CLAIMS

1. A composition for a catalytic cracking catalyst comprising: a rare-earth-modified Y-type molecular sieve, a binder, a matrix material, a rare earth element source, and optionally an REUSY molecular sieve,

wherein a content of SO_4^{2-} in the rare-earth-modified Y-type molecular sieve is not greater than 1wt%;

wherein the rare-earth-modified Y-type molecular sieve is obtained by subjecting a Na-type Y molecular sieve to a modification treatment, and a method of the modification treatment comprises the following steps:

(a) subjecting a Na-type Y molecular sieve to a rare earth ion exchange to obtain a rare earth ion slurry;

(b) adding a first precipitating agent into the rare earth ion slurry to cause a first precipitation of a part of rare earth ions in said rare earth ion slurry to obtain a first precipitation slurry;

(c) subjecting solid matter in the first precipitation slurry to a first ammonium sulfate exchange, a first water washing and a first calcination to obtain an once-exchanged and once-calcined molecular sieve dry powder;

(d) mixing a slurry containing the once-exchanged and once-calcined molecular sieve dry powder with a second precipitating agent to cause a second precipitation of a part of rare earth ions in the once-exchanged and once-calcined molecular sieve dry powder, and then sequentially performing a second ammonium sulfate exchange, a second water washing and an optional heat treatment to obtain the rare-earth-modified Y-type molecular sieve.

2. The composition according to claim 1, wherein the rare earth element source is calculated based on the weight of rare earth oxide, and the composition comprises 15-35wt% of the rare-earth-modified Y-type molecular sieve, 0-20wt% of the REUSY molecular sieve, 6-30wt% of the binder, 30-55wt% of the matrix material, and 0.5-4wt% of the rare earth element source.

3. The composition according to claim 2, wherein the rare earth element source is calculated based on the weight of rare earth oxide, and the composition comprises 18-27wt% of the rare-earth-modified Y-type molecular sieve, 8-15wt% of the REUSY molecular sieve, 8-25wt% of the binder, 35-45wt% of the matrix material, and 0.5-3wt% of the rare earth element source.

4. The composition according to claim 1, wherein in the rare-earth-modified Y-type molecular

sieve,

the content of SO_4^{2-} is not greater than 0.5wt%; and/or

a content of sodium calculated in terms of Na_2O is not greater than 1.5wt%; and/or

a content of rare earth calculated in terms of rare earth oxide is 5wt% -20wt%; and/or

a crystallinity C/C_0 of said rare-earth-modified Y-type molecular sieve is 50-80%.

5. The composition according to claim 4, wherein in the rare-earth-modified Y-type molecular sieve:

the content of sodium calculated in terms of Na_2O is 0.5wt%-1.2wt%; and/or

the content of rare earth calculated in terms of rare earth oxide is 10wt% -20wt%; and/or

the crystallinity C/C_0 of the rare-earth-modified Y-type molecular sieve is 58-65%.

6. The composition according to claim 1, wherein in step (a), a process of the rare earth ion exchange comprises: carrying out the rare earth ion exchange between Na-type Y molecular sieve and a rare earth source in the presence of water; and/or

the rare earth ion exchange conditions comprise: a temperature between room temperature and 180°C; and/or an exchange time of 0.3-3.5h; and/or a pH of 2.8-6.5.

7. The composition according to claim 6, wherein the rare earth source is selected from chlorate and/or nitrate containing at least one of rare earth elements; and/or

the Na-type Y molecular sieve is calculated on a dry basis, the rare earth source is calculated in terms of rare earth oxide, and a content of the rare earth source in the Na-type Y molecular sieve is 1-20wt%; and/or

a weight ratio of water to the Na-type Y molecular sieve is (1.5-30) : 1.

