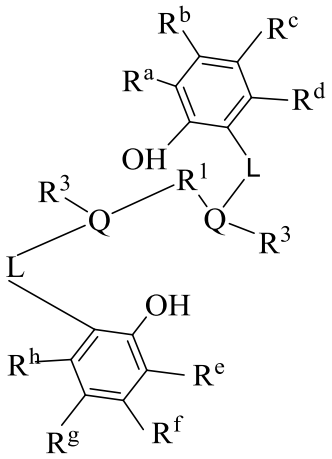
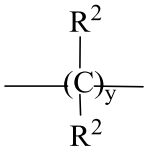
CLAIMS

What is claimed is:

1. A ligand represented by the formula (A):



where each Q is neutral donor group comprising at least one atom from Group 15 or Group 16, and R^3 is not present when Q is a Group 16 atom;

each L is independently  and is not part of an aromatic ring;

y is greater than or equal to 2;

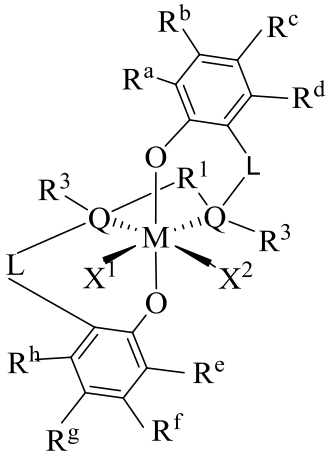
R^1 is a divalent C_1-C_{40} hydrocarbyl radical or divalent substituted hydrocarbyl radical comprising a portion that comprises a linker backbone comprising from 1 to 18 carbon atoms linking or bridging between the two Q groups;

each R^a, R^b, R^c, R^d, R^e, R^f, R^g, and R^h is, independently, a hydrogen, a C_1-C_{40} hydrocarbyl radical, a C_1-C_{40} substituted hydrocarbyl radical, a heteroatom or a heteroatom-containing group, or two or more of R^a to R^h may independently join together to form a C_4 to C_{62} cyclic, polycyclic or heterocyclic structure, or a combination thereof;

each R^2 is, independently, a hydrogen, a C_1-C_{40} hydrocarbyl radical, a C_1-C_{40} substituted hydrocarbyl radical, a heteroatom or a heteroatom-containing group, or two or more adjacent R^2 groups may independently join together to form a C_4 to C_{62} cyclic or polycyclic ring structure, or a combination thereof, provided that such cyclic or polycyclic ring structure is not aromatic; and

each R^3 is, independently, a hydrogen, a C_1-C_{40} hydrocarbyl radical, a C_1-C_{40} substituted hydrocarbyl radical, a heteroatom or a heteroatom-containing group.

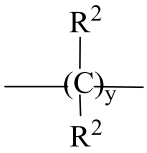
2. A transition metal complex represented by the formula (I):



(I)

wherein M is a Group 4 transition metal;

each Q is neutral donor group comprising at least one atom from Group 15 or Group 16, and R^3 is not present when Q is a Group 16 atom;

each L is independently  and is not part of an aromatic ring;

y is greater than or equal to 2;

X^1 and X^2 are, independently, a univalent C_1 to C_{20} hydrocarbyl radical, a C_1 to C_{20} substituted hydrocarbyl radical, a heteroatom or a heteroatom-containing group, or X^1 and X^2 join together to form a C_4 to C_{62} cyclic, polycyclic or heterocyclic structure;

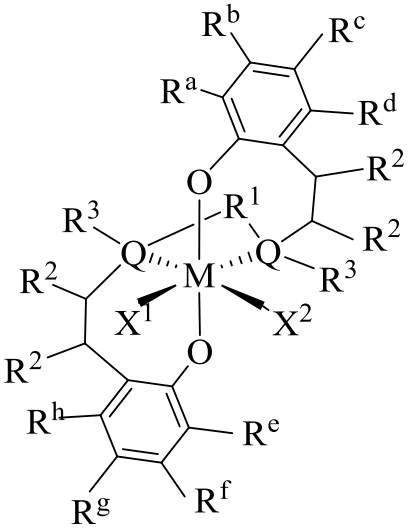
R^1 is a divalent C_1-C_{40} hydrocarbyl radical or divalent substituted hydrocarbyl radical comprising a portion that comprises a linker backbone comprising from 1 to 18 carbon atoms linking between the two Q groups;

each R^a, R^b, R^c, R^d, R^e, R^f, R^g, and R^h is, independently, a hydrogen, a C_1-C_{60} hydrocarbyl radical, a C_1-C_{40} substituted hydrocarbyl radical, a heteroatom or a heteroatom-containing group, or two or more of R^a to R^h may independently join together to form a C_4 to C_{62} cyclic, polycyclic or heterocyclic structure, or a combination thereof;

