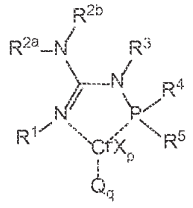
CLAIMS

What is claimed:

1. A composition comprising an N^2-phosphinyl guanidine metal salt complex comprising a chromium salt complexed to an N^2-phosphinyl guanidine compound.

2. The composition of claim 1, wherein the N^2-phosphinyl guanidine metal salt complex has a general structure:



wherein:

R^1 is a C_1 to C_{30} organyl group,

R^{2a} and R^{2b} independently are C_1 to C_{30} organyl groups consisting essentially of inert functional groups,

R^3 is hydrogen or a C_1 to C_{30} organyl group consisting essentially of inert functional groups,

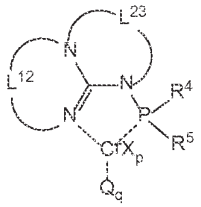
R^4 and R^5 each independently are C_1 to C_{30} organyl groups consisting essentially of inert functional groups,

CrX_p represents a chromium salt where X is a monoanion, and p ranges from 2 to 6, and

Q is a neutral ligand, and q ranges from 0 to 6.

3. The composition of claim 2, wherein
   a) R^1 and R^{2a} can be joined to form a ring or a ring system,
   b) R^{2a} and R^{2b} can be joined to form a ring or a ring system,
   c) R^{2b} and R^3 can be joined to form a ring or a ring system, or
   d) R^1 and R^{2a} can be joined to form a ring or a ring system and R^{2b} and R^3 can be joined to form a ring or a ring system.

4. The composition of claim 2, wherein the N^2-phosphinyl guanidine metal salt complex has the general structure:



wherein L^{12} and L^{23} independently are C_2 to C_{15} organylene group consisting of inert functional groups.

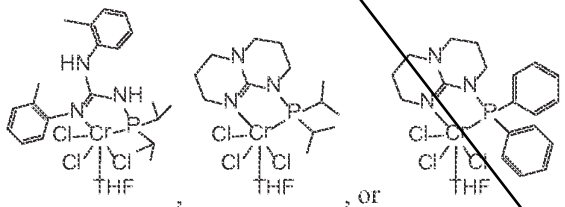
5. The composition of claim 1, wherein the chromium salt comprises a chromium(III) carboxylate, a chromium(III) β-diketonate, or a chromium(III) halide.

6. The composition of claim 1, wherein the chromium salt comprises a chromium(III) halide.

7. The composition of claim 2, wherein Q comprises a C_1 to C_{20} nitrile or a C_1 to C_{40} ether.

8. The composition of claim 2, wherein CrX_p comprises a chromium(III) halide and each Q independently is a C_2 to C_{30} aliphatic acyclic ether or a C_3 to C_{30} aliphatic cyclic ether.

9. The composition of claim 1 wherein the N^2-phosphinyl guanidine metal salt complex has the structure:



, , or .

10. A catalyst system composition comprising:
    a) an N^2-phosphinyl guanidine metal salt complex comprising a chromium salt complexed to an N^2-phosphinyl guanidine compound; and
    b) a metal alkyl compound.

11. The catalyst system composition of claim 10, wherein the metal alkyl compound comprises an aluminoxane.

12. The catalyst system composition of claim 11, the aluminoxane comprises methylaluminoxane, modified methylaluminoxane, ethylaluminoxane, n-propylaluminoxane, iso-propylaluminoxane, n-

butylaluminoxane, sec-butylaluminoxane, iso-butylaluminoxane, t-butyl aluminoxane, 1-pentyl-aluminoxane, 2-pentylaluminoxane, 3-pentylaluminoxane, iso-pentylaluminoxane, neopentylaluminoxane, and mixtures thereof.

13. The catalyst system composition of claim 11, wherein the metal alkyl comprises modified methylaluminoxane.

14. The catalyst system composition of claim 12, wherein an aluminum of the aluminoxane to chromium of the N^2-phosphinyl guanidine metal salt complex molar ratio is at least 5:1.

15. A process of preparing a catalyst system composition comprising contacting an N^2-phosphinyl guanidine metal salt complex and a metal alkyl compound.

16. The process of claim 15, wherein the catalyst system composition is aged in the substantial absence of an olefin for at least 15 minutes.

