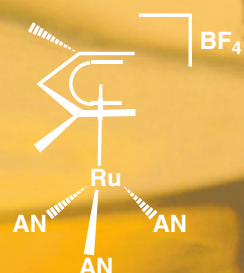
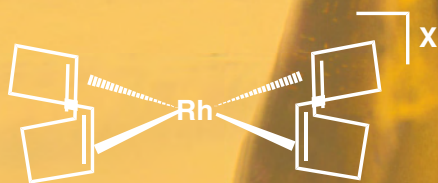
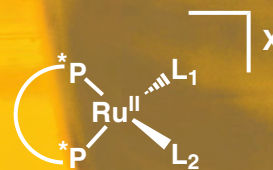
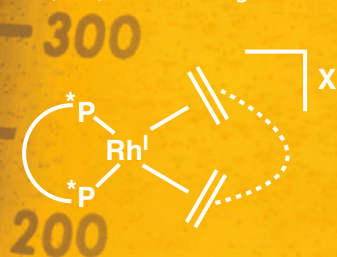


Precursors



Rh, Ru, Ir Metal-Ligand complexes



... and more to come

Chiralyst

Umicore M

Ecolyst

Umicore CX

# Chiralyst – Chiral Catalysts

When activity and selectivity matter

# » From screening to production

For in situ catalyst preparation or pre-catalyst supply,  
Umicore Precious Metals Chemistry is your partner of choice

We have developed over the past decades extensive expertise in manufacturing precious metal based chemicals and catalysts at industrial scale in consistently high levels of purity.

Focusing on chiral catalysis, we have set up a portfolio of precursors, chiral Metal-Ligand complexes and related technologies leading to

- » comprehensive range of Rh, Ru, Ir based precursors
- » reliable access to today's most powerful ligand families
- » modular range of chiral Metal-Ligand complexes spanning from most versatile ligand based MLs to custom-manufacturing of special complexes.

Stand alone or with cooperation partners we support you with defining and scaling up your most efficient enantioselective synthesis step.

## Precious Metal precursors

From screening to production, you can rely on the high quality standards of our precursors

Compound		CAS No.	Umicore Product No.
<b>Ir</b>			
Ir(COD)acac	Acetylacetonato-(1,5-cyclooctadiene)iridium(I)	12154-84-6	68 1854 3448
[Ir(COD) <sub>2</sub> Cl] <sub>2</sub>	Chloro-(1,5-cyclooctadiene)iridium(I)-dimer	12112-67-3	68 1854 3057
[Ir(COE) <sub>2</sub> Cl] <sub>2</sub>	Chloro-bis-cyclooctene-iridium(I)-dimer	12246-51-4	68 1854 3243
Ir(acac) <sub>3</sub>	Tris(acetylacetonato)iridium(III)	15635-87-7	68 1874 1739
Ir[(COD) <sub>2</sub> ]BF <sub>4</sub>	Bis(cyclooctadiene)iridium(I)tetrafluoroborate	35138-23-9	68 1854 2139
[Ir(COD) <sub>2</sub> ]BARF	Bis(cyclooctadiene)iridium(I)(tetrakis-[3,5-bis(trifluoromethyl)phenyl]borate)	666826-16-0	68 1854 2015
[Ir(C <sub>5</sub> Me <sub>2</sub> )Cl <sub>2</sub> ] <sub>2</sub>	Dichloro(pentamethylcyclopentadienyl)iridium(III)-dimer	12354-84-6	68 1854 3449
[Ir(C <sub>5</sub> Me <sub>2</sub> )I <sub>2</sub> ] <sub>2</sub>	Diiodo(pentamethylcyclopentadienyl)iridium(III)-dimer	33040-12-9	68 1854 3533



Ask for our kit at [sigmaaldrich.com](http://sigmaaldrich.com)

Having it in your labs allows you to regularly screen the most popular precursors 20 Pd, Rh, Ru, Ir compounds



