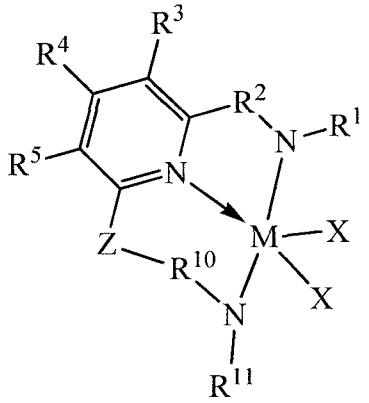
CLAIMS

1. Aprocess of producing ethylene α-olefin copolymers comprising:

contacting ethylene and a C_3 to C_{10} α-olefin with a transition metal pyridyldiamide catalyst component and an activator, as well as from 10 equivalents to 1000 equivalents relative to the catalyst component of the alkyl or aryl zinc chain transfer agent;

isolating an ethylene-α-olefin copolymer having a T_m of less than 140°C, a Mw/Mn of less than 2.5, and a weight average molecular weight (Mw) within the range of from 5 kDa to 500 kDa;

wherein the transition metal pyridyldiamide catalyst component is selected from the following structural formula (2):



wherein M is a Group 4 transition metal;

R^1 and R^{11} are independently selected from the group consisting of hydrocarbyls, substituted hydrocarbyls, heterohydrocarbyls, and silyl groups;

R^2 and R^{10} are each, independently, divalent hydrocarbyls or aryls;

R^3, R^4, and R^5 are indepenetly selected from the group consisting of hydrogen, hydrocarbyls (e.g., alkyls and aryls), substituted hydrocarbyls (e.g., heteraryl), alkoxy, aryloxy, halogen, amino, and silyl, and wherein adjacent R groups may be joined to form a substituted or unsubstituted hydrocarbyl or heterocyclic ring, where the ring has 5, 6, 7, or 8 ring atoms and where substitutions on the ring can join to form additional rings;

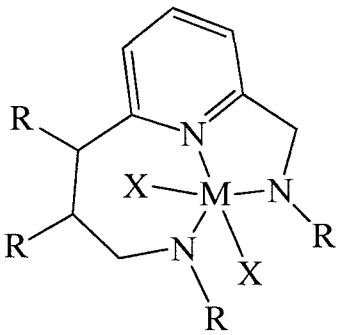
X is an anionic leaving group, where the X groups may be the same or different and any two X groups may be linked to form a dianionic leaving group;

Z is — $(R^{14})_pQJ(R^{15})_q$—, wherein Q is carbon, oxygen, nitrogen, or silicon, and where J is carbon or silicon, p is 1 or 2; and q is 1 or 2, and R^{14} and R^{15} are independently selected from the group consisting of hydrogen, hydrocarbyls (preferably alkyls), and substituted hydrocarbyls, and wherein adjacent R^{14} and R^{15} groups may be joined to form an aromatic or saturated, substituted or unsubstituted hydrocarbyl ring, where the ring has 5, 6, 7, or 8 ring carbon atoms and where substitutions on the ring can join to form additional rings.

2. The process of claim 1, wherein the chain transfer agent is selected from diphenyl zinc or dialkyl zinc compounds, where the alkyl is selected independently from methyl, ethyl, propyl, butyl, isobutyl, tertbutyl, pentyl, hexyl, and cyclohexyl.

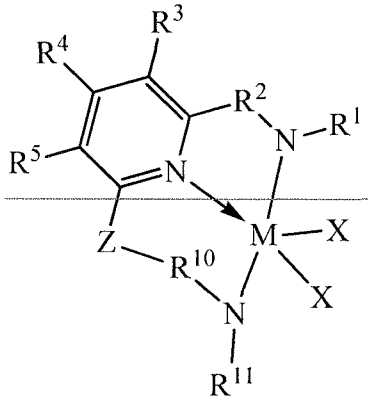
3. The process of claim 1, wherein the presence of the chain transfer agent increases the activity of the catalyst component by a factor of at least 4 relative to the activity under the same conditions when chain transfer agent is not present.

4. The process of claim 1, wherein the transition metal pyridyldiamide catalyst component is selected from compounds of the following structural formula:



wherein M is a Group 4 transition metal, and each R group is selected independently from hydrogen or alkyls or aryls, and wherein any adjacent R groups may form an aliphatic or aromatic ring; and X is a halogen or alkyl.