17. The process of claim 16, wherein the aged catalyst system composition displays a) increased oligomerization catalytic activity when compared to an otherwise similar catalyst system that has not been aged, b) reduced percentage of produced polymer when compared to an otherwise similar catalyst system that has not been aged, or c) increased oligomerization catalytic activity and a reduced percentage of produced polymer when compared to an otherwise similar catalyst system that has not been aged.

18. An oligomerization process comprising:
    a) contacting
        i) an olefin, and
        ii) a catalyst system comprising
            (a) N^2-phosphinyl guanidine metal salt complex comprising a chromium salt complexed to an N^2-phosphinyl guanidine compound, and
            (b) a metal alkyl compound,
        to form an oligomer product; and
    b) recovering an oligomer.

19. The process of claim 18, wherein the catalyst system, the olefin, and hydrogen are contacted to form an oligomer product.

20. The process of claim 18, wherein the oligomer product is formed at a temperature ranging from 20 °C to 150 °C.

21. The process of claim 18, wherein the olefin comprises ethylene and wherein the oligomer product comprises a liquid oligomer product comprising from 60 to 99.9 wt. % C_6 and C_8 olefins.

22. The process of claim 18, wherein the olefin comprises ethylene and wherein a C_6 oligomer product comprises at least 90 wt. % 1-hexene.

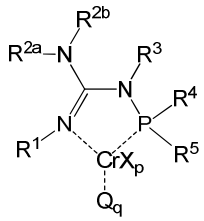
23. The process of claim 18, wherein the olefin comprises ethylene and wherein a C_8 oligomer product comprises at least 90 wt. % 1-octene.

24. The process of claim 18, wherein the catalyst system, the olefin, and hydrogen are contacted to form an oligomer product,
wherein the olefin comprises ethylene
wherein the oligomer product is formed at
(a) an ethylene partial pressure ranging from 150 psig to 2,000 psig.
(b) a hydrogen partial pressure ranging from 5 psig to 400 psig, and
(c) a temperature ranging from 20 °C to 150 °C, and
wherein the oligomer product comprises a liquid oligomer product comprising from 60 to 99.9 wt. % wt. % C_6 and C_8 olefins, a C_6 oligomer product comprises at least 90 wt. % 1-hexene and a C_8 oligomer product comprises at least 90 wt. % 1-octene.

CLAIMS

1. A composition comprising an N^2-phosphinyl guanidine metal salt complex comprising a chromium salt complexed to an N^2-phosphinyl guanidine compound.

2. The composition of claim 1, wherein the N^2-phosphinyl guanidine metal salt complex has a general structure:



wherein:

R^1 is a C_1 to C_{30} organyl group,

R^{2a} and R^{2b} independently are C_1 to C_{30} organyl groups consisting essentially of inert functional groups,

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CrX_p represents a chromium salt where X is a monoanion, and p ranges from 2 to 6, and

Q is a neutral ligand, and q ranges from 0 to 6,

wherein the inert functional groups are selected from the group consisting of halo groups, nitro groups, hydrocarboxy groups, hydrocarbosulfidyl groups, or combinations thereof.

3. The composition of claim 2, wherein

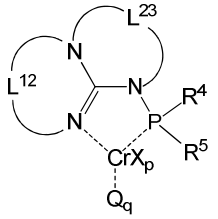
a) R^1 and R^{2a} can be joined to form a ring or a ring system,

b) R^{2a} and R^{2b} can be joined to form a ring or a ring system,

c) R^{2b} and R^{3} can be joined to form a ring or a ring system, or

d) R^{1} and R^{2a} can be joined to form a ring or a ring system and R^{2b} and R^{3} can be joined to form a ring or a ring system.

4. The composition of claim 2, wherein the N^2-phosphinyl guanidine metal salt complex has the general structure:



wherein L^{12} and L^{23} independently are C_2 to C_{15} organylene group consisting of inert functional groups,

wherein the inert functional groups are selected from the group consisting of halo groups, nitro groups, hydrocarboxy groups, hydrocarbosulfidyl groups, or combinations thereof.

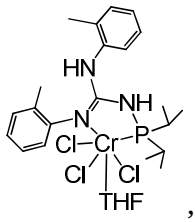
5. The composition of claim 1, wherein the chromium salt comprises a chromium(III) carboxylate, a chromium(III) β-diketonate, or a chromium(III) halide.