8. The composition according to claim 7, wherein the rare earth element comprises at least one of lanthanum, cerium and yttrium; and/or

the Na-type Y molecular sieve is calculated on a dry basis, the rare earth source is calculated in terms of rare earth oxide, and the content of the rare earth source in the Na-type Y molecular sieve is 10-16wt%; and/or

the weight ratio of water to the Na-type Y molecular sieve is (2-5) : 1; and/or

the rare earth ion exchange conditions comprise: a temperature is of 50-80°C; and/or an exchange time of 0.5-1.5h; and/or a pH of 3.5-4.5.

9. The composition according to claim 1, wherein in step (b), an amount of the first precipitating

agent is based on a molar ratio for the precipitation of 1-4 wt% of the rare earth ions present in the Na-type Y molecular sieve; and/or

the conditions of the first precipitation comprise: a temperature of 25-180°C; and/or a time of 0.1-5h.

10. The composition according to claim 9, wherein in step (b), the amount of the first precipitating agent is based on a molar ratio for the precipitation of 1.5-2.5 wt% of the rare earth ions present in the Na-type Y molecular sieve; and/or

the conditions of the first precipitation comprise: a temperature of 50-80°C; and/or a time of 0.1-2h.

11. The composition according to claim 1, wherein in step (c), an amount of ammonium sulfate in the first ammonium sulfate exchange is 5-50wt% of the Na-type Y molecular sieve; and/or

the conditions of the first ammonium sulfate exchange comprise: a temperature of 20-85°C; and/or a time of 0.1-5h; and/or

the conditions of the first calcination comprise: 100% water vapor atmosphere; and/or a temperature of 400-700°C; and/or a time of 0.1-5h.

12. The composition according to claim 11, wherein in step (c), the amount of ammonium sulfate in the first ammonium sulfate exchange is 10-25wt% of the weight of Na-type Y molecular sieve; and/or

the conditions of the first ammonium sulfate exchange comprise: a temperature of 50-80°C; and/or a time of 0.1-2h; and/or

the conditions of the first calcination comprise: a temperature of 500-650°C; and/or a time of 0.5-3h; and/or

the first ammonium sulfate exchange process comprises: subjecting the solid matter in the first precipitation slurry to a first ammonium sulfate exchange with an aqueous ammonium sulfate solution.

13. The composition according to claim 12, wherein a concentration of the aqueous ammonium sulfate solution is 20-400g/L.

14. The composition according to claim 1, wherein in step (d), a weight ratio of water to the once-exchanged and once-calcined molecular sieve dry powder in the slurry containing the once-exchanged and once-calcined molecular sieve dry powder is (1.5-30) : 1; and/or

an amount of the second precipitating agent is based on a molar ratio for the second precipitation of 0.5-3wt% of the rare earth ions present in the once-exchanged and once-calcined molecular sieve dry powder; and/or

the conditions of the second precipitation comprise: a temperature of 15-40°C; and/or a time of 0.1-5h; and/or

an amount of ammonium sulfate in the second ammonium sulfate exchange is 5-50wt% of a weight of said once-exchanged and once-calcined molecular sieve dry powder; and/or

the conditions for the second ammonium sulfate exchange comprise: a temperature of 20-85°C; and/or a time of 0.1-5h; and/or

the heat treatment comprises drying and a second calcination, and the conditions of the second calcination comprise: in an oxygen-containing atmosphere; and/or a temperature of 400-700°C; and/or a time of 0.1-10h.

15. The composition according to claim 14, wherein in step (d), the weight ratio of water to the once-exchanged and once-calcined molecular sieve dry powder in the slurry containing the once-exchanged and once-calcined molecular sieve dry powder is (2-5) : 1; and/or

the amount of the second precipitating agent is based on the molar ratio for the second precipitation of 1-2wt% of the rare earth ions present in the once-exchanged and once-calcined molecular sieve dry powder; and/or

the conditions of the second precipitation comprise: a temperature of 20-30°C; and/or a time of 0.1-2h; and/or

the amount of ammonium sulfate in the second ammonium sulfate exchange is 10-25wt% of the weight of said once-exchanged and once-calcined molecular sieve dry powder; and/or

the conditions for the second ammonium sulfate exchange comprise: a temperature of 50-80°C; and/or a time of 0.1-2h; and/or

the conditions of the second calcination comprise: a temperature of 450-650°C; and/or a time of 0.5-5h.

