Claims

[Claim 1] A manufacturing method for a hydrotreating catalyst for hydrocarbon oil, the method comprising:

a titania coating step including simultaneously and continuously adding an aqueous solution of an acidic compound containing titanium and an aqueous solution containing an alkaline compound to a hydrosol containing an alumina hydrate particle at a temperature ranging from 10 to 100°C and a pH ranging from 4.5 to 6.5, and coating a surface of the alumina hydrate particle with a titanium hydroxide particle while keeping the pH constant to give a titania-coated alumina hydrate particle;

a washing step of washing the resultant titania-coated alumina hydrate particle to remove a contaminating ion which coexists with the particle;

a forming step of forming the washed titania-coated alumina hydrate particle after dehydrating the particle so as to have a moisture content at which the particle is formable;

a first drying step of drying a shaped material of a titanium-coated alumina hydrate particle obtained by the forming to give a titania-coated alumina support;

an impregnating step of impregnating the resultant titania-coated alumina support with a catalytic component-containing aqueous solution containing at least one kind of periodic table group 6 metal compound, at least one kind of periodic table group 8-10 metal compound, and at least one kind of phosphorus

compound as catalytic components, and a saccharide; and

a second drying step of drying the titania-coated alumina support impregnated with the catalytic component-containing aqueous solution.

[Claim 2] A manufacturing method for a hydrotreating catalyst for hydrocarbon oil according to claim 1, wherein the saccharide to be used in the impregnating step comprises at least one kind of saccharide selected from the group consisting of erythritol, arabinose, xylose, xylitol, ribose, fructose, sorbose, glucose, mannose, galactose, sorbitol, mannitol, invert sugar, dulcitol, sucrose, lactose, maltose, trehalose, maltitol, isomerized sugar, and raffinose.

[Claim 3] A manufacturing method for a hydrotreating catalyst for hydrocarbon oil according to claim 1, wherein the saccharide to be used in the impregnating step comprises at least one kind of saccharide selected from the group consisting of erythritol, xylose, xylitol, sorbitol, mannitol, invert sugar, maltose, trehalose, maltitol, isomerized sugar, and raffinose.

[Claim 4] A manufacturing method for a hydrotreating catalyst according to any one of claims 1 to 3, wherein a crystal system of the alumina hydrate particle comprises boehmite, pseudoboehmite, and/or an alumina gel.

[Claim 5] A manufacturing method for a hydrotreating catalyst according to any one of claims 1 to 4, wherein a pore sharpness degree of the alumina hydrate particle after calcination at 500°C for 3 hours is 60% or more.

[Claim 6] A manufacturing method for a hydrotreating catalyst according to any one of claims 1 to 5, wherein a temperature condition of the titania coating step is a temperature ranging from 15 to 90°C.

[Claim 7] A manufacturing method for a hydrotreating catalyst for hydrocarbon oil according to any one of claims 1 to 6, wherein an operation of the titania coating step is carried out under the following conditions for (a) pH and (b) coating time:

(a) pH: within a pH variation range of ±0.5 with respect to a pH to be determined with the following equation (1):

$$pH=6.0-0.03\times T \cdots \text{Equation (1)}$$

in the equation (1), T represents a ratio (mass%) of titania with respect to a whole of the titania-coated alumina hydrate particle (oxide basis); and

(b) coating time: within a range of 5 minutes to 5 hours.

[Claim 8] A manufacturing method for a hydrotreating catalyst for hydrocarbon oil according to any one of claims 1 to 7, wherein an

amount of titanium hydroxide with which the alumina hydrate particle is coated falls within a range of 5 to 40% by mass with respect to a total amount on an oxide basis.

[Claim 9] A manufacturing method for a hydrotreating catalyst for hydrocarbon oil according to any one of claims 1 to 8, wherein an aging time in the impregnating step falls within a range of 10 minutes to 24 hours.

[Claim 10] A manufacturing method for a hydrotreating catalyst for hydrocarbon oil according to any one of claims 1 to 9, wherein the periodic table group 6 metal to be used in the impregnating step comprises molybdenum and the periodic table group 8-10 metal comprises cobalt and/or nickel.

