CLAIMS:

1. A method for making a catalyst for the hydrodesulfurisation (HDS) of naphtha, the method comprising:

(i) impregnating a silica support that has a silica content of at least about 85 wt.%, based on silica, and has a pore volume between about 0.6 cc/g and about 2.0 cc/g, and median pore sizes in the range of about 150Å to 2000Å with (a) an aqueous solution of a cobalt salt, (b) an aqueous solution of a molybdenum salt and at least one organic additive, said organic additive comprising at least one organic acid and at least one compound selected from the group consisting of compounds comprising at least two hydroxyl groups and 2-20 carbon atoms, and the (poly)ethers of these compounds, to form a catalyst precursor;

(ii) drying the catalyst precursor at a temperature of less than about 350°C to form a dried catalyst precursor; and

(iii) optionally sulfiding the dried catalyst precursor, provided that the dried catalyst precursor or catalyst is not calcined prior to sulfiding or use for HDS.

2. A method for making a catalyst for the hydrodesulfurisation (HDS) of naphtha, the method comprising:

(i) impregnating a silica support that has a silica content of at least about 85 wt.%, based on silica, and has a pore volume between about 0.6 cc/g and about 2.0 cc/g, and median pore sizes in the range of about 150Å to 2000Å with (a) an aqueous solution of a cobalt salt and (b) an aqueous solution of a molybdenum salt to form a first catalyst precursor;

(ii) drying the first catalyst precursor at a temperature of less than about 350°C to form a first dried catalyst precursor;

(iii) impregnating the dried catalyst precursor with (c) at least one organic acid and at least one organic additive, the organic additive comprising at least one compound selected from the group consisting of compounds

comprising at least two hydroxyl groups and 2-20 carbon atoms, and the (poly)ethers of these compounds, to form a second catalyst precursor;

(iv) optionally drying the second catalyst precursor to form a second dried catalyst precursor; and

(v) optionally sulfiding the second catalyst precursor, provided that the second dried catalyst precursor or catalyst is not calcined prior to sulfiding or use for HDS.

3. A method for making a catalyst for the hydrodesulfurisation (HDS) of naphtha, the method comprising:

(i) regenerating a spent catalyst comprising a silica support that has a silica content of at least about 85 wt.%, based on silica, and has a pore volume between about 0.6 cc/g and about 2.0 cc/g, and median pore sizes in the range of about 150Å to 2000Å, into which a cobalt salt and a molybdenum salt have been impregnated, to form a regenerated catalyst

(ii) impregnating the regenerated catalyst with at least one organic additive, said organic additive comprising at least one organic acid and at least one compound selected from the group consisting of compounds comprising at least two hydroxyl groups and 2-20 carbon atoms, and the (poly)ethers of these compounds, to form a catalyst precursor;

(ii) drying the catalyst precursor at a temperature of less than about 350°C to form a dried catalyst precursor; and

(iii) optionally sulfiding the dried catalyst precursor, provided that the dried catalyst precursor or catalyst is not calcined prior to sulfiding or use for HDS.

4. The method of any of the preceding claims wherein the compound comprising two hydroxyl groups and 2-20 carbon atoms further comprises at least one secondary amine group.

5. The method of claim 4 wherein the at least 2 hydroxyl groups are separated from the secondary amine group by 1 or more carbon atoms, preferably by 2 to 4 carbon atoms.

6. The method of any one of claims 1 or 2 wherein the organic additive is chosen from the group consisting of polyhydroxyalkanes and polyhydroxyalkenes comprising two or more hydroxyl groups and between 1 and 4 carbon atoms per hydroxyl group and polycondensates thereof, and secondary amines comprising alkanol or alkenol groups and polycondensates thereof.

7. The method of any one of claims 1 or 2 wherein the additive is at least one compound selected from ethylene glycol, diethylene glycol, polyethylene glycol, di-ethanolamine or a dialkanoldiamine.

8. The method of any one of the preceding claims wherein the mole ratio between the amount of additive and the amount of cobalt and molybdenum is in the range of from 0.01:1 to 2.5:1.

9. The method of any one of the preceding claims wherein the amount of additive is at least 5 wt% relative to the total weight of the catalyst.

10. The method of any one of the preceding claims wherein the silica support has a pore volume between about 1.0 cm^3/g and about 1.5 cm^3/g.

11. The method of any one of the preceding claims wherein the median pore sizes of the silica support before impregnation are in the range of from about 150Å to about 1000Å.

12. The method of any one of the preceding claims wherein the silica support contains at least about 90 wt.% silica.

13. The method of any one of the preceding claims wherein the amounts of cobalt salt and molybdenum salts are sufficient to provide a catalyst containing from about 2 wt.% to about 8 wt.% cobalt oxide and about 8 wt.% to about 30 wt.% molybdenum oxide, based on silica support.

14. The method of any one of the preceding claims wherein the catalyst precursor is sulfided in-situ or ex-situ in the presence of at least one sulfiding agent.

15. The method of any one of the preceding claims wherein the dried catalyst precursor or sulfided catalyst is not heated to temperatures greater than about 350°C prior to sulfiding or use for HDS.

16. A catalyst suitable for the hydrodesulfurisation (HDS) of naphtha, obtainable by the method of any of claims 1 to 16.

17. A catalyst comprising a silica support that has a silica content of at least about 85 wt.%, based on silica, and has a pore volume between about 0.6 cc/g and about 2.0 cc/g, and median pore sizes in the range of about 150Å to 2000Å, said silica support having impregnated therein a cobalt salt, a molybdenum salt and at least one organic additive, said organic additive comprising at least one organic acid