16. The composition according to claim 15, wherein a process of the second ammonium sulfate exchange is as follows: performing a second ammonium sulfate exchange on a product of the second precipitation with a second aqueous ammonium sulfate solution, wherein a concentration of the second ammonium sulfate aqueous solution is 20-400g/L.

17. The composition according to claim 1, wherein the Na-type Y molecular sieve comprises at least one of NaY molecular sieve, NaHY molecular sieve, NaUSY molecular sieve, NaREHY molecular sieve and NaREUSY molecular sieve; and/or

the first precipitating agent and the second precipitating agent are each independently selected from ammonium compounds that can provide rare earth ions to generate anions of oxide precipitation precursors.

18. The composition according to claim 17, wherein the first precipitating agent and the second precipitating agent are each independently selected from one or more of ammonium oxalate, ammonium carbonate, ammonium bicarbonate and aqueous ammonia.

19. The composition according to any one of claims 1-3, wherein the binder comprises at least one of aluminum sol, acidified pseudo-boehmite, acidic silica sol and phosphate-aluminum sol; and/or

the matrix material contains clay, wherein the clay comprises at least one of kaolin, halloysite, porous stone, diatomite and sepiolite; and/or

the rare earth element source is selected from at least one of rare earth chloride, rare earth nitrate, rare earth oxide, rare earth carbonate, rare earth oxalate and rare earth acetate; and/or

the REUSY molecular sieve comprises at least one of a LaUSY molecular sieve, a CeUSY molecular sieve, and a mixed rare earth USY molecular sieve.

20. A method of preparing a catalytic cracking catalyst comprising:

(1) homogenizing a slurry containing the composition for a catalytic cracking catalyst according to any one of claims 1-19, followed by molding and a third calcination to obtain a catalyst precursor;

(2) performing sodium reduction and modification on the catalyst precursor to obtain the catalytic cracking catalyst.

21. The preparation method according to claim 20, wherein the solid content of the slurry containing the composition for a catalytic cracking catalyst is 25-45wt%; and/or

conditions of the third calcination comprise: a temperature of 400-550°C; and/or a time of 0.1-5h; and/or

the method for sodium reduction and modification comprises: mixing a slurry containing the catalyst precursor with an ammonium salt to obtain a mixed solution, and then separating the solid matter from the mixed solution for drying.

22. The method according to claim 21, wherein the solid content of the slurry containing the composition for a catalytic cracking catalyst is of 35-45wt%; and/or

the conditions of the third calcination comprise: a temperature of 450-500°C; and/or a time of 0.1-2h; and/or

the ammonium salt comprises at least one of ammonium chloride, ammonium phosphate, diammonium hydrogen phosphate and diammonium dihydrogen phosphate; and/or

a weight ratio of the ammonium salt to the catalyst precursor is (2-10) :100; and/or

a solid content of the catalyst precursor-containing slurry is 0.5wt%-35wt%.

23. A catalytic cracking catalyst prepared by the method according to any one of claims 20-22.

24. The catalytic cracking catalyst according to claim 23, wherein a content of Na^+ in the catalytic cracking catalyst calculated in terms of Na_2O is not greater than 0.2wt%.

25. A use of the catalytic cracking catalyst according to claim 23 or 24 in the catalytic cracking of heavy oil.

26. The use according to claim 25, wherein the catalytic cracking catalyst is used in the catalytic cracking of heavy oil with a high content of heavy metals.

27. The use according to claim 26, wherein the heavy metals comprise V, and optionally Ni.