Claims

1. An aluminosilicate molecular sieve catalyst, which is a ZSM-5 molecular sieve and shows a desorption curve having three peaks P1, P2 and P3 in its NH_3-TPD pattern, and the desorption temperatures corresponding to the summits of the three peaks P1, P2 and P3 are respectively in a range of 180-220 °C, 250-290 °C and 370-410 °C, preferably in a range of 190-210 °C, 260-280 °C and 380-400 °C,

wherein the weak acid content S1, the medium-strong acid content S2 and the strong acid content S3 of the catalyst satisfy the following relationship:

S2/S1= (0.38-0.52) : 1, preferably, S2/S1= (0.4-0.5) : 1;

S2/S3= (0.32-0.58) : 1, preferably, S2/S3= (0.35-0.55) : 1; and

S3/S1= (0.8-1.2) : 1, preferably, S3/S1= (0.9-1.1) : 1,

wherein the ratios between the weak acid content S1, the medium-strong acid content S2 and the strong acid content S3 are calculated based on the ratios between the integral areas of the desorption curve within the temperature ranges of 100-240 °C, 240-300 °C and 300-500 °C in the NH_3-TPD pattern of the catalyst.

2. The catalyst according to claim 1, wherein the peak heights H1, H2 and H3 of the three peaks P1, P2 and P3 satisfy the relationship H1> H2> H3, preferably the peak heights H1, H2 and H3 satisfy the following relationships:

H2/H1= (0.5-0.8) : 1;

H3/H2= (0.8-0.9) : 1; and

H3/H1= (0.4-0.7) : 1.

3. The catalyst according to claim 1 or 2, wherein the proportion of the weak acid content S1 to the total acid content of the catalyst is 40-50%, the proportion of the medium-strong acid content S2 to the total acid content is 15-25%, and the proportion of the strong acid content S3 to the total acid content is 35-45%, wherein the proportions of the weak acid content S1, the medium-strong acid content S2 and the strong acid content S3 to the total acid content are calculated from the proportions of the integral areas of the desorption curve within the temperature ranges of 100-240 °C, 240-300 °C and 300-500 °C in the NH_3-TPD pattern of the catalyst relative to the total integral area of the desorption curve in the temperature range of 100-500 °C in the NH_3-TPD pattern of the catalyst.

4. The catalyst according to any one of claims 1-3, wherein the catalyst has one or

more of the following characteristics:

the proportion of the super acid content to the total acid content of the catalyst is less than 5%, preferably less than 3%, wherein the proportion of the super acid content to the total acid content is calculated from the proportion of the integral area of the desorption curve in a temperature range of more than 500 °C in the NH_3-TPD pattern of the catalyst to the total integral area of the desorption curve in a temperature range of 100-500 °C in the NH_3-TPD pattern of the catalyst;

no additional modifying metallic or non-metallic component, such as zinc, magnesium, calcium, iron, cobalt, nickel, phosphorus, lanthanum, copper, zirconium, chromium, manganese, silver, ruthenium, palladium, platinum, titanium, tin, strontium, barium, vanadium, lithium, and the like, is supported on the catalyst;

the catalyst comprises two types of crystalline grains of different sizes, and the sizes of the crystalline grains are respectively 10-300nm and 400-1600nm; preferably, the number of the type of crystalline grains having a size of 10-300nm accounts for 5-60% of the total number of the crystalline grains, and the number of the type of crystalline grains having a size of 400-1600nm accounts for 40-95% of the total number of the crystalline grains;

the catalyst has an isolated aluminum content of 97.5-100%, preferably 99-100%;

the catalyst has a mechanical strength of 100-170N/cm, preferably 110-160N/cm; and

the catalyst has a SiO_2/Al_2O_3 molar ratio of 30-400.

5. A method for producing an aluminosilicate molecular sieve catalyst according to any one of claims 1-4, comprising the steps of:

1) mixing a template, a silicon source, a first aluminum source and water while heating to obtain a first mixture;

2) mixing the first mixture, silicon powder and a second aluminum source to obtain a second mixture;

3) shaping the second mixture to obtain a third mixture;

4) contacting the third mixture, an alkali source, and a regulator to obtain a fourth mixture, wherein the regulator is a polyhydroxy high molecular compound, preferably selected from the group consisting of hydroxyethylcellulose, hydroxymethylcellulose, hydroxypropylmethylcellulose, methylcellulose, casein, gum arabic, or any combination thereof; and

5) treating the fourth mixture to obtain the aluminosilicate molecular sieve catalyst, wherein the treatment comprises calcining.

