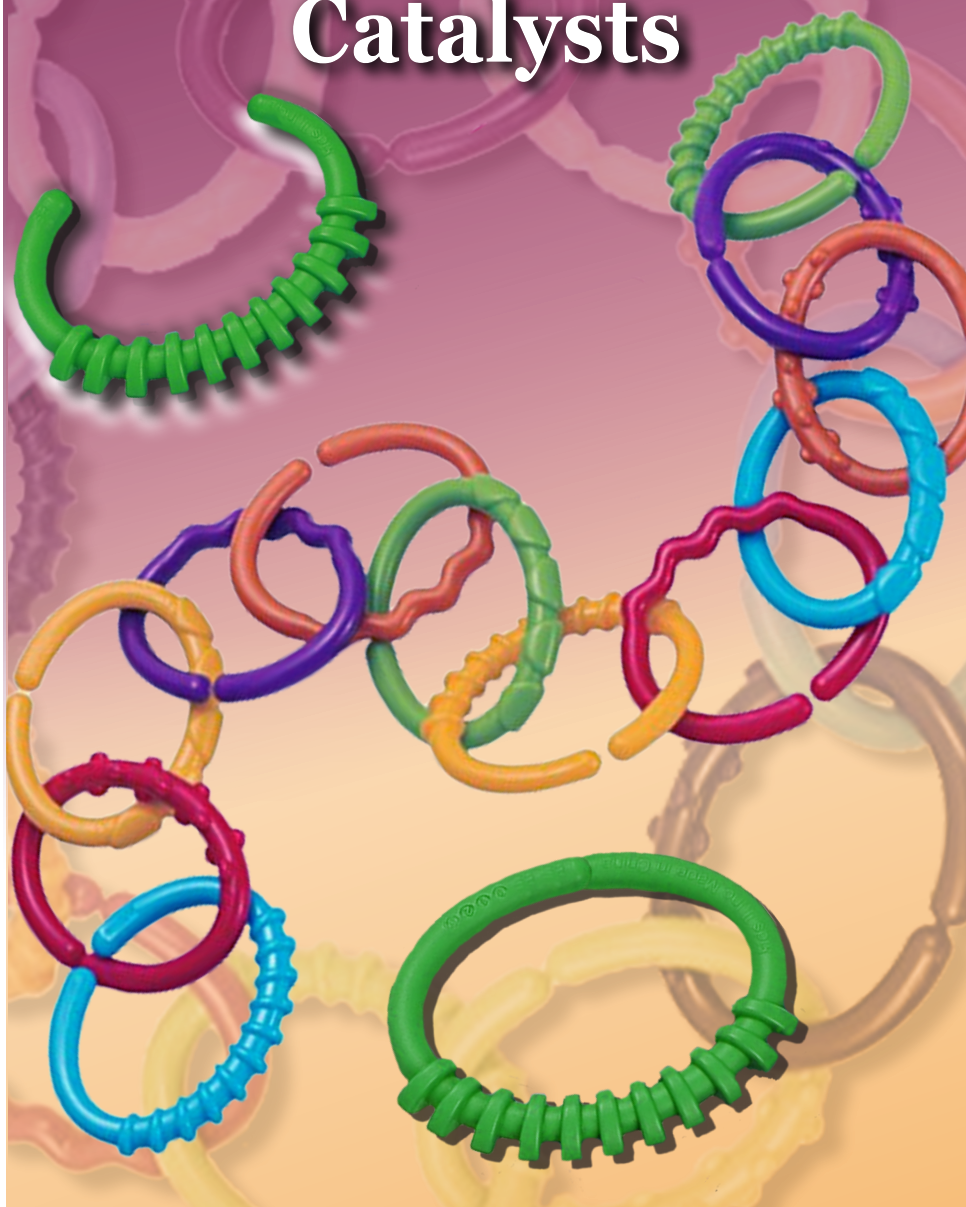


Metathesis Catalysts



STREM

Metathesis Catalysts



Strem Chemicals has been providing fine chemicals for research and commercial production for over fifty years. In this booklet you will find our selection of molybdenum and ruthenium metathesis catalysts as well as related kits for screening purposes. These catalysts can be used in a variety of metathesis applications including olefin metathesis, ring-closing metathesis, ring-opening polymerization and cross-metathesis.

At Strem, we also offer a wide variety of ligands, nanomaterials and CVD/ALD precursors. Most of our products are of high purity, typically at 99%, while some are as high as 99.9999% metals purity. We continually seek to provide new technologies from around the globe and add to our product line. We have licensing agreements with industry and academia, which allow easier access to these patent-protected products for our customers. We look forward to continued growth in order to best serve our customers' needs with the quality and service they can trust from Strem.

As part of our ongoing commitment to quality, we have achieved ISO 9001 certification for the Quality Management System (QMS) at our corporate headquarters in Newburyport, Massachusetts.

In addition, custom synthesis services are provided on a contract basis. For pharmaceutical applications, manufacturing is conducted under current Good Manufacturing Practices (cGMP) in FDA inspected kilo-lab suites. Complete documentation is available, including validation and stability studies. Active Drug Master Files (DMF's) are maintained in North America and Europe.

Our other booklets, which focus on applications and product classes, are available in print per request and also on our website. Below is a list of current booklet titles that are available. Please also check our Product Resources section online to find additional literature offerings, such as the Strem Chemiker, our technical publication, and product literature sheets.

- Biocatalysts
- Buchwald Ligands and Precatalysts
- Carbon-Based Nanomaterials & Elemental Forms
- Catalysts & Ligands
Sold in Collaboration with Takasago
- Chiral Phosphoric Acids
- Gold Elements & Compounds
- Heterogeneous Catalysts
- High Purity Chiral Reagents - Sold in Collaboration with Daicel
- Kits
- Materials for Energy Applications
- Metal Catalysts for Organic Synthesis
- Metathesis Catalysts
- MOCVD, CVD & ALD Precursors
- MOFs and Ligands for MOF Synthesis
- Nanomaterials
- New Products
- Other Ligands
- Phosphorous Ligands and Compounds
- Photocatalysts
- PURATREM: High Purity Inorganics

Ephraim S. Honig, Ph.D., M.B.A.
Chief Executive Officer



Metathesis 02/20

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Glossary of Terms

[α]_D		Specific rotation
AAS		Atomic Absorption Standard
ACS		Conforms to American Chemical Society specifications
air sensitive	.....	Product may chemically react with atmospheric oxygen or carbon dioxide at ambient conditions. Handle and store under an inert atmosphere of nitrogen or argon.
amp	.....	Ampouled
b.p.	.....	Boiling point in °C at 760mm, unless otherwise noted
d.	.....	Density
dec.	.....	Decomposes
elec. gr.	.....	Electronic Grade, suitable for electronic applications
f.p.	.....	Flash point in °F
gran.	.....	Granular
heat sensitive	.....	Product may chemically degrade if stored for prolonged periods of time at ambient temperatures or higher. Store at 5°C or lower.
hydrate	.....	Unspecified water content which may vary slightly from lot to lot
hygroscopic	.....	Product may absorb water if exposed to the atmosphere for prolonged periods of time (dependent on humidity and temperature). Handle and store under an inert atmosphere of nitrogen or argon.
light sensitive	.....	Product may chemically degrade if exposed to light
liq.	.....	Liquid
m.p.	.....	Melting point in °C
moisture sensitive	.....	Product may chemically react with water. Handle and store under an inert atmosphere of nitrogen or argon.
NMR grade	.....	Suitable as a Nuclear Magnetic Resonance reference standard
optical grade	.....	For optical applications
pwdr.	.....	Powder
primary standard	.....	Used to prepare reference standards and standardize volumetric solutions
PURATREM	.....	Product has a minimum purity of 99.99% (metals basis)
purified	.....	A grade higher than technical, often used where there are no official standards
P. Vol.	.....	Pore volume
pyrophoric	.....	Product may spontaneously ignite if exposed to air at ambient conditions
reagent	.....	High purity material, generally used in the laboratory for detecting, measuring, examining or analyzing other substances
REO	.....	Rare Earth Oxides. Purity of a specific rare-earth metal expressed as a percentage of total rare-earths oxides.
SA	.....	Surface area
store cold	.....	Product should be stored at -18°C or 4°C, unless otherwise noted (see product details)
subl.	.....	Sublimes
superconductor grade	.....	A high purity, analyzed grade, suitable for preparing superconductors
tech. gr.	.....	Technical grade for general industrial use
TLC	.....	Suitable for Thin Layer Chromatography
v.p.	.....	Vapor pressure mm of Hg
xtl.	.....	Crystalline

About Purity

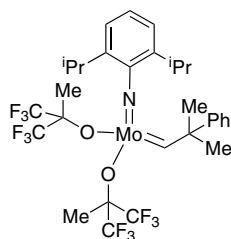
Chemical purity	.....	is reported after the chemical name, e.g. Ruthenium carbonyl, 99%
Metals purity	.....	is reported in parentheses with the respective element, e.g. Gallium (III) bromide, anhydrous, granular (99.999%-Ga) PURATREM where 100% minus the metal purity is equal to the maximum allowable percentage of trace metal impurity

MOLYBDENUM (Compounds)

42-0575

NEW

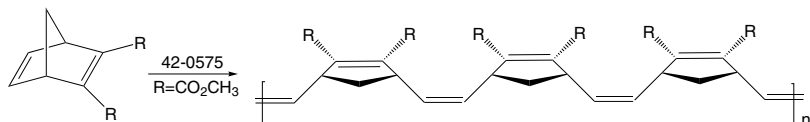
[2,6-bis(1-methylethyl)benzenaminato(2-)] bis(1,1,1,3,3,3-hexafluoro-2-methyl-2-propanolato-κO)(2-methyl-2-phenylpropylidene)-, (T-4) molybdenum, paraffin pellet (139220-25-0)
 $C_{30}H_{35}F_{12}MoNO_2$; FW: 763.53; paraffin pellet
air sensitive, moisture sensitive
 Note: Developed by XiMo. Sold under license from XiMo for research purposes only.



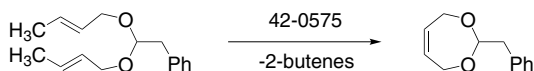
2pcs
10pcs

Technical Notes:

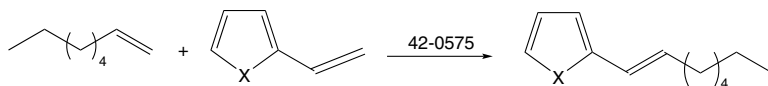
- General metathesis of many ordinary olefins, especially terminal olefins, and will ROMP many norbornene or substituted norbornadiene monomers to give all cis, and often isotactic, polymers.
- Useful for the "ring-closing" of dienes or the coupling of terminal olefins.
- Highly active and most commonly used in cross metathesis of aliphatic alkenes with 2-vinyl aromatics.



Tech. Note (1)
Ref. (1,2)



Tech. Note (2)
Ref. (3,4)



Tech. Note (3)
Ref. (6)

X = S, O

References:

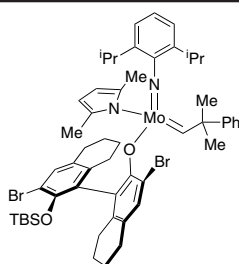
- J. Am. Chem. Soc.*, **1994**, 116, 3414.
- J. Am. Chem. Soc.*, **1993**, 115, 4413.
- J. Am. Chem. Soc.*, **1992**, 114, 5426.
- J. Am. Chem. Soc.*, **1992**, 114, 7324.
- Tetrahedron*, **1998**, 54, 4413. (review article)
- J. Mol. Catal. Chem.*, **2002**, 190, 45.

42-0530

NEW

amp

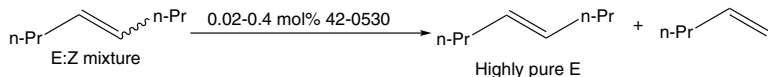
[2,6-bis(1-methylethyl)benzenaminato(2-)] [(1R)-3,3'-dibromo-2'-[[[(1,1-dimethylethyl)dimethylsilyl]oxy]-5,5',6,6',7,7',8,8'-octahydro[1,1'-binaphthalen]-2-olato-κO](2,5-dimethyl-1H-pyrrol-1-yl)(2-methyl-2-phenylpropylidene) molybdenum (VI) (1103220-99-0)
 $C_{54}H_{70}Br_2MoN_2O_2Si$; FW: 1063; orange pwdr.
air sensitive, moisture sensitive
 Note: Developed by XiMo. Sold under license from XiMo for research purposes only.
 Patents: U.S. 9,687,834, EP2242578.



100mg
500mg

Technical Notes:

- Catalyst used in Z-selective cross metathesis.¹
- Catalyst used in enantio- or diastereo-selective ene-yne ring closing metathesis.^{1,3}

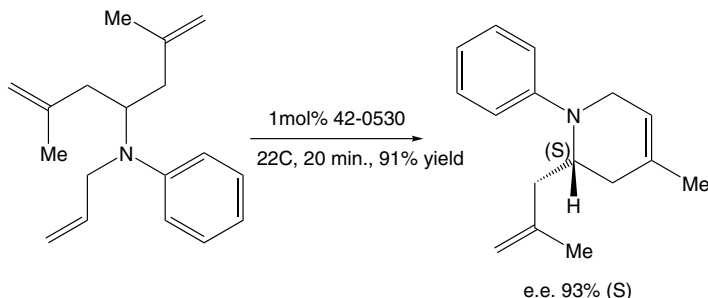


Tech. Note (1)
Ref. (2)

MOLYBDENUM (Compounds)

42-0530
(continued)

[2,6-bis(1-methylethyl)benzenaminato(2-)][(1R)-3,3'-dibromo-2'-[[[1,1-dimethylethyl]dimethylsilyl]oxy]-5,5',6,6',7,7',8,8'-octahydro[1,1'-binaphthalen]-2-olato-kO](2,5-dimethyl-1H-pyrrol-1-yl)(2-methyl-2-phenylpropylidene) molybdenum (VI) (1103220-99-0)



Tech. Note (2)
Ref. (1)

References:

1. *Nature*, **2008**, 456, 933-937.
2. *J. Am. Chem. Soc.*, **2011**, 133, 11512
3. *J. Am. Chem. Soc.*, **2009**, 131, 10652.
4. *Org. Process Res. & Dev.*, **2016**, 20, 1709.

