PCT Application
Docket No. W9914-02
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WHAT IS CLAIMED IS:

1. An alumina composition which comprises a precipitated alumina comprising at least about 0.1 wt% silica, said composition having a pore volume of about 0.60 cc/g or greater, a median pore size ranging from about 70 Å to about 120 Å, a pore size distribution such that at least about 90% of the total pore volume falls within the range of about 20 Å to about 250 Å, and a pore size distribution width of 40 Å or greater.

2. The alumina composition of claim 1, wherein the composition comprise at least 3 wt% SiO_2.

3. The alumina composition of claim 1, wherein the composition comprises from about 0.1 to about 15 wt% SiO_2.

4. The alumina composition of claim 2, wherein the composition comprise from about 3 to about 10 wt% SiO_2.

5. The alumina composition of claim 1, 2, 3 or 4, wherein the composition has a total pore volume of about 0.60 cc/g to about 1.0 cc/g.

6. The alumina composition of claim 5, wherein the pore size distribution width ranges from about 40 Å to about 120 Å.

7. The alumina composition of claim 6, wherein from about 90 to about 95% of the total pore volume falls within the range of about 20 Å to about 250 Å.

8. The alumina composition of claim 1, wherein the pore volume and pore size distribution properties are determined by mercury penetration porosimetry using a mercury porosimeter at a pressure range from about atmospheric pressure to about 60,000 psi, with a contact angle, $\theta = 140°$ and a mercury surface tension of 474 mN/m at 25 °C.

9. A support material suitable for use as a component of a catalyst composition for use in the hydroconversion of a middle distillate or a heavy hydrocarbon feedstock, said support material comprises a precipitated alumina comprising at least 0.1 about wt% silica, said support material having a pore volume of about 0.60 cc/g or greater, a median pore size ranging from about 70 Å to about 120 Å, a pore size distribution such that at least about 90%

of the total pore volume falls within the range of about 20 Å to about 250 Å, and a pore size distribution width of40 Å to 120 Å.

10. The support material of claim 9, wherein said precipitated alumina comprises at least 3 wt% silica.

11. The support material of claim 9, wherein said precipitated alumina comprises from about 0.1 to about 15 wt% silica.

12. The support material of claim 10, wherein the composition comprise from 3 to about 10 wt% SiO_2.

13. The support material of claim 9, 10, 11 or 12, wherein the composition has a total pore volume of about 0.60 to about 1.0 cc/g.

14. The support material of claim 13, wherein the pore size distribution width ranges from about 40 Å to about 120 Å.

15. The support material of claim 14, wherein from about 90 to about 95% of the total pore volume falls within the range of about 20 Å to about 250 Å.

16. The support material of claim 9, wherein the pore volume and pore size distribution properties are determined by mercury penetration porosimetry using a mercury porosimeter at a pressure range from about atmosphere to about 60,000 psi, with a contact angle, $\theta = 140°$ and a mercury surface tension of 474 mN/m at 25 °C.

17. A catalyst composition suitable for use in the hydroconversion of a middle distillate or a heavy hydrocarbon feedstock, said catalyst composition comprises a support material comprised of a precipitated alumina composition comprising at least about 0.1 wt% SiO_2, wherein the support material has a pore volume of about 0.60 cc/g or greater, a median pore size ranging from about 70 to about 120 Å, a pore size distribution such that at least about 90% of the total pore volume falls within the range of about 20 Å to about 250 Å, and a pore size distribution width of40 Å to 120 Å; and at least one catalytically active component selected from the group consisting of a Group VIB metal component, a Group VIII metal component, a phosphorous compound, and combinations thereof.

18. The catalyst composition of claim 17, wherein the alumina composition of the support material comprises from about 0.1 to about 15 wt% SiO_2.

19. The catalyst composition of claim 17, wherein the alumina composition of the support material comprise from 3 to about 10 wt% SiO_2.

20. The catalyst composition of claim 17, 18 or 19 wherein the support material has a total pore volume of about 0.60 to about 1.0 cc/g.

