Claims

1. A zirconium-based metal-organic framework material having a chemical structural formula $[C_{18}H_6O_{16}Zr_3]_n$, wherein the zirconium-based metal-organic framework material comprises a zirconium element and an organic ligand which forms a coordination bond with the zirconium element, and the organic ligand is diphenylethyne-3,3',5,5'-tetracarboxylic acid.

2. The zirconium-based metal-organic framework material according to claim 1, wherein the crystal of the zirconium-based metal-organic framework material belongs to the tetragonal crystal system with I4/mmm space group.

3. The zirconium-based metal-organic framework material according to claim 1, wherein the molecular structure of the zirconium-based metal-organic framework material is a three-dimensional network structure with one-dimensional channels.

4. The zirconium-based metal-organic framework material according to claim 3, wherein the one-dimensional channels have a size of 5-7 Å.

5. The zirconium-based metal-organic framework material according to claim 3, wherein the three-dimensional network structure is formed by ZrO_6 octahedron connected with the organic ligand.

6. The zirconium-based metal-organic framework material according to claim 5, wherein the ZrO_6 octahedron comprises six Zr atoms.

7. The zirconium-based metal-organic framework material according to claim 1, wherein the zirconium-based metal-organic framework material has a specific surface area of 500-1000 m^2/g.

8. The zirconium-based metal-organic framework material according to claim 7, wherein the zirconium-based metal-organic framework material has a thermal decomposition temperature of 350-500°C.

9. The zirconium-based metal-organic framework material according to claim 7, wherein the zirconium-based metal-organic framework material is in the form of white powder crystals.

10. A method for preparing the zirconium-based metal-organic framework material according to claim 1, comprising the steps of:

(1) mixing a zirconium salt, an organic ligand, a first solvent and an acid in a proportion, and performing a solvothermal reaction or a microwave synthesis process to obtain a semi-finished product; and

(2) removing the solvent in the channels of the semi-finished product, to obtain a finished product of the zirconium-based metal-organic framework material.

11. The method according to claim 10, wherein the molar ratio of the zirconium salt, the organic ligand, the first solvent and the acid is 10:(1-100):(1-100):(2-200).

12. The method according to claim 10, wherein the zirconium salt is selected from at least one of zirconium nitrate, zirconium chloride, aluminum zirconium oxide, and zirconium sulfate;

the organic ligand is diphenylethyne-3,3',5,5'-tetracarboxylic acid;

the first solvent is selected from at least one of N,N-dimethylformamide, N,N-dimethylacetamide, and N,N-diethylformamide

the acid is selected from at least one of formic acid, acetic acid, hydrochloric acid, and benzoic acid.

13. The method according to claim 10, wherein the reaction temperature of the solvothermal reaction is 80-200°C and the reaction time is 12-72 h;

the reaction temperature of the microwave synthesis process is 80-180°C and the reaction time is 1-60 min;

the removing the solvent in the channels of the semi-finished product is carried out by vacuum drying the semi-finished product, or by impregnating the semi-finished product in a second solvent for solvent exchange, and then vacuum drying; the second solvent is selected from at least one of methanol, dichloromethane, ethanol, and acetone.

14. An adsorption separation method for alkane isomers, comprising: passing a mixture gas or mixture liquid containing hexane isomers through an adsorption column filled with an adsorbent, collecting the constituent isomers one by one, and desorbing the adsorbent after completion of the collection; wherein the adsorbent is the zirconium-based metal-organic framework material according to claim 1.

15. The adsorption separation method for alkane isomers according to claim 14, wherein the desorption is carried out by one or more of heating, vacuum treatment, and inert gas purging.

16. The adsorption separation method for alkane isomers according to claim 14, wherein the adsorption temperature is 0-200°C.

17. The adsorption separation method for alkane isomers according to claim 14, wherein the total pressure of the mixture gas during the adsorption is 0-5 bar.

18. The adsorption separation method for alkane isomers according to claim 14, wherein

the desorption temperature is 100-200°C.

19. The adsorption separation method for alkane isomers according to claim 14, wherein the total pressure of the mixture gas during the desorption is 0.05-1 bar.

20. The adsorption separation method for alkane isomers according to claim 14, wherein the total amount of the hexane isomers is 70-90% of the total mass of the mixture gas or mixture liquid.