42-0535

NEW

[2,6-bis(1-methylethyl)benzenaminato(2-)][(1R)-3,3'-dibromo-2'-[[[1,1-dimethylethyl]dimethylsilyl]oxy]-5,5',6,6',7,7',8,8'-octahydro[1,1'-binaphthalen]-2-olato-kO](2,5-dimethyl-1H-pyrrol-1-yl)(2-methyl-2-phenylpropylidene) molybdenum (VI), paraffin pellets (75980-60-8)

C₆₄H₇₀Br₂MoN₂O₂Si; FW: 1063; paraffin pellet
air sensitive, moisture sensitive, (store cold)

Note: Developed by XiMo. Sold under license from XiMo for research purposes only. Patents: U.S. 9,687,834, EP2242578.

2pcs
10pcs

Technical Note:

1. See 42-0530 (page 1)

42-0520

NEW

amp

[2,6-bis(1-methylethyl)benzenaminato(2-)](2,5-dimethyl-1H-pyrrol-1-yl)(2-methyl-2-phenylpropylidene)([1,1':3',1''-terphenyl]-2'-olato) molybdenum(VI) (1703808-70-1)

C₄₆H₅₀MoN₂O; FW: 742.86; yellow powdr.
air sensitive, moisture sensitive, (store cold)

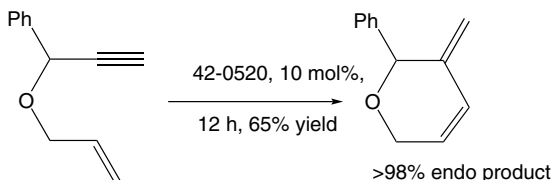
Note: Developed by XiMo. Sold under license from XiMo for research purposes only.

Patents: US20140309466, WO14139679.

100mg
500mg

Technical Note:

1. Catalyst for general metathesis reactions including cross metathesis and endo-selective ene-yne ring closing metathesis.¹



Tech. Note (1)
Ref. (1)

References:

1. *J. Am. Chem. Soc.*, **2009**, 131, 10652.

MOLYBDENUM (Compounds)

42-0525

NEW

[2,6-bis(1-methylethyl)benzenaminato(2-)](2,5-dimethyl-1H-pyrrol-1-yl)(2-methyl-2-phenylpropylidene)([1,1':3',1''-terphenyl]-2'-olato) molybdenum(VI), paraffin formulated pellet (1703808-70-1)
 $C_{46}H_{50}MoN_2O$; FW: 742.86; paraffin pellet
air sensitive, moisture sensitive, (store cold)
 Note: Developed by XiMo. Sold under license from XiMo for research purposes only.
 Patents: US20140309466, WO14139679.

2pcs
10pcs

Technical Note:

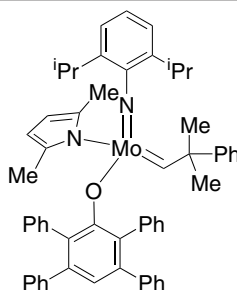
1. See 42-0520 (page 2)

42-0510

NEW

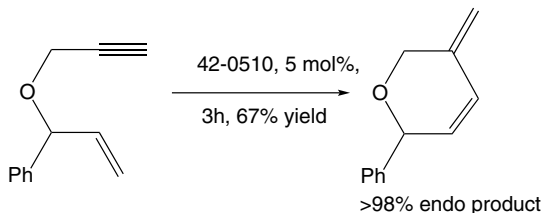
amp

[2,6-Bis(1-methylethyl)benzenaminato(2-)](2,5-dimethyl-1H-pyrrol-1-yl)(4',6'-diphenyl[1,1':3',1''-terphenyl]-2'-olato)(2-methyl-2-phenylpropylidene)molybdenum(VI) (1572180-69-8)
 $C_{58}H_{58}MoN_2O$; FW: 895.05; orange powdr.
air sensitive, moisture sensitive, (store cold)
 Note: Developed by XiMo. Sold under license from XiMo for research purposes only.
 Patents: US20140309466, WO14139679.

100mg
500mg

Technical Note:

1. Catalyst for general metathesis² reactions including cross metathesis² and ring closing metathesis.¹

Tech. Note (1)
Ref. (1)

References:

1. *J. Am. Chem. Soc.*, **2009**, 131, 10652.
2. *Org. Process Res. & Dev.*, **2016**, 20, 1709.

42-0515

NEW

[2,6-Bis(1-methylethyl)benzenaminato(2-)](2,5-dimethyl-1H-pyrrol-1-yl)(4',6'-diphenyl[1,1':3',1''-terphenyl]-2'-olato)(2-methyl-2-phenylpropylidene) molybdenum(VI) in paraffin formulated pellet
 $C_{58}H_{58}MoN_2O$; FW: 895.05; paraffin pellet
air sensitive, moisture sensitive, (store cold)
 Note: Developed by XiMo. Sold under license from XiMo for research purposes only.
 Patents: US20140309466, WO14139679.

2pcs
10pcs

Technical Note:

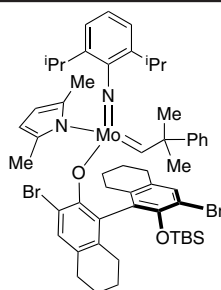
1. See 42-0510 (page 3)

42-0560

NEW

amp

(S)-1-((3,3'-dibromo-2'-((tert-butyldimethylsilyl)oxy)-5,5',6,6',7,7',8,8'-octahydro-[1,1'-binaphthalen]-2-yl)oxy)-N-(2,6-diisopropylphenyl)-1-(2,5-dimethyl-1H-pyrrol-1-yl)-1-(2-methyl-2-phenylpropylidene) molybdenum (VI) (1196674-83-5)
 $C_{54}H_{70}Br_2MoN_2O_2Si$; FW: 1063; red powdr.
air sensitive, moisture sensitive, (store cold)
 Note: Developed by XiMo. Sold under license from XiMo for research purposes only.
 Patents: U.S. 9,687,834, EP2242578.

100mg
500mg

Technical Notes:

1. Z-selective cross metathesis.²
2. Enantio- or diastereoselective en-yne ring closing metathesis.^{1,3}

References:

1. *Nature*, **2008**, 456, 933-937.
2. *J. Am. Chem. Soc.*, **2011**, 133, 11512.
3. *J. Am. Chem. Soc.*, **2009**, 131, 10652.

MOLYBDENUM (Compounds)

42-0565

NEW

(S)-1-((3,3'-dibromo-2'-((tert-butyldimethylsilyl)oxy)-5,5',6,6',7,7',8,8'-octahydro-[1,1'-binaphthalen]-2-yl)oxy)-N-(2,6-diisopropylphenyl)-1-(2,5-dimethyl-1H-pyrrol-1-yl)-1-(2-methyl-2-phenylpropylidene)molybdenum (VI) paraffin pellets (1196674-83-5)

C₅₄H₇₀Br₂MoN₂O₂Si; FW: 1063; paraffin pellet

air sensitive, moisture sensitive, (store cold)

Note: Developed by XiMo. Sold under license from XiMo for research purposes only.

Patents: U.S. 9,687,834, EP2242578.

2pcs

10pcs

Technical Note:

- See 42-0560 (page 3)

42-0540

NEW

amp

(R)-1-((3,3'-dibromo-2'-((tert-butyldimethylsilyl)oxy)-5,5',6,6',7,7',8,8'-octahydro-[1,1'-binaphthalen]-2-yl)oxy)-1-(2,5-dimethyl-1H-pyrrol-1-yl)-N-(2,6-dimethylphenyl)-1-(2-methyl-2-phenylpropylidene)molybdenum (VI) (1300026-28-1)

C₅₀H₆₂Br₂MoN₂O₂Si; FW: 1006.89; orange powdr.

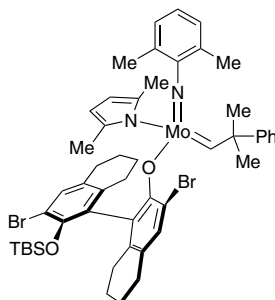
air sensitive, moisture sensitive, (store cold)

Note: Developed by XiMo. Sold under license from XiMo for research purposes only.

Patents: U.S. 9,687,834, EP2242578.

100mg

500mg



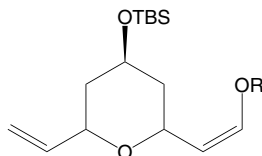
Technical Note:

- Catalyst used for:
 - Enantio-selective ring opening²/cross metathesis.
 - Ring closing metathesis.
- Enantio- and endo-selective ene-yne ring closing metathesis.



1 mol% 42-0540

C₆H₆, 22C, 0.5h

R = n-Bu or p-MeOC₅H₄


>98% Z

Tech. Note (1)
Ref. (2)

References:

- Nature, **2011**, 471, 461-466.
- J. Am. Chem. Soc., **2012**, 134, 2788-2799.

42-0545

NEW

(R)-1-((3,3'-dibromo-2'-((tert-butyldimethylsilyl)oxy)-5,5',6,6',7,7',8,8'-octahydro-[1,1'-binaphthalen]-2-yl)oxy)-1-(2,5-dimethyl-1H-pyrrol-1-yl)-N-(2,6-dimethylphenyl)-1-(2-methyl-2-phenylpropylidene)molybdenum (VI) paraffin pellets (1300026-28-1)

C₅₀H₆₂Br₂MoN₂O₂Si; FW: 1006.89; paraffin pellet

air sensitive, moisture sensitive, (store cold)

Note: Developed by XiMo. Sold under license from XiMo for research purposes only. Patents: U.S. 9,687,834, EP2242578.

2pcs

10pcs

Technical Note:

- See 42-0540 (page 4)

42-1205

amp

2,6-Diisopropylphenylimidoneophylidene molybdenum(VI) bis(hexafluoro-t-butoxide) SCHROCK'S CATALYST (139220-25-0)

Mo(C₁₀H₁₂)(C₁₂H₁₇N)(OC(CF₃)₃)₂;

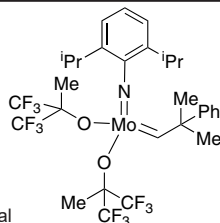
FW: 765.53; yellow to orange powdr.

air sensitive, moisture sensitive, (store cold)

100mg

500mg

2g



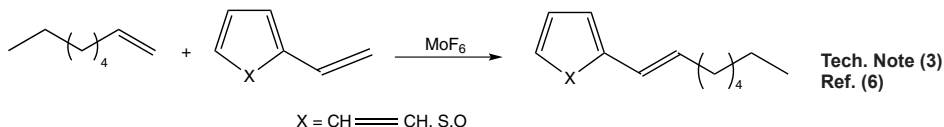
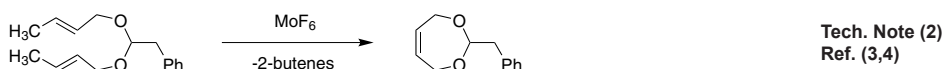
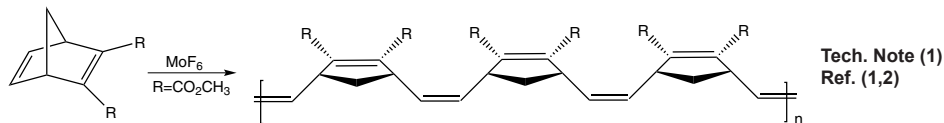
Technical Notes:

- Unlike Mo(C₁₀H₁₂)(C₁₂H₁₇N)(OC(CF₃)₃)₂, the bis(hexafluoro-t-butoxide) (MoF₆) derivative will metathesize many ordinary olefins, especially terminal olefins, and will ROMP many norbornene or substituted norbornadiene monomers to give all cis, and often isotactic, polymers.

MOLYBDENUM (Compounds)

42-1205 **2,6-Diisopropylphenylimidoneophylidene molybdenum(VI) bis(hexafluoro-t-butoxide)**
(continued) **SCHROCK'S CATALYST** (139220-25-0)

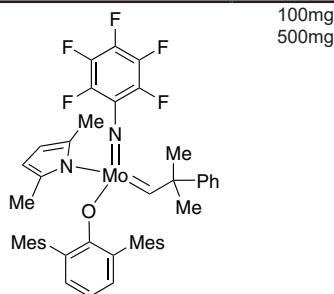
- Useful for the "ring-closing" of dienes or the coupling of terminal olefins.
- Useful for cross-metathesis of aliphatic alkenes with 2-vinyl aromatics.



References:

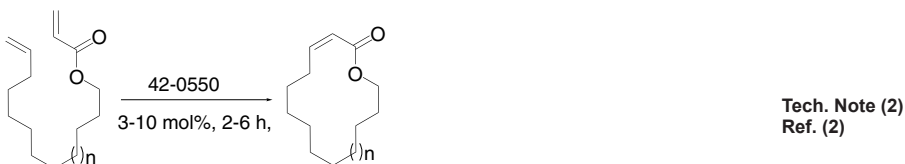
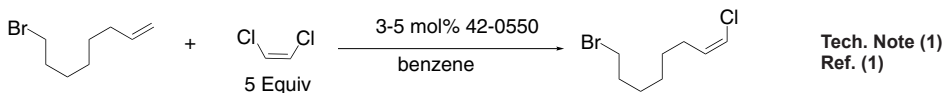
- J. Am. Chem. Soc.*, **1994**, 116, 3414.
- J. Am. Chem. Soc.*, **1993**, 115, 4413.
- J. Am. Chem. Soc.*, **1992**, 114, 5426.
- J. Am. Chem. Soc.*, **1992**, 114, 7324.
- Tetrahedron*, **1998**, 54, 4413. (review article)
- J. Mol. Catal. Chem.*, **2002**, 190, 45.

