What is claimed is:

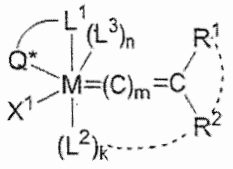
1. A C-H activated olefin metathesis catalyst compound, comprising a Group 8 transition metal center M, and a 2-electron anionic donor bridging moiety Q*, wherein M, L^1 and Q* form an M-Q*-L^1 chelating ligand ring structure having a ring size of 5, 6, or 7 atoms, wherein the compound has the structure of formula (I):

(I) $X^1(L^3)_n(L^2)_kL^1Q^*M=(C)_mCR^1R^2$

wherein X^1 is any anionic ligand, L^1, L^2, and L^3 are, independently, any neutral electron donor ligand, n and k are, independently, 0 or 1, m is 0, 1, or 2, and R^1 and R^2 are, independently, hydrogen, hydrocarbyl, substituted hydrocarbyl, heteroatom-containing hydrocarbyl, substituted heteroatom-containing hydrocarbyl, or functional groups.

2. The compound of claim 1, wherein the compound has the structure of formula (II):

(II)



wherein,

M is a Group 8 transition metal;

X^1 is any anionic ligand;

L^1 is a neutral two electron ligand;

L^2 is a neutral two electron ligand, that may optionally be connected with R^2;

L^3 is a neutral electron donor ligand;

R^1 and R^2 are, independently, hydrogen, hydrocarbyl, substituted hydrocarbyl, heteroatom-containing hydrocarbyl, substituted heteroatom-containing hydrocarbyl, or functional groups, wherein R^2 may optionally be connected with R^1 and/or L^2;

Q* is a two electron anionic donor bridging moiety linking L^1 and M, which can, together with L^1 and M, form one or more cyclic groups, and wherein M, L^1 and Q* form an M-Q*-L^1 chelating ligand ring structure having a ring size of 5, 6, or 7 atoms;

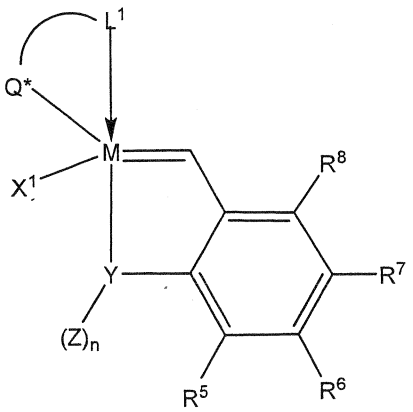
n and k are independently 0 or 1, such that L^3 may or may not be present; and

m is 0, 1, or 2.

3. The compound of claim 2, wherein any two or more of X^1, Q*, L^1, L^2, L^3, R^1, and R^2 together form one or more cyclic groups.

4. The compound of any of claims 2 to 3, wherein any one or more of X^1, Q*, L^1, L^2, L^3, R^1, and R^2 are attached to a support.

5. The compound of 1 or 2, wherein the compound has the structure of formula (VIII):



(VIII)

wherein,

M, L^1, and Q* are as previously defined;

X^1 is any anionic ligand;

Y is a heteroatom selected from N, O, S, and P;

R^5, R^6, R^7, and R^8 are each, independently, selected from the group consisting of hydrogen, halogen, alkyl, alkenyl, alkynyl, aryl, heteroalkyl, heteroatom containing alkenyl, heteroalkenyl, heteroaryl, alkoxy, alkenyloxy, aryloxy, alkoxycarbonyl, carbonyl, alkylamino, alkylthio, aminosulfonyl, monoalkylaminosulfonyl, dialkylaminosulfonyl, alkylsulfonyl, nitrile, nitro, alkylsulfinyl, trihaloalkyl, perfluoroalkyl, carboxylic acid, ketone, aldehyde, nitrate, cyano, isocyanate, hydroxyl, ester, ether, amine, imine, amide, halogen-substituted amide, trifluoroamide, sulfide, disulfide, sulfonate, carbamate, silane, siloxane, phosphine, phosphate, or borate, wherein any combination of R^5, R^6, R^7, and R^8 can be linked to form one or more cyclic groups;

n is 1 or 2, such that n is 1 for the divalent heteroatoms O or S, and n is 2 for the trivalent heteroatoms N or P; and

Z is selected from hydrogen, alkyl, aryl, functionalized alkyl, or functionalized aryl wherein the functional group(s) may independently be one or more of the following: alkoxy, aryloxy, halogen, carboxylic acid, ketone, aldehyde, nitrate, cyano, isocyanate, hydroxyl, ester, ether, amine, imine, amide, trifluoroamide, sulfide, disulfide, carbamate, silane, siloxane, phosphine, phosphate, or borate; methyl, isopropyl, sec-butyl, t-butyl, neopentyl, benzyl, phenyl and trimethylsilyl; and wherein any combination or combinations of X^1, Q*, L^1,Y, Z, R^5, R^6, R^7, and R^8 may be linked to a support.