6. The method according to claim 5, wherein the step 1) has one or more of the following characteristics:

the template is selected from tetrapropylammonium hydroxide, tetrapropylammonium bromide, tetraethylammonium hydroxide, tetraethylammonium bromide or a combination thereof, the silicon source is selected from silica sol, white carbon black, tetraethyl silicate, silicon powder or a combination thereof, and the first aluminum source is selected from aluminum chloride, aluminum nitrate, aluminum sulfate, aluminum isopropoxide, pseudo-boehmite or a combination thereof;

the molar ratios between the template, the silicon source, the first aluminum source and water satisfy: template : silicon source = (0.05-1.0) : 1, silicon source : first aluminum source = (30-400) : 1, and water : silicon source = (3-12) : 1, wherein the silicon source is calculated as SiO_2 , and the first aluminum source is calculated as Al_2O_3; and

the mixing while heating in step 1) comprises the step of mixing the template, the silicon source, the first aluminum source and water while stirring in a closed container for 4-20 hours at a temperature of 90-150 °C.

7. The method according to claim 5 or 6, wherein the step 2) has one or more of the following characteristics:

the silicon powder comprises two types of silica particles having different sizes, the sizes of the silica particles are respectively 0.1-2 μm and 4-12 μm, and the mass ratio of the two types of silica particles is (0.5-2.0) : 1;

the second aluminum source is selected from aluminum chloride, aluminum nitrate, aluminum sulfate, aluminum alkoxide, pseudo-boehmite, aluminum hydroxide or a combination thereof; and

the ratios between the first mixture, the silicon powder and the second aluminum source satisfy: the weight ratio of the first mixture to the silicon powder is (0.2-0.8) : 1; the molar ratio of the silicon powder to the second aluminum source is (30-400) : 1; wherein the silicon powder is calculated as SiO_2, and the second aluminum source is calculated as Al_2O_3.

8. The method according to any one of claims 5-6, wherein the step 4) has one or more of the following characteristics:

the alkali source is selected from tetrapropylammonium hydroxide, tetraethylammonium hydroxide, ammonia water, ethylamine, ethylenediamine, n-butylamine, hexamethylenediamine, cyclohexylamine, piperidine, hexamethyleneimine, homopiperazine, dicyclohexylamine, or a combination thereof;

the mass ratios between the third mixture, the alkali source and the regulator satisfy: alkali source : third mixture = (0.1-0.4) : 1; and regulator : third mixture = (0.01-0.05) : 1; and

the contacting of step 4) comprises mixing the alkali source and the regulator at 30-60 °C for 3-10 hours while stirring, then adding the third mixture, and standing in a closed space at 30-60 °C for 5-10 hours.

9. The method according to any one of claims 5 to 8, wherein the treatment of step 5) comprises subjecting the fourth mixture to standing or stirring 130-190 °C for 12-72 hours in a closed space, followed by washing, drying, calcining and acid washing.

10. A process for gas-phase alkylation of an aromatic hydrocarbon with an olefin, comprising the step of contacting the aromatic hydrocarbon with the olefin for alkylation reaction in the presence of the catalyst according to any one of claims 1 to 4, to obtain an alkylaromatic hydrocarbon.

11. The process according to claim 10, wherein the aromatic hydrocarbon is selected from benzene, alkylbenzene or a combination thereof, preferably selected from benzene, toluene, ethylbenzene, n-propylbenzene, isopropylbenzene, n-butylbenzene, isobutylbenzene, tert-butylbenzene, or a combination thereof; the olefin is selected from C2-C6 olefins, preferably selected from ethylene, propylene, n-butene, isobutylene, or a combination thereof;

preferably, the alkylation conditions include: a reaction temperature of 260-400 °C, a reaction pressure of 0.1-3.0MPa, a mass space velocity of the olefin of 0.1-10.0 h^{-1}, and a molar ratio of the aromatic hydrocarbon to the olefin of 2-20.