42-0550 (2,5-Dimethyl-1H-pyrrol-1-yl)
(2,2'',4,4'',6,6''-hexamethyl[1,1':3'',1''-terphenyl]-
2'-olato)(2-methyl-2-phenylpropylidene)
[2,3,4,5,6-pentafluorobenzenaminato(2-)-κN]
,(T-4) molybdenum(VI) (1433803-79-2)
C₄₆H₄₅F₅MoN₂O; FW: 832.81; orange powdr.
air sensitive, moisture sensitive, (store cold)
Note: Developed by XiMo. Sold under license from
XiMo for research purposes only.
Patent: U.S. 9,441,059.



Technical Notes:

- Z-selective alkenyl halide synthesis by cross metathesis.¹
- Stereoselective macrocyclic ring closing metathesis.²



Macrocyclic Z-enolates

References:

- Nature*, **2016**, 531, 459.
- J. Am. Chem. Soc.*, **2014**, 136, 16493.

MOLYBDENUM (Compounds)

42-0555 NEW	(2,5-Dimethyl-1H-pyrrol-1-yl)(2,2'',4,4'',6,6''-hexamethyl[1,1':3',1''-terphenyl]-2'-olato)(2-methyl-2-phenylpropylidene)[2,3,4,5,6-pentafluorobenzenaminato(2-)-κN],(T-4) molybdenum(VI), paraffin pellets (1433803-79-2)	2pcs 10pcs
	C ₄₆ H ₄₅ F ₅ MoN ₂ O; FW: 832.81; paraffin pellet <i>air sensitive, moisture sensitive, (store cold)</i> Note: Developed by XiMo. Sold under license from XiMo for research purposes only. Patent: U.S. 9,441,059.	

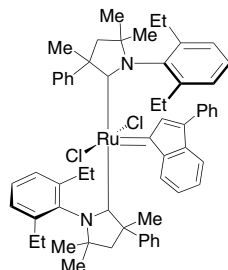
Technical Note:

1. See 42-0550 (page 5)

RUTHENIUM (Compounds)

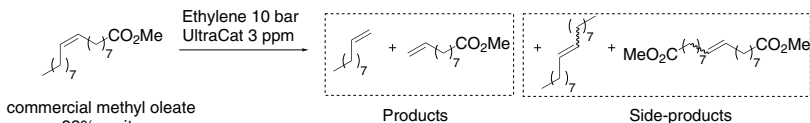
96-0440	Apeiron Ammonium Catalysts Kit See page 23
96-0420	Apeiron Bulky Catalysts Kit See page 24
96-0410	Apeiron nitro-Grela Catalysts Kit See page 25
96-0430	Apeiron Polymerization Catalysts Kit See page 26
96-0400	Apeiron Ruthenium Metathesis Catalyst Kit See page 27

44-0775 NEW	Bis(1-(2,6-diethylphenyl)-3,5,5-trimethyl-3-phenylpyrrolidin-2-ylidene)(3-phenyl-1H-inden-1-ylidene)ruthenium(II) dichloride UltraCat (2055540-61-7)	100mg 500mg
	C ₆₁ H ₆₈ Cl ₂ N ₂ Ru; FW: 1001.18; burgundy powdr. <i>air sensitive, (store cold)</i> Note: Sold in collaboration with Apeiron Synthesis, Inc. Patent: PCT/IB2016/054486.	



Technical Note:

1. Highly selective versatile cross metathesis catalyst leading to terminal and internal olefins, such as ethenolysis via ring closing metathesis (including challenging macrocyclization), cross metathesis (involving electron deficient partners like acrylates), or ene-yne metathesis. These transformations are highly selective and take place at exceptionally low catalyst loadings.



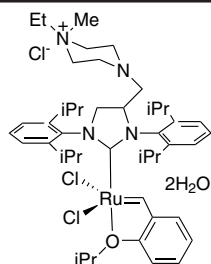
Tech. Note (1)
Ref. (1)

selectivity = 95%; TON = 88000

References:

1. *Angew. Chem. Int. Ed. Engl.*, **2017**, 56, 981-986.

44-0759	(1,3-Bis(2,6-diisopropylphenyl)-4-((4-ethyl-4-methylpiperazin-1-ium-1-yl)methyl)imidazolidin-2-ylidene)(2-isopropoxybenzylidene)ruthenium(II) dichloride dihydrate FixCat (1799947-97-9)	100mg 500mg
	C ₄₆ H ₆₇ Cl ₂ N ₄ ORuCl 2(H ₂ O); FW: 887.47 (923.50); green powdr. <i>(store cold)</i> Note: Sold in collaboration with Apeiron Synthesis, Inc. U.S. Patent 61/603,790; PCT/EP2013/053967	



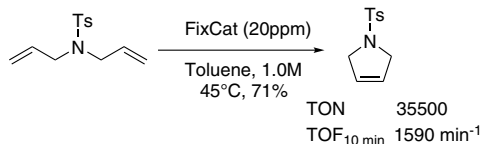
Technical Note:

1. Fixcat is a stable olefin metathesis initiator with very good solubility in neat water. The product efficiently promotes ring-closing, cross, and enyne metathesis reactions of water soluble substrates. Suitable for homogeneous and heterogeneous in batch or flow setup.

RUTHENIUM (Compounds)

44-0759 (continued) **(1,3-Bis(2,6-diisopropylphenyl)-4-((4-ethyl-4-methylpiperazin-1-ium-1-yl)methyl)imidazolidin-2-ylidene)(2-isopropoxybenzylidene)ruthenium(II)dichloride chloride dihydrate FixCat (1799947-97-9)**

The Fixcat structure was also optimized to serve as a versatile and very stable catalyst, easily immobilized on solid supports. In its SCA-15 supported version, it showed exceptional efficiency in promoting ring-closing and cross-metathesis reactions, in both batch and continuous flow setups. Fix Cat is also applicable as a homogeneous catalyst, where compatible solvents include alcohols and halogenated solvents.

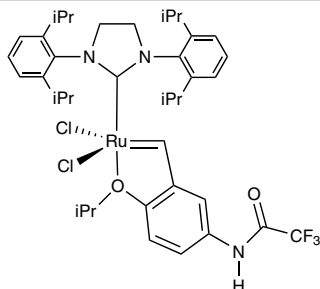


Tech. Note (1)
Ref. (1)

References:

1. *ChemSus Chem.*, **2015**, *8*, 4139.

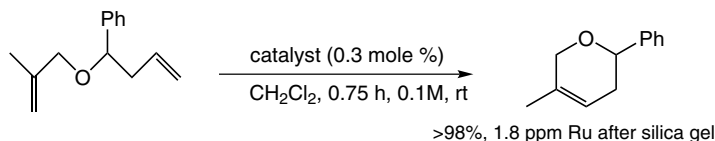
44-0055 **[1,3-Bis(2,6-di-i-propylphenyl)-4,5-dihydroimidazol-2-ylidene]-[2-i-propoxy-5-(trifluoroacetamido)phenyl]methyleneruthenium(II) dichloride M71-S1Pr (1212008-99-5)**
C₃₉H₅₀Cl₂F₃N₃O₂Ru; FW: 821.80; green powdr.
Note: Sold under license from Omega Cat System for research purposes only
WO 2008/065187, PCT/EP2008/054901, Fr n°08/05403.



100mg
500mg

Technical Note:

1. Enhanced activity ruthenium "boomerang" pre-catalyst used in the olefin metathesis, enyne metathesis, and cross metathesis reactions, that can be recycled, and leaves reduced ruthenium in the product after silica gel chromatography.

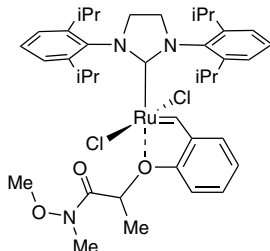


Tech. Note (1)
Ref. (1,2)

References:

1. *Eur. J. Org. Chem.*, **2009**, 4254.
2. *J. Org. Chem.*, **2008**, *73*, 4225.

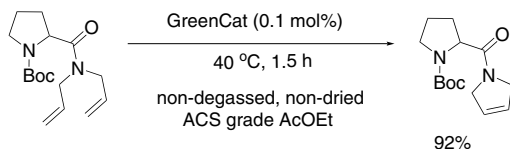
44-0750 **[1,3-Bis(2,6-di-i-propylphenyl)imidazolidin-2-ylidene]{2-[[1-(methoxy(methyl)amino)-1-oxopropan-2-yl]oxy]benzylidene}ruthenium(II) dichloride GreenCat (1448663-06-6)**
C₃₉H₅₃Cl₂N₃O₃Ru; FW: 783.33; green powdr.
Note: Sold in collaboration with Apeiron Synthesis, Inc. U.S. Patent 61/666,009, PCT/EP2013/062435. Apeiron Ruthenium Metathesis Catalyst Kit component.



100mg
500mg

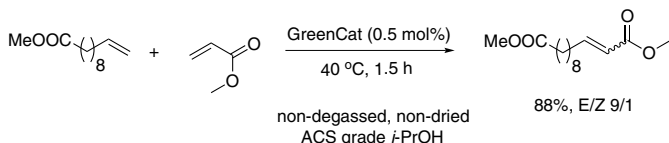
Technical Note:

1. Efficient, durable and reusable olefin metathesis catalyst with a high affinity to silica gel.



Tech. Note (1)
Ref. (1)

RUTHENIUM (Compounds)

44-0750
(continued)**[1,3-Bis(2,6-di-*i*-propylphenyl)imidazolidin-2-ylidene]{2-[[1-(methoxy(methyl)amino)-1-oxopropan-2-yl]oxy]benzylidene}ruthenium(II) dichloride** **GreenCat (1448663-06-6)**Tech. Note (1)
Ref. (1)

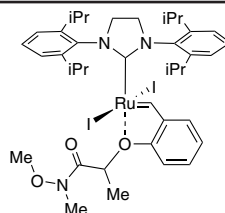
References:

1. *Tetrahedron*, **2013**, 69, 7408

44-0748

NEW

[1,3-Bis(2,6-di-*i*-propylphenyl)imidazolidin-2-ylidene][(2-((1-methoxy(methyl)amino)-1-oxopropan-2-yl)oxy)benzylidene]diodoruthenium(II) GreenCat-I2
 $C_{39}H_{53}I_2N_3O_3Ru$; FW: 966.74; green solid
air sensitive, (store cold)
 Note: Recommended storage 2-8°C. Sold in collaboration with Apeiron Synthesis, Inc.
 U.S. Patent 61/666,009 PCT/EP2013/062435.

100mg
500mg

Technical Note:

1. Catalyst for metathesis applications.

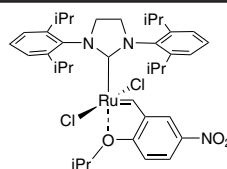
References:

1. *Angew. Chem.* **2017**, 129, 1001–1006.

44-0770

NEW

1,3-Bis(2,6-di-*i*-propylphenyl)imidazolidin-2-ylidene) (2-*i*-propoxy-5-nitrobenzylidene) ruthenium(II) dichloride Nitro-Grela SiPr (928795-51-1)
 $C_{37}H_{49}Cl_2N_3O_3Ru$; FW: 755.78; green powdr.
air sensitive, (store cold)
 Note: Recommended storage 2-8°C. Sold in collaboration with Apeiron Synthesis, Inc.
 U.S. Patent 6/867,303 PCT/EP2003/0112

100mg
500mg

Technical Note:

1. Catalyst for metathesis applications.

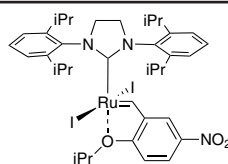
References:

1. *ACS Catalysis*, **2017**, 7(8), 5443-5449.
2. *Catalysis Science & Technology* **2017**, 7(6), 1284-1296.
3. *Angew. Chem.* **2017**, 129, 1001–1006.

44-0782

NEW

[1,3-Bis(2,6-di-*i*-propylphenyl)imidazolidin-2-ylidene)(2-*i*-propoxy-5-nitrobenzylidene) ruthenium(II) diiodide nitro-Grela I2 SiPr (1874265-00-5)
 $C_{37}H_{49}I_2N_3O_3Ru$; FW: 938.68; olive brown powdr.
air sensitive, (store cold)
 Note: Recommended storage 2-8°C. Sold in collaboration with Apeiron Synthesis, Inc.
 U.S. Patent 6/867,303 PCT/EP2003/01122.

100mg
500mg

Technical Note:

1. Catalyst for metathesis applications.

References:

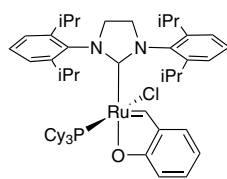
1. *Beilstein Journal of Organic Chemistry*, **2015**, 11, 1823-1832.

RUTHENIUM (Compounds)

44-0793

NEW

[1,3-Bis(2,6-di-*i*-propylphenyl)imidazolidin-2-ylidene) (tricyclohexylphosphine)-(2-oxobenzylidene) ruthenium(II) chloride LatMet SiPr (1544328-59-7)
 $C_{52}H_{77}ClN_2OPRu$; FW: 913.68; dark green xtl.
air sensitive, (store cold)
 Note: Recommended storage 2-8°C. Sold in collaboration with Apeiron Synthesis, Inc.
 U.S. Patent 9,328,132, PCT/EP2013/065839.