6. The compound of any of claims 1 or 2 to 5, wherein M is directly bonded to a carbon atom of Q* in the M-Q*-L^1 chelating ligand ring structure.

7. The compound of any of claims 1 or 2 to 6, wherein M is Ru or Os.

8. The compound of any of claims 1 or 2 to 7, where X^1 is selected from halide, nitrate, alkyl, aryl, alkoxy, alkylcarboxylate, aryloxy, alkoxycarbonyl, aryloxycarbonyl, arylcarboxylate, acyl, acyloxy, alkylsulfonato, arylsulfonato, alkylsulfanyl, arylsulfanyl, alkylsulfinyl, or arylsulfinyl.

9. The compound of any of claims 1 or 2 to 7, wherein X^1 is selected from carboxylate, nitrate, phenoxide, halide, sulfoxide, or nitrite.

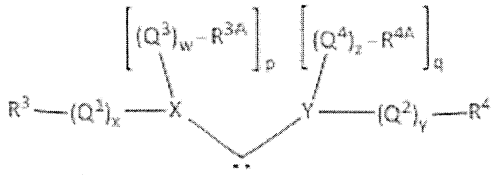
10. The compound of any of claims 1 or 2 to 9, wherein Q* is selected from hydrocarbylene, substituted hydrocarbylene, heteroatom-containing hydrocarbylene, or substituted heteroatom-containing hydrocarbylene.

11. The compound of claim 10, wherein Q* is selected from alkylene, substituted alkylene, heteroatom-containing alkylene, substituted heteroatom-containing alkylene, cycloalkylene, substituted cycloalkylene, heteroatom-containing cycloalkylene, substituted heteroatom-containing cycloalkylene, aryl, substituted aryl, heteroatom-containing aryl, or substituted heteroatom-containing aryl.

12. The compound of claim 10, wherein Q* is selected from cycloalkylene, substituted cycloalkylene, aryl, or substituted aryl.

13. The compound of any of claims 1 or 2 to 12, wherein L^1 is a carbene ligand having the structure of formula (III)

(III)



wherein,

X and Y are heteroatoms selected from N, O, S, and P;

Q^1, Q^2, Q^3, and Q^4 are independently selected from hydrocarbylene, substituted hydrocarbylene, heteroatom-containing hydrocarbylene, and substituted heteroatom-containing hydrocarbylene;

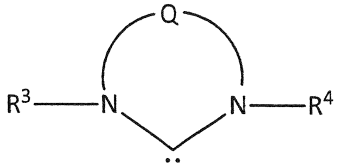
R^3, R^{3A}, R^4, and R^{4A} are independently selected from hydrogen, hydrocarbyl, substituted hydrocarbyl, heteroatom-containing hydrocarbyl, and substituted heteroatom-containing, hydrocarbyl;

p and q are zero or 1, such that p is zero when X is O or S, q is zero when Y is O or S, p is 1 when X is N or P, and q is 1 when Y is N or P; and

w, x, y, and z are independently zero or 1.

14. The compound of claim 13, wherein R^{3A} and R^{4A} are linked to form a cyclic group such that L^1 is a carbene ligand having the structure of formula (V)

(V)



wherein,

Q is selected from hydrocarbylene, substituted hydrocarbylene, heteroatom-containing hydrocarbylene, or substituted heteroatom-containing hydrocarbylene, wherein two or more substituents on adjacent atoms within Q may also be linked to form an additional cyclic structure;

R^3 and R^4 are independently selected from hydrocarbyl, substituted hydrocarbyl, heteroatom-containing hydrocarbyl, or substituted heteroatom-containing hydrocarbyl [[;]].

