

CLAIMS

1. A method for preparing a catalyst system used in a process of oligomerization of olefins, comprising mixing a chromium source compound, a nitrogen-containing ligand, alkylaluminum, and a zinc compound, characterized in that the alkylaluminum or a mixture of the alkylaluminum and the zinc compound is activated by heating and SHF irradiation (microwave irradiation) prior to the mixing thereof with the other components of the catalyst system.
2. The method of claim 1 characterized in that the chromium source compound is a compound of the general formula CrX_n , wherein X are the same or different organic or non-organic substituents, and n is an integer of from 1 to 6.
3. The method of claim 2 characterized in that X are organic substituents comprising 1 to 20 carbon atoms, selected from the group including alkyl, alkoxy, carboxy, acetylacetonate, amino, and amido; or non-organic substituents selected from the group including halides, sulfates, and chromium oxides.
4. The method of claims 1 to 3 characterized in that the chromium source compound is a compound selected from the group including chromium (III) chloride, chromium (III) acetate, chromium (III) 2-ethylhexanoate, chromium (III) acetylacetonate, chromium (III) pyrrolide, chromium (II) acetate, and chromium (IV) dioxide dichloride (CrO_2Cl_2).
5. The method of claim 1 characterized in that the nitrogen-containing ligand is a pyrrole ring-containing organic compound.
6. The method of any one of claims 1 to 5 characterized in that the nitrogen-containing ligand is a compound selected from the group including pyrrole, 2,5-dimethylpyrrole, lithium pyrrolide ($\text{C}_4\text{H}_4\text{NLi}$), 2-

ethylpyrrole, indole, 2-methylindole, and 4,5,6,7-tetrahydroindole.

7. The method of any one of claims 1 to 6 characterized in that the alkylaluminum is a compound
5 selected from the group including triethylaluminum, diethylaluminum chloride, tripropylaluminum, triisobutylaluminum, diethylaluminum ethoxide, ethylaluminum sesquichloride, or a mixture thereof.

8. The method of any one of claims 1 to 7
10 characterized in that the zinc compound is a compound selected from the group including zinc metal; zinc-copper couple; activated zinc; alkylzinc compounds, in particular, dimethyl-, diethyl- and dibutylzinc; arylzinc compounds, such as diphenyl- and ditolylzinc; zinc amides, in
15 particular, zinc pyrrolide and zinc-porphyrin complexes; zinc oxygenates, including formate, acetate, basic acetate, 2-ethylhexanoate; and zinc halides, in particular anhydrous zinc chloride; or a combination thereof.

9. The method of any one of claims 1 to 8
20 characterized in that, during the preparation of the catalyst system, the zinc compound is used in the absence of visible and UV-radiation.

10. The method of any one of claims 1-7, characterized in that a molar ratio of aluminum/chromium in the catalyst
25 system is from 5:1 to 500:1, preferably from 10:1 to 100:1, most preferably from 20:1 to 50:1.

11. The method of any one of claims 1-10, characterized in that a molar ratio of ligand/chromium in the catalyst system is from 2:1 to 50:1, preferably from
30 2.5:1 to 5:1.

12. The method of any one of claims 1-11, characterized in that a molar ratio of zinc/chromium in the

catalyst system is from 2:1 to 100:1, preferably from 5:1 to 50:1.

13. The method of any one of claims 1-12, characterized in that the heating of the alkylaluminum or the mixture of the alkylaluminum and the zinc compound during the preparation of the catalyst system is carried out up to at least 40°C, preferably to at least 50°C, most preferably to at least 60°C.

14. The method of any one of claims 1-13, characterized in that the frequency of the SHF radiation (microwave radiation) is selected between 0.2 and 20 GHz.

15. The method of claim 14, characterized in that the frequency of the SHF radiation (microwave radiation) is 2.45 GHz.

16. The method of claim 14, characterized in that the time of the SHF irradiation (microwave irradiation) is from 20 sec to 20 min.

17. The method of any one of claims 1-16, characterized in that the mixing of the alkylaluminum or the mixture of the alkylaluminum and the zinc compound, which are activated by heating or SHF irradiation (microwave irradiation), with the chromium source and the nitrogen-containing ligand is carried out not more than 3 min after the irradiation, preferably not more than 1 min after the irradiation.

18. A method for preparing a catalyst system used in a process of oligomerization of olefins and comprising a chromium source compound, a nitrogen-containing ligand, alkylaluminum, and a zinc compound, the method comprising activating the alkylaluminum or a mixture of the alkylaluminum and the zinc compound by heating prior to mixing thereof with the other components of the catalyst system, mixing the activated alkylaluminum or mixture of

the alkylaluminum and the zinc compound with the other components of the catalyst system to prepare the catalyst system, and holding (aging) the prepared catalyst system for a certain period of time.

5 19. The method of claim 18 characterized in that the chromium source compound is a compound of the general formula CrX_n , wherein X are the same or different organic or non-organic substituents, and n is an integer of from 1 to 6.

10 20. The method of claim 19 characterized in that X are organic substituents comprising 1 to 20 carbon atoms, selected from the group including alkyl, alkoxy, carboxy, acetylacetonate, amino, and amido; or non-organic substituents selected from the group including halides, 15 sulfates, and chromium oxides.

 21. The method of claims 18-20, characterized in that the chromium source compound is a compound selected from the group including chromium (III) chloride, chromium (III) acetate, chromium (III) 2-ethylhexanoate, chromium (III) 20 acetylacetonate, chromium (III) pyrrolide, chromium (II) acetate, and chromium (IV) dioxide dichloride (CrO_2Cl_2).

 22. The method of any one of claims 18-21 characterized in that the nitrogen-containing ligand is a pyrrole ring-containing organic compound.

25 23. The method of claim 18 or 22 characterized in that the nitrogen-containing ligand is a compound selected from the group including pyrrole, 2,5-dimethylpyrrole, lithium pyrrolide ($\text{C}_4\text{H}_4\text{NLi}$), 2-ethylpyrrole, indole, 2-methylindole, and 4,5,6,7-tetrahydroindole.

30 24. The method of any one of claims 18 to 23 characterized in that the alkylaluminum is a compound selected from the group including triethylaluminum, diethylaluminum chloride, tripropylaluminum,

triisobutylaluminum, diethylaluminum ethoxide, ethylaluminum sesquichloride, or a mixture thereof.

25. The method of any one of claims 18 to 24 characterized in that the zinc compound is a compound
5 selected from the group including zinc metal; zinc-copper couple; activated zinc; alkylzinc compounds, in particular, dimethyl-, diethyl- and dibutylzinc; arylzinc compounds, such as diphenyl- and ditolylzinc; zinc amides, in particular, zinc pyrrolide and zinc-porphyrin complexes;
10 zinc oxygenates, including formate, acetate, basic acetate, 2-ethylhexanoate; and zinc halides, in particular anhydrous zinc chloride; or a combination thereof.

26. The method of any one of claims 18 to 25 characterized in that, during the preparation of the
15 catalyst system, the zinc compound is used in the absence of visible or UV-radiation.

27. The method of any one of claims 18 to 26, characterized in that a ratio of aluminum/chromium in the catalyst system is from 5:1 to 500:1, preferably from 10:1
20 to 100:1, most preferably from 20:1 to 50:1.

28. The method of any one of claims 18 to 27, characterized in that a molar ratio of ligand/chromium in the catalyst system is from 2:1 to 50:1, preferably from 2.5:1 to 5:1.

25 29. The method of any one of claims 18 to 28, characterized in that a molar ratio of zinc/chromium in the catalyst system is from 2:1 to 100:1, preferably from 5:1 to 50:1.

30. The method of any one of claims 18 to 29,
30 characterized in that the heating of the alkylaluminum or the mixture of the alkylaluminum and the zinc compound during the preparation of the catalyst system is carried

out at least 40°C, preferably to at least 50°C, most preferably to at least 60°C.

31. The method of any one of claims 18 to 30, characterized in that the holding (aging) of catalyst system is carried out for 1 to 120 days, preferably 2 to 60 days, most preferably 14 to 45 days.

32. A catalyst system used in a process of oligomerization of olefins, wherein the catalyst system is prepared by the method of any one of claims 1 to 17.

10 33. A catalyst system used in the process of oligomerization of olefins, wherein the catalyst system is prepared by the method of any one of claims 18 to 31.

34. A method for oligomerization of olefins in the presence of the catalyst system of claim 32 or 33, or a catalyst system prepared by the method of any one of claims 1 to 17 or 18 to 31.

35. The method of claim 34 characterized in that the process of oligomerization of olefins is carried out at temperature of 0 to 160°C, preferably 40 to 130°C, most preferably 80 to 120°C.

36. The method of claim 34 or 35 characterized in that the process of oligomerization of olefins is carried out in the absence of water and oxygen.

37. The method of any one of claims 34 to 36 characterized in that the olefin subjected to oligomerization is selected from ethylene (ethene), propylene (propene), and butylene (butene).

38. The method of any one of claims 34 to 37 characterized in that the olefin in the process of oligomerization is ethylene (ethene).

39. α -Olefin prepared by the process of any one of claims 34 to 38, wherein the α -olefin is C₅-C₄₀ α -olefins or a mixture thereof.

40. The α -olefin of claim 39, wherein the α -olefin is 1-hexene.