~~5. The process of claim 1, wherein the transition metal pyridyldiamide catalyst component is selected from the following structural formula:~~



~~wherein M is a Group 4 transition metal;~~

~~R^1 and R^{11} are independently selected from the group consisting of hydrocarbyls, substituted hydrocarbyls, heterohydrocarbyls, and silyl groups;~~

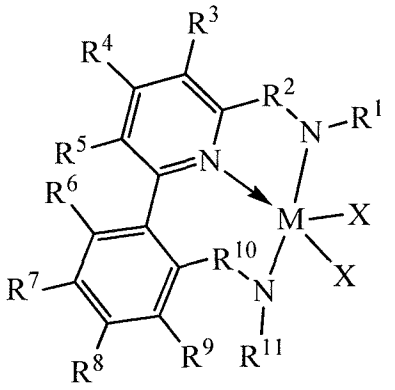
~~R^2 and R^{10} are each, independently, divalent hydrocarbyls or aryls;~~

~~R^3, R^4, and R^5 are independently selected from the group consisting of hydrogen, hydrocarbyls (e.g., alkyls and aryls), substituted hydrocarbyls (e.g., heteroaryl), alkoxy, aryloxy, halogen, amino, and silyl, and wherein adjacent R groups may be joined to form a substituted or unsubstituted hydrocarbyl or heterocyclic ring, where the ring has 5, 6, 7, or 8 ring atoms and where substitutions on the ring can join to form additional rings;~~

~~X is an anionic leaving group, where the X groups may be the same or different and any two X groups may be linked to form a dianionic leaving group;~~

~~Z is $(R^{14})_pQJ(R^{15})_q$, wherein Q is carbon, oxygen, nitrogen, or silicon, and where J is carbon or silicon, p is 1 or 2; and q is 1 or 2; and R^{14} and R^{15} are independently selected from the group consisting of hydrogen, hydrocarbyls (preferably alkyls), and substituted hydrocarbyls, and wherein adjacent R^{14} and R^{15} groups may be joined to form an aromatic or saturated, substituted or unsubstituted hydrocarbyl ring, where the ring has 5, 6, 7, or 8 ring carbon atoms and where substitutions on the ring can join to form additional rings.~~

~~6.~~5. The process of claim 1, wherein the transition metal pyridyldiamide catalyst component is selected from the following structural formula:



wherein M is a Group 4 transition metal;

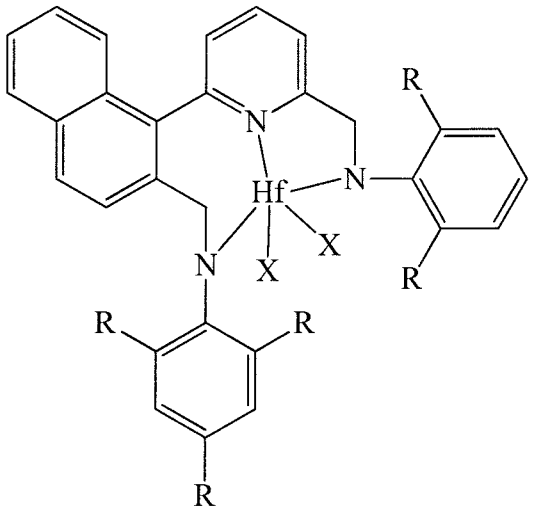
R^1 and R^{11} are independently selected from the group consisting of hydrocarbyls, substituted hydrocarbyls, heterohydrocarbyls, and silyl groups;

R^2 and R^{10} are each, independently, divalent C_1 to C_4 hydrocarbyls or C_5 to C_{12} aryls;

R^3, R^4, R^5, R^6, R^7, R^8, R^9, are independently selected from the group consisting of hydrogen, hydrocarbyls (e.g., alkyls and aryls), substituted hydrocarbyls (e.g., heteroaryl), alkoxy, aryloxy, halogen, amino, and silyl, and wherein adjacent R groups may be joined to form a substituted or unsubstituted hydrocarbyl or heterocyclic ring, where the ring has 5, 6, 7, or 8 ring atoms and where substitutions on the ring can join to form additional rings; and

X is an anionic leaving group, where the X groups may be the same or different and any two X groups may be linked to form a dianionic leaving group.

~~7.~~6. The process of claim 1, wherein the transition metal pyridyldiamide catalyst component is selected from compounds of the following structural formula:



wherein each R group is selected from methyl, ethyl, propyl, isopropyl, isobutyl, and tert-butyl; and X is a halogen or alkyl.

~~8.~~7. The process of claim 1, wherein the contacting first takes place in the absence of the chain transfer agent and ethylene-α-olefin copolymer is first isolated having a weight average molecular weight (Mw) within the range of greater than 200 kDa; followed by addition of the chain transfer agent and isolation of ethylene-α-olefin copolymer having a Mw of less than 400 kDa.

~~9.~~8. The process of claim 1, wherein the contacting first takes place in the absence of the chain transfer agent and ethylene-α-olefin copolymer is first isolated having a Mw/Mn within the range of from 1.5 to 2.5; followed by addition of the chain transfer agent and isolation of ethylene-α-olefin copolymer having a MWD of less than 2.0.

~~10.~~9. The process of claim 1, wherein the activator is a compound(s) distinguishable from the chain transfer agent.