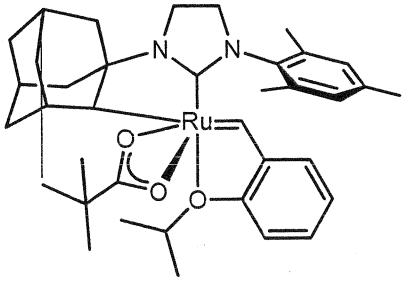
15. The compound of claim 13 or claim 14, wherein R^3 and R^4 are independently selected from cycloalkyl, substituted cycloalkyl, heteroatom-containing cycloalkyl, substituted heteroatom-containing cycloalkyl, aryl, substituted aryl, heteroatom-containing aryl, or substituted heteroatom-containing aryl.

16. The compound of claim 13 or claim 14, wherein R^3 is a cycloalkyl or substituted cycloalkyl group and R^4 is a substituted aryl group.

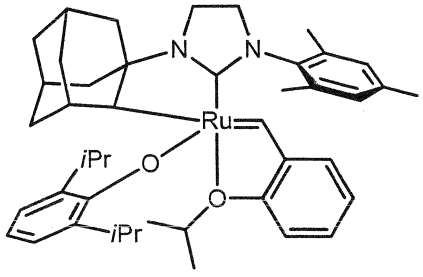
17. The compound of claim 16, wherein R^3 is an adamantyl or substituted adamantyl group, or a substituted C_3-C_{12} cycloalkyl group.

18. The compound of claim 17, wherein R^4 is a substituted aryl group in which both ortho ring positions are substituted.

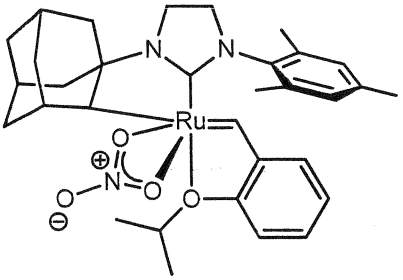
19. A C-H activated olefin metathesis catalyst compound, selected from



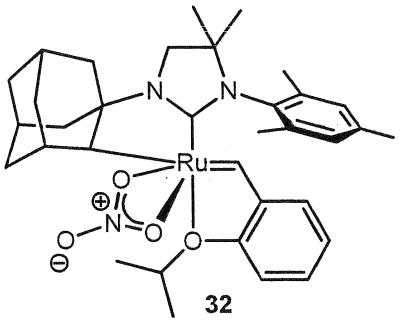
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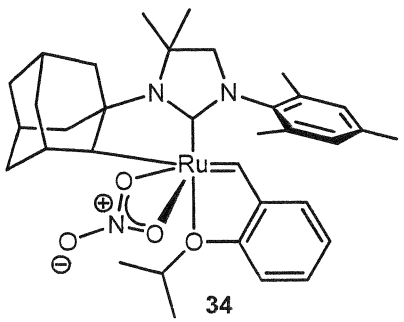
21a



22e

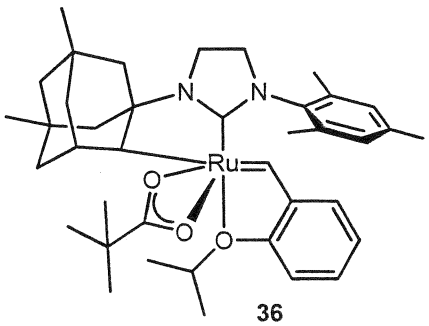


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or



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20. A method of making a C-H activated olefin metathesis catalyst compound, the method comprising contacting a carboxylate compound of the formula M^1X^2, wherein M^1 is selected from silver, lithium, sodium, potassium, rubidium, cesium, magnesium, calcium, strontium, barium, iron, zinc, or thalium, and X^2 is a carboxylate anion, with an olefin metathesis catalyst of the formula $(X^1)_2(L^3)_n(L^2)_kL^1M=(C)_mCR^1R^2$, wherein X^1 is any anionic ligand, L^1, L^2, and L^3 are, independently, any neutral electron donor ligand, n and k are, independently, 0 or 1, m is 0, 1, or 2, M is a Group 8 transition metal, and R^1 and R^2 are, independently, selected from hydrogen, hydrocarbyl, substituted hydrocarbyl, heteroatom-containing hydrocarbyl, substituted heteroatom-containing hydrocarbyl, or functional groups; under conditions effective to promote the exchange of X^2 anions for the X^1 anionic ligands, such that a C-H activated olefin metathesis catalyst compound is produced in which M and L^1 are linked together by a 2-electron anionic donor bridging moiety Q*in a M-Q*-L^1 chelating ligand ring structure having a ring size of 5, 6, or 7 atoms, and the catalyst compound contains an X^2 anionic ligand.