100mg
500mg

Technical Note:

1. Catalyst for metathesis applications.

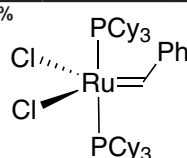
References:

1. U.S. Pat. Appl. Publ. **2015**, US 20150158896 A1 20150611.
2. PCT Int. Appl. **2014**, WO 2014016422 A1 20140130.

44-0944

NEW

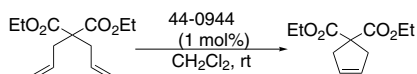
Benzylidene-bis(tricyclohexylphosphine)dichlororuthenium, 97% [Grubbs Catalyst Gen. 1] (172222-30-9)
 $C_{43}H_{72}Cl_2P_2Ru$; FW: 822.97; purple powdr.; m.p. 153 (dec)
(store cold)



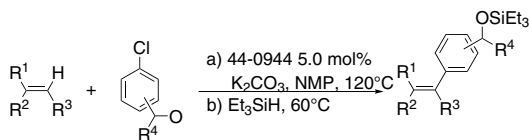
1g
5g
25g

Technical Notes:

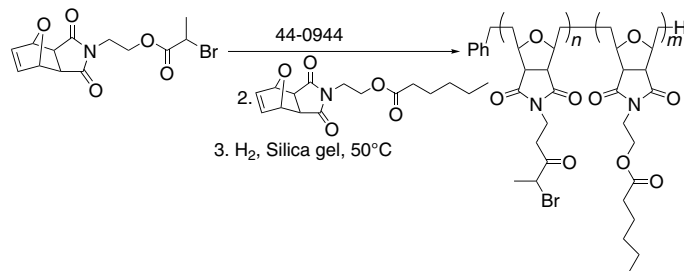
1. N-Heterocyclic carbene and phosphine ruthenium indenylidene precatalysts: A comparative study in olefin metathesis.
2. Ruthenium(IV) alkylidenes as precatalysts for direct arylations of alkenes with aryl chlorides and an application to sequential catalysis.
3. Synthesis of high molecular weight comb block copolymers and their assembly into ordered morphologies in the solid state.
4. Autonomic healing of epoxy vinyl esters via ring opening metathesis polymerization.
5. Amide synthesis from alcohols and amines catalyzed by ruthenium N-heterocyclic carbene complexes.
6. Stereoselective synthesis of E,Z-configured 1,3-dienes by ring-closing metathesis. Application to the total synthesis of lactimidomycin.
7. A highly efficient olefin metathesis process for the synthesis of terminal alkenes from fatty acid esters.
8. Long-Spaced aliphatic polyesters.
9. Enaminones via ruthenium-catalyzed coupling of thioamides and α -diazocarbonyl compounds.
10. Stereoselective synthesis of macrocyclic peptides via a dual olefin metathesis and ethenolysis approach.
11. Synthesis and characterization of precisely-defined ethylene-co-aryl ether polymers via ADMET polymerization.
12. Regio- and stereoselective dehydrogenative silylation and hydrosilylation of vinylarenes catalyzed by ruthenium alkylidenes.



Tech. Note (1)
Ref. (1)



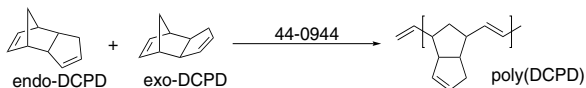
Tech. Note (2)
Ref. (2)



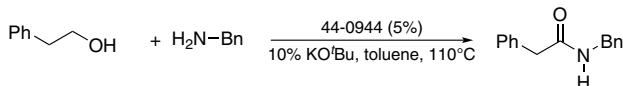
Tech. Note (3)
Ref. (3)

RUTHENIUM (Compounds)

44-0944 **Benzylidene-bis(tricyclohexylphosphine)dichlororuthenium, 97% [Grubbs Catalyst Gen. 1]**
(continued) (172222-30-9)

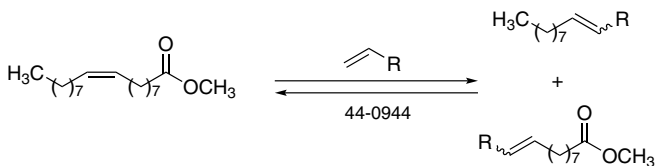


Tech. Note (4)
Ref. (4)

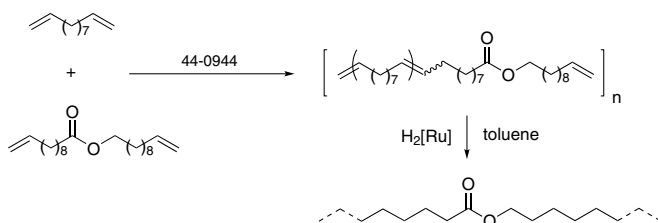


Tech. Note (5)
Ref. (5)

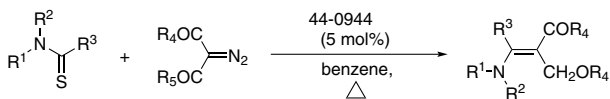
Tech. Note (6)
Ref. (6)



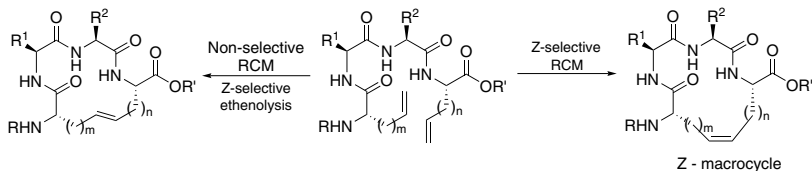
Tech. Note (7)
Ref. (7)



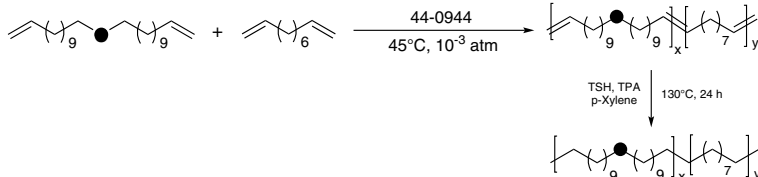
Tech. Note (8)
Ref. (8)



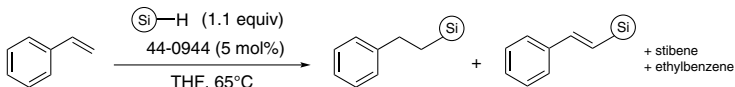
Tech. Note (9)
Ref. (9)



Tech. Note (10)
Ref. (10)



Tech. Note (11)
Ref. (11)



Tech. Note (12)
Ref. (12)

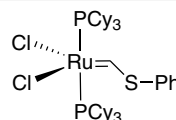
RUTHENIUM (Compounds)

44-0944 **Benzylidene-bis(tricyclohexylphosphine)dichlororuthenium, 97% [Grubbs Catalyst Gen. 1]**
(continued) **(172222-30-9)**

References:

1. *Chem. Eur. J.*, **2007**, 13, 8029.
2. *Angew. Chem. Int. Ed.*, **2007**, 46, 6364.
3. *J. Am. Chem. Soc.*, **2007**, 129, 10551.
4. *Adv. Funct. Mater.*, **2008**, 18, 44.
5. *Chem. Eur. J.*, **2010**, 16, 6820.
6. *J. Am. Chem. Soc.*, **2011**, 133, 9232.
7. *Top. Catal.*, **2012**, 55, 518.
8. *Macromolecules*, **2013**, 46, 7213.
9. *J. Org. Chem.*, **2014**, 79, 7405.
10. *Chem. Sci.*, **2015**, 6, 4561
11. *Polymer*, **2015**, 64, 76.
12. *Org. Lett.*, **2016**, 18, 5324.

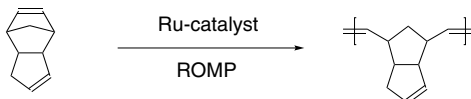
44-0073 **Bis(tricyclohexylphosphine)[(phenylthio)methylene] ruthenium(II) dichloride, min. 97% (219770-99-7)**
 $\text{RuCl}_2(\text{CHSC}_6\text{H}_5)_2[\text{P}(\text{C}_6\text{H}_{11})_3]_2$; FW: 855.02;
 purple powdr.



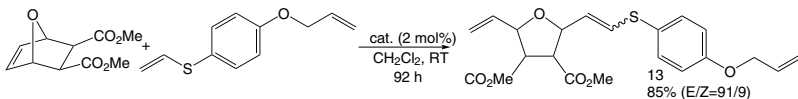
1g
5g

Technical Notes:

1. Metathesis catalyst, stable in air and can be used in aqueous media.
2. Catalyst of choice for the ring-opening metathesis polymerization of cycloolefins.
3. Catalyst concentration 2-3 times lower than comparable phenyl and vinyl substituted ruthenium carbenes.
4. Excellent initiator for solvent-free polymerization and control of initiation rates and gelation times.
5. Highly selective catalyst for the ring opening/cross-metathesis of norbornene derivatives.



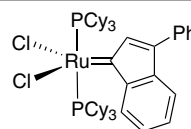
Tech. Note (5)
Ref. (3)



References:

1. *J. Organomet. Chem.*, **2000**, 606, 16
2. "Ring Opening Metathesis Polymerization of Related Chemistry", NATO Science Series II, **2002**, 23.
3. *Organometallics*, **2003**, 22, 586

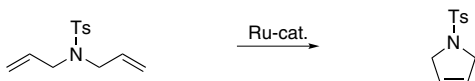
44-0063 **Bis(tricyclohexylphosphine)-3-phenyl-1H-inden-1-ylideneruthenium(II) dichloride (250220-36-1)**
 $\text{RuCl}_2(\text{C}_{15}\text{H}_{10})[\text{P}(\text{C}_6\text{H}_{11})_3]_2$; FW: 923.07; brown powdr.
 Note: Sold in collaboration with Umicore for research purposes only.



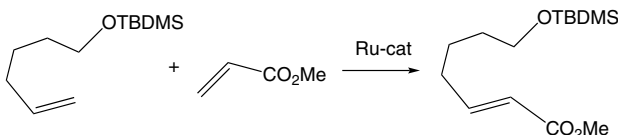
1g
5g

Technical Notes:

1. Highly active, air-stable catalyst used for the ring closing metathesis of dienes.
2. Used in cross-metathesis.



Tech. Note (1)
Ref. (1)



Tech. Note (2)
Ref. (2)

References:

1. *Angew. Chem. Int. Ed.*, **2000**, 112, 3012. (review article)
2. *Adv. Synth. Catal.*, **2008**, 350, 2959.

RUTHENIUM (Compounds)

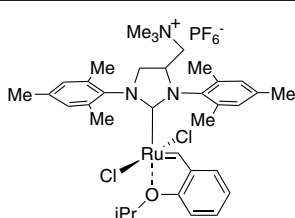
44-0755

NEW

1,3-Bis(2,4,6-trimethylphenyl)-4-[(trimethylammonio)methyl]imidazolidin-2-ylidene)-(2-*i*-propoxybenzylidene) dichlororuthenium(II) hexafluorophosphate StickyCat PF6

$C_{35}H_{48}Cl_2F_6N_3OPRu$; FW: 843.72; green powdr. *air sensitive, (store cold)*

Note: Recommended storage 2-8°C. Sold in collaboration with Apeiron Synthesis, Inc. U.S. Patent 61/603,790, PCT/EP2013/053967.



100mg
500mg

Technical Note:

1. Catalyst for metathesis applications.

Reference:

1. *Angew. Chem.* **2017**, *129*, 1001–1006.

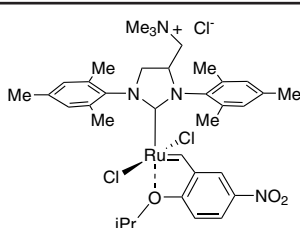
44-0795

NEW

1,3-Bis(2,4,6-trimethylphenyl)-4-[(trimethylammonio)methyl]imidazolidin-2-ylidene)-(2-*i*-propoxy-5-nitrobenzylidene) dichlororuthenium(II) chloride nitro-StickyCat Cl (1415661-45-8)

$C_{35}H_{47}Cl_2N_3O_3Ru$; FW: 779.20; green powdr. *air sensitive, (store cold)*

Note: Recommended storage 2-8°C. Sold in collaboration with Apeiron Synthesis, Inc. U.S. Patent 61/603,790 PCT/EP2013/053967.



100mg
500mg

Technical Note:

1. Catalyst for olefin metathesis applications.

References:

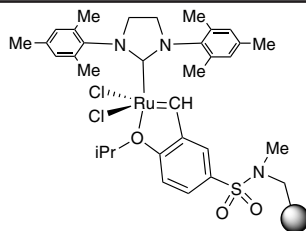
1. *U.S. Pat. Appl. Publ.* **2013**, US 20130225807 A1 20130829.
2. *Green Chemistry*, **2012**, *14*(12), 3264-3268.

44-0083

1,3-Bis(2,4,6-trimethylphenyl)-4,5-dihydroimidazol-2-ylidene[2-(*i*-propoxy)-5-(*N,N*-dimethyl aminosulfonyl)phenyl] methyleneruthenium(II) dichloride (resin supported) Zhan Catalyst II

FW: >1000; black solid; Loading: 0.5 mmol/g

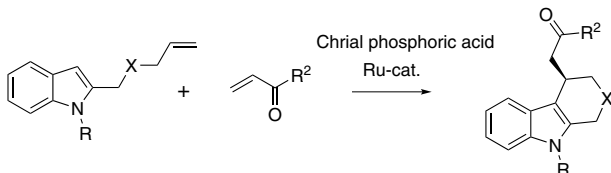
Note: Sold under license from Zannan for research purposes only. Patents CN1907992A, US 2007/0043180 A1, PCT WO 2007/003135 A1.