each R^2 is, independently, a hydrogen, a C_1-C_{40} hydrocarbyl radical, a C_1-C_{40} substituted hydrocarbyl radical, a heteroatom or a heteroatom-containing group, or two or more adjacent R^2 groups may independently join together to form a C_4 to C_{62} cyclic or polycyclic ring structure, or a combination thereof, provided that such cyclic or polycyclic ring structure is not aromatic; and

each R^3 is, independently, a hydrogen, a C_1-C_{40} hydrocarbyl radical, a C_1-C_{40} substituted hydrocarbyl radical, a heteroatom or a heteroatom-containing group.

3. The transition metal complex of claim 2 where in the complexes are represented by the formula (II)



(II)

wherein M is a Group 4 transition metal;

each Q is neutral donor group comprising at least one atom from Group 15 or Group 16, and R^3 is not present when Q is a Group 16 atom;

X^1 and X^2 are, independently, a univalent C_1 to C_{20} hydrocarbyl radical, a C_1 to C_{20} substituted hydrocarbyl radical, a heteroatom or a heteroatom-containing group, or X^1 and X^2 join together to form a C_4 to C_{62} cyclic, polycyclic or heterocyclic structure;

R^1 is a divalent C_1-C_{40} hydrocarbyl radical or divalent substituted hydrocarbyl radical comprising a portion that comprises a linker backbone comprising from 1 to 18 carbon atoms linking between the two Q groups;

each R^a, R^b, R^c, R^d, R^e, R^f, R^g, and R^h is, independently, a hydrogen, a C_1-C_{40} hydrocarbyl radical, a C_1-C_{40} substituted hydrocarbyl radical, a heteroatom or a heteroatom-containing group, or two or more of R^a to R^h may independently join

together to form a C_4 to C_{62} cyclic, polycyclic or heterocyclic structure, or a combination thereof;
each R^2 is, independently, a hydrogen, a C_1-C_{40} hydrocarbyl radical, a C_1-C_{40} substituted hydrocarbyl radical, a heteroatom or a heteroatom-containing group, or two or more adjacent R^2 groups may independently join together to form a C_4 to C_{62} cyclic or polycyclic ring structure, or a combination thereof, provided that such cyclic, polycyclic or heterocyclic structure is not aromatic; and
each R^3 is, independently, a hydrogen, a C_1-C_{40} hydrocarbyl radical, a C_1-C_{40} substituted hydrocarbyl radical, a heteroatom or a heteroatom-containing group.

4. The ligand or transition metal complex of claim 1, 2, or 3, wherein R^a and R^e are carbazolyl, substituted carbazolyl, indolyl, substituted indolyl, indolinyl, substituted indolinyl, imidazolyl, substituted imidazolyl, indenyl, substituted indenyl, indanyl, substituted indanyl, fluorenyl, or substituted fluorenyl, preferably R^a and R^e are the same.

5. The ligand or transition metal complex of any of claims 1 to 3, wherein Q is a neutral donor group comprising at least one atom from Group 15 or Group 16 and the -(-Q-R^1-Q-)- fragment can form a substituted or unsubstituted heterocycle which may or may not be aromatic and may have multiple fused rings, preferably wherein Q is NR'_2, OR', SR', PR'_2, where R' is as defined for R^a.

6. The ligand or transition metal complex of any of claims 1 to 3, wherein each R^a, R^b, R^c, R^d, R^e, R^f, R^g, and R^h is independently a hydrogen, a C_1-C_{60} hydrocarbyl radical, a substituted hydrocarbyl radical, a heteroatom, or a heteroatom-containing group, or may independently form a C_4 to C_{60} cyclic or polycyclic ring structure with R^6, R^7, or R^6, or a combination thereof.

7. The transition metal complex of claim 2 or 3, wherein M is Hf or Zr.

8. The ligand or transition metal complex of any of claims 1 to 3, wherein Q is O, N, S, or P.

9. The ligand or transition metal complex of any of claims 1 to 3, wherein R^a and

R^e are carbazolyl or substituted carbazolyl.

10. The ligand or transition metal complex of any of claims 1 to 3, wherein R^1 is a divalent C_1-C_{20} hydrocarbyl radical or divalent substituted hydrocarbyl radical comprising a portion that comprises a linker backbone comprising from 1 to 18 carbon atoms linking or bridging between the two Q groups.