21. The method of claim 20, wherein M is directly bonded to a carbon atom of Q* in the M-Q*-L^1 chelating ligand ring structure.

22. The method of claim 20, wherein M^1 is silver or sodium.

23. The method of claim 20, wherein the carboxylate is of the formula $(R)_3COOM^1$, wherein R is independently selected from hydrogen, C_1-C_{12} alkyl, substituted C_1-C_{12} alkyl, C_3-C_{12} cycloalkyl, substituted C_3-C_{12} cycloalkyl, aryl or substituted aryl, wherein at least one R is not hydrogen.

24. The method of claim 23, wherein R is independently selected from hydrogen, C_1-C_{12} alkyl or aryl.

25. The method of claim 23, wherein $(R)_3$ is selected from *t*-butyl, $PhMe_2C$, Ph_2MeC, or Ph_3C.

26. The method of claim 20, further comprising contacting the C-H activated olefin metathesis catalyst compound with an anionic ligand exchange compound of the formula M^2X^3, wherein M^2 is a cation and X^3 is an anion; under conditions effective to promote the exchange of X^3 anions for the X^2 anionic ligands, such that the C-H activated olefin metathesis catalyst compound contains a M-Q*-L^1 chelating ligand ring structure having a ring size of 5, 6, or 7 atoms and an X^3 anionic ligand.

27. The method of claim 26, wherein M^2 is selected from hydrogen, ammonium, silver, lithium, sodium, potassium, rubidium, cesium, magnesium, calcium, strontium, barium, iron, zinc, or thalium, and X^3 is selected from halogen, alkyl, aryl, carboxylate, alkoxy, aryloxy, sulfonate, phosphate, or nitrate.

28. The method of any of claims 20-26, wherein the catalyst compound is a compound according to any one of claims 1 or 2 to 19.

What is claimed is:

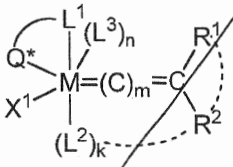
1. A C-H activated olefin metathesis catalyst compound comprising a Group 8 transition metal center M, a neutral 2-electron donor ligand L^1, and a 2-electron anionic bridging moiety Q*, wherein M, L^1 and Q* form an M-Q*-L^1 chelating ligand ring structure having a ring size of 5, 6, or 7 atoms.

2. The compound of claim 1, wherein the compound has the structure of formula (I):

(I) $X^1(L^3)_n(L^2)_kL^1Q^*M=(C)_mCR^1R^2$

wherein X^1 is any anionic ligand, L^1, L^2, and L^3 are, independently, any neutral electron donor ligand, n and k are, independently, 0 or 1, m is 0, 1, or 2, Q* is a 2-electron anionic donor bridging moiety linking L^1 and M, M is a Group 8 transition metal, and R^1 and R^2 are, independently, hydrogen, hydrocarbyl, substituted hydrocarbyl, heteroatom-containing hydrocarbyl, substituted heteroatom-containing hydrocarbyl, or functional groups.

3. A compound having the structure of formula (II):

(II) 

wherein,

M is a Group 8 transition metal;

X^1 is any anionic ligand;

L^1 is a neutral two electron ligand;

L^2 is a neutral two electron ligand, that may optionally be connected with R^2;

L^3 is a neutral electron donor ligand;

R^1 and R^2 are, independently, hydrogen, hydrocarbyl, substituted hydrocarbyl, heteroatom-containing hydrocarbyl, substituted heteroatom-containing hydrocarbyl, or functional groups, wherein R^2 may optionally be connected with R^1 and/or L^2;

Q* is a two electron anionic donor bridging moiety linking L^1 and M, which can, together with L^1 and M, form one or more cyclic groups, and wherein M, L^1 and Q* form an M-Q*-L^1 chelating ligand ring structure having a ring size of 5, 6, or 7 atoms;

n and k are independently 0 or 1, such that L^3 may or may not be present; and

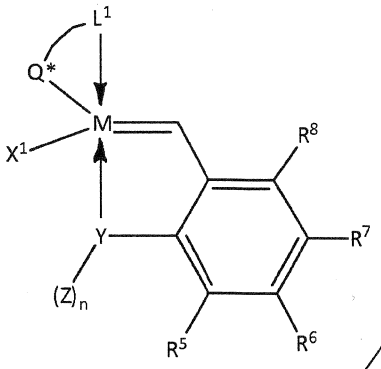
m is 0, 1, or 2.

