CLAIMS

What is Claimed is:

1. A process for polymerizing ~~one or more olefins~~ propylene, either alone or in the presence of ethylene, comprising contacting under polymerization conditions one or more olefin monomers with a catalyst system ~~comprising~~ consisting essentially of a transition metal compound and an activator having the following formula (2):

$$[R_nAH]^+ [Y]^-, \qquad (2)$$

wherein $[Y]^-$ is a non-coordinating anion (NCA),

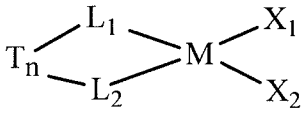
A is nitrogen, phosphorus or oxygen,

n is 3 if A is nitrogen or phosphorus, and n is 2 if A is oxygen,

and the groups R are identical or different and are a C_1 to C_3 alkyl group,

wherein at a given reaction temperature the weight average molecular weight (Mw) of the polymer formed increases or at least does not substantially decrease with increasing monomer conversion,

wherein the transition metal compound is represented by the formula:



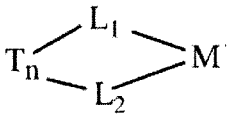
wherein M is zirconium or hafnium;

n is 0 or 1;

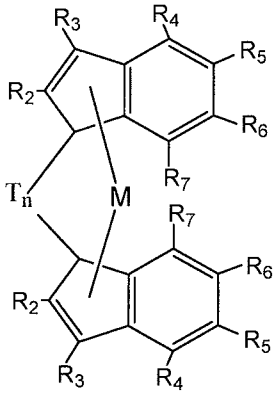
T is selected from dialkylsilyl, diarylsilyl, dialkylmethyl, ethylenyl ($-CH_2-CH_2-$) or hydrocarbylethylenyl wherein one, two, three or four of the hydrogen atoms in ethylenyl are substituted by hydrocarbyl, where hydrocarbyl can be independently C_1 to C_{16} alkyl or phenyl, tolyl, xylyl and the like, and when T is present, the catalyst represented can be in a racemic or a meso form;

L_1 and L_2 are the same or different indenyl rings, that are each bonded to M;

X_1 and X_2 are, independently, hydrogen, halogen, hydride radicals, hydrocarbyl radicals, substituted hydrocarbyl radicals, halocarbyl radicals, substituted halocarbyl radicals, silylcarbyl radicals, substituted silylcarbyl radicals, germylcarbyl radicals, or substituted germylcarbyl radicals; or both X are joined and bound to the metal atom to form a metallacycle ring containing from about 3 to about 20 carbon atoms; or both together can be an olefin, diolefin or aryne ligand, and



is represented by the formula:



wherein M, n and T are as defined above, R_2 is hydrogen, and R_3, R_4, R_5, R_6 and R_7 are hydrogen, a heteroatom, a substituted heteroatom group, a substituted or unsubstituted alkyl group, ~~and a substituted or unsubstituted aryl group,~~

where when the polymerization process is a homogeneous process the monomer concentration is up to 15 mol/L.

~~2. The process of claim 1, wherein the one or more olefins are alpha-olefins, optionally in combination with another alpha-olefin.~~

~~3. The process of claim 1, wherein the one or more olefins comprise propylene.~~

~~4.~~2. The process of claim 1, wherein $[R_nAH]^+$ is trimethylammonium, and $[Y]^-$ is tetrakis(pentafluorophenyl)borate, tetrakis(heptafluoronaphthyl)borate or tetrakis (perfluorobiphenyl)borate.

~~5.~~3. The process of claim 1, wherein the transition metal compound is a metallocene selected from the group consisting of a rac-dimethylgermylbis(indenyl)hafnocene or -zirconocene, a rac-dimethylsilyl bis(indenyl) hafnocene or -zirconocene, and an ethylenyl (indenyl) hafnocene or -zirconocene.

~~6.~~4. The process of claim 1, wherein the polymerization is conducted in solution and at a temperature of at least about 80 °C.