21. The catalyst composition of claim 20, wherein said Group VIB metal component is present in said catalyst composition in the range of from about 10 wt% to about 40 wt%; said Group VIII metal component is present in said catalyst composition in the range of from about 1 wt% to about 15 wt%; and said phosphorus compound is present in said catalyst composition in the range of from about 0.1 wt% to about 10 wt%, as oxide, and all wt% being based on the total weight of said catalyst composition.

22. The catalyst composition of claim 17, wherein from about 90 to about 95% of the total pore volume falls within the range of about 20 Å to about 250 Å.

23. The catalyst composition of claim 22, wherein the pore size distribution width ranges from about 40 Å to about 120 Å.

24. The catalyst compositions of claim 17 or 23, wherein the pore volume and pore size distribution properties of the support material were determined by mercury penetration porosimetry using a mercury porosimeter at a pressure range from about atmosphere to about 60,000 psi, with a contact angle, $\theta = 140°$ and a mercury surface tension of 474 mN/m at 25 °C.

25. A method of hydroprocessing a middle distillate or a heavy hydrocarbon feedstock, said method comprises contacting under suitable hydroprocessing conditions said feedstock with a catalyst of claim 17, 18, 19, 22 or 23.

26. A method as recited in claim 25, wherein the hydroprocessing conditions are hydrodesulfurization conditions.

27. A method as recited in claim 25, wherein the hydroprocessing conditions are hydrodenitrogenation conditions.

28. A method of preparing a catalyst support comprising:

(a) forming a first aqueous slurry of alumina by mixing an aqueous alkaline solution comprising at least one alkaline compound and an aqueous acidic solution

comprising at least one acidic compound, provided that either the alkaline compound of the aqueous alkaline solution or the acidic compound of the aqueous acidic solution, or both of such solutions, is a compound containing aluminum, at pH in the range of from about 6 to about 11 while maintaining the aqueous slurry at temperature ranging from about 45 °C to 70 °C so as to precipitate seed alumina as a first aqueous slurry;

(b) increasing said first aqueous slurry temperature to the range of from about 48 °C to 80 °C to provide a second aqueous slurry;

(c) adding to said second aqueous slurry an aqueous solution of an aluminum compound and an aqueous alkaline solution at a second pH in the range of from about 6 to 11 while maintaining the second aqueous slurry at a temperature ranging from about 48 °C to 80 °C to precipitate alumina and form a second aqueous alumina containing slurry;

(d) filtering and washing the second aqueous alumina containing slurry to obtain alumina particles;

(e) reslurrying the alumina particles in an aqueous solution to obtain a third alumina containing slurry;

(f) heating the third alumina containing slurry at a temperature ranging from about 60 °C to about 90°C;

(g) adding a silica-containing compound to the heated slurry in an amount sufficient to provide at least about 0.1 wt% SiO_2 in the catalyst support;

(h) optionally, peptizing the silica containing alumina slurry;

(i) filtering and drying the slurry in (g) to obtain an extrudable silica-containing alumina mixture;

(j) extruding the silica containing alumina mixture in (i) to form an extrudate; and

(k) calcining the extrudate at a temperature ranging from about 400°C to about 900 °C to obtain a catalyst support comprising precipitated alumina powder comprising at least about 0.1 wt% silica;

wherein said support has a pore volume of about 0.60 cc/g or greater, a median pore size ranging from about 70 Å to about 120 Å, a pore size distribution such that at least about 90% of the total pore volume falls within the range of about 20 Å to about 250 Å, and a pore size distribution width of about 40 Å or greater.

29. A method of preparing a catalyst support comprising:

(a) forming a first aqueous slurry of alumina by combining an aqueous slurry containing a silica containing compound in an amount sufficient to provide at least about 0.1 wt% silica in the catalyst support, with an aqueous alkaline solution and an aqueous solution of an aluminum compound at pH in the range of from about 6 to about 11 while maintaining the aqueous slurry at temperature ranging from about 45 °C to 70 °C so as to form a first aqueous slurry of precipitated silica-containing alumina;

(b) increasing said first aqueous slurry temperature to the range of from about 48 °C to 80 °C to provide a second aqueous slurry;

(c) adding to said second aqueous slurry an aqueous solution of an aluminum compound and an aqueous alkaline solution at a second pH in the range of from about 6 to 11 while maintaining the second aqueous slurry at a temperature ranging from about 48 °C to 80 °C to precipitate alumina and form a second aqueous silica-containing alumina slurry;

