CLAIMS

1. A method for preparing α-olefins by oligomerization of C_2-C_4 olefins in the presence of a catalyst system comprising a transition metal source, an activator, which is an alkylaluminoxane, and a compound of formula (I),

Ar^1Ar^2P-N(R)-PAr^3Ar^4 [formula I],

wherein

Ar^{1-4} are the same or different and selected from substituted or unsubstituted C_6-C_{10} aryl groups;

R is selected from linear or branched C_1-C_4 alkyl group, substituted or unsubstituted C_6-C_{10} aryl group, and substituted or unsubstituted C_3-C_{10} cycloalkyl group;

wherein the oligomerization process is carried out in a solvent, which is a bicyclic compound or a mixture of bicyclic compounds.

2. The method of claim 1, wherein the oligomerization is trimerization or tetramerization.

3. The method of claim 1, wherein C_2-C_4 olefin is ethylene.

4. The method of claim 1, wherein the transition metal is selected from the group comprising Ti, Zr, Hf, Ni, Cr, Fe, Co, Pd, Pt, and a combination thereof, preferably Cr.

5. The method of claim 1, wherein the transition metal source is a compound of the formula: MeX_n, wherein Me is a transition metal selected from the group comprising Ti, Zr, Hf, Ni, Cr, Fe, Co, Pd, Pt, and a combination thereof, X is an organic or inorganic substituent, the same or different, and n is an integer from 1 to 6.

6. The method of claim 5, wherein X is an organic substituent having 1 to 20 carbon atoms and is selected from the group comprising alkyl, alkoxyl, carboxyl, acetylacetonate, amino, amido, and a combination thereof;

or wherein X is an inorganic substituent and is selected from the group comprising halides, sulfates, and oxides of transition metals.

7. The method of claim 5, wherein the transition metal source is a Cr compound of the formula: CrXn, selected from the group comprising chromium (III) chloride, chromium (III) acetate, chromium (III) *tris*-ethylhexanoate, chromium (III) acetylacetonate, chromium (III) pyrrolide, chromium (II) acetate, or chromium (IV) dioxide dichloride.

8. The method of claim 1, wherein alkylaluminoxane is methylaluminoxane.

9. The method of claim 1, wherein the bicyclic compound is decalin (decahydronaphthaline).

10. The method of claim 9, wherein decalin may be *cis*-decalin, *trans*-decalin, or a mixture thereof;

and/or wherein decalin comprises not more than 30 wt.% of impurities.

11. The method of claim 1, wherein the catalyst system further comprises a zinc compound.

12. The method of claim 11, wherein the zinc compound is selected from the group comprising alkylzinc compounds, arylzinc compounds, zinc amides, zinc oxygenates, zinc halides, and a combination thereof;

or wherein the zinc compound is zinc metal (Zn);

or wherein the zinc compound is diethylzinc.

13. The method of claim 1, wherein Ar^{1-4} are alkylaryl selected from the group comprising phenyl, tolyl, ethylphenyl, cumyl, and naphthyl.

14. The method of claim 1, wherein R is a radical selected from the group comprising methyl, ethyl, propyl, butyl, isobutyl, benzyl, allyl, cyclopropyl, cyclobutyl, cyclopentyl, cyclohexyl, cycloheptyl, cyclooctyl, and cyclononyl.

15. The method of claim 1, wherein the catalyst system is prepared by mixing the transition metal source and a compound of formula (I), wherein the mixing is carried out under ultrasonic exposure to prepare a homogenous mixture, followed by mixing the prepared mixture with alkylaluminoxane;

or wherein the catalyst system is homogenous or heterogeneous;

or preferably wherein the mixing of the transition metal source and a compound of formula (I) is carried out in a solvent selected from the group comprising benzene, toluene, ethylbenzene, xylene, mesitylene, and cumene, preferably toluene and ethylbenzene.

16. The method of claim 15, further comprising adding a zinc compound when preparing the catalyst system.

17. The method of claim 1, wherein a ratio of aluminum:transition metal in the catalyst system is from 10:1 to 5000:1, preferably from 100:1 to 1000:1, most preferably from 200:1 to 500:1.

18. The method of claim 1, wherein a ratio of compound of formula (I):transition metal in the catalyst system is from 2:1 to 1:2, preferably from 1.5:1 to 1:1.5.

19. The method of claim 11, wherein a ratio of zinc:transition metal in the catalyst system is from 2:1 to 1000:1, preferably from 20:1 to 200:1.

20. The method of any one of claims 1 to 9, comprising:

a) mixing the catalyst system with a solvent, which is a bicyclic compound or a mixture of bicyclic compounds;

b) feeding the resulting mixture to an oligomerization reactor; and

c) feeding C_2-C_4 olefins to the oligomerization reactor and carrying out the oligomerization to prepare α-olefins.

21. The method of claim 20, wherein the oligomerization reactor is selected from the group comprising a continuous reactor with a stirrer, a batch reactor, a plug-flow reactor, and a tubular reactor.

22. The method of claim 20, wherein the catalyst system is added for not more than 60 minutes, preferably 20 minutes, most preferably 5 minutes, after preparing thereof.

23. The method of claim 20, wherein the oligomerization is carried out at a temperature of from 0 to 160ºC, preferably from 30 to 120ºC, most preferably from 40 to 80ºC.

24. The method of claim 20, wherein the time of oligomerization in the reactor is from 30 to 60 minutes.

25. The method of claim 20, further comprising feeding gaseous hydrogen.

26. The method of claim 9, wherein the content of aromatic hydrocarbons in decalin is not more than 2 wt.%.

27. The method of claim 9, wherein decalin is substantially free of tetralin.

28. The method of claim 1, wherein the prepared α-olefins comprise C_5-C_{40} α-olefins;

preferably wherein α-olefins contain hexene-1 and octene-1.

29. The method of claim 20, further comprising a step of cooling an effluent from the reactor to a temperature of from 100°C to 20°C, preferably to a temperature of less than 95°C, less than 90°C, less than 85°C, less than 80°C, less than 75°C, less than

70°C, less than 65°C, less than 60°C, less than 55°C, less than 50°C, less than 45°C, less than 40°C, less than 35°C, less than 30°C, and less than 25°C;

preferably wherein the effluent from the reactor is cooled to a temperature of from 20 to 25°C.

30. The method of claim 20, further comprising a step of treating the effluent from the reactor with a deactivation agent selected from the group comprising water, alcohols, amines, aminoalcohols, and a mixture thereof.

31. The method of claim 30, wherein the deactivation agent is selected from the group comprising methanol, ethanol, n-propanol, isopropanol, n-butanol, isobutanol, *tert*-butanol, 2-ethylhexanol, and a mixture thereof;

or wherein the deactivation agent is selected from the group comprising ammonia, methylamine, dimethylamine, trimethylamine, ethylamine, diethylamine, triethylamine, tri-n-propylamine, diisopropylethylamine, tri-n-butylamine, piperazine, pyridine, ethylenediamine, diethylenetriamine, and a mixture thereof;

or wherein the deactivation agent is selected from the group comprising ethanolamine, diethanolamine, triethanolamine, methyldiethanolamine, dodecyldiethanolamine, 1-amino-2-propanol, and a mixture thereof.

32. Use of a solvent, which is a bicyclic compound or a mixture of bicyclic compounds, in the method for preparing α-olefins by oligomerization of C_2-C_4 olefins according to any one of claims 1 to 31.

33. The use of claim 32, wherein the solvent is decalin.