~~11.~~10. A process of producing ethylene α-olefin copolymers comprising:

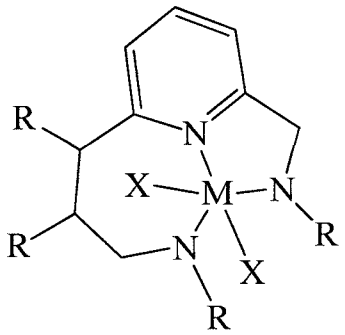
contacting ethylene and a C_3 to C_{10} α-olefin with a transition metal pyridyldiamide catalyst component and an activator, as well as from 10 equivalents to 1000 equivalents relative to the catalyst component of the alkyl or aryl zinc chain transfer agent;

wherein the contacting first takes place in the absence of the chain transfer agent and ethylene-α-olefin copolymer is first isolated having a weight average molecular weight (Mw) within the range of greater than 200 kDa; followed by addition of chain transfer agent and isolation of ethylene-α-olefin copolymer having a Mw of less than 400 kDa, or within a range of from 5 kDa to 200 kDa.

~~12.~~11. The process of claim ~~11~~ 10, wherein the chain transfer agent is selected from diphenyl zinc or dialkyl zinc compounds, where the alkyl is selected independently from methyl, ethyl, propyl, butyl, isobutyl, tertbutyl, pentyl, hexyl, and cyclohexyl.

~~13.~~12. The process of claim ~~11~~ 10, wherein the presence of the chain transfer agent increases the activity of the catalyst component by a factor of at least 4 relative to the activity under the same conditions when the chain transfer agent is not present.

~~14.~~13. The process of claim ~~11~~ 10, wherein the transition metal pyridyldiamide catalyst component is selected from compounds of the following structural formula:



wherein M is a Group 4 transition metal, and each R group is selected independently from hydrogen or alkyls or aryls, and wherein any adjacent R groups may form an aliphatic or aromatic ring; and X is a halogen or alkyl.

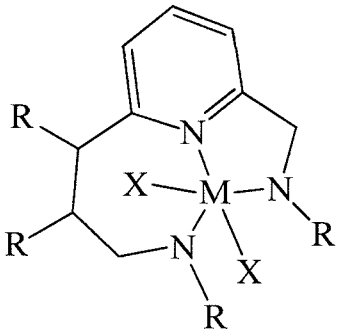
~~15.~~14. A process of producing ethylene α-olefin copolymers comprising:

contacting ethylene and a C_3 to C_{10} α-olefin with a transition metal pyridyldiamide catalyst component and an activator, as well as from 10 equivalents to 1000 equivalents relative to the catalyst component of the alkyl or aryl zinc chain transfer agent;

wherein the contacting first takes place in the absence of chain transfer agent and ethylene-α-olefin copolymer is first isolated having a Mw/Mn within the range of from 1.5 to 2.5; followed by addition of the chain transfer agent and isolation of ethylene-α-olefin copolymer having a MWD of less than 2.0.

~~16.~~15. The process of claim ~~15~~ 14, wherein the presence of the chain transfer agent increases the activity of the catalyst component by a factor of at least 4 relative to the activity under the same conditions when the chain transfer agent is not present.

~~17.~~16. The process of claim ~~15~~ 14, wherein the transition metal pyridyldiamide catalyst component is selected from compounds of the following structural formula:



wherein M is a Group 4 transition metal, and each R group is selected independently from hydrogen or alkyls or aryls, and wherein any adjacent R groups may form an aliphatic or aromatic ring; and X is a halogen or alkyl.

~~18.~~17. A process of producing ethylene α-olefin copolymers comprising:

contacting ethylene and a C_3 to C_{10} α-olefin with a transition metal pyridyldiamide catalyst component and an activator, as well as from 10 equivalents to 1000 equivalents relative to the catalyst component of diphenyl zinc chain transfer agent;

isolating an ethylene-α-olefin copolymer having a T_m of less than 140°C, a Mw/Mn of less than 2.5, and a weight average molecular weight (Mw) within the range of from 5 kDa to 500 kDa,

wherein the presence of the chain transfer agent increases the activity of the catalyst component by a factor of at least 2 relative to the activity under the same

conditions when chain transfer agent is not present.

~~19.~~18. The process of claim ~~11~~ 10, wherein the chain transfer agent is diphenyl zinc.

~~20.~~19. The process of claim ~~11~~ 10, further comprising scavenger, where the scavenger is not the same chemical compounds as the chain transfer agent.

~~21.~~20. The process of claim ~~20~~ 19, where the scavenger is tri-n-octylaluminum.

~~22.~~21. The process of claim ~~21~~ 10, wherein the chain transfer agent is diethylzinc.

~~23.~~22. The process of claim ~~11~~ 10, further comprising scavenger, where the scavenger is not the same chemical compounds as the chain transfer agent and the chain transfer agent is diethylzinc.