(d) filtering and washing the second aqueous silica-containing alumina containing slurry to obtain silica containing alumina;

(e) optionally, peptizing the silica containing alumina slurry;

(f) filtering and drying the slurry from (d) or (e) to obtain silica-containing alumina;

(g) extruding the silica-containing alumina from (f) to form an extrudate; and

(h) calcining the extrudate at a temperature ranging from about 400 °C to about 900 °C to obtain a catalyst support comprising precipitated alumina powder containing at least about 0.1 wt% silica, said support having a pore volume of about 0.60 cc/g or greater, a median pore size ranging from about 70 Å to about 120 Å, a pore size distribution such that at least about 90% of the total pore volume falls within the range of about 20 Å to about 250 Å, and a pore size distribution width of about 40 Å or greater.

30. A method of preparing a catalyst support comprising:

(a) forming a first aqueous slurry of alumina by mixing an aqueous alkaline solution and an aqueous solution of an aluminum compound at pH in the range of from about 6 to about 11 while maintaining the aqueous slurry at temperature ranging from about 45 °C to 70 °C so as to precipitate seed alumina;

(b) increasing said first aqueous slurry temperature to the range of from about 48 °C to 80 °C to provide a second aqueous slurry;

(c) adding to said second aqueous slurry an aqueous solution of an aluminum compound and an aqueous alkaline solution at a second pH in the range of from about 6 to 11 while maintaining the second aqueous slurry at a temperature ranging from about 48 °C to 80 °C to precipitate alumina and form a second aqueous alumina containing slurry;

(d) washing the second aqueous alumina containing slurry;

(e) heating the second aqueous alumina containing slurry at a temperature ranging from about 60 °C to about 90 °C;

(f) adding a silica-containing compound to the slurry from (e) in an amount sufficient to provide at least about 0.1 wt% SiO_2 in the catalyst support;

(g) optionally, peptizing the silica containing alumina slurry;

(h) filtering and drying the slurry from (f) or (g) to obtain extrudable silica-containing alumina;

(i) extruding the silica containing alumina from (h) to form an extrudate; and

(j) calcining the extrudate at a temperature ranging from about 400 °C to about 900 °C to obtain a catalyst support comprising precipitated alumina powder containing at least about 0.1 wt% silica, said support having a pore volume of about 0.60 cc/g or greater, a median pore size ranging from about 70 Å to about 120 Å, a pore size distribution such that at least about 90% of the total pore volume falls within the range of about 20 Å to about 250 Å, and a pore size distribution width of about 40 Å or greater.

31. A method of preparing a catalyst support comprising:

(a) forming a first aqueous slurry of alumina by mixing an aqueous alkaline solution and an aqueous solution of an aluminum compound at pH in the range of from about 6 to about 11 while maintaining the aqueous slurry at temperature ranging from about 45 °C to 70 °C so as to precipitate seed alumina;

(b) increasing said first aqueous slurry temperature to the range of from about 48 °C to 80 °C to provide a second aqueous slurry;

(c) adding to said second aqueous slurry an aqueous solution of an aluminum compound and an aqueous alkaline solution at a second pH in the range of from about 6 to 11 while maintaining the second aqueous slurry at a temperature ranging from about 48 °C to 80 °C to precipitate alumina and form a second aqueous alumina containing slurry;

(d) spray drying the second aqueous alumina containing slurry to obtain alumina particles;

(e) forming an extrudable silica-containing alumina mixture by contacting the spray dried alumina particles from (d) with a silica-containing compound in an amount sufficient to provide at least about 0.1 wt% SiO_2 in the catalyst support and wetting the mixture with an aqueous solution;

(f) extruding the silica-containing alumina from (e) to form an extrudate; and

(g) calcining the extrudate at a temperature ranging from about 400 °C to about 900 °C to obtain a catalyst support comprising precipitated alumina powder containing at least about 0.1 wt% silica, said support having a pore volume of about 0.60 cc/g or greater, a median pore size ranging from about 70 Å to about 120 Å, a pore size distribution such that at least about 90% of the total pore volume falls within the range of about 20 Å to about 250 Å, and a pore size distribution width of about 40 Å or greater.