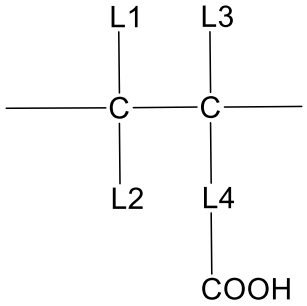
Claims

1. A copolymer particle of olefin and unsaturated carboxylic acid or unsaturated carboxylic acid derivative, comprising a spherical and/or spherical-like copolymer particle, at least part of the spherical and/or spherical-like copolymer particle having a cavity therein~~.~~

~~2. The copolymer according to claim 1~~, wherein the copolymer particle comprises a structural unit derived from olefin and a structural unit of Formula I or ~~a structural unit of~~ a derivative of Formula I,



Formula I

wherein in Formula I, L1-L3 each are independently selected from the group consisting of H and C_1-C_{30} alkyl, and L4 is C_1-C_{30} alkylene having a side group, the derivative of Formula I being a IIA, IIIA or IIB Group metal salt of Formula I~~, the C_1-C_{30} alkyl being optionally substituted by a substituent which is preferably one or more selected from the group consisting of halogen, C_1-C_{10} alkyl, C_1-C_{10} alkoxy, C_6-C_{10} aryl, cyano group and carboxyl; and preferably, the side group in L4 is one or more selected from the group consisting of halogen, C_6-C_{20} aryl, C_1-C_{20} alkyl and C_1-C_{20} alkoxy~~.

2. The copolymer particle according to claim 1, wherein in Formula I, the C_1-C_{30} alkyl are optionally substituted by a substituent which is one or more selected from the group consisting of halogen, C_1-C_{10} alkyl, C_1-C_{10} alkoxy, C_6-C_{10} aryl, cyano group and carboxyl; and/or, the side group in L4 is one or more selected from the group consisting of halogen, C_6-C_{20} aryl, C_1-C_{20} alkyl and C_1-C_{20} alkoxy.

3. The copolymer particle according to claim 1 or claim 2, wherein a density of the spherical and/or spherical-like copolymer particle is 0.3000-0.8500g/cm^3, ~~preferably 0.4000-0.7500g/cm^3,~~ and the density is measured by using GB/T6463-2009.

4. The copolymer particle according to claim 3, wherein the density of the spherical and/or spherical-like copolymer particle is 0.4000-0.7500g/cm^3.

~~4~~5. The copolymer particle according to any one of claims 1-~~3~~4, wherein an average particle size of the spherical and/or spherical-like copolymer particle is 0.1-50.0mm~~, preferably 0.5-20.0mm~~.

6. The copolymer particle according to claim 5, wherein the average particle size of the spherical and/or spherical-like copolymer particle is 0.5-20.0mm.

~~5~~7. The copolymer particle according to any one of claims 1-~~4~~6, wherein a volume of the cavity in the spherical and/or spherical-like copolymer particle having a cavity therein is 5-99%~~, preferably 30-95%, more preferably 50-90%,~~ of a volume of the spherical and/or spherical-like copolymer particle.

8. The copolymer particle according to claim 7, wherein the volume of the cavity in the spherical and/or spherical-like copolymer particle having a cavity therein is 30-95% of the volume of the spherical and/or spherical-like copolymer particle.

9. The copolymer particle according to claim 8, wherein the volume of the cavity in the spherical and/or spherical-like copolymer particle having a cavity therein is 50-90% of the volume of the spherical and/or spherical-like copolymer particle.

~~6~~10. The copolymer particle according to any one of claims 1-~~5~~9, wherein in the copolymer particle, a content of the structural unit of Formula I or ~~the structural unit of~~ the derivative of Formula I is 0.2-15.0mol%~~, preferably 0.4-10.0mol%~~.

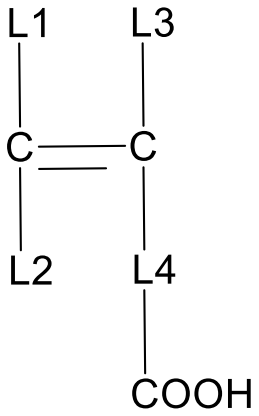
11. The copolymer particle according to claim 10, wherein in the copolymer particle, the content of the structural unit of Formula I or the derivative of Formula I is 0.4-10.0mol%.

