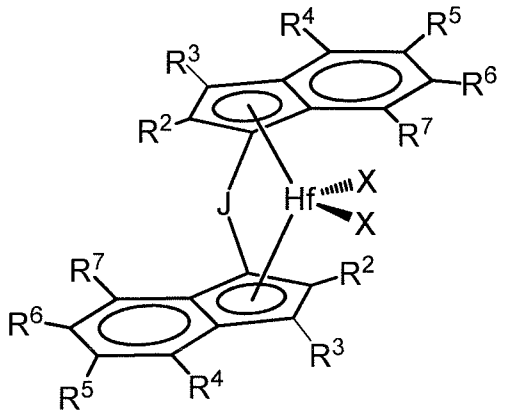
CLAIMS:

1. A process for polymerization, comprising:

(i) contacting one or more monomers comprising propylene and optionally ethylene, with a catalyst system comprising a metallocene catalyst compound and an activator, wherein the metallocene catalyst compound is represented by the formula:



where each R^3 is hydrogen; each R^4 is independently a C_1-C_{10} alkyl; each R^2 and R^7 is independently hydrogen, or C_1-C_{10} alkyl, each R^5 and R^6 is independently hydrogen, C_1-C_{50} substituted or unsubstituted hydrocarbyl, or C_1-C_{50} substituted or unsubstituted halocarbyl; and R^4 and R^5, R^5 and R^6 and/or R^6 and R^7 ~~may~~ are optionally be bonded together to form a ring structure; J is a bridging group represented by the formula $R^a{}_2J'$, where J' is C or Si, and each R^a is, independently, C_1 to C_{20} substituted or unsubstituted hydrocarbyl, and the two R^a form a cyclic structure incorporating J' and the cyclic structure ~~may be~~ is optionally a saturated or partially saturated cyclic or fused ring system; and each X is a univalent anionic ligand, or two Xs are joined and bound to the metal atom to form a metallocycle ring, or two Xs are joined to form a chelating ligand, a diene ligand, or an alkylidene ligand; and

(ii) obtaining a polymer having: 1) greater than 40% vinyl chain ends, relative to the total unsaturated chain ends, 2) a Tm of 70°C or more; 3) an Mw of 3000 to 300,000 g/mol, and 4) a g'_{vis} of 0.90 or less.

2. The process of claim 1, wherein step (i) occurs at a temperature of greater than 60 °C.

3. The process of claim 1, wherein the polymer produced has 1) greater than 70% vinyl chain ends, relative to total unsaturated chain ends, and 2) an Mw of 3000 to 200,000 g/mol.

4. The process of claim 1, ~~2 or 3~~, wherein the polymer produced is isotactic polypropylene having a Tm of 115 °C or more.

5. The process of claim 1, wherein the polymer produced is a propylene-ethylene copolymer containing 30 wt% or less of ethylene.

6. The process of claim 1, ~~2, 3, 4, or 5~~, wherein the polyolefin produced has a g'_{vis} of 0.85 or less.

7. The process of claim 1~~, 2, 3, 4, 5, or 6,~~ wherein the polyolefin produced has at least X% vinyl chain ends~~,~~ ~~(~~relative to total unsaturations as measured by ^{1}H NMR, where X = 47.8* g'_{vis} + 45.1.

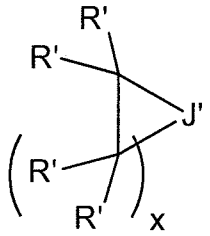
8. The process of claim 1 wherein R^2, R^4 and R^7 are, independently, selected from the group consisting of methyl, ethyl, propyl, butyl, pentyl, heptyl, hexyl, octyl, nonyl, decyl and an isomers thereof.

9. The process of claim 1 wherein R^2 and R^4 are, independently, a C_1 to C_{10} alkyl.

10. The process of claim 1 wherein R^4 and R^7 are, independently, a C_1 to C_{10} alkyl.

11. The process of claim 1 wherein each X is, independently, selected from the group consisting of hydrocarbyl radicals having from 1 to 20 carbon atoms, hydrides, amides, alkoxides, sulfides, phosphides, halides, dienes, amines, phosphines, ethers, and a combination thereof~~,~~ ~~(~~ and two X's ~~may~~ optionally form a part of a fused ring or a ring system~~)~~.

12. The process of claim 1 wherein J is represented by the formula:



wherein J′ is a carbon or silicon atom, x is 1, 2, 3, or 4, and each R′ is, independently, hydrogen or C_1-C_{10} hydrocarbyl.

13. The process of claim 1 wherein J is cyclopentamethylenesilylene, cyclotetramethylenesilylene, cyclotrimethylenesilylene.

14. The process of claim 1 wherein the activator comprises alumoxane.

15. The process of claim 1 wherein alumoxane is present at a molar ratio of aluminum to catalyst compound transition metal of 100:1 or more.

16. The process of claim 1 wherein the activator comprises a non-coordinating anion activator.

17. The process of claim 1 wherein activator is represented by the formula:

$(Z)_d^+ (A^{d-})$

wherein Z is (L-H) or a reducible Lewis Acid, L is an neutral Lewis base; H is hydrogen; $(L-H)^+$ is a Bronsted acid; A^{d-} is a non-coordinating anion having the charge d-; and d is an integer from 1 to 3.

18. The process of claim 1 wherein activator is represented by the formula:

$(Z)_d^+ (A^{d-})$

wherein A^{d-} is a non-coordinating anion having the charge d-; d is an integer from 1 to 3, and Z is a reducible Lewis acid represented by the formula: (Ar_3C^+), where Ar is aryl or aryl

substituted with a heteroatom, a C_1 to C_{40} hydrocarbyl, or a substituted C_1 to C_{40} hydrocarbyl.

19. The process of claim 1 wherein the activator is one or more of:

N,N-dimethylanilinium tetrakis(pentafluorophenyl)borate,
triphenylcarbenium tetrakis(pentafluorophenyl)borate,
trimethylammonium tetrakis(perfluoronaphthyl)borate,
triethylammonium tetrakis(perfluoronaphthyl)borate,
N,N-dimethylanilinium tetrakis(perfluoronaphthyl)borate,
N,N-diethylanilinium tetrakis(perfluoronaphthyl)borate,
tropillium tetrakis(perfluoronaphthyl)borate,
triphenylcarbenium tetrakis(perfluoronaphthyl)borate,
triphenylphosphonium tetrakis(perfluoronaphthyl)borate,
triethylsilylium tetrakis(perfluoronaphthyl)borate,
benzene(diazonium) tetrakis(perfluoronaphthyl)borate,
trimethylammonium tetrakis(perfluorobiphenyl)borate,
triethylammonium tetrakis(perfluorobiphenyl)borate,
tripropylammonium tetrakis(perfluorobiphenyl)borate,
tri(n-butyl)ammonium tetrakis(perfluorobiphenyl)borate,
tri(t-butyl)ammonium tetrakis(perfluorobiphenyl)borate,
N,N-dimethylanilinium tetrakis(perfluorobiphenyl)borate,
N,N-diethylanilinium tetrakis(perfluorobiphenyl)borate,
N,N-dimethyl-(2,4,6-trimethylanilinium) tetrakis(perfluorobiphenyl)borate,
tropillium tetrakis(perfluorobiphenyl)borate,
triphenylcarbenium tetrakis(perfluorobiphenyl)borate,
triphenylphosphonium tetrakis(perfluorobiphenyl)borate,
triethylsilylium tetrakis(perfluorobiphenyl)borate,
benzene(diazonium) tetrakis(perfluorobiphenyl)borate,
[4-t-butyl-PhNMe$_2$H][($C_6F_3(C_6F_5)_2)_4$B],
trimethylammonium tetrakis(pentafluorophenyl)borate,
tripropylammonium tetrakis(pentafluorophenyl)borate,
tri(n-butyl)ammonium tetrakis(pentafluorophenyl)borate,
N,N-dimethylanilinium tetrakis(pentafluorophenyl)borate,
N,N-diethylanilinium tetrakis(pentafluorophenyl)borate,
tropillium tetrakis(pentafluorophenyl)borate,
triphenylcarbenium tetrakis(pentafluorophenyl)borate,
triphenylphosphonium tetrakis(pentafluorophenyl)borate,
triethylsilylium tetrakis(pentafluorophenyl)borate,
benzene(diazonium) tetrakis(pentafluorophenyl)borate,

trimethylammonium tetrakis-(2,3,4,6-tetrafluorophenyl) borate,
triethylammonium tetrakis-(2,3,4,6-tetrafluorophenyl)borate,
tripropylammonium tetrakis-(2,3,4,6-tetrafluorophenyl)borate,
tri(n-butyl)ammonium tetrakis-(2,3,4,6-tetrafluoro-phenyl)borate,
dimethyl(t-butyl)ammonium tetrakis-(2,3,4,6-tetrafluorophenyl)borate,
N,N-dimethylanilinium tetrakis-(2,3,4,6-tetrafluorophenyl)borate,
N,N-diethylanilinium tetrakis-(2,3,4,6-tetrafluorophenyl)borate,
N,N-dimethyl-(2,4,6-trimethylanilinium) tetrakis-(2,3,4,6-tetrafluorophenyl)borate,
tropillium tetrakis-(2,3,4,6-tetrafluorophenyl)borate,
triphenylcarbenium tetrakis-(2,3,4,6-tetrafluorophenyl)borate,
triphenylphosphonium tetrakis-(2,3,4,6-tetrafluorophenyl)borate,
triethylsilylium tetrakis-(2,3,4,6-tetrafluorophenyl)borate,
benzene(diazonium) tetrakis-(2,3,4,6-tetrafluorophenyl)borate,
trimethylammonium tetrakis(3,5-bis(trifluoromethyl)phenyl)borate,
triethylammonium tetrakis(3,5-bis(trifluoromethyl)phenyl)borate,
tripropylammonium tetrakis(3,5-bis(trifluoromethyl)phenyl)borate,
tri(n-butyl)ammonium tetrakis(3,5-bis(trifluoromethyl)phenyl)borate,
tri(t-butyl)ammonium tetrakis(3,5-bis(trifluoromethyl)phenyl)borate,
N,N-dimethylanilinium tetrakis(3,5-bis(trifluoromethyl)phenyl)borate,
N,N-diethylanilinium tetrakis(3,5-bis(trifluoromethyl)phenyl)borate,
N,N-dimethyl-(2,4,6-trimethylanilinium) tetrakis(3,5-bis(trifluoromethyl)phenyl)borate,
tropillium tetrakis(3,5-bis(trifluoromethyl)phenyl)borate,
triphenylcarbenium tetrakis(3,5-bis(trifluoromethyl)phenyl)borate,
triphenylphosphonium tetrakis(3,5-bis(trifluoromethyl)phenyl)borate,
triethylsilylium tetrakis(3,5-bis(trifluoromethyl)phenyl)borate,
benzene(diazonium) tetrakis(3,5-bis(trifluoromethyl)phenyl)borate,
tri(2,6-dimethylphenyl)phosphonium tetrakis(pentafluorophenyl)borate,
triphenylcarbenium tetrakis(perfluorophenyl)borate,
1-(4-(tris(pentafluorophenyl)borate)-2,3,5,6-tetrafluorophenyl)pyrrolidinium,
tetrakis(pentafluorophenyl)borate,
4-(tris(pentafluorophenyl)borate)-2,3,5,6-tetrafluoropyridine, and
triphenylcarbenium tetrakis(3,5-bis(trifluoromethyl)phenyl)borate).

20. The process of claim 1 wherein the process occurs at a temperature of from about 0°C to about 300°C, at a pressure in the range of from about 0.35 MPa to about 10 MPa, and at a time up to 300 minutes.

21. The process of claim 1 further comprising obtaining polymer having at least 90% allyl chain ends.

22. The process of claim 1 wherein the monomers comprise ethylene and propylene.

23. A polymer having: 1) greater than 70% vinyl chain ends, relative to the total unsaturated chain ends; 2) a Tm of 90°C or more; 3) an Mw of 3000 to 200,000 g/mol; and 4) a g'_{vis} of 0.90 or less.

24. A branched isotactic polypropylene polymer having at least X% vinyl chain ends, (relative to total unsaturations as measured by ^{1}H NMR), where $X = 47.8 * g'_{vis} + 45.1$.

25. The polymer of claim 23 having greater than 80% vinyl unsaturation (relative to total unsaturation as measured by ^{1}H NMR).

26. The polymer of claim 23 having a Mw of 3000 to 100,000 g/mol.

27. The polymer of claim 23 having a Tm of 100 °C more.

28. A branched ethylene-propylene copolymer having 1) 20 wt% or less ethylene, 2) a Tm of 50 °C or more; and 3) greater than 75% vinyl chain ends, (relative to the total unsaturated chain ends).

29. The polymer of claim 28 having a Mw of 20,000 to 300,000 g/mol.