100mg
500mg
2g

Technical Notes:

1. Efficient, air-stable metathesis catalyst.
2. Used in cross-metathesis/Friedel-Crafts Cascade reaction.



Tech. Note (2)
Ref. (1)

References:

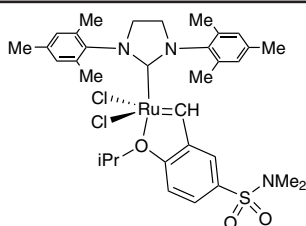
1. *Angew. Chem. Int. Ed.*, **2009**, *48*, 7428.

44-0082

1,3-Bis(2,4,6-trimethylphenyl)-4,5-dihydroimidazol-2-ylidene[2-(*i*-propoxy)-5-(*N,N*-dimethylaminosulfonyl)phenyl] methyleneruthenium (II) dichloride, Zhan Catalyst-1B, min 96% (918870-76-5)

$RuCl_2[C_{22}H_{26}N_2][C_{12}H_{17}NO_3S]$; FW: 733.75; green solid

Note: Sold under license from Zannan for research purposes only. Patents CN1907992A, US 2007/0043180 A1, PCT WO 2007/003135 A1.



100mg
500mg
2g

Technical Notes:

1. See 44-0083 (page 12)

RUTHENIUM (Compounds)

44-0768

[1,3-Bis(2,4,6-trimethylphenyl)-4-[(4-ethyl-4-methylpiperazin-1-ium-1-yl)methyl]imidazolidin-2-ylidene]-[2-i-propoxybenzylidene]dichlororuthenium(II) chloride AquaMet (1414707-08-6)

C₃₉H₅₅Cl₃N₄ORu; FW: 803.31; green powdr.

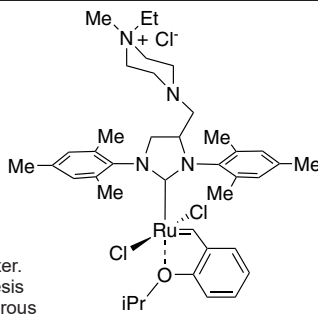
Note: Sold in collaboration with Apeiron

Synthesis, Inc.

U.S. Patent 61/603,790, PCT/EP2013/053967.

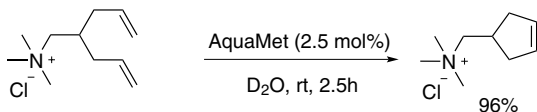
Apeiron Ruthenium Metathesis Catalyst Kit component.

100mg
500mg

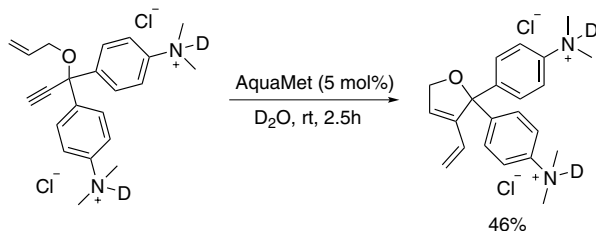


Technical Notes:

1. This is an highly active catalyst for olefin metathesis in water.
2. This catalyst is used as linker free heterogeneous metathesis catalysts after immobilization on silica or siliceous mesoporous molecular sieves. TON of ~16000 for the RCM of (-)-β-citronellene are reported.²



Tech. Note (1)
Ref. (1)



Tech. Note (1)
Ref. (1)

References:

1. *Catal. Sci. Technol.*, **2012**, 22, 2424
2. *ACS Catal.*, **2014**, 4, 3227

44-0047

[1,3-Bis(2,4,6-trimethylphenyl)-2-imidazolidinylidene]-[2-[[[(4-methylphenyl)imino]methyl]-4-nitrophenolyl]-[3-phenyl-1H-inden-1-ylidene]ruthenium(II) chloride (934538-04-2)

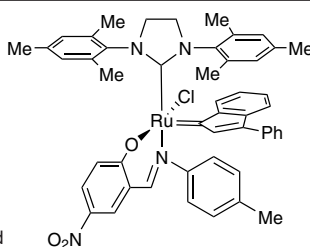
C₅₀H₄₇ClN₃O₃Ru; FW: 888.46;

orange-brown solid

Note: Sold in collaboration with Umicore for research purposes only.

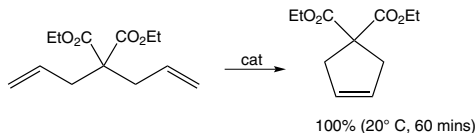
EP 1 468 004 B1, US 2002/0349956.

100mg
500mg

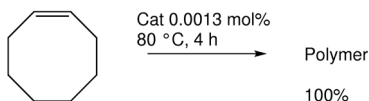


Technical Note:

1. Highly active catalyst for ring opening polymerization and ring closing metathesis reactions.



Ref. (1-3)



Ref. (1-3)

References:

1. *WO 2003062253*.
2. *Eur. J. Org. Chem.*, **2009**, 655.
3. *Curr. Org. Synth.*, **2008**, 5, 291

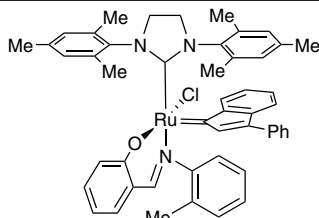
RUTHENIUM (Compounds)

44-0049

[1,3-Bis(2,4,6-trimethylphenyl)-2-imidazolidinylidene]-[2-[[[(2-methylphenyl)imino] methyl]phenolyl]-[3-phenyl-1H-inden-1-ylidene]ruthenium(II) chloride
(934538-12-2)

$C_{50}H_{48}ClN_2ORu$; FW: 843.46; red-brown solid
Note: Sold in collaboration with Umicore for research purposes only.

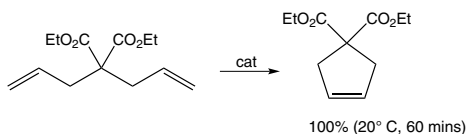
EP 1 468 004 B1, US 2002/0349956.



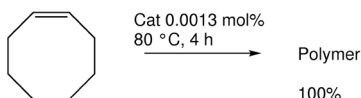
100mg
500mg

Technical Note:

1. Highly active catalyst for ring opening and ring closing metathesis reactions.



Ref. (1-3)



Ref. (1-3)

References:

1. WO 2003062253.
2. Eur. J. Org. Chem., **2009**, 655.
3. Curr. Org. Synth., **2008**, 5, 291

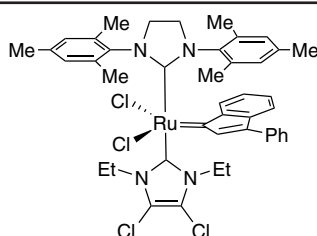
44-0026

1,3-Bis(2,4,6-trimethylphenyl)-2-imidazolidinylidene)(3-phenyl-1H-inden-1-ylidene)(4,5-dichloro-1,3-diethyl-1,3-dihydro-2H-imidazol-2-ylidene)ruthenium(II) dichloride (1228169-92-3)

$C_{45}H_{46}Cl_4N_4Ru$; FW: 861.73;
orange-brown solid

Note: Sold in collaboration with Umicore for research purpose only.

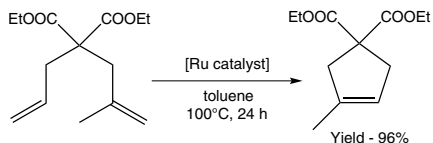
Patent US 10,873,026.



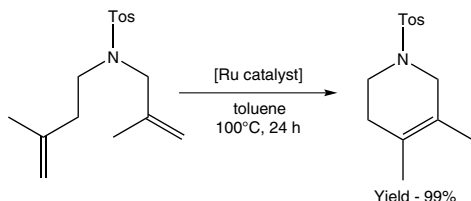
50mg
250mg
1g

Technical Note:

1. Catalyst used for RCM reactions leading to trisubstituted olefins.

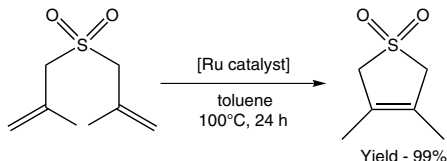


Tech. Note (1)
Ref. (1)



Tech. Note (1)
Ref. (1)

RUTHENIUM (Compounds)

44-0026
(continued)1,3-Bis(2,4,6-trimethylphenyl)-2-imidazolidinylidene(3-phenyl-1H-inden-1-ylidene)
(4,5-dichloro-1,3-diethyl-1,3-dihydro-2H-imidazol-2-ylidene)ruthenium(II) dichloride
(1228169-92-3)Tech. Note (1)
Ref. (1)

References:

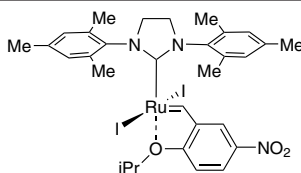
1. *Organometallics*, **2010**, 29, 2761

44-0767

NEW

[1,3-Bis(2,4,6-trimethylphenyl)imidazolidin-2-ylidene)-(2-i-propoxy-5-nitrobenzylidene) ruthenium(II) diiodide nitro-Grela I2
(1874264-99-9)C₃₁H₃₇I₂N₃O₃Ru; FW: 854.52; olive brown powdr.
air sensitive, (store cold)

Note: Recommended storage 2-8°C. Sold in collaboration with Apeiron Synthesis, Inc. U.S. Patent 6/867,303 PCT/EP2003/01122.

100mg
500mg

Technical Note:

1. Catalyst for metathesis applications.

References:

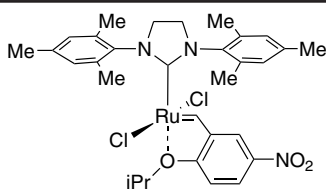
1. *Beilstein Journal of Organic Chemistry* **2015**, 11, 1823-1832.

44-0758

[1,3-Bis(2,4,6-trimethylphenylimidazolidin-2-ylidene)]-(2-i-propoxy-5-nitrobenzylidene)ruthenium(II) dichloride nitro-Grela (502964-52-5)

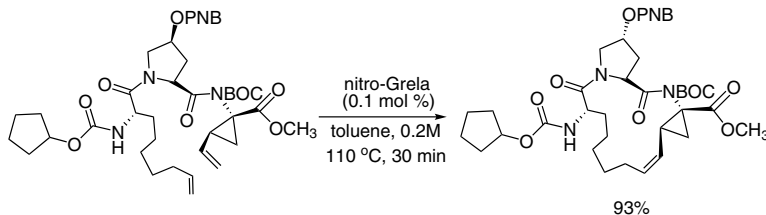
C₃₁H₃₇Cl₂N₃O₃Ru; FW: 671.62; green powdr.

Note: Sold in collaboration with Apeiron Synthesis, Inc. U.S. Patent 6,867,303, PCT/EP2003/01122. Apeiron Ruthenium Metathesis Catalyst Kit component.

100mg
500mg

Technical Notes:

1. This catalyst is used for an efficient synthesis of HCV Protease Inhibitor, BILN 2061.
2. The nitro-Grela catalyst is a stable olefin metathesis initiator active in various ring-closing, cross, and enyne metathesis reactions. Its efficiency has been proven in numerous total syntheses of natural and biologically active compounds, and in material science (see Ref. 1-9)

Tech. Note (1)
Ref. (1,2)

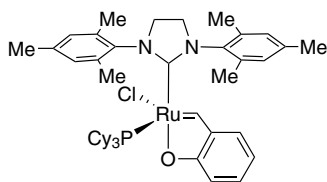
References:

1. *Org. Lett.*, **2008**, 10, 1303
2. *Org. Process Res. Dev.*, **2009**, 13, 250
3. *Org. Lett.*, **2013**, 15, 1016
4. *Chem. Eur. J.*, **2013**, 19, 11847
5. *Org. Lett.*, **2010**, 12, 248
6. *Angew. Chem. Int. Ed.*, **2008**, 47, 6483
7. *Tetrahedron Lett.*, **2006**, 47, 6351
8. *J. Am. Chem. Soc.*, **2004**, 126, 9318
9. *Angew. Chem. Int. Ed.*, **2002**, 41, 4038

RUTHENIUM (Compounds)

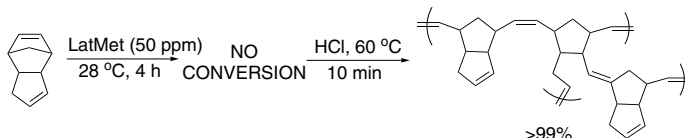
44-0753

[1,3-Bis(2,4,6-trimethylphenylimidazolidin-2-ylidene)](tricyclohexylphosphine)-(2-oxobenzylidene)ruthenium(II) chloride LatMet (1407229-58-6)
 $C_{46}H_{65}ClN_2OPRu$; FW: 829.52; green powdr.
 Note: Sold in collaboration with Apeiron Synthesis, Inc. U.S. Patent 9,328,132, PCT/EP2013/065839. Apeiron Ruthenium Metathesis Catalyst Kit component.

100mg
500mg

Technical Note:

1. This catalyst is used for olefin metathesis polymerization.

Tech. Note (1)
Ref. (1,2)

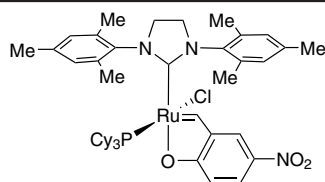
References:

1. *Chem. Eur. J.*, **2014**, 20, 14120
2. *Eur. J. Inorg. Chem.*, **2014**, 1131

44-0787

NEW

[1,3-Bis(2,4,6-trimethylphenylimidazolidin-2-ylidene)](tricyclohexylphosphine)-(2-oxo-5-nitrobenzylidene)ruthenium(II) chloride Nitro-LatMet (1544328-53-1)
 $C_{46}H_{64}ClN_3O_3PRu$; FW: 874.52; brown xtl.
 air sensitive, (store cold)
 Note: Recommended storage 2-8°C. Sold in collaboration with Apeiron Synthesis, Inc. U.S. Patent 9,328,132, PCT/EP2013/065839.