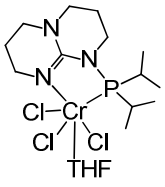
6. The composition of claim 1, wherein the chromium salt comprises a chromium(III) halide.

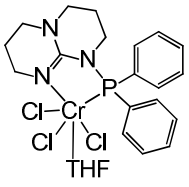
7. The composition of claim 2, wherein Q comprises a C_1 to C_{20} nitrile or a C_1 to C_{40} ether.

8. The composition of claim 2, wherein CrX_p comprises a chromium(III) halide and each Q independently is a C_2 to C_{30} aliphatic acyclic ether or a C_3 to C_{30} aliphatic cyclic ether.

9. The composition of claim 1 wherein the N^2-phosphinyl guanidine metal salt complex has the structure:



, 

, or 

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10. A catalyst system composition comprising:

    a) an N^2-phosphinyl guanidine metal salt complex comprising a chromium salt complexed to an N^2-phosphinyl guanidine compound; and

    b) a metal alkyl compound.

11. The catalyst system composition of claim 10, wherein the metal alkyl compound comprises an aluminoxane.

12. The catalyst system composition of claim 11, the aluminoxane comprises methylaluminoxane, modified methylaluminoxane, ethylaluminoxane, n-propylaluminoxane, iso-propylaluminoxane, n-butylaluminoxane, sec-butylaluminoxane, iso-butylaluminoxane, t-butyl aluminoxane, 1-pentylaluminoxane, 2-pentylaluminoxane, 3-pentylaluminoxane, iso-pentylaluminoxane, neopentylaluminoxane, and mixtures thereof.

13. The catalyst system composition of claim 11, wherein the metal alkyl comprises modified methylaluminoxane.

14. The catalyst system composition of claim 12, wherein an aluminum of the aluminoxane to chromium of the N^2-phosphinyl guanidine metal salt complex molar ratio is at least 5:1.

15. A process of preparing a catalyst system composition comprising contacting an N^2-phosphinly guanidine metal salt complex comprising a chromium salt complexed to an N^2-phosphinyl guanidine compound and a metal alkyl compound.

16. The process of claim 15, wherein the catalyst system composition is aged in the substantial absence of an olefin for at least 15 minutes.

17. The process of claim 16, wherein the aged catalyst system composition displays a) increased oligomerization catalytic activity when compared to an otherwise similar catalyst system that has not been aged, b) reduced percentage of produced polymer when compared to an otherwise similar catalyst system that has not been aged, or c) increased oligomerization catalytic activity and a reduced percentage of produced polymer when compared to an otherwise similar catalyst system that has not been aged.

18. An oligomerization process comprising:

    a) contacting

        i) an olefin, and

        ii) a catalyst system comprising

(a) N^2-phosphinyl guanidine metal salt complex comprising a chromium salt complexed to an N^2-phosphinyl guanidine compound, and

(b) a metal alkyl compound,

to form an oligomer product; and

b) recovering an oligomer.

19. The process of claim 18, wherein the catalyst system, the olefin, and hydrogen are contacted to form an oligomer product.

20. The process of claim 18, wherein the oligomer product is formed at a temperature ranging from 20 °C to 150 °C.

21. The process of claim 18, wherein the olefin comprises ethylene and wherein the oligomer product comprises a liquid oligomer product comprising from 60 to 99.9 wt. % C_6 and C_8 olefins.

22. The process of claim 18, wherein the olefin comprises ethylene and wherein a C_6 oligomer product comprises at least 90 wt. % 1-hexene.

23. The process of claim 18, wherein the olefin comprises ethylene and wherein a C_8 oligomer product comprises at least 90 wt. % 1-octene.

24. The process of claim 18, wherein the catalyst system, the olefin, and hydrogen are contacted to form an oligomer product,

wherein the olefin comprises ethylene,

wherein the oligomer product is formed at:

(a) an ethylene partial pressure ranging from 150 psig to 2,000 psig.

(b) a hydrogen partial pressure ranging from 5 psig to 400 psig, and

(c) a temperature ranging from 20 °C to 150 °C, and

wherein the oligomer product comprises a liquid oligomer product comprising from 60 to 99.9 wt. % wt. % C_6 and C_8 olefins, a C_6 oligomer product comprises at least 90 wt. % 1-hexene and a C_8 oligomer product comprises at least 90 wt. % 1-octene.