalysts is preferred for large scale production. Johnson Matthey catalysts are an excellent choice for the transfer of hydrogen from a donor to a substrate.

Reaction Conditions:
 Temperature: 35°C
 Pressure: 1 bar H₂
 Catalyst Loading: 26 wt% (active Pd) on 10% H₂O catalyst
 Reaction Time: 11 hours
 Screening: 100% (active Pd) on 10% H₂O catalyst
 Reaction Yielding: 100% (active Pd) on 10% H₂O catalyst

O-Debenzylation

The hydrogenation of N-benzyloxycarbonyl-L-phenylalanine and N-benzyloxycarbonyl-L-phenylalanine (see above) gives:

Reaction Conditions:
 Substrate: N-benzyloxycarbonyl-L-phenylalanine
 Temperature: 35°C
 Pressure: 1 bar H₂
 Catalyst Loading: 26 wt% (active Pd) on 10% H₂O catalyst
 Reaction Time: 11 hours
 Screening: 100% (active Pd) on 10% H₂O catalyst
 Reaction Yielding: 100% (active Pd) on 10% H₂O catalyst

N-Debenzylation

The hydrogenation of N-benzyloxycarbonyl-L-phenylalanine and N-benzyloxycarbonyl-L-phenylalanine (see above) gives:

Reaction Conditions:
 Substrate: N-benzyloxycarbonyl-L-phenylalanine
 Temperature: 35°C
 Pressure: 1 bar H₂
 Catalyst Loading: 26 wt% (active Pd) on 10% H₂O catalyst
 Reaction Time: 11 hours
 Screening: 100% (active Pd) on 10% H₂O catalyst
 Reaction Yielding: 100% (active Pd) on 10% H₂O catalyst

Catalyst Activity and Selectivity

A series of catalysts (5R39, 5R338, 5R394, A405028-5, A405032-5, A503129-5, A402028-10, A501023-10, 10R39, 20R91) were tested for their activity and selectivity in the deprotection of N-benzyloxycarbonyl-L-phenylalanine. The results show that the 5R39 catalyst is the most active and selective, with a reaction time of 11 hours and a yield of 100%.

Catalog Part #S7011

To view our full brochure online go to www.jmcatlysts.com/pharma. Click on the link for literature.

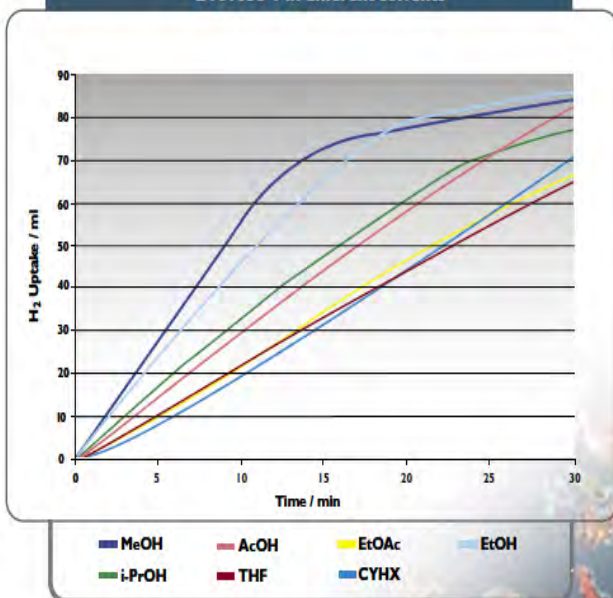
Kits are available for purchase through Johnson Matthey Catalysis and Chiral Technologies. Please contact your local sales representative for additional details.

Halonitroaromatics Catalyst Kit

Johnson Matthey Catalysts has recently developed a new range of more active and selective catalysts for the efficient reduction of halonitroaromatics to haloaminoaromatics.

NEW!