[Claim 11] A manufacturing method for a hydrotreating catalyst for hydrocarbon oil according to any one of claims 1 to 10, wherein an addition amount of the saccharide to be used in the impregnating step falls within a range of 1 to 20% by mass with respect to a total amount on an oxide basis of the support and the catalytic components.

[Claim 12] A hydrotreating catalyst for hydrocarbon oil, which is manufactured by the manufacturing method for a hydrotreating catalyst for hydrocarbon oil according to any one of claims 1 to

11.

[Claim 13] A hydrotreating catalyst for hydrocarbon oil according to claim 12, wherein the catalyst has supported thereon a periodic table group 6 metal compound, a periodic table group 8-10 metal compound, a phosphorus compound, and a saccharide.

[Claim 14] A hydrotreating catalyst for hydrocarbon oil according to claim 12 or 13, wherein a repetition length of a crystal lattice plane of titania in the titania-coated alumina support is 50 Å or less.

[Claim 15] A hydrotreating catalyst for hydrocarbon oil according to any one of claims 12 to 14, wherein a pore sharpness degree of the titania-coated alumina support is 60% or more.

[Claim 16] A hydrotreating catalyst for hydrocarbon oil according to any one of claims 12 to 15, wherein a pore volume of the titania-coated alumina support is 0.36 to 1.10 ml/g.

[Claim 17] A hydrotreating catalyst for hydrocarbon oil according to any one of claims 12 to 16, wherein a specific surface area of the titania-coated alumina support is 200 m^2/g or more.

[Claim 18] A hydrotreating catalyst for hydrocarbon oil according

to any one of claims 12 to 17, wherein a compact bulk density (CBD) of the catalyst is 0.5 to 1.1 g/ml.

[Claim 19] A hydrodesulfurization treatment method for hydrocarbon oil, comprising using a hydrotreating catalyst for hydrocarbon oil manufactured by the manufacturing method for a hydrotreating catalyst for hydrocarbon oil according to any one of claims 1 to 11.

[Claims]

[Claim 1]

A manufacturing method for a hydrotreating catalyst for hydrocarbon oil, the method comprising:

a titania coating step including simultaneously and continuously adding an aqueous solution of an acidic compound containing titanium and an aqueous solution containing an alkaline compound to a hydrosol containing an alumina hydrate particle at a temperature ranging from 10 to 100°C and a pH ranging from 4.5 to 6.5, and coating a surface of the alumina hydrate particle with a titanium hydroxide particle while keeping the pH constant to give a titania-coated alumina hydrate particle;

a washing step of washing the resultant titania-coated alumina hydrate particle to remove a contaminating ion which coexists with the particle;

a forming step of forming the washed titania-coated alumina hydrate particle after dehydrating the particle so as to have a moisture content at which the particle is formable;

a first drying step of drying a shaped material of a titania-coated alumina hydrate particle obtained by the forming to give a titania-coated alumina support;

an impregnating step of impregnating the titania-coated alumina support obtained in the first drying step

with a catalytic component-containing aqueous solution containing at least one kind of periodic table group 6 metal compound, at least one kind of periodic table group 8-10 metal compound, and at least one kind of phosphorus compound as catalytic components, and at least one kind of saccharide selected from monosaccharides, disaccharides, trisaccharides, tetrasaccharides, and oligosaccharides; and

a second drying step of drying the titania-coated alumina support impregnated with the catalytic component-containing aqueous solution.

[Claim 2]

A manufacturing method for a hydrotreating catalyst for hydrocarbon oil according to claim 1, wherein the saccharide to be used in the impregnating step comprises at least one kind of saccharide selected from the group consisting of erythritol, arabinose, xylose, xylitol, ribose, fructose, sorbose, glucose, mannose, galactose, sorbitol, mannitol, invert sugar, dulcitol, sucrose, lactose, maltose, trehalose, maltitol, isomerized sugar, and raffinose.

[Claim 3]

A manufacturing method for a hydrotreating catalyst for hydrocarbon oil according to claim 1, wherein the saccharide to be used in the impregnating step comprises at least one kind of saccharide selected from the group consisting of erythritol, xylose, xylitol, sorbitol, mannitol, invert sugar, maltose, trehalose,

maltitol, isomerized sugar, and raffinose.