100mg
500mg

Technical Note:

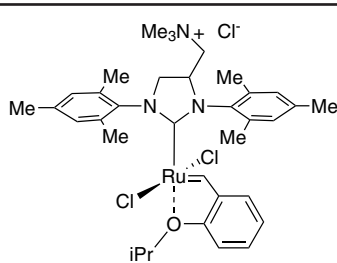
1. Catalyst for metathesis applications.

References:

1. *Angew. Chem.* **2017**, 129, 1001–1006.
2. *U.S. Pat. Appl. Publ.* **2015**, US 20150158896 A1 20150611.
3. *Chemistry - A European Journal*, **2014**, 20(43), 14120-14125.
4. *PCT Int. Appl.* **2014**, WO 2014016422 A1 20140130.
5. *European Journal of Inorganic Chemistry*, **2014**, 2014(7), 1131-1136.

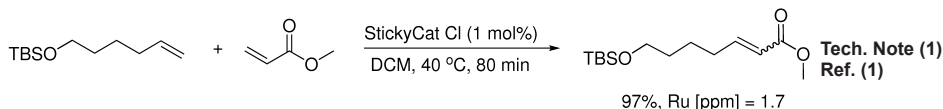
44-0765

[1,3-Bis(2,4,6-trimethylphenyl)-4-[(trimethylammonio)methyl]imidazolidin-2-ylidene]-(2-i-propoxybenzylidene)dichlororuthenium(II) chloride StickyCat Cl (1452227-72-3)
 $C_{36}H_{48}Cl_2N_3ORu$; FW: 734.20; green powdr.
 Note: Sold in collaboration with Apeiron Synthesis, Inc. U.S. Patent 61/603,790, PCT/EP2013/053967. Apeiron Ruthenium Metathesis Catalyst Kit component.

100mg
500mg

Technical Note:

1. This is an easily removable olefin metathesis catalyst.
 It shows high activity at 40-110°C. Residual ruthenium metal is usually below 5 ppm.

Tech. Note (1)
Ref. (1)

References:

1. *Green Chem.*, **2012**, 14, 3264

RUTHENIUM (Compounds)

44-0797

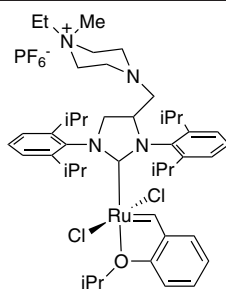
NEW

Dichloro(1,3-Bis(2,6-di-*i*-propylphenyl)-4-((4-ethyl-4-methylpiperazin-1-ium-1-yl)methyl)imidazolidin-2-ylidene)(2-isopropoxybenzylidene)ruthenium(II) hexafluorophosphate FixCat PF6

$C_{45}H_{67}Cl_2F_6N_4OPRu$; FW: 996.98; green powdr.
air sensitive, (store cold)

Note: Recommended storage 2-8°C. Sold in collaboration with Apeiron Synthesis, Inc.

U.S. Patent 61/603,790 PCT/EP2013/053967.



100mg
500mg

Technical Note:

1. Catalyst for metathesis applications.

References:

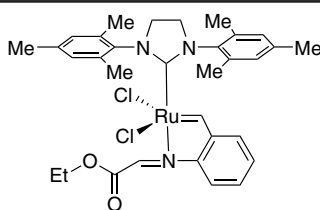
1. *Angew. Chem.* **2017**, 129, 1001–1006.

44-0760

Dichloro(1,3-bis(2,4,6-trimethylphenyl)imidazolidin-2-ylidene){2-[(ethoxy-2-oxoethylidene)amino]benzylidene)ruthenium(II) HeatMet

$C_{32}H_{37}Cl_2N_3O_2Ru$; FW: 667.63;
dark purple xtls.
(store cold)

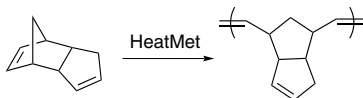
Note: Sold in collaboration with Apeiron Synthesis, Inc. U.S. Patent 14/443,034; PCT/IN2013/002543.



100mg
500mg

Technical Note:

1. HeatMet catalyst is a highly efficient latent catalyst, requiring thermal activation to initiate catalytic activity. Its characteristics are especially suitable to mold polymerization of reactive monomers such as dicyclopentadiene (DCPD). The catalyst is soluble in toluene and dichloromethane.



**Tech. Note (1)
Ref. (1)**

References:

1. *ChemSus Chem.*, **2015**, 8, 4139.

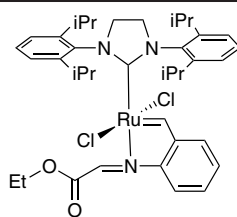
44-0792

NEW

Dichloro(1,3-di-*i*-propylphenylimidazolidin-2-ylidene){2-[(ethoxy-2-oxoethylidene)amino]benzylidene} ruthenium(II) HeatMet SiPr (2097273-88-4)

$C_{38}H_{49}Cl_2N_3O_2Ru$; FW: 751.79; dark violet powdr.
air sensitive, (store cold)

Note: Recommended storage 2-8°C. Sold in collaboration with Apeiron Synthesis, Inc. U.S. Patent 14/443,034.



100mg
500mg

Technical Note:

1. Catalyst for metathesis applications.

References:

1. *ACS Catalysis*, **2017**, 7(6), 4115-4121.

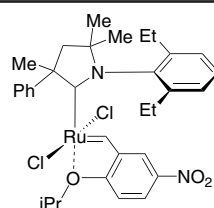
44-0778

NEW

(1-(2,6-Diethylphenyl)-3,5,5-trimethyl-3-phenylpyrrolidin-2-ylidene)(2-isopropoxy-5-nitrobenzylidene)ruthenium(II) dichloride UltraNitroCat (2106819-64-9)

$C_{33}H_{40}Cl_2N_2O_3Ru$; FW: 684.66; green powdr.
air sensitive, (store cold)

Note: Sold in collaboration with Apeiron Synthesis, Inc. Patent: PCT/IB2016/054486.



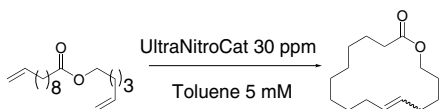
100mg
500mg

Technical Note:

1. High turnover selective catalyst for cross metathesis in macrocyclization reactions.

RUTHENIUM (Compounds)

44-0778 (1-(2,6-Diethylphenyl)-3,5,5-trimethyl-3-phenylpyrrolidin-2-ylidene)(2-isopropoxy-5-nitrobenzylidene)ruthenium(II) dichloride UltraNitroCat (2106819-64-9)
(continued)



GC yield = 90%; TON = 30000

Tech. Note (1)
Ref. (1)

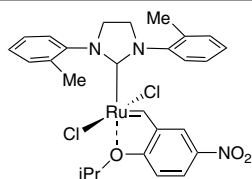
References:

1. *ACS Catal.*, **2017**, 7, 5443-5449

44-0740 (1,3-Di-o-tolylimidazolidin-2-ylidene)(2-i-propoxy-5-nitrobenzylidene)dichlororuthenium(II)
Nitro-Grela SI-o-Tolyl

NEW

$C_{27}H_{29}Cl_2N_3O_3Ru$; FW: 615.51; green pwdr.
air sensitive, (store cold)
Note: Recommended storage 2-8°C. Sold in collaboration with Apeiron Synthesis, Inc.
U.S. Patent 6/867,303 PCT/EP2003/01122.



100mg
500mg

Technical Note:

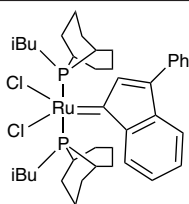
1. Catalyst for metathesis applications.

References:

1. *Angew. Chem.* **2017**, 129, 1001–1006.

44-7778 3-Phenyl-1H-inden-1-ylidene[bis(i-butylphobane)]ruthenium(II) dichloride (894423-99-5)

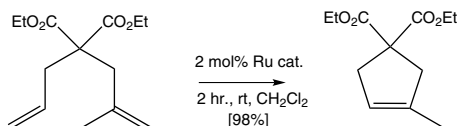
$C_{39}H_{56}Cl_2P_2Ru$; FW: 758.78; red pwdr.
Note: Sold in collaboration with Umicore for research purposes only. Patent US 10,518,716.



250mg
1g

Technical Note:

1. This catalyst exhibits high selectivity as a general purpose metathesis catalyst for applications other than polymerization. It has improved air, moisture and heat resistance.

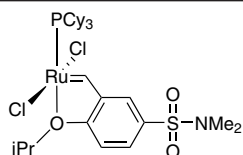


References:

1. *J. Org. Chem.*, **2008**, 73, 259

44-0078 {[2-(i-Propoxy)-5-(N,N-dimethylaminosulfonyl)phenyl]methylene}(tricyclohexylphosphine)ruthenium(II) dichloride Zhan Catalyst -1C (918871-44-0)

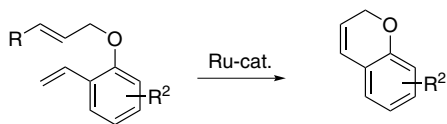
$C_{30}H_{50}Cl_2NO_3PRuS$; FW: 707.74; brown solid
Note: Sold under license from Zannan for research purposes only. Patents CN1907992A, US 2007/0043180 A1, PCT WO 2007/003135 A1.



500mg
2g

Technical Notes:

1. Efficient, air-stable metathesis catalyst.
2. Used in cross-metathesis/Friedel-Crafts Cascade reaction.

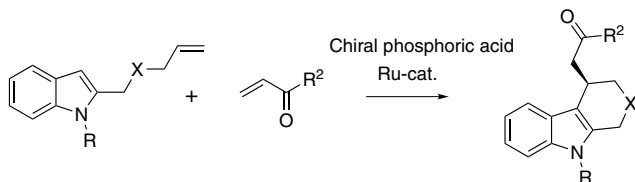


Tech. Note (1)

RUTHENIUM (Compounds)

44-0078
(continued)

{[2-(*i*-Propoxy)-5-(*N,N*-dimethylaminosulfonyl)phenyl]methylene}(tricyclohexylphosphine) ruthenium(II) dichloride Zhan Catalyst -1C (918871-44-0)



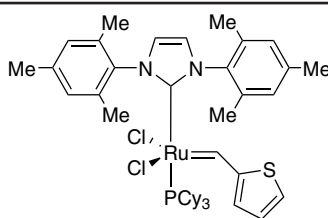
Tech. Note (2)
Ref. (2)

References:

1. PCT Int. Appl. (2007), WO 2007003135 A1
2. *Angew. Chem. Int. Ed.*, **2009**, 48, 7428

44-7785

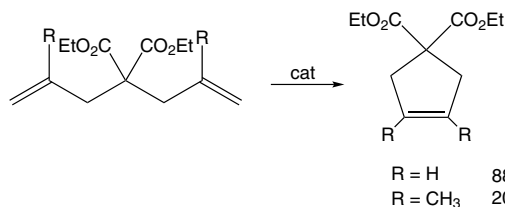
Tricyclohexylphosphine[1,3-bis(2,4,6-trimethylphenyl)imidazol-2-ylidene][2-thienylmethylene]ruthenium(II) dichloride, min. 95% [catMETium® RF 2] (1190427-49-6)
C₄₄H₆₁Cl₂N₂PRuS; FW: 852.98; brown powdr.
Note: Sold in collaboration with Evonik for research purposes only.
Patent US 6635768.



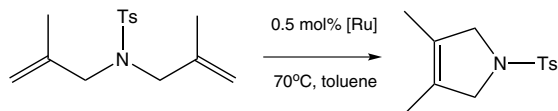
100mg
500mg
2g

Technical Note:

1. Efficient catalyst for ring-closing metathesis.



Ref. (1)



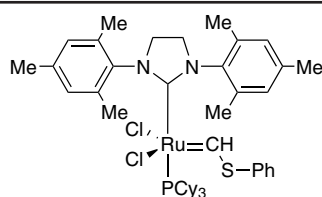
Ref. (2)

References:

1. *Organometallics*, **1999**, 18, 5416
2. *Chemistry Today*, **2009**, 27, 24

44-7780

Tricyclohexylphosphine[1,3-bis(2,4,6-trimethylphenyl)-4,5-dihydroimidazol-2-ylidene][(phenylthio)methylene]ruthenium(II) dichloride (1155422-69-7)
RuCl₂[C₂₁H₂₈N₂][C₆H₅S][P(C₆H₁₁)₃]; FW: 881.04; purple-brown solid



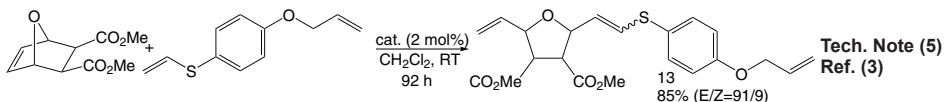
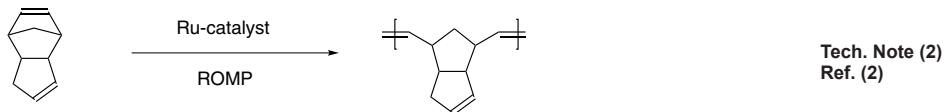
100mg
500mg

Technical Notes:

1. Metathesis catalyst, stable in air and can be used in aqueous media.
2. Catalyst of choice for the ring-opening metathesis polymerization of cycloolefins.
3. Catalyst concentration 2-3 times lower than comparable phenyl and vinyl substituted ruthenium carbenes.
4. Excellent initiator for solvent-free polymerization and control of initiation rates and gelation times.
5. Highly selective catalyst for the ring opening/cross-metathesis of norbornene derivatives.