4. The compound of claim 3, wherein any two or more of X^1, Q* , L^1, L^2, L^3, R^1, and R^2 together form one or more cyclic groups.

5. The compound of any of claims 3-4, wherein any one or more of X^1, Q*, L^1, L^2, L^3, R^1, and R^2 are attached to a support.

6. The compound of any of claims 1-3, wherein the compound has the structure of formula (VIII):

(VIII)



wherein,

M, L^1, and Q* are as previously defined;

X^1 is any anionic ligand;

Y is a heteroatom selected from N, O, S, and P;

R^5, R^6, R^7, and R^8 are each, independently, selected from the group consisting of hydrogen, halogen, alkyl, alkenyl, alkynyl, aryl, heteroalkyl, heteroatom containing alkenyl, heteroalkenyl, heteroaryl, alkoxy, alkenyloxy, aryloxy, alkoxycarbonyl, carbonyl, alkylamino, alkylthio, aminosulfonyl, monoalkylaminosulfonyl, dialkylaminosulfonyl, alkylsulfonyl, nitrile, nitro, alkylsulfinyl, trihaloalkyl, perfluoroalkyl, carboxylic acid, ketone, aldehyde, nitrate, cyano, isocyanate, hydroxyl, ester, ether, amine, imine, amide, halogen-substituted amide, trifluoroamide, sulfide, disulfide, sulfonate, carbamate, silane, siloxane, phosphine, phosphate, or borate, wherein any combination of R^5, R^6, R^7, and R^8 can be linked to form one or more cyclic groups;

n is 1 or 2, such that n is 1 for the divalent heteroatoms O or S, and n is 2 for the trivalent heteroatoms N or P; and

Z is selected from hydrogen, alkyl, aryl, functionalized alkyl, or functionalized aryl wherein the functional group(s) may independently be one or more or the following: alkoxy, aryloxy, halogen, carboxylic acid, ketone, aldehyde, nitrate, cyano, isocyanate, hydroxyl, ester, ether, amine, imine, amide, trifluoroamide, sulfide, disulfide, carbamate, silane, siloxane, phosphine, phosphate, or borate; methyl,

isopropyl, sec-butyl, t-butyl, neopentyl, benzyl, phenyl and trimethylsilyl; and wherein any combination or combinations of X^1, Q*, L^1,Y, Z, R^5, R^6, R^7, and R^8 may be linked to a support.

7. The compound of any of claims 1-6, wherein M is directly bonded to a carbon atom of Q* in the M-Q*-L^1 chelating ligand ring structure.

8. The compound of any of claims 1-7, wherein M is Ru or Os.

9. The compound of any of claims 1-8, where X^1 is selected from halide, nitrate, alkyl, aryl, alkoxy, alkylcarboxylate, aryloxy, alkoxycarbonyl, aryloxycarbonyl, arylcarboxylate, acyl, acyloxy, alkylsulfonato, arylsulfonato, alkylsulfanyl, arylsulfanyl, alkylsulfinyl, or arylsulfinyl.

10. The compound of any of claims 1-8, wherein X^1 is selected from carboxylate, nitrate, phenoxide, halide, sulfoxide, or nitrite.

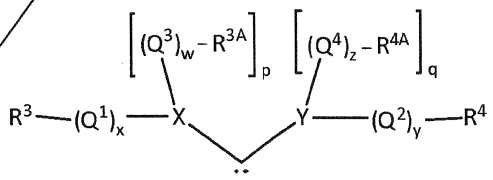
11. The compound of any of claims 1-10, wherein Q* is selected from hydrocarbylene, substituted hydrocarbylene, heteroatom-containing hydrocarbylene, or substituted heteroatom-containing hydrocarbylene.

