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 and/or palladium, wherein the carrier has an ammonia adsorption capacity of 0.25 to 0.65 mmol/g, preferably 0.3 to 0.6 mmol/g, as measured by NH_3-TPD test,

the carrier comprises a matrix and a doping element,

the doping element is selected from a metallic element, a non-metallic element or a combination thereof and does not include sodium or chlorine, the metallic element is selected from Group IA metal elements, Group IIA metal elements, Group VA metal elements, lanthanide series metal elements or combinations thereof; the non-metallic element is selected from Group IIIA non-metallic elements, Group VA non-metallic elements, Group VIA non-metallic elements, Group VIIA non-metallic elements or combinations thereof.

2. The catalyst according to claim 1, wherein the matrix comprises a first carrier component and optionally a second carrier component, wherein the first carrier component is selected from alumina, silica, molecular sieves, aluminosilicates, or combinations thereof, the second carrier component is selected from diatomite and titania, and

he metallic element is selected from calcium, magnesium, potassium, bismuth, strontium, barium, lanthanum or a combination thereof; the non-metallic element is selected from boron, fluorine, phosphorus, sulfur, selenium or combinations thereof;

preferably, the doping element in the carrier is derived from metal cations and/or acid radical ions, but does not include sodium ion or chloride ion; the metal cation is selected from Group IA metal cations, Group IIA metal ions, Group VA metal ions, lanthanide series metal ions or combinations thereof, preferably selected from calcium ion, magnesium ion, potassium ion, bismuth ion, strontium ion, barium ion, lanthanum ion or combinations thereof; the acid radical ion is selected from non-metallic acid radical ions, preferably selected from borate ion, fluoride ion, phosphate ion, sulfate ion, selenate ion or combinations thereof.

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

the carrier has a carbon dioxide adsorption capacity of 0.05-0.4 mmol/g, preferably 0.05-0.3 mmol/g, more preferably 0.06-0.2 mmol/g;

the doping element is present in the carrier in an amount of 0.03 to 6 wt%, preferably 0.05 to 6 wt%, more preferably 0.08 to 4 wt%, relative to the total weight of the matrix;

the carrier has a specific surface area of 120-240 m^2/g, preferably 120-210 m^2/g, and more preferably 125-200 m^2/g;

the carrier has a pore volume of 0.45-1.2 ml/g, preferably 0.45-1.1 ml/g, and more preferably 0.5-1 ml/g;

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% or more, more preferably 70 to 90%, and preferably the proportion of the pore volume of pores having a pore diameter of less than 7 nm to the pore volume of the carrier is 0 to 10%, for example 0 to 8%;

the matrix in the carrier comprises a combination of alumina and titania at a weight ratio of 1.5-5 : 1, preferably 2-4.5 : 1; and

the alumina content in the carrier is 70 wt% or more, preferably 75 wt% or more, more preferably 80-100 wt%, based on the total weight of the matrix.

4. The catalyst according to any one of claims 1-3, wherein the active metal component is present in an amount of from 5 to 46 g, preferably from 10 to 42 g, for example from 13 to 40 g, per 100g of the matrix.

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

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

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 IIB metal is zinc, and the Group VIB metal is selected from molybdenum, tungsten, or a combination thereof.

7. A method for producing the catalyst according to any one of claims 1-6, comprising the steps of:

1) providing an inorganic porous carrier containing aluminium and/or silicon, which has an ammonia adsorption capacity of 0.25 to 0.65 mmol/g, preferably 0.3 to 0.6 mmol/g, as measured by NH_3-TPD test, which step 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, 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 500-1100 °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.

8. The method according to claim 7,

wherein the matrix comprises a first carrier component and optionally a second carrier component, wherein the first carrier component is selected from alumina, silica, molecular sieves, aluminosilicates or combinations thereof, the second carrier component

is selected from diatomite, titanium white powder or a combination thereof, preferably, the first carrier component is alumina, and the precursor of the first carrier component is pseudo-boehmite having a specific surface area of 250-410 m^2/g, preferably 260-400 m^2/g, more preferably 260-380 m^2/g and a pore volume of 0.7-1.3 ml/g, preferably 0.7-1.2 ml/g, more preferably 0.8-1.2 ml/g;

the doping element is selected from a metallic element, a non-metallic element or a combination thereof and does not include sodium or chlorine, the metallic element is selected from Group IA metal elements, Group IIA metal elements, Group VA metal elements, lanthanide series metal elements or combinations thereof, and preferably selected from calcium, magnesium, potassium, bismuth, strontium, barium, lanthanum or a combination thereof; the non-metallic element is selected from Group IIIA non-metallic elements, Group VA non-metallic elements, Group VIA non-metallic elements, Group VIIA non-metallic elements or combinations thereof, preferably selected from boron, fluorine, phosphorus, sulfur, selenium or combinations thereof.

