Claims

1. An integrated catalyst for olefin disproportionation, wherein the integrated catalyst comprises a plurality of different active phases integrated together, and the relative position between the different active phases is kept substantially unchanged during the olefin disproportionation; characterized in that the effective distance between the respective bisecting surfaces of two adjacent different active phases is 0.5-5 mm, and preferably 1-3 mm.

2. The integrated catalyst according to claim 1, wherein the different active phases are integrated by means selected from the group consisting of: filling each active phase into a container with a plurality of chambers respectively; laminating the respective active phases; bonding the active phases; rolling the active phases in sequence; and coextruding the active phases.

3. The integrated catalyst according to claim 1, wherein the ratio of the effective distances occupied by two different active phases among the distances between the centers of gravity of two adjacent different active phases is 1: 10 to 10: 1.

4. The integrated catalyst according to claim 1, wherein the plurality of different active phases are alternated one or more times in a periodic regular arrangement.

5. The integrated catalyst according to claim 1, wherein any two adjacent active phases are a disproportionation catalyst and an isomerization catalyst, respectively, and the ratio between the effective distances occupied respectively by the adjacent disproportionation catalyst active phase and isomerization catalyst active phase is (1:1) to (1:5), preferably (1:2) to (1: 3).

6. The integrated catalyst according to claim 1, wherein the relative position displacement, if any, between the different active phases during the olefin disproportionation reaction is not more than 0.5mm, preferably not more than 0.1 mm.

7. The integrated catalyst according to claim 1, wherein the catalyst is in the form of particles.

8. The integrated catalyst according to claim 7, characterized in that the catalyst particles have a total thickness of from 2.0 mm to 8.0 mm, preferably from

2.5mm to 6.0 mm; a radial length of 1.8mm to 6.0mm, and preferably in a cylindrical shape.

9. The integrated catalyst according to claim 7, characterized in that the catalyst particles are in a multi-layer structure with at least two layers, preferably in a two-layer structure or a three-layer structure.

10. The integrated catalyst according to claim 1, characterized in that the first active phase in the plurality of different active phases is a disproportionation catalyst, which comprises the following components in parts by weight:

(1) 85-95 parts of a support, and

(2) 5-15 parts of tungsten oxide.

11. The integrated catalyst according to claim 10, characterized in that the support is selected from SiO_2 and mesoporous molecular sieve; preferably, the mesoporous molecular sieve is a silicon-containing mesoporous molecular sieve, preferably selected from the group consisting of an MCM molecular sieve, an SBA molecular sieve, an HMS molecular sieve and an MSU molecular sieve.

12. The integrated catalyst according to claim 1, characterized in that the second active phase of the plurality of different active phases is an isomerization catalyst that is an alkaline earth metal oxide, selected from the group consisting of calcium oxide, magnesium oxide, strontium oxide, and barium oxide, preferably magnesium oxide.

13. The integrated catalyst according to claim 12, characterized in that the second active phase is magnesium oxide in the form of polycrystalline hexagonal flakes; preferably, the hexagon has a side length of 180-600nm and a thickness of 8-30 nm.

14. The integrated catalyst according to claim 13, characterized in that the magnesium oxide is prepared by a process comprising:

1) preparing a solution of soluble magnesium salt with a concentration of 5-20%, heating to 40-80 ℃ and stirring to be homogeneous;

2) adding a surfactant and a complexing agent, wherein the molar ratio of the surfactant to magnesium ions of the magnesium salt is 0.5-3%, and the molar ratio of the complexing agent to the magnesium ions of the magnesium salt is 1-8%;

3) adding a precipitator, wherein the molar ratio of the precipitator to magnesium ions is 2:1-5: 1;

4) washing the precipitate obtained in the step 3) with water, washing with absolute ethanol, and drying at 70-90 ℃ for 8-12 h; and

5) calcining the product obtained in the step 4), controlling the heating rate to be 5-15 ℃/min, and calcining at 400-520 ℃ for 3-6h.

15. The integrated catalyst according to claim 14, characterized in that the soluble magnesium salt is selected from magnesium sulfate, magnesium chloride and magnesium carbonate; the surfactant is a molecular surfactant, preferably selected from polyethylene glycol and P123; the complexing agent is selected from ethylenediamine tetraacetic acid and nitrilotriacetic acid; and the precipitator is selected from aqueous ammonia and urea, at a concentration of 5-30%.

16. A process of preparing the integrated catalyst according to any one of claims 1 to 13, comprising:

1) respectively providing powders of a plurality of different active phases;

2) respectively molding the powders of the plurality of different active phases from step 1) to form a plurality of active phases with stable structures; and

3) integrating the plurality of active phases together by a means selected from the group consisting of: filling each active phase into a container with a plurality of chambers respectively; laminating the respective active phases; bonding the respective active phases; rolling the active phases in sequence; or co-extruding the active phases; wherein, the effective distance between the respective bisecting surfaces of two adjacent different active phases is controlled to be 0.5-5 mm, and preferably 1-3 mm.

17. The process of claim 16, characterized in that the particle size of the powders is 8 to 400 mesh.

18. The process according to claim 16 for preparing a multilayer structure of at least two layers, comprising:

1) respectively providing powders of a first active phase and powders of a second active phase;

2) molding one type of the powders obtained from step 1) to prepare a catalyst layer A;

3) combining a catalyst layer B formed by another type of powders in the step 1) on one bottom surface of the catalyst layer A;

4) optionally, using the method of step 3), combining other catalyst layer(s) on the basis of the two-layer catalyst particles compact obtained in step 3); and

5) drying and calcining the finally obtained catalyst particles compact to obtain the catalyst particles.

19. The process according to claim 18, characterized in that a tabletting or rolling process is used for the molding process.

20. The process according to claim 18 or 19, characterized in that the first active phase is a disproportionation catalyst, wherein a first adhesive is used during the first active phase powder being molded, and the first adhesive is at least

one selected from silica sol and aluminum sol; and/or the second active phase is an isomerization catalyst, wherein a second binder is used during the second active phase powder being molded,, and the second binder is at least one selected from polyvinyl alcohol, hydroxymethyl cellulose, hydroxypropyl methyl cellulose, hydroxypropyl cellulose and polyvinylpyrrolidone.

21. The process according to claim 20, characterized in that the weight ratio of the first active phase powders to the first adhesive is 3: 1-1: 2; and/or the weight ratio of the second active phase powders to the second adhesive is 3: 1-1: 2.

22. The process according to claim 18, characterized in that the step 5) is carried out under conditions of: drying at a temperature of 80-110 ℃ for 8-15 hours; and preferably the calcining process is as follows: controlling the heating rate to be 0.5-1.5 ℃/min in the whole process, raising the temperature from room temperature to 280-320 ℃ in an inert atmosphere, keeping the temperature for 4-8 h, raising again the temperature to 460-500 ℃, keeping temperature for 4-8 h, then shifting the atmosphere to an oxygen-containing atmosphere, raising the temperature to 530-570 ℃, keeping the temperature for 4-8 h, then shifting the atmosphere to the inert atmosphere again, and keeping the temperature for 4-8 h.

23. Use of the integrated catalyst according to any of claims 1 to 13 for the disproportionation of olefins.