Claims

1. A catalyst useful for producing organic amines by catalytic amination, comprising an inorganic porous carrier containing aluminium and/or silicon and an active metal component supported on the carrier, wherein the active metal component comprises cobalt, nickel or a combination thereof, wherein the carrier has an L acid content of 85% or more, preferably 88% or more, more preferably 90% or more, especially preferably 92% or more, relative to the total of the L acid and B acid contents, and the ratio of the L acid content of the catalyst carrier to the total of the L acid and B acid contents is measured by pyridine probe adsorption spectrometry,

the carrier comprises a matrix and a doping element, wherein the matrix is selected from alumina, silica, molecular sieves, diatomite, aluminosilicates, or combinations thereof, and

the doping element is selected from the group consisting of Group IIIA non-metallic elements, Group VA non-metallic elements, Group VIA non-metallic elements, Group VIIA non-metallic elements and combinations thereof, excluding chlorine.

2. The catalyst according to claim 1, wherein

the doping element is selected from boron, fluorine, phosphorus, sulfur, selenium or a combination thereof;

preferably, the doping element in the carrier was derived from a non-metallic acid radical ion, the non-metallic acid radical ion is preferably selected from the group consisting of borate ion, fluoride ion, phosphate ion, sulfate ion, selenate ion and combinations thereof.

3. The catalyst according to claim 1 or 2, wherein the carrier has at least one of the following characteristics:

the proportion of the pore volume of pores having a pore diameter in a range of 7-27 nm to the pore volume of the carrier is greater than 65%, preferably 70 to 90%, and the proportion of the pore volume of pores having a pore diameter less than 7 nm to the pore volume of the carrier is 0 to 10%, preferably 0 to 8%;

the proportion of the pore volume of pores having a pore diameter of less than 7.5nm to the pore volume of the carrier is less than 20%, preferably 5-17%, the proportion of the pore volume of pores having a pore diameter of less than 9nm to the pore volume of the carrier is less than 40%, the proportion of the pore volume of pores having a pore diameter

of greater than 27nm to the pore volume of the carrier is less than 5%, preferably 0.5-5%, preferably, the proportion of the pore volume of pores having a pore diameter of more than or equal to 7.5nm and less than 9nm to the pore volume of the carrier is 5-17%, and the proportion of the pore volume of pores having a pore diameter of more than or equal to 9nm and less than or equal to 27nm to the pore volume of the carrier is 61-89.5%;

the carrier has an ammonia adsorption capacity of 0.25-0.65 mmol/g, preferably 0.3-0.6 mmol/g, and more preferably 0.3-0.5 mmol/g;

the content of alumina in the carrier was 65 wt% or more, preferably 70 wt% or more, more preferably 75 wt% or more, based on the total amount of the matrix;

the content of the doping element is 0.05 to 6 wt%, preferably 0.05 to 5 wt%, more preferably 0.05 to 4.5 wt%, and particularly preferably 0.07 to 4 wt%, relative to the total amount of the matrix;

the carrier has a specific surface area of 100-220 m^2/g, preferably 105-210 m^2/g, more preferably 110-210 m^2/g, and particularly preferably 120-210 m^2/g;

the carrier has a pore volume of 0.4-1.1 ml/g, preferably 0.43-1.1 ml/g, more preferably 0.45-1.1 ml/g, and particularly preferably 0.45-1 ml/g; and

the isoelectric point of the carrier is 3-6, preferably 3.5-5.5.

4. The catalyst according to any one of claims 1-3, wherein the active metal component is present in an amount of 5 to 45 g, preferably 8 to 44 g, more preferably 10 to 38 g, particularly preferably 15 to 37 g, per 100g of the matrix, preferably the active metal component has a grain size of less than 10nm, more preferably 3 to 8 nm.

5. The catalyst according to any one of claims 1-4, further comprising a metal promoter supported on the carrier, and the metal promoter comprises at least one metal selected from the group consisting of Group VIB, Group VIIB, Group IB, Group IIB, and lanthanide series metals, preferably at least one metal selected from Cr, Mo, W, Mn, Re, Cu, Ag, Au, Zn, La, and Ce;

preferably, the metal promoter is present in an amount of 0 to 10g, preferably 0.1 to 10g, more preferably 0.5 to 8 g, per 100 g of the matrix.

6. The catalyst according to claim 5, wherein:

the metal promoter comprises a combination of at least one Group VIIB metal and at least one Group IB metal, wherein the weight ratio of the Group VIIB metal to the Group IB metal, calculated as metal element, is 0.05-15 : 1, preferably 0.1-12 : 1; or alternatively

the metal promoter comprises a combination of at least one Group VIIB metal and at least one Group IIB metal, wherein the weight ratio of the Group VIIB metal to the Group IIB metal, calculated as metal element, is 0.2-20 : 1, preferably 0.3-6 : 1; or alternatively

the metal promoter comprises a combination of at least one Group VIB metal, at least one Group IB metal and at least one Group IIB metal, wherein the weight ratio of the Group VIB metal to the Group IB metal and to the Group IIB metal, calculated as metal element, is 0.1-10 : 0.1-10 : 1, preferably 0.2-8 : 0.2-8 : 1,

preferably, the Group VIIB metal is selected from manganese, rhenium, or a combination thereof, the Group IB metal is selected from copper, silver, gold, or a combination thereof, the Group IB metal is zinc, and/or the Group VIB metal is selected from molybdenum, tungsten, or a combination thereof.