## Available at multi-kg scale

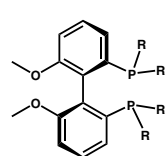
Compound		CAS No.	Umicore Product No.
<b>Rh</b>			
[Rh(OAc) <sub>2</sub> ] <sub>2</sub>	Tetrakisacetatodirhodium(II)	15956-28-2	68 1864 2442
Rh(COD)acac	Acetylacetonato(1,5-cyclooctadiene)rhodium(I)	12245-39-5	68 1864 5433
[Rh(COD)Cl] <sub>2</sub>	Chloro-(1,5-cyclooctadiene)rhodium(I)-dimer	12092-47-6	68 1864 3041
[Rh(COD) <sub>2</sub> ]BF <sub>4</sub>	Bis-(1,5-cyclooctadiene)rhodium(I)tetrafluoroborate	35138-22-8	68 1864 3025
[Rh(COD) <sub>2</sub> ]OTf	Bis-(1,5-cyclooctadiene)rhodium(I)trifluoromethanesulfonate	99326-34-8	68 1864 3822
Rh(nbd)acac	Acetylacetonato(norbornadiene)rhodium(I)	32354-50-0	68 1864 3734
[Rh(NBD)Cl] <sub>2</sub>	Chloro(norbornadiene)rhodium(I)-dimer	12257-42-0	68 1864 3145
[Rh(NBD) <sub>2</sub> ]BF <sub>4</sub>	Bis(norbornadiene)rhodium(I)tetrafluoroborate	36620-11-8	68 1864 3627
[Rh(C <sub>5</sub> Me <sub>5</sub> Cl <sub>2</sub> ) <sub>2</sub> ]	Dichloro(pentamethylcyclopentadienyl)rhodium(III)-dimer	12354-85-7	68 1864 3033
[Rh(C <sub>7</sub> H <sub>15</sub> CO <sub>2</sub> ) <sub>2</sub> ] <sub>2</sub>	Rhodium(II)octanoate-dimer	73482-96-9	68 1864 4726
Rh(COD) <sub>2</sub> BARF	Bis(cyclooctadiene)rhodium(I)(tetrakis-[3,5-bis(trifluoromethyl)phenyl]borate)	404573-66-6	68 1864 7809
<b>Ru</b>			
[Ru(COD)Cl] <sub>2</sub>	Dichloro-(1,5-cyclooctadiene)ruthenium(II)-polymer	50982-13-3	68 1874 2336
[Ru( <i>p</i> -cymene) <sub>2</sub> ] <sub>2</sub>	Diiodo( <i>p</i> -cymene)ruthenium(II)-dimer	90614-07-6	68 1874 2621
[Ru( <i>p</i> -cymene)Cl] <sub>2</sub>	Dichloro( <i>p</i> -cymene)ruthenium(II)-dimer	52462-29-0	68 1874 2533
[Ru(benzene)Cl] <sub>2</sub>	Dichloro(benzene)ruthenium(II)-dimer	37366-09-9	68 1874 3540
Ru(COD)(methylallyl) <sub>2</sub>	Bis-(2-methylallyl)-(1,5-cyclooctadiene)ruthenium(II)	12289-94-0	68 1874 2432
[Ru(COD)(trifluoroacetate) <sub>2</sub> ] <sub>2</sub> · μ(H <sub>2</sub> O)	Bis(trifluoroacetato)-(1,5-cyclooctadiene)Ruthenium(II)-dimer aqua complex	93582-31-1	68 1874 2423
Ru(COD)(OAc) <sub>2</sub>	Bis(acetato)-(1,5-cyclooctadiene)ruthenium(II)	133519-03-6	68 1874 2431
Ru(C <sub>7</sub> H <sub>11</sub> ) <sub>2</sub>	Bis(η <sup>5</sup> -2,4-dimethylpentadienyl)ruthenium(II)	85908-78-7	68 1874 3834
Ru(C <sub>7</sub> H <sub>11</sub> )(C <sub>7</sub> H <sub>12</sub> )BF <sub>4</sub>	[(η <sup>5</sup> -2,4-dimethyl-2,4-pentadienyl)(η <sup>4</sup> -2,4-dimethylpenta-1,3-diene)ruthenium(II)]tetrafluoroborate	122260-79-1	68 1874 3426
Ru(C <sub>7</sub> H <sub>11</sub> )(CH <sub>3</sub> CN) <sub>3</sub> BF <sub>4</sub>	[Tris(acetonitrile)(η <sup>5</sup> -2,4-dimethylpentadienyl)ruthenium(II)]tetrafluoroborate	145271-55-2	68 1874 3325

## Ligands

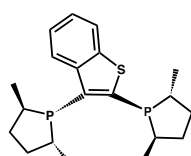
Whether you want to enantioselectively hydrogenate a ketone, a keto-ester, a dehydroamino-acid or many more derivatives, or you want to secure the multi-kg scale supply of your defined ligand, Umicore Precious Metals Chemistry and its partners network can support you:

- » screening and process optimisation
- » Ligand supply (access to atropisomeric, diammine, ferrocenyl, P-chiral, phospholane type ligands)
- » custom-manufacturing
- » customer oriented IP models

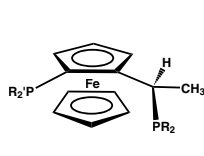
## Ligand families marketed by Solvias



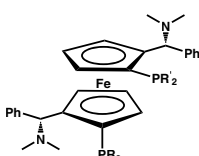
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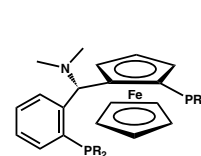
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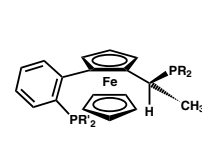
Josiphos