12. The compound of claim 11, wherein Q* is selected from alkylene, substituted alkylene, heteroatom-containing alkylene, substituted heteroatom-containing alkylene, cycloalkylene, substituted cycloalkylene, heteroatom-containing cycloalkylene, substituted heteroatom-containing cycloalkylene, aryl, substituted aryl, heteroatom-containing aryl, or substituted heteroatom-containing aryl.

13. The compound of claim 11, wherein Q* is selected from cycloalkylene, substituted cycloalkylene, aryl, or substituted aryl.

14. The compound of any of claims 1-13, wherein L^1 is a carbene ligand having the structure of formula (III)

(III)



wherein,

X and Y are heteroatoms selected from N, O, S, and P;

Q^1, Q^2, Q^3, and Q^4 are independently selected from hydrocarbylene, substituted hydrocarbylene, heteroatom-containing hydrocarbylene, and substituted heteroatom-containing hydrocarbylene;

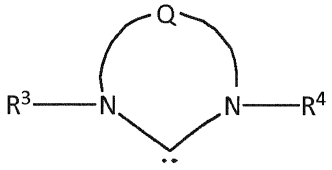
R^3, R^{3A}, R^4, and R^{4A} are independently selected from hydrogen, hydrocarbyl, substituted hydrocarbyl, heteroatom-containing hydrocarbyl, and substituted heteroatom-containing, hydrocarbyl;

p and q are zero or 1, such that p is zero when X is O or S, q is zero when Y is O or S, p is 1 when X is N or P, and q is 1 when Y is N or P; and

w, x, y, and z are independently zero or 1.

15. The compound of claim 14, wherein R^{3A} and R^{4A} are linked to form a cyclic group such that L^1 is a carbene ligand having the structure of formula (V)

(V)



wherein,

Q is selected from hydrocarbylene, substituted hydrocarbylene, heteroatom-containing hydrocarbylene, or substituted heteroatom-containing hydrocarbylene, wherein two or more substituents on adjacent atoms within Q may also be linked to form an additional cyclic structure;

R^3 and R^4 are independently selected from hydrocarbyl, substituted hydrocarbyl, heteroatom-containing hydrocarbyl, or substituted heteroatom-containing hydrocarbyl;

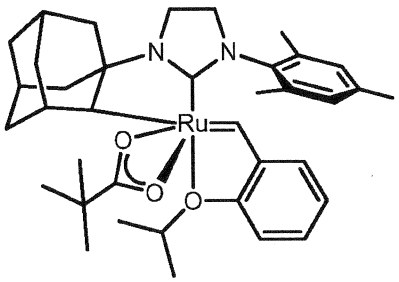
16. The compound of claim 14 or claim 15, wherein R^3 and R^4 are independently selected from cycloalkyl, substituted cycloalkyl, heteroatom-containing cycloalkyl, substituted heteroatom-containing cycloalkyl, aryl, substituted aryl, heteroatom-containing aryl, or substituted heteroatom-containing aryl.

17. The compound of claim14 or claim 15, wherein R^3 is a cycloalkyl or substituted cycloalkyl group and R^4 is a substituted aryl group.

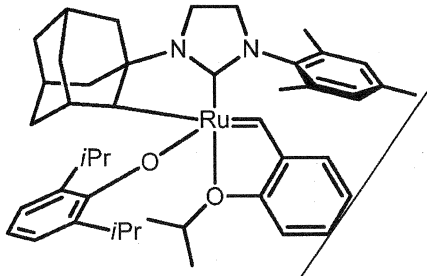
18. The compound of claim 17, wherein R^3 is an adamantyl or substituted adamantyl group, or a substituted C_3-C_{12} cycloalkyl group.

19. The compound of claim 18, wherein R^4 is a substituted aryl group in which both ortho ring positions are substituted.

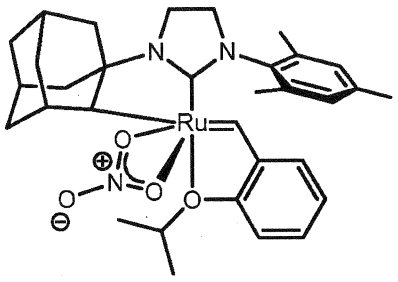
20. A C-H activated olefin metathesis catalyst compound, selected from