~~7~~12. The copolymer particle according to any one of claims 1-~~6~~11, wherein a number-average molecular weight of the copolymer particle is 5000-200000~~, preferably 15000-150000~~.

13. The copolymer particle according to claim 12, wherein the number-average molecular weight of the copolymer particle is 15000-150000.

~~8~~14. The copolymer particle according to any one of claims 1-~~8~~13, wherein in Formula I, L1 and L2 are H, L3 is ~~selected from the group consisting of~~ H, or C_1-C_{10} alkyl or halogen-substituted C_1-C_{10} alkyl, L4 is C_1-C_{10} alkylene having a side group which is ~~preferably~~ one or more selected from the group consisting of halogen, C_6-C_{10} aryl, and C_1-C_{10} alkyl.

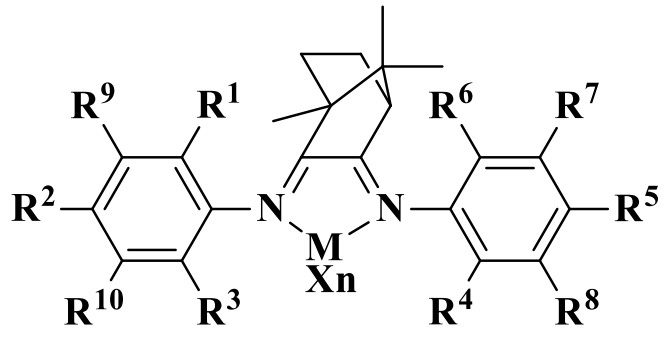
~~9~~15. A preparation method for the copolymer particle according to any one of claims 1-~~8~~14, comprising: contacting an olefin, and an unsaturated carboxylic acid shown in Formula II or an ~~derivative of the~~ unsaturated carboxylic acid derivative shown in Formula II with a catalyst and optionally a chain transfer agent for reaction in the presence of an alkane solvent to obtain the copolymer particle;



Formula II

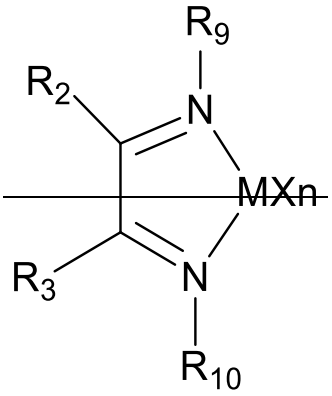
wherein ~~in Formula II,~~ definitions of L1-L4 in Formula II are the same as the definitions of L1-L4 in Formula I, and

the catalyst comprises a main catalyst and a co-catalyst, and the main catalyst is at least one selected from ~~at least one~~ metal complex shown in Formula ~~III~~V:



Formula V

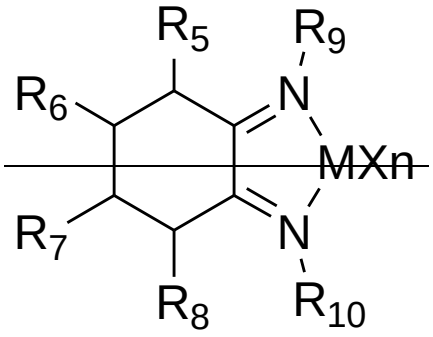
wherein in Formula V, R^1-R^{10} are identical to or different from each other, and each are independently selected from the group consisting of hydrogen, halogen, C_1-C_{24} hydrocarbyl and C_1-C_{24} hydrocarbyloxy, R^1-R^3, R^9, and R^{10} optionally forming a ring to each other, R^4-R^6, R^7, and R^8 optionally forming a ring to each other;



~~Formula III~~

~~wherein in Formula III, R_9 and R_{10} are identical to or different from each other, and each are independently selected from substituted or unsubstituted hydrocarbyl; R_2 and R_3 are identical to or different from each other, each are independently selected from the group consisting of H, halogen, and substituted or unsubstituted hydrocarbyl, and R_2 and R_3 optionally form a ring with each other;~~ M is a Group VIII metal; X is one or more selected from the group consisting of halogen and C_1-C_{10} alkyl; and n is an integer that meets an M valence state.