9. The method according to claim 8, wherein the doping element is provided using a carrier modifier comprising at least one compound capable of providing a cation and/or an anion, wherein the cation is selected from Group IA cations, Group IIA metal ions, Group VA metal ions, lanthanide series metal ions, or combinations thereof, preferably from calcium ion, magnesium ion, potassium ion, bismuth ion, strontium ion, barium ion, lanthanum ion, or combinations thereof;

the anion is selected from non-metallic acid radical ions, preferably selected from borate ion, fluoride ion, phosphate ion, sulfate ion, selenate ion or combinations thereof;

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

10. The method according to any one of claims 7-9, 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.

11. A process for producing an organic amine, comprising: contacting an amination raw material and an amination reagent with the catalyst according to any one of claims 1-6 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 combinations thereof, preferably selected from ammonia, C1-12 primary amines, C2-12 secondary amines, or combinations thereof, more preferably selected from ammonia, monomethylamine, dimethylamine, methylethylamine, monoethylamine, diethylamine or a combination thereof.

12. The process according to claim 11, wherein the amination conditions include: a molar ratio of hydrogen to the amination reagent and to the amination raw material of 1-5 : 2-35 : 1, preferably 1-5 : 2-33 : 1, more preferably 1-5 : 2-30 : 1, a temperature of 105-220 °C, preferably 110-220 °C, more preferably 130-200 °C, a pressure of 0.7-25 MPa, preferably 0.8-25 MPa, more preferably 1-15 MPa, and a liquid phase volume space velocity of the amination raw material of 0.06-1 $m^3/(m^3 \cdot h)$.

13. The process according to claim 12, 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 1-4 : 2-10 : 1, preferably 1-4 : 2-9 : 1, more preferably 1-4 : 2-8 : 1, a temperature of 130-210 °C, preferably 130-200 °C, a pressure of 1-4 MPa, preferably 1-3.5 MPa, more 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 110-180 °C, more preferably 110-170 °C, a pressure of 0.7-3.5 MPa, preferably 0.7-2.5 MPa, more preferably 0.8-2.5 MPa, and a liquid phase volume space velocity of the amination raw material of 0.1-1 $m^3/(m^3 \cdot h)$, preferably 0.1-0.8 $m^3/(m^3 \cdot h)$;

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 : 3-25 : 1, preferably 1-4 : 3-20 : 1, a temperature of 130-200 °C, preferably 135-200 °C, a pressure of 1-18 MPa, preferably 1-15 MPa, more preferably 1-11 MPa, and a liquid phase volume space velocity of the amination raw material of 0.06-0.8 $m^3/(m^3 \cdot h)$;

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 0.3-4 : 3-45 : 1, preferably 1-4 : 3-35 : 1, more preferably 1-4 : 3-33 : 1, a temperature of 130-220 °C, preferably 130-210 °C, a pressure of 1-15 MPa, preferably 4-25 MPa, and a liquid phase volume space velocity of the amination raw material of 0.06-0.8 $m^3/(m^3 \cdot h)$, preferably 0.1-0.8 $m^3/(m^3 \cdot h)$, 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 : 3-45 : 1, preferably 1-4 : 3-35 : 1, more preferably 1-4 : 3-33 : 1, more preferably 1-4 : 3-30 : 1, a temperature of 130-220 °C, preferably 130-210 °C, a pressure of 1-25 MPa, preferably 2-25 MPa, more preferably 4-25 MPa, and a liquid phase volume space velocity of the amination raw material of 0.06-0.8 $m^3/(m^3 \cdot h)$, preferably 0.1-0.8 $m^3/(m^3 \cdot h)$.