RUTHENIUM (Compounds)

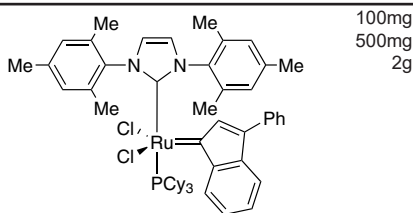
44-7780 Tricyclohexylphosphine[1,3-bis(2,4,6-trimethylphenyl)-4,5-dihydroimidazol-2-ylidene] [(phenylthio)methylene]ruthenium(II) dichloride (1155422-69-7)
(continued)



References:

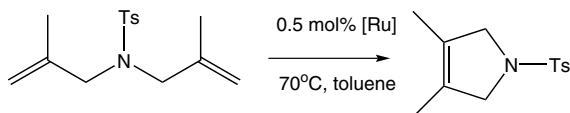
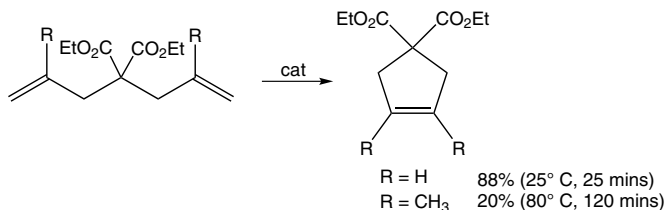
1. *J. Org. Chem.*, **2000**, 606, 65.
2. "Ring Opening Metathesis Polymerization of Related Chemistry", NATO Science Series II, **2002**, 23.
3. *Organometallics*, **2003**, 22, 586.

44-7775 Tricyclohexylphosphine[1,3-bis(2,4,6-trimethylphenyl)imidazol-2-ylidene] [3-phenyl-1H-inden-1-ylidene]ruthenium(II) dichloride, min. 95% [catMETium® RF1] (254972-49-1)
RuCl₂[C₂₁H₂₄N₂][C₁₅H₁₀][P(C₆H₁₁)₃];
FW: 947.07; orange to brown powdr.
Note: Sold in collaboration with Evonik for research purposes only. Patent US 6635768.
For use in pharmaceutical applications only.
Other uses are unauthorized.



Technical Note:

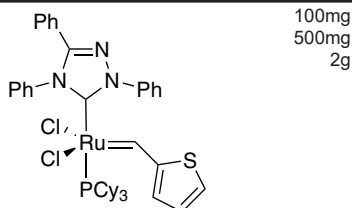
1. Efficient catalyst for ring-closing metathesis.



References:

1. *Organometallics*, **1999**, 18, 5416
2. *ChemistryToday*, **2009**, 27, 24

44-7795 Tricyclohexylphosphine[2,4-dihydro-2,4,5-triphenyl-3H-1,2,4-triazol-3-ylidene] [2-thienylmethylene]ruthenium(II) dichloride, min. 95% [catMETium® RF 4] (1190427-51-0)
C₄₃H₅₂Cl₂N₃PRuS; FW: 845.91; violet to brown powdr.
Note: Sold in collaboration with Evonik for research purposes only. Patent US 6635768.



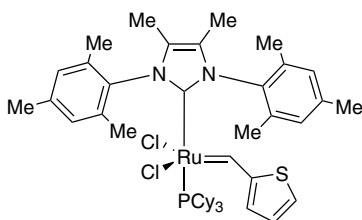
Technical Note:

1. See 44-7775 (page 20)

RUTHENIUM (Compounds)

44-7790

Tricyclohexylphosphine[4,5-dimethyl-1,3-bis(2,4,6-trimethylphenyl)imidazol-2-ylidene][2-thienylmethylene]ruthenium(II) dichloride, min. 95% [catMETium® RF 3] (1190427-50-9)
 $C_{46}H_{65}Cl_2N_2PRuS$; FW: 881.04; violet to brown powdr.
 Note: Sold in collaboration with Evonik for research purposes only.
 Patent US 6635768.



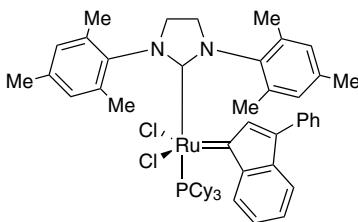
100mg
500mg
2g

Technical Note:

- See 44-7775 (page 20)

44-7777

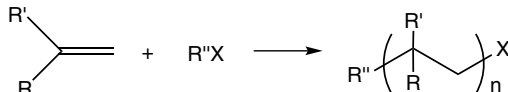
Tricyclohexylphosphine[3-phenyl-1H-inden-1-ylidene][1,3-bis(2,4,6-trimethylphenyl)-4,5-dihydroimidazol-2-ylidene]ruthenium(II) dichloride, min. 95% (536724-67-1)
 $C_{54}H_{69}Cl_2N_2PRu$; FW: 949.09; dark red powdr.
 Note: Sold in collaboration with Umicore for research purposes only. For use in lifecycle applications and research purposes only.



100mg
500mg

Technical Note:

- Catalyst used for the Atom Transfer Radical Polymerization (ATRP) of vinyl monomers.



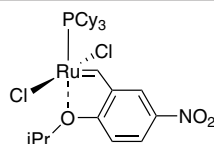
References:

- New J. Chem., 2003, 27, 257

44-0763

NEW

Tricyclohexylphosphine(2-i-propoxy-5-nitrobenzylidene)dichlororuthenium(II) Nitro-Grela 1 gen. (625082-83-9)
 $C_{28}H_{44}Cl_2NO_3PRu$; FW: 645.60; brown powdr.
air sensitive, (store cold)
 Note: Recommended storage 2-8°C. Sold in collaboration with Apeiron Synthesis, Inc.
 U.S. Patent 6/867,303 PCT/EP2003/01122.



100mg
500mg

Technical Note:

- Catalyst for metathesis applications.

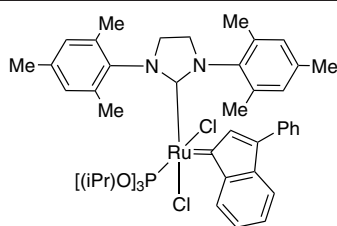
References:

- ACS Catalysis, 2017, 7(8), 5443-5449.
- Angew. Chem. 2017, 129, 1001–1006.
- Chemistry - A European Journal, 2014, 20(42), 13716-13721.
- Advanced Synthesis & Catalysis, 2013, 355(10), 1997-2006.

RUTHENIUM (Compounds)

44-7783

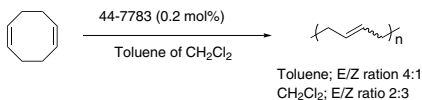
Tri(*i*-propoxy)phosphine(3-phenyl-1H-inden-1-ylidene)[1,3-bis(2,4,6-trimethylphenyl)-4,5-dihydroimidazol-2-ylidene] ruthenium (II) dichloride, min. 95%
 cis-Caz-1 (1255536-61-8)
 $C_{45}H_{57}Cl_2N_2O_3PRu$; FW: 876.89; brown powdr.



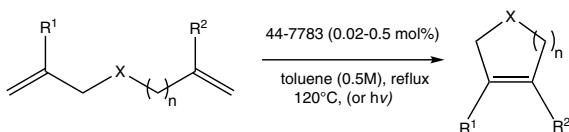
50mg
250mg

Technical Notes:

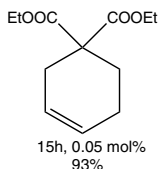
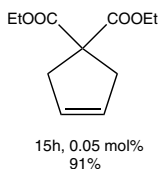
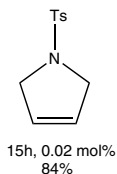
1. Solvent dependent catalyst for the photoinduced ring opening metathesis polymerization of 1,5 cyclooctadiene
2. Thermo and Photoactivation of 44-7783 at elevated and room temperatures enables a wide variety of olefin metathesis reaction to be carried out under mild conditions with excellent yields



Tech. Note (1)
Ref. (1)



Tech. Note (2)
Ref. (1,2)



References:

1. *ACS Catal.*, **2018**, 8, 6413–6418.
2. *Chem. Commun.*, **2010**, 7115.

KITS - Apeiron Ammonium Catalysts Kit

96-0440

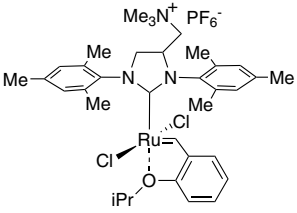
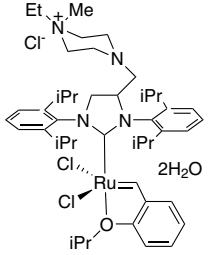
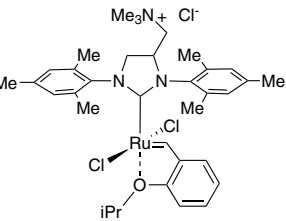
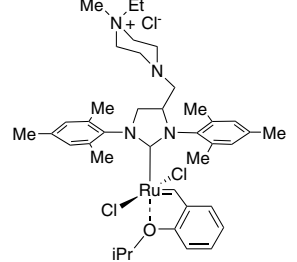
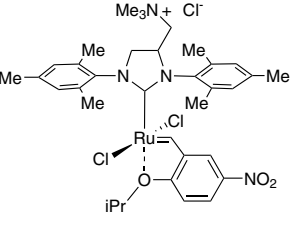
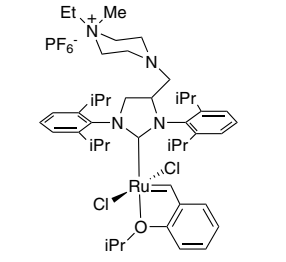
NEW

Apeiron Ammonium Catalysts Kit

Sold in collaboration with Apeiron Synthesis, Inc. Complexes from our Ammonium Catalysts Kit can be applied to metathesis in neat water [44-0768 (AquaMet), 44-0765 (StickyCat Cl), 44-0795 (nitro-StickyCatCl)], ethyl acetate/dimethyl carbonate [44-0755 (StickyCat PF6), 44-0797 (FixCat PF6)] or heterogeneously after catalyst deposition on solid support [44-0768 (AquaMet), 44-0759 (FixCat)].

These catalysts are especially recommended for applications in which low levels of residual ruthenium is desired.

Components also available for individual sale. Contains the following:

 44-0755 100mg	 44-0759 100mg	 44-0765 100mg
 44-0768 100mg	 44-0795 100mg	 44-0797 100mg

44-0755	1,3-Bis(2,4,6-trimethylphenyl)-4-[(trimethylammonio)methyl]imidazolidin-2-ylidene]-(2-i-propoxybenzylidene) dichlororuthenium(II) hexafluorophosphate StickyCat PF6	100mg	See page 12
44-0759	(1,3-Bis(2,6-diisopropylphenyl)-4-((4-ethyl-4-methylpiperzain-1-ium-1-yl)methyl)imidazolidin-2-ylidene) (2-isopropoxybenzylidene)ruthenium(II)dichloride chloride dihydrate FixCat (1799947-97-9)	100mg	See page 6
44-0765	[1,3-Bis(2,4,6-trimethylphenyl)-4-[(trimethylammonio)methyl]imidazolidin-2-ylidene]-(2-i-propoxybenzylidene) dichlororuthenium(II) chloride StickyCat Cl (1452227-72-3)	100mg	See page 16
44-0768	[1,3-Bis(2,4,6-trimethylphenyl)-4-[(4-ethyl-4-methylpiperazin-1-ium-1-yl)methyl]imidazolidin-2-ylidene]-(2-i-propoxybenzylidene) dichlororuthenium(II) chloride AquaMet (1414707-08-6)	100mg	See page 13
44-0795	1,3-Bis(2,4,6-trimethylphenyl)-4-[(trimethylammonio)methyl]imidazolidin-2-ylidene]-(2-i-propoxy-5-nitrobenzylidene) dichlororuthenium(II) chloride nitro-StickyCat Cl (1415661-45-8)	100mg	See page 12
44-0797	Dichloro(1,3-Bis(2,6-di-i-propylphenyl)-4-((4-ethyl-4-methylpiperzain-1-ium-1-yl)methyl)imidazolidin-2-ylidene) (2-isopropoxybenzylidene)ruthenium(II) hexafluorophosphate FixCat PF6	100mg	See page 17

KITS - Apeiron Bulky Catalysts Kit

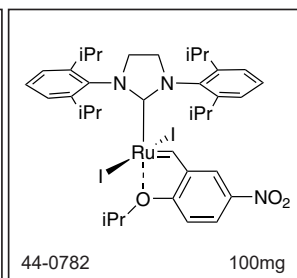
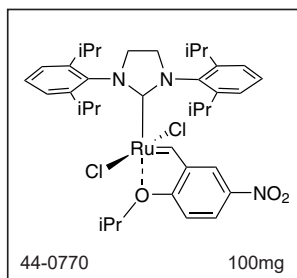
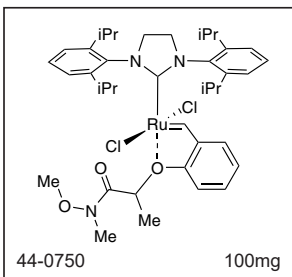
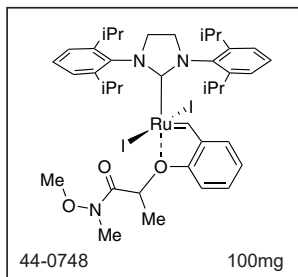
96-0420

NEW

Apeiron Bulky Catalysts Kit

Sold in collaboration with Apeiron Synthesis, Inc. Catalysts within the Bulky Catalysts Kit were designed to be less sensitive to minor impurities that are commonly present in metathesis substrates/solvents. The bulkiness of the ligands in this kit helps to reduce the risk of unwanted double-bond migration. These complexes are especially recommended for RCM and CM of sterically non-demanding substrates.