[Claim 4]

A manufacturing method for a hydrotreating catalyst according to any one of claims 1 to 3, wherein a crystal system of the alumina hydrate particle comprises boehmite, pseudoboehmite, and/or an alumina gel.

[Claim 5]

A manufacturing method for a hydrotreating catalyst according to any one of claims 1 to 4, wherein a pore sharpness degree of the alumina hydrate particle after calcination at 500°C for 3 hours is 60% or more.

[Claim 6]

A manufacturing method for a hydrotreating catalyst according to any one of claims 1 to 5, wherein a temperature condition of the titania coating step is a temperature ranging from 15 to 90°C.

[Claim 7]

A manufacturing method for a hydrotreating catalyst for hydrocarbon oil according to any one of claims 1 to 6, wherein an operation of the titania coating step is carried out under the following conditions for (a) pH and (b) coating time:

(a) pH: within a pH variation range of ±0.5 with respect to a pH to be determined with the following equation (1):

$$pH=6.0-0.03\times T \cdots \text{Equation (1)}$$

in the equation (1), T represents a ratio (mass%) of titania with respect to a whole of the titania-coated alumina hydrate particle

(oxide basis); and

(b) coating time: within a range of 5 minutes to 5 hours.

[Claim 8]

A manufacturing method for a hydrotreating catalyst for hydrocarbon oil according to any one of claims 1 to 7, wherein an amount of titanium hydroxide with which the alumina hydrate particle is coated falls within a range of 5 to 40% by mass with respect to a total amount on an oxide basis.

[Claim 9]

A manufacturing method for a hydrotreating catalyst for hydrocarbon oil according to any one of claims 1 to 8, wherein an aging time in the impregnating step falls within a range of 10 minutes to 24 hours.

[Claim 10]

A manufacturing method for a hydrotreating catalyst for hydrocarbon oil according to any one of claims 1 to 9, wherein the periodic table group 6 metal to be used in the impregnating step comprises molybdenum and the periodic table group 8-10 metal comprises cobalt and/or nickel.

[Claim 11]

A manufacturing method for a hydrotreating catalyst for hydrocarbon oil according to any one of claims 1 to 10, wherein an addition amount of the saccharide to be used in the impregnating step falls within a range of 1 to 20% by mass with respect to a total amount on an oxide basis of the support and the catalytic

components.

[Claim 12]

A hydrotreating catalyst for hydrocarbon oil, which is manufactured by the manufacturing method for a hydrotreating catalyst for hydrocarbon oil according to any one of claims 1 to 11.

[Claim 13]

A hydrotreating catalyst for hydrocarbon oil according to claim 12, wherein the catalyst has supported thereon a periodic table group 6 metal compound, a periodic table group 8-10 metal compound, a phosphorus compound, and a saccharide.

[Claim 14]

A hydrotreating catalyst for hydrocarbon oil according to claim 12 or 13, wherein a repetition length of a crystal lattice plane of titania in the titania-coated alumina support is 50 Å or less.

[Claim 15]

A hydrotreating catalyst for hydrocarbon oil according to any one of claims 12 to 14, wherein a pore sharpness degree of the titania-coated alumina support is 60% or more.

[Claim 16]

A hydrotreating catalyst for hydrocarbon oil according to any one of claims 12 to 15, wherein a pore volume of the titania-coated alumina support is 0.36 to 1.10 ml/g.

[Claim 17]

A hydrotreating catalyst for hydrocarbon oil according to any

one of claims 12 to 16, wherein a specific surface area of the titania-coated alumina support is 200 m^2/g or more.

[Claim 18]

A hydrotreating catalyst for hydrocarbon oil according to any one of claims 12 to 17, wherein a compact bulk density (CBD) of the catalyst is 0.5 to 1.1 g/ml.

[Claim 19]

A hydrodesulfurization treatment method for hydrocarbon oil, comprising using a hydrotreating catalyst for hydrocarbon oil manufactured by the manufacturing method for a hydrotreating catalyst for hydrocarbon oil according to any one of claims 1 to 11.