7. The catalyst according to any one of claims 1-4, further comprising a metal promoter supported on the carrier, wherein the metal promoter is a combination of at least one Group IIA metal, at least one Group IIB metal and at least one Group VA metal,

preferably, the metal promoter is present in an amount of 0.1 to 10g, preferably 0.5 to 6g, per 100 g of the matrix;

preferably, the weight ratio of the Group IIA metal to the Group IIB metal and to the Group VA metal in the metal promoter is 0.1-10 : 0.1-10 : 1, preferably 0.2-8 : 0.2-8 : 1;

preferably, the Group IIA metal is selected from magnesium, calcium, barium, or a combination thereof, the Group IIB metal is zinc, and/or the Group VA metal is bismuth.

8. A method for producing the catalyst according to any one of claims 1-7, comprising the steps of:

1) providing an inorganic porous carrier containing aluminum and/or silicon, which comprises subjecting a mixture comprising a doping element and a matrix or a precursor thereof to shaping, drying and calcining sequentially to obtain the carrier, which carrier has an L acid content of 85% or more, preferably 88% or more, more preferably 90% or more, particularly preferably 92% or more, relative to the total of the L acid and B acid contents, the drying conditions include: a temperature of 80-150 °C, and a drying time of 6-20 h; and the calcining conditions include: a temperature of 500-1120 °C, and a calcining time of 2-20 h;

2) loading the active metal component and optionally the metal promoter on the carrier; and

3) carrying out a heat treatment and optionally a reduction treatment on the material obtained in step 2) to obtain the catalyst,

preferably, the heat treatment comprises calcining, or a combination of drying and calcining.

9. The method according to claim 8, wherein the matrix is selected from alumina, silica, molecular sieves, diatomite, aluminosilicates or combinations thereof, preferably, the alumina precursor is pseudo-boehmite having a specific surface area of 250-400 m^2/g, preferably 255-360 m^2/g, more preferably 255-340 m^2/g, particularly preferably 260-330 m^2/g and a pore volume of 0.5-1.3 ml/g, preferably 0.75-1.25 ml/g, more preferably 0.78-1.2 ml/g, particularly preferably 0.78-1.1 ml/g;

the doping element is a non-metallic element, preferably selected from the group consisting of Group IIIA non-metallic elements, Group VA non-metallic elements, Group VIA non-metallic elements, Group VIIA non-metallic elements and combinations thereof excluding chlorine, preferably selected from boron, fluorine, phosphorus, sulfur, selenium or a combination thereof, and

the calcining conditions of step 1) include: a temperature of 800-1050 °C.

10. The method according to claim 9, wherein the doping element is provided using a carrier modifier comprising at least one compound capable of providing a non-metallic acid radical ion, such as an inorganic acid and/or an inorganic salt comprising a non-metallic acid radical, preferably the non-metallic acid radical ion is selected from borate ion, fluoride ion, phosphate ion, sulfate ion, selenate ion or a combination thereof;

preferably, the carrier modifier is selected from boric acid, nickel borate, cobalt borate, potassium borate, ammonium borate, magnesium borate, potassium fluoride, magnesium fluoride, cobalt fluoride, nickel fluoride, hydrofluoric acid, ammonium fluoride, phosphoric acid, aluminum phosphate, tripotassium phosphate, potassium dihydrogen phosphate, potassium hydrogen phosphate, magnesium phosphate, calcium phosphate, ammonium phosphate, sulfuric acid, cobalt sulfate, nickel sulfate, aluminum sulfate, calcium sulfate, potassium sulfate, magnesium sulfate, strontium phosphate, strontium sulfate, selenic acid, or combinations thereof.

11. The method according to any one of claims 8-10, wherein the loading of step 2) comprises impregnating the carrier with a solution comprising a precursor of the active metal component and optionally a precursor of the metal promoter, preferably the impregnation

solution has a pH in a range of 3.5-5.5.