Mandyphos



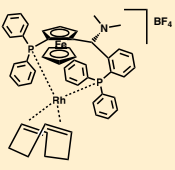
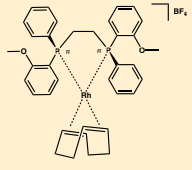
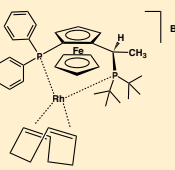
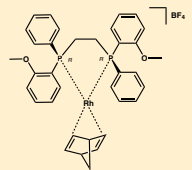
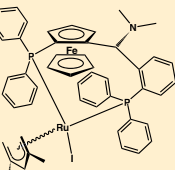
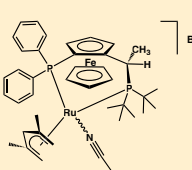
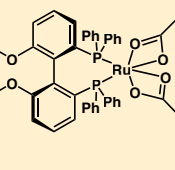
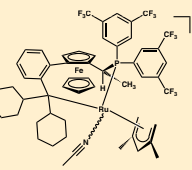
Taniaphos



Walphos

## Metal-Ligand complexes

Developed and scaled up with high requirements of purity, these well-defined pre-catalysts lead to most active catalytic species in your reactors

<p>Name: Chiralyst ML98455-T001-1-Rh</p> <p>CAS No. 673458-84-9</p> <p>Umicore Product No. 68 1864 7210</p> <p>[(S)-1-Diphenylphosphino-2-[(a-(S)-N,N-dimethylamino)-(o-diphenylphosphinophenyl)-methyl]-ferrocene-(1,5-cyclooctadiene)-rhodium(I)] tetrafluoroborate</p> 	<p>Name: Chiralyst ML756RR-DIPAMP-Rh</p> <p>CAS No. 56977-92-5</p> <p>Umicore Product No. 68 1864 7014</p> <p>[[[(R,R)-1,2-Ethanediybis-[(2-methoxyphenyl)phenylphosphine]]-(1,5-cyclooctadiene)rhodium(I)] tetrafluoroborate</p> 
<p>Name: Chiralyst ML489RS-J002-1-Rh</p> <p>CAS No. 673458-86-1</p> <p>Umicore Product No. 68 1864 7312</p> <p>[(R)-(-)-1-[(S)-2-(Diphenylphosphino)-ferrocenyl]-ethylidene-t-butylphosphine-(1,5-cyclooctadiene)-rhodium(I)]-tetrafluoroborate</p> 	<p>Name: Chiralyst ML740RR-DIPAMP-Rh</p> <p>CAS No. 894423-88-2</p> <p>Umicore Product No. 68 1864 7614</p> <p>[[[(R,R)-1,2-Ethanediybis-[(2-methoxyphenyl)phenylphosphine]](norbornadiene)rhodium(I)]tetrafluoroborate</p> 
<p>Name: Chiralyst ML1010SS-T001-2-Ru</p> <p>CAS No. 942042-53-7</p> <p>Umicore Product No. 68 1874 3910</p> <p>[(S)-1-Diphenylphosphino-2-[(S)-α-(N,N-dimethylamino)-o-diphenylphosphinophenyl)methyl]ferrocene)-(η<sup>5</sup>-2,4-dimethylpentadienyl)ruthenium(II)iodide</p> 	<p>Name: Chiralyst ML867RS-J002-1-Ru</p> <p>CAS No. 1016168-44-7</p> <p>Umicore Product No. 68 1874 5412</p> <p>[1-[(1R)-1-[bis(1,1-dimethylethyl)phosphino]ethyl]-[(S)-2-(diphenylphosphino)ferrocene)-(η<sup>5</sup>-2,4-dimethylpentadienyl)-(N-acetonitrile)ruthenium(II)] tetrafluoroborate</p> 
<p>Name: Chiralyst ML802R-A101-1-Ru</p> <p>CAS No. 133519-04-7</p> <p>Umicore Product No. 68 1874 4212</p> <p>Bisacetato-[[[(1R)-6,6'-dimethoxy-[1,1'-biphenyl]-2,2'-diyl]bis(diphenyl)phosphine]ruthenium(II)]</p> 	<p>Name: Chiralyst ML1267RR-W008-1-Ru</p> <p>CAS No. 1021494-98-3</p> <p>Umicore Product No. 68 1874 5308</p> <p>[(R)-1-[(R)-2-(2'-Dicyclohexylphosphinophenyl)ferrocenyl]ethylidene-(bis-3,5-trifluoromethylphenyl)phosphine)-(η<sup>5</sup>-2,4-dimethylpentadienyl)(N-acetonitrile)ruthenium(II)] tetrafluoroborate</p> 

Please visit our website [www.chemistry.umicore.com](http://www.chemistry.umicore.com) to see our updated list

## Customized Metal-Ligand complexes

Your pre-catalyst may not be in our ML complex list, please ask us!

We will scale it up according to standardized development, optimisation and scale up methods



Approx. 6 months from 1<sup>st</sup> gram delivery to multi-kg scale

## For inquiries and additional info please contact

**Umicore AG & Co. KG**  
Rodenbacher Chaussee 4  
63457 Hanau-Wolfgang  
Germany

Tel. +49 6181 59 2471  
Fax +49 6181 59 2970  
chemistry@umicore.com  
www.chemistry.umicore.com

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