Components also available for individual sale. Contains the following:



44-0748	[1,3-Bis(2,6-di-i-propylphenyl)imidazolidin-2-ylidene] [(2-((1-methoxy(methyl)amino)-1-oxopropan-2-yl)oxy)benzylidene]diodoruthenium(II) GreenCat-I2	100mg	See page 8
44-0750	[1,3-Bis(2,6-di-i-propylphenyl)imidazolidin-2-ylidene] {2-[[1-(methoxy(methyl)amino)-1-oxopropan-2-yl]oxy]benzylidene}ruthenium(II) dichloride GreenCat (1448663-06-6)	100mg	See page 7
44-0770	1,3-Bis(2,6-di-i-propylphenyl)imidazolidin-2-ylidene) (2-i-propoxy-5-nitrobenzylidene) ruthenium(II) dichloride Nitro-Grela SiPr (928795-51-1)	100mg	See page 8
44-0782	[1,3-Bis(2,6-di-i-propylphenyl)imidazolidin-2-ylidene) (2-i-propoxy-5-nitrobenzylidene) ruthenium(II) diiodide nitro-Grela I2 SiPr (1874265-00-5)	100mg	See page 8

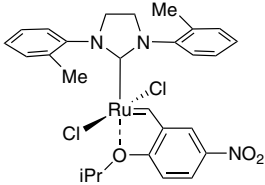
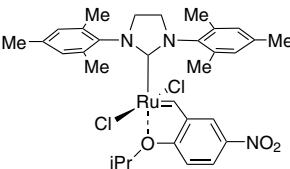
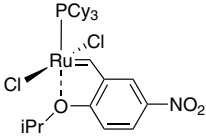
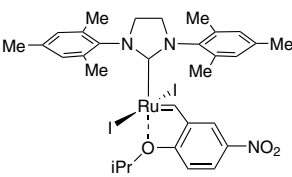
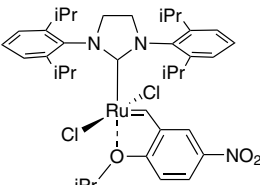
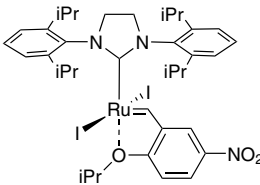
KITS - Apeiron nitro-Grela Catalysts Kit

96-0410

NEW

Apeiron nitro-Grela Catalysts Kit

Sold in collaboration with Apeiron Synthesis, Inc. Our nitro-Grela catalysts kit contains complexes with wide-ranging activity and application profiles. These testing catalysts have excellent potential within the early stages of development. Components also available for individual sale. Contains the following:

 44-0740 100mg	 44-0758 100mg	 44-0763 100mg
 44-0767 100mg	 44-0770 100mg	 44-0782 100mg

44-0740	(1,3-Di-o-tolylimidazolidin-2-ylidene)(2-i-propoxy-5-nitrobenzylidene)dichlororuthenium(II) Nitro-Grela SI-o-Tolyl	100mg	See page 18
44-0758	[1,3-Bis(2,4,6-trimethylphenylimidazolidin-2-ylidene)]-(2-i-propoxy-5-nitrobenzylidene)ruthenium(II) dichloride nitro-Grela (502964-52-5)	100mg	See page 15
44-0763	Tricyclohexylphosphine(2-i-propoxy-5-nitrobenzylidene) dichlororuthenium(II) Nitro-Grela 1 gen. (625082-83-9)	100mg	See page 21
44-0767	[1,3-Bis(2,4,6-trimethylphenyl)imidazolidin-2-ylidene)-(2-i-propoxy-5-nitrobenzylidene) ruthenium(II) diiodide nitro-Grela I2 (1874264-99-9)	100mg	See page 15
44-0770	1,3-Bis(2,6-di-i-propylphenyl)imidazolidin-2-ylidene (2-i-propoxy-5-nitrobenzylidene) ruthenium(II) dichloride Nitro-Grela SiPr (928795-51-1)	100mg	See page 8
44-0782	[1,3-Bis(2,6-di-i-propylphenyl)imidazolidin-2-ylidene) (2-i-propoxy-5-nitrobenzylidene) ruthenium(II) diiodide nitro-Grela I2 SiPr (1874265-00-5)	100mg	See page 8

KITS - Apeiron Polymerization Catalysts Kit

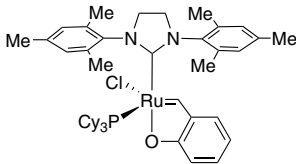
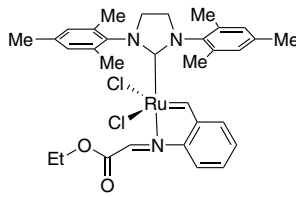
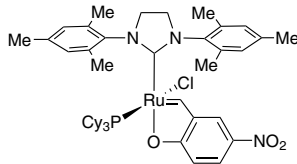
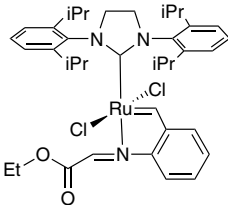
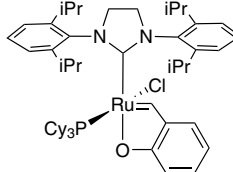
96-0430

NEW

Apeiron Polymerization Catalysts Kit

Sold in collaboration with Apeiron Synthesis, Inc. The catalysts included in our Polymerization Catalysts Kit were specifically designed for ROMP of strained monomers such as dicyclopentadiene or norbornene. The latency of these catalysts allows for controlled preparation of formulation and curing within various conditions.

Components also available for individual sale. Contains the following:

 44-0753 100mg	 44-0760 100mg	 44-0787 100mg
 44-0792 100mg	 44-0793 100mg	

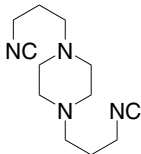
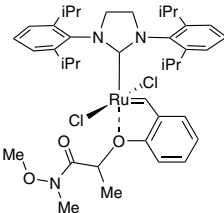
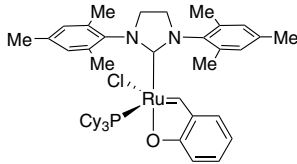
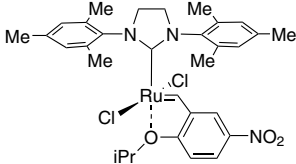
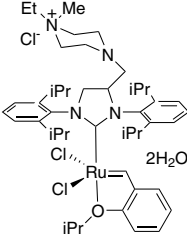
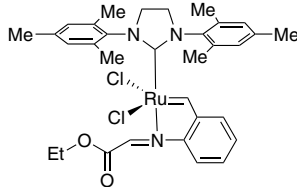
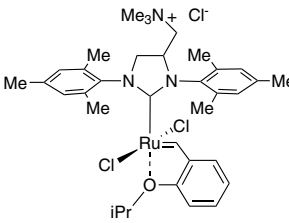
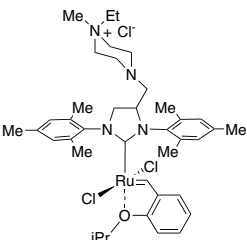
44-0753	[1,3-Bis(2,4,6-trimethylphenyl)imidazolidin-2-ylidene] (tricyclohexylphosphine)-(2-oxobenzylidene)ruthenium(II) chloride LatMet (1407229-58-6)	100mg	See page 16
44-0760	Dichloro(1,3-bis(2,4,6-trimethylphenyl)imidazolidin-2-ylidene){2-[(ethoxy-2-oxoethylidene)amino]benzylidene} ruthenium(II) HeatMet	100mg	See page 17
44-0787	[1,3-Bis(2,4,6-trimethylphenyl)imidazolidin-2-ylidene] (tricyclohexylphosphine)-(2-oxo-5-nitrobenzylidene) ruthenium(II) chloride Nitro-LatMet (1544328-53-1)	100mg	See page 16
44-0792	Dichloro(1,3-di-i-propylphenyl)imidazolidin-2-ylidene) {2-[(ethoxy-2-oxoethylidene)amino]benzylidene} ruthenium(II) HeatMet SiPr (2097273-88-4)	100mg	See page 17
44-0793	[1,3-Bis(2,6-di-i-propylphenyl)imidazolidin-2-ylidene) (tricyclohexylphosphine)-(2-oxobenzylidene)ruthenium(II) chloride LatMet SiPr (1544328-59-7)	100mg	See page 9

KITS - Apeiron Ruthenium Metathesis Catalyst Kit

96-0400

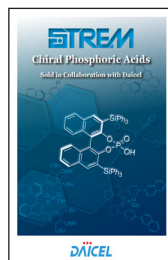
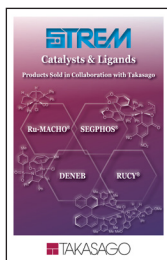
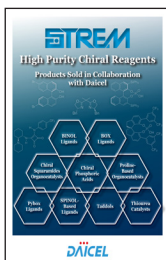
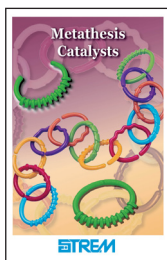
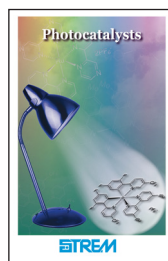
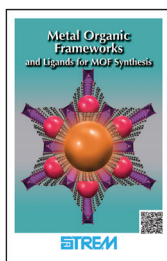
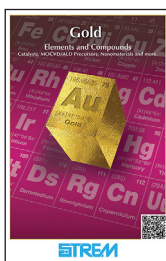
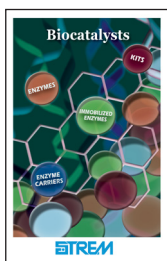
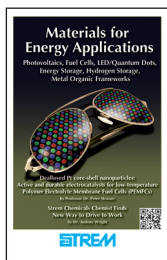
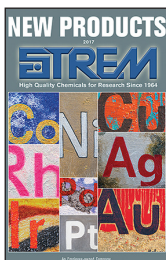
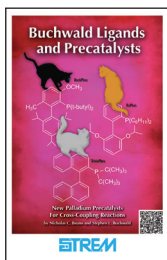
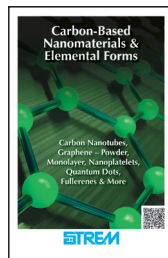
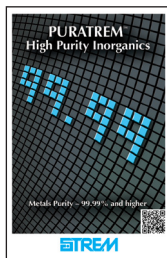
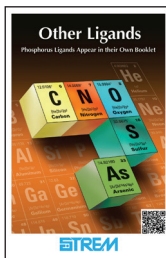
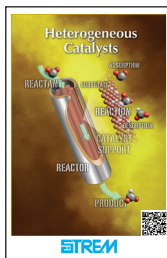
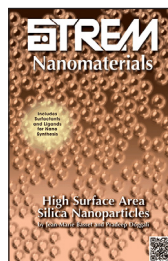
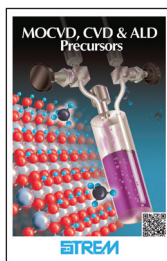
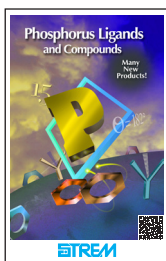
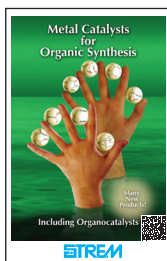
Apeiron Ruthenium Metathesis Catalyst Kit

Sold in collaboration with Apeiron Synthesis, Inc. This kit also includes a metal scavenger (07-2203). Components also available for individual sale. Contains the following:

		
07-2203 1g	44-0750 100mg	44-0753 100mg
		
44-0758 100mg	44-0759 100mg	44-0760 100mg
		
44-0765 100mg	44-0768 100mg	

07-2203	1,4-Bis(2-isocyanopropyl)piperazine (SnatchCat Metal Scavenger) (51641-96-4)	1g	Visit strem.com
44-0750	[1,3-Bis(2,6-di-i-propylphenyl)imidazolidin-2-ylidene]-2-[[1-(methoxy(methyl)amino)-1-oxopropan-2-yl]oxy] ruthenium(II) dichloride GreenCat (1448663-06-6)	100mg	See page 7
44-0753	[1,3-Bis(2,4,6-trimethylphenyl)imidazolidin-2-ylidene]-(tricyclohexylphosphine)-(2-oxobenzylidene)ruthenium(II) chloride LatMet (1407229-58-6)	100mg	See page 16
44-0758	[1,3-Bis(2,4,6-trimethylphenyl)imidazolidin-2-ylidene]-(2-i-propoxy-5-nitrobenzylidene)ruthenium(II) dichloride nitro-Grela (502964-52-5)	100mg	See page 15
44-0759	(1,3-Bis(2,6-diisopropylphenyl)-4-[(4-ethyl-4-methylpiperazin-1-ium-1-yl)methyl]imidazolidin-2-ylidene)(2-isopropoxybenzylidene)ruthenium(II)dichloride chloride dihydrate FixCat (1799947-97-9)	100mg	See page 6
44-0760	Dichloro[1,3-bis(2,4,6-trimethylphenyl)imidazolidin-2-ylidene]-2-[(ethoxy-2-oxoethylidene)amino]benzylidene)ruthenium(II) HeatMet	100mg	See page 17
44-0765	[1,3-Bis(2,4,6-trimethylphenyl)-4-[(trimethylammonio)methyl]imidazolidin-2-ylidene]-(2-i-propoxybenzylidene)dichlororuthenium(II) chloride StickyCat Cl (1452227-72-3)	100mg	See page 16
44-0768	[1,3-Bis(2,4,6-trimethylphenyl)-4-[(4-ethyl-4-methylpiperazin-1-ium-1-yl)methyl]imidazolidin-2-ylidene]-(2-i-propoxybenzylidene)dichlororuthenium(II) chloride AquaMet (1414707-08-6)	100mg	See page 13

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