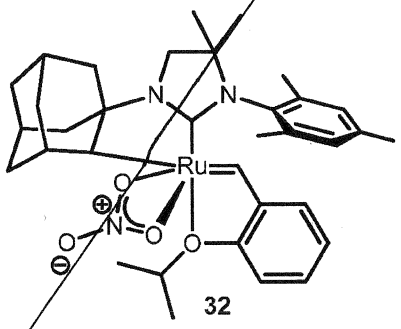
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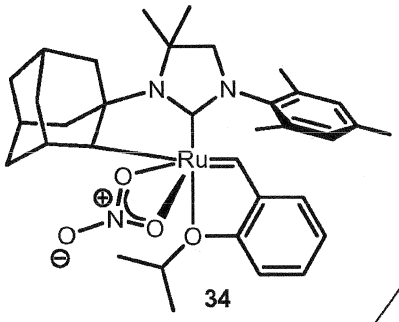
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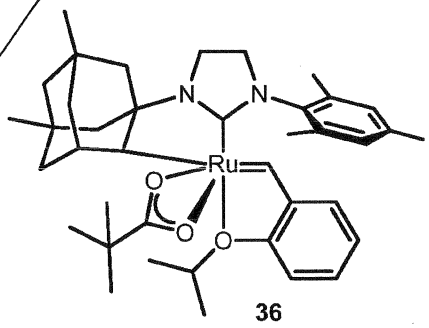


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21. A method of making a C-H activated olefin metathesis catalyst compound, the method comprising contacting a carboxylate compound of the formula M^1X^2, wherein M^1 is selected from silver, lithium, sodium, potassium, rubidium, cesium, magnesium, calcium, strontium, barium, iron, zinc, or thalium, and X^2 is a carboxylate anion, with an olefin metathesis catalyst of the formula $(X^1)_2(L^3)_n(L^2)_kL^1M=(C)_mCR^1R^2$, wherein X^1 is any anionic ligand, L^1, L^2, and L^3 are, independently, any neutral electron donor ligand, n and k are, independently, 0 or 1, m is 0, 1, or 2, M is a Group 8 transition metal, and R^1 and R^2 are, independently, selected from hydrogen, hydrocarbyl, substituted hydrocarbyl, heteroatom-containing hydrocarbyl, substituted heteroatom-containing hydrocarbyl, or functional groups; under conditions effective to promote the exchange of X^2 anions for the X^1 anionic ligands, such that a C-H activated olefin metathesis catalyst compound is produced in which M and L^1 are linked together by a 2-electron anionic bridging moiety Q*in a M-Q*-L^1 chelating ligand ring structure having a ring size of 5, 6, or 7 atoms, and the catalyst compound contains an X^2 anionic ligand.

22. The method of claim 21, wherein M is directly bonded to a carbon atom of Q* in the M-Q*-L^1 chelating ligand ring structure.

23. The method of claim 21, wherein M^1 is silver or sodium.

24. The method of claim 21, wherein the carboxylate is of the formula $(R)_3COOM^1$, wherein R is independently selected from hydrogen, C_1-C_{12} alkyl, substituted C_1-C_{12} alkyl, C_3-C_{12} cycloalkyl, substituted C_3-C_{12} cycloalkyl, aryl or substituted aryl, wherein at least one R is not hydrogen.

25. The method of claim 24, wherein R is independently selected from hydrogen, C_1-C_{12} alkyl or aryl.

26. The method of claim 24, wherein $(R)_3$ is selected from *t*-butyl, $PhMe_2C$, Ph_2MeC, or Ph_3C.

27. The method of claim 21, further comprising contacting the C-H activated olefin metathesis catalyst compound with an anionic ligand exchange compound of the formula M^2X^3, wherein M^2 is a cation and X^3 is an anion; under conditions effective to promote the exchange of X^3 anions for the X^2 anionic ligands, such that the C-H activated olefin metathesis catalyst compound contains a M-Q*-L^1 chelating ligand ring structure having a ring size of 5, 6, or 7 atoms and an X^3 anionic ligand.

28. The method of claim 27, wherein M^2 is selected from hydrogen, ammonium, silver, lithium, sodium, potassium, rubidium, cesium, magnesium, calcium, strontium, barium, iron, zinc, or thalium, and X^3 is selected from halogen, alkyl, aryl, carboxylate, alkoxy, aryloxy, sulfonate, phosphate, or nitrate.

29. The method of any of claims 21-27, wherein the catalyst compound is a compound according to any one of claims 1-20.