11. A catalyst system comprising activator and the complex of any of claims 2 to 10.

12. The catalyst system of claim 11, wherein the catalyst system further comprises chain transfer agent.

13. The catalyst system of claim 11, wherein the catalyst system further comprises chain transfer agent represented by the formula R_3Al or R_2Zn, where R is a C_1 to C_{20} alkyl group.

14. The catalyst system of claim 11, wherein the activator is an alumoxane.

15. The catalyst system of claim 11, wherein the activator is a non-coordinating anion.

16. The catalyst system of claim 11, wherein the activator is selected from the group consisting of: methylalumoxane, ethylalumoxane, isobutyl alumoxane, N,N-dimethylanilinium tetra(perfluorophenyl)borate, N,N-dimethylanilinium tetrakis(perfluoronaphthyl)borate, N,N-dimethylanilinium tetrakis(perfluorobiphenyl)borate, N,N-dimethylanilinium tetrakis(3,5-bis(trifluoromethyl)phenyl)borate, triphenylcarbenium tetrakis(perfluoronaphthyl)borate, triphenylcarbenium tetrakis(perfluorobiphenyl)borate, triphenylcarbenium tetrakis(3,5-bis(trifluoromethyl)phenyl)borate, triphenylcarbenium tetra(perfluorophenyl)borate, triphenylcarbenium tetrakis(perfluorophenyl)borate, 1-(4-(tris(pentafluorophenyl)borate)-2,3,5,6-tetrafluorophenyl)pyrrolidinium, tetrakis(pentafluorophenyl)borate, and 4-(tris(pentafluorophenyl)borate)-2,3,5,6-tetrafluoropyridine.

17. A polymerization process to produce polyolefin comprising:

a) contacting one or more olefin monomers with the catalyst system of any of claims 11 to 16, and

b) recovering olefin polymer.

18. The process of claim 17, wherein the monomer comprises ethylene and/or propylene.

19. The process of claim 17, wherein the transition metal complex is supported.

20. The process of claim 17, wherein the chain transfer agent represented by the formula R_3Al or R_2Zn is present at a molar ratio of transition metal to Al and Zn of at least 10:1, where R is a C_1 to C_{40} alkyl group.

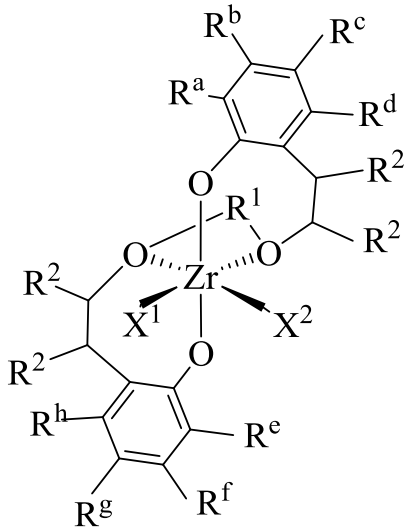
21. The process of claim 17, wherein the process is a continuous process.

22. The process of claim 17, wherein step a) occurs at a temperature of at least 70°C.

23. The process of claim 17, wherein hydrogen is present in step a).

24. The process of claim 17, wherein hydrogen and chain transfer agent are present in step a).

25. A transition metal complex are represented by the formula:



wherein X^1 and X^2 are, independently, a univalent C_1 to C_{20} hydrocarbyl radical, a C_1

to C_{20} substituted hydrocarbyl radical, a heteroatom or a heteroatom-containing group, or X^1 and X^2 join together to form a C_4 to C_{62} cyclic, polycyclic or heterocyclic structure;

R^1 is a divalent C_1-C_{40} hydrocarbyl radical or divalent substituted hydrocarbyl radical comprising a portion that comprises a linker backbone comprising from 1 to 18 carbon atoms linking or bridging between the two Q groups;

each R^a and R^e is, independently, phenyl or substituted phenyl;

each R^b, R^c, R^d, R^f, R^g, and R^h is, independently, a hydrogen, a C_1-C_{40} hydrocarbyl radical, a C_1-C_{40} substituted hydrocarbyl radical, a heteroatom or a heteroatom-containing group, or two or more of R^a to R^h may independently join together to form a C_4 to C_{62} cyclic, polycyclic or heterocyclic structure, or a combination thereof; and

each R^2 is, independently, a hydrogen, a C_1-C_{40} hydrocarbyl radical, a C_1-C_{40} substituted hydrocarbyl radical, a heteroatom or a heteroatom-containing group, or two or more adjacent R^2 groups may independently join together to form a C_4 to C_{62} cyclic or polycyclic ring structure, or a combination thereof, provided that such cyclic, polycyclic or heterocyclic structure is not aromatic.