12. A process for producing organic amines, comprising: contacting an amination raw material and an amination reagent with the catalyst according to any one of claims 1-7 in the presence of hydrogen for amination reaction to obtain an organic amine,

wherein the amination raw material is selected from alcohols, ketones, alcohol amines, aldehydes or combinations thereof, preferably selected from C2-20 alcohols, C3-20 ketones, C2-20 alcohol amines, C2-20 aldehydes or combinations thereof, more preferably selected from ethanol, acetaldehyde, n-propanol, propionaldehyde, isopropanol, n-butanol, butyraldehyde, isobutanol, isobutyraldehyde, 2-ethylhexanol, 2-ethylhexaldehyde, octanol, octanal, dodecanol, dodecanal, hexadecanol, hexadecanal, cyclopentanol, cyclohexanol, cyclooctanol, cyclododecanol, benzyl alcohol, benzaldehyde, phenethyl alcohol, phenylacetaldehyde, 1,4-butanediol, 1,4-butanedial, 1,5-pentanediol, 1,5-glutaraldehyde, 1,6-hexanediol, 1,6-hexandial, 1,8-octanediol, 1,8-octanedial, 1,12-dodecanediol, 1,12-dodecanedialdehyde, ethanolamine, propanolamine, isopropanolamine, 6-aminohexanol, diethanolamine, diisopropanolamine, dimethylethanolamine, acetone, ethylene glycol, 1,3-propanediol, or combinations thereof;

the amination reagent is selected from ammonia, primary amines, secondary amines or a combination thereof, preferably selected from ammonia, C1-12 primary amines, C1-12 secondary amines or a combination thereof, more preferably selected from ammonia, monomethylamine, dimethylamine, methylethylamine, monoethylamine, diethylamine or a combination thereof.

13. The process according to claim 12, wherein the amination conditions include: a molar ratio of hydrogen to the amination reagent and to the amination raw material of 1-6 : 2-35 : 1, preferably 1-6 : 2-33 : 1, more preferably 1-5 : 3-33 : 1, a temperature of 105-230 °C, preferably 110-220 °C, more preferably 110-210 °C, a pressure of 0.7-25 MPa, preferably 1-25 MPa, more preferably 1-22 MPa, particularly preferably 1-17 MPa, and a liquid phase volume space velocity of the amination raw material of 0.06-1 $m^3/(m^3 \cdot h)$.

14. The process according to claim 13, wherein:

where the amination raw material is a monohydric alcohol, the amination conditions include: a molar ratio of hydrogen to the amination reagent and to the amination raw material of preferably 1-4 : 2-9 : 1, more preferably 1-4 : 2-8 : 1, a temperature of 130-210 °C, preferably 130-2080 °C, more preferably 130-200 °C, a pressure of 0.8-3.5 MPa, preferably

1-2.5 MPa, and a liquid phase volume space velocity of the amination raw material of 0.1-0.8 $m^3/(m^3 \cdot h)$;

where the amination raw material is a ketone or an aldehyde, the amination conditions include: a molar ratio of hydrogen to the amination reagent and to the amination raw material of 1-4 : 2-6 : 1, preferably 1-4 : 2-5 : 1, a temperature of 105-180 °C, preferably 110-170 °C, more preferably 110-160 °C, a pressure of 0.7-2.5 MPa, preferably 1-2.5 MPa, more preferably 1-2 MPa, and a liquid phase volume space velocity of the amination raw material of 0.1-1 $m^3/(m^3\ h)$, preferably 0.1-0.8 $m^3/(m^3\ h)$;

where the amination raw material is an alcohol amine, the amination conditions include: a molar ratio of hydrogen to the amination reagent and to the amination raw material of 1-4 : 3-23 : 1, preferably 1-4 : 3-20 : 1, more preferably 1-4 : 3-10 : 1, a temperature of 130-200 °C, a pressure of 1-16 MPa, preferably 1-13 MPa, more preferably 1-11 MPa, and a liquid phase volume space velocity of the amination raw material of 0.06-0.8 $m^3/(m^3\ h)$;

where the amination raw material is a dihydric alcohol, the amination conditions include: a molar ratio of hydrogen to the amination reagent and to the amination raw material of 0.3-5 : 2-35 : 1, preferably 1-4 : 3-35 : 1, more preferably 1-4 : 3-33 : 1, particularly preferably 1-4 : 3-32 : 1, a temperature of 130-230 °C, preferably 130-220 °C, more preferably 130-210 °C, a pressure of 1-25 MPa, preferably 1-22 MPa, more preferably 1-17 MPa, and a liquid phase volume space velocity of the amination raw material of 0.1-0.9 $m^3/(m^3\ h)$, preferably 0.1-0.8 $m^3/(m^3\ h)$; or

where the amination raw material is a mixture of 1,6-hexanediol, hexamethyleneimine and 6-amino-1-hexanol, the amination conditions include: a molar ratio of hydrogen to the amination reagent and to the amination raw material of 0.3-4 : 3-35 : 1, preferably 1-4 : 3-33 : 1, more preferably 1-4 : 3-32 : 1, a temperature of 130-230 °C, preferably 130-220 °C, more preferably 130-210 °C, a pressure of 1-22 MPa, preferably 1-17 MPa, and a liquid phase volume space velocity of the amination raw material of 0.1-0.9 $m^3/(m^3\ h)$, preferably 0.1-0.8 $m^3/(m^3\ h)$.