Hydrogenation of 1-Chloro-2-nitrobenzene at 25° C,
80 psi hydrogen pressure using 1% Pt/C
B101038-1 in different solvents



Kit includes 5gms dwb
of the following catalysts:

1% Pt/C B101038-1

1% Pt/C B102018-1

1% Pt/C 1R163

5% Pt/C 5R163

Catalog Part #S7016

To view our full brochure online go to www.jmcatalysts.com/pharma. Click on the link for literature.

Kits are available for purchase through Johnson Matthey Catalysis and Chiral Technologies

Please contact your local sales representative for additional details.



Johnson Matthey Catalysts

Heterogeneous Catalyst Screening Kit



- Instant availability to 40 catalyst types with varying characteristics and metal distribution
- Supplied with an Applications Table that allows for easy identification of prime candidates for your catalytic process
- Excellent tool for screening and research projects
- All samples are commercially available on a production scale

10% Palladium Pd/Carbon (1)	3% Platinum Pt/Carbon (1)	5% Rhodium Rh/Carbon (2) Rh/Al ₂ O ₃ (1)	
5% Palladium Pd/Carbon (10) Pd/Al ₂ O ₃ (2) Pd/CaCO ₃ (1) Pd(Pb)/CaCO ₃ (2) Pd/BaSO ₄ (1)	5% Platinum Pt/Carbon (6) Pt(Bi)/Carbon (1) Pt(S)/Carbon (2) Pt/Al ₂ O ₃ (2)	Mixed Metal 4% Pd, 1% Pt/C (2) 4.5% Pd, 0.5% Rh/C (2) 5% Ru, 0.25% Pd/C (1)	5% Ruthenium Ru/Carbon (2) Ru/Al ₂ O ₃ (1)

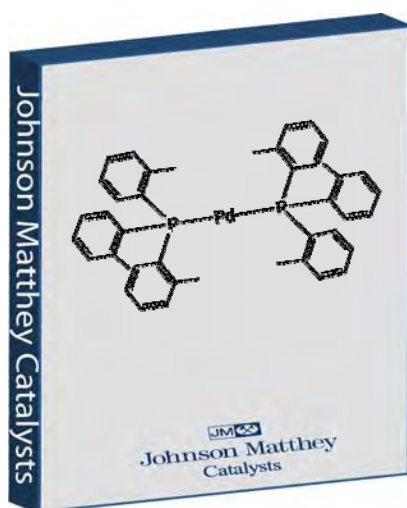
Catalog Part #S7003

Catalysts are supplied on a water wet,
5 grams dry weight basis



Pd(0) Catalyst Kit

Introducing a new line of Pd(0) phosphine complexes



Applications include:

- Negishi, Heck, Suzuki, Stille coupling
- α -arylation
- Aryl triflate coupling in the presence of a halide group
- Cu free Sonogashira

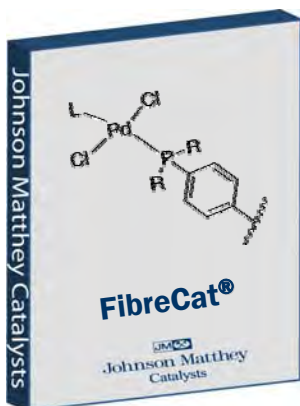
Kit includes 1g each of the following catalysts:

Pd-116	$\text{Pd}(t\text{-Bu}_3\text{P})_2$
Pd-137	$\text{Pd}[(\text{Cy})_3\text{P}]_2$
Pd-141	$\text{Pd}[(o\text{-tol})_3\text{P}]_2$
Pd-148	$\text{Pd}[\text{P}(t\text{Bu}_2\text{Ph})]_2$
Pd-149	$\text{Pd}[t\text{-Bu}_2(\text{p-PhMe}_2\text{N})\text{P}]_2$
Pd-150	$\text{Pd}[\text{P}(\text{C}_5\text{H}_4\text{FeC}_5\text{Ph}_5)(t\text{-Bu})_2]_2$

Catalog Part #S7015



Palladium FibreCat[®] Kit Supported Homogeneous Catalyst System



Johnson Matthey has developed FibreCat[®], a line of tunable, polymer supported palladium complexes of electron rich and bulky monodentate ligands that provide:

- excellent activity
- minimal metal leaching
- ability to be recycled

Advantages of FibreCat[®]:

- Easy to handle
- Good mechanical properties
- Good functional group accessibility
- Can be processed in various forms
- Insoluble in most solvents

Catalysts included in Kit:

Catalog #	Ligand
FC-1029	MeCn R=Ph
FC-1032	<i>t</i> -Bu ₃ P
FC-1033	Q-Phos
FC-1034A	(Me ₂ NC ₆ H ₄)P <i>t</i> -Bu ₂
FC-1035	dppf
Pd Smopex 111	Pd Acetate

References:

Tunable Palladium-FibreCats for Aryl Chloride Suzuki Coupling with Minimal Metal Leaching

Thomas J. Colacot, William A. Carole, Bruce A. Neide and Ajay Harad
Organometallics, **2008**, 27, 5605-5611

Pd-Smopex-111 A New Catalyst for Heck and Suzuki Cross-Coupling Reactions

Xinglong Jiang, Josept Sclafani, Kapa Prasad, Oljan Repic and Thomas J. Blacklock
Org. Process Res. Dev. **2007**, 11, 4, 769-772

Catalog Part #S7013

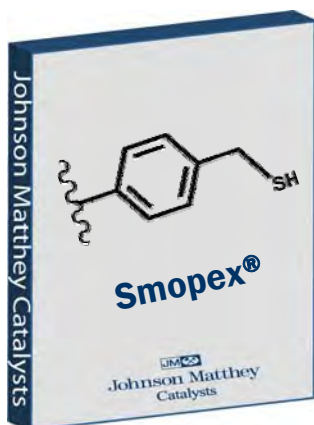
Kits are available for purchase through Johnson Matthey Catalysis and Chiral Technologies
Please contact your local sales representative for additional details or email your request to cct@jmtusa.com.
Kit is supplied with one gram of each catalyst.



Johnson Matthey Catalysts

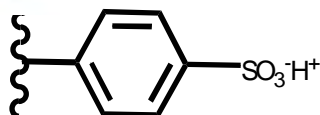
SMOPEX[®] Kit

Precious Metal Scavenging Fibers

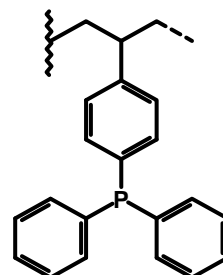


SMOPEX[®] is a unique metal scavenging system, where metal binding functionality is grafted onto fibres, allowing for the effective recovery of precious metals from process streams.

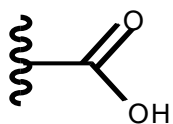
Smopex-101



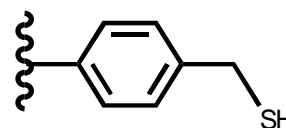
Smopex-301



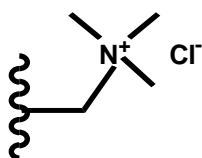
Smopex-102



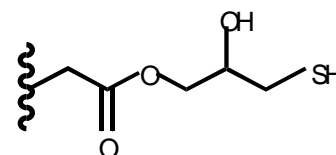
Smopex-111



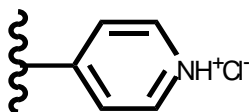
Smopex-103



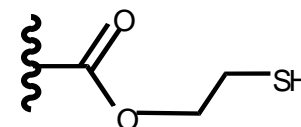
Smopex-112



Smopex-105



Smopex-234



The kits is supplied with 10 grams of each fiber type. These products may be used for a variety of applications. Guidelines are provided with each kit detailing the product functionality and recommended usage.



Catalog Part #S7010

Kits are available for purchase through Johnson Matthey Catalysis and Chiral Technologies. Please contact your local sales representative for additional details or email your request to cct@jmtusa.com.



Johnson Matthey Catalysts

Catalysis and Chiral Technologies

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Royston
Hertfordshire SG8 5HE
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