~~7.~~5. The process of claim 1, wherein the monomer conversion is from 5 to 50 %.

~~8.~~6. The process of claim 1, wherein the activator is a combination of at least two different compounds of formula (2).

~~9.~~7. The process of claim 1, wherein R_2 and R_3 are hydrogen.

~~10.~~8. The process of claim 1, wherein the transition metal compound is dimethylsilyl bis(indenyl) hafnium dimethyl, rac-dimethylsilyl bis(indenyl) zirconium dimethyl, rac-ethylenylbis(indenyl)zirconium dimethyl, or rac-ethylenylbis(indenyl)hafnium dimethyl.

~~11.~~9. The process of claim 1, wherein the transition metal compound is a bridged or unbridged bis(substituted or unsubstituted indenyl) hafnium dialkyl or dihalide.

~~12.~~10. The process of claim 1, wherein the transition metal compound is a metallocene selected from the group consisting of a rac-dimethylsilyl bis(indenyl) hafnocene, a rac-dimethylsilyl bis(indenyl) zirconocene, a rac-ethylenyl bis(indenyl) hafnocene, rac-dimethylgermylbis(indenyl)halhocene, rac-dimethylgermylbis(indenyl) zirconocene, and a rac-ethylenyl bis(indenyl) zirconocene, and wherein the zirconocene or hafnocene have two leaving groups, X_1 and X_2, as defined above.

~~13.~~11. The process of claim 1, wherein the transition metal compound and/or the activator are supported on a solid support.

~~14.~~12. The process of claim 1, wherein the catalyst system further comprises a support comprising silica or alumina.

~~15.~~13. The process of claim ~~9~~ 7, wherein A is nitrogen or phosphorus, n is 3, and the groups R are identical.

~~16.~~14. The process of claim ~~9~~ 7, wherein n is 3, and the groups R are all identically methyl, ethyl or propyl groups.

~~17.~~15. The process of claim ~~9~~ 7, wherein $[R_nAH]^+$ is trimethylammonium, trimethylphosphonium, triethylammonium, triethylphosphonium, tri(iso-propyl)ammonium, tri (iso-propyl)phosphonium, tri(n-propyl)ammonium, or tri(n-propyl)phosphonium.

~~18.~~16. The process of claim ~~9~~ 7, wherein $[R_nAH]^+$ is an oxonium derivative of dimethyl ether, diethyl ether, tetrahydrofurane and dioxane.

~~19.~~17. The process of claim 1, wherein the transition metal compound is dimethylsilylbis(indenyl)hafnium dimethyl, rac-dimethylsilylbis(indenyl)zirconium dimethyl, rac-ethylenylbis(indenyl)zirconium dimethyl, or rac-ethylenylbis(indenyl)hafnium dimethyl and $[R_nAH]^+$ is trimethylammonium.

~~20.~~18. The process of claim 1, where when the polymerization process is a homogeneous process the monomer concentration is up to 15 mol/L.

~~21.~~19. The process of claim 1, where when the polymerization process is a homogeneous process the monomer concentration is up to 10 mol/L.

~~22.~~20. The process of claim 1, where when the polymerization process is a homogeneous process the monomer concentration is up to 5 mol/L.

~~23.~~21. The process of claim 1, where when the polymerization process is a slurry process the concentration of predominant monomer in the reactor liquid medium is from 1 to 10 wt %.

~~24.~~22. The process of claim 1, where when the polymerization process is a homogeneous solution process the monomer concentration is up to 2 mol/L.

~~25.~~23. The process of claim 1, wherein the polymer produced has a melting point of at least 75°C and an Mw of at least 10,000.

~~26.~~24. The process of claim 1, wherein the polymer produced has a melting point of at least 100°C and an Mw of at least 40,000.

~~27.~~25. The process of claim 1, wherein the polymer produced has a melting point of at least 110°C and an Mw of at least 50,000.