~~10. The preparation method according to claim 9, wherein the main catalyst is selected from at least one metal complex shown in Formula IV:~~



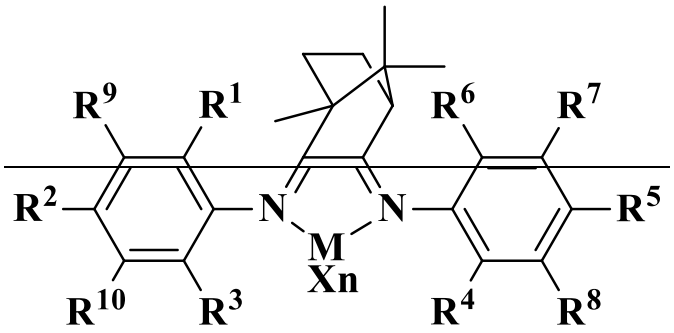
~~Formula IV~~

~~wherein in Formula IV, R_9, R_{10}, M, X, and n have the same definitions as those in Formula III; and R_5-R_8 are identical to or different from each other, each independently selected from~~

~~the group consisting of H, halogen, and substituted or unsubstituted C_1-C_{20} hydrocarbyl, and R_5-R_8 optionally form a ring with each other.~~

~~11. The preparation method according to claim 9 or claim 10, wherein in Formula IV, R_9 and R_{10} each are independently selected from the group consisting of substituted or unsubstituted C_6-C_{30} aryl or substituted and unsubstituted C_7-C_{30} aralkyl; and R_5-R_8 are identical to or different from each other, each independently selected from the group consisting of H and C_1-C_{20} hydrocarbyl, and R_5-R_8 optionally form a ring with each other.~~

~~12. The preparation method according to any one of claims 9-11, wherein the main catalyst is selected from at least one metal complex shown in Formula V:~~



~~Formula V~~

~~wherein in Formula V, R^1-R^{10} are identical to or different from each other, and each are independently selected from the group consisting of hydrogen, halogen, C_1-C_{24} hydrocarbyl or C_1-C_{24} hydrocarbyloxy, R^1-R^3, R^9, and R^{10} optionally forming a ring to each other, R^4-R^6, R^7, and R^8 optionally forming a ring to each other; and M, X and n have the same definitions as those in Formula III and Formula IV.~~

~~13~~16. The preparation method according to claim ~~12~~15, wherein in Formula V, R^7-R^{10} are H, and R^1-R^6 are identical to or different from each other and each are independently selected from the group consisting of H and C_1-C_3 alkyl.

~~14~~17. The preparation method according to ~~any one of~~ claims ~~9-13~~15 or 16, wherein the M is nickel.

~~15~~18. The preparation method according to any one of claims ~~9-14~~15-17, wherein the co-catalyst is selected from the group consisting of an organic aluminum compound and an organic

boron compound; the organic aluminum compound is one or more selected from the group consisting of alkyl aluminoxane, alkylaluminum and alkylaluminum halides; and

the organic boron compound is selected from the group consisting of aryl boron and borate.

~~16~~19. The preparation method according to any one of claims ~~9-15~~15-18, wherein a concentration of the main catalyst in a reaction system is 0.00001-100mmol/L; when the co-catalyst is the organic aluminum compound, a molar ratio of aluminum in the co-catalyst and M in the main catalyst is (10-10000000):1; and when the co-catalyst is the organic boron compound, a molar ratio of boron in the co-catalyst and M in the main catalyst is (0.1-1000):1.

~~17~~20. The preparation method according to any one of claims ~~9-16~~15-19, wherein the chain transfer agent is one or more selected from the group consisting of aluminum alkyl, magnesium alkyl and zinc alkyl, and a molar ratio of the chain transfer agent and M in the main catalyst is (0.1-2000):1

~~18~~21. The preparation method according to any one of claims ~~9-17~~15-20, wherein a ~~molar ratio~~concentration of the unsaturated carboxylic acid shown in Formula II or the unsaturated carboxylic acid derivative shown in Formula II in the reaction system is 0.01-6000mmol/L.

~~19~~22. The preparation method according to any one of claims ~~9-18~~15-21, wherein reaction conditions comprise: a reaction temperature in a range from -50 ºC to 50 ºC and a reaction time of 10-200min.

~~20~~23. Use of the copolymer particle according to any one of claims 1-~~8~~14 or the copolymer particle obtained from the preparation method according to any one of claims ~~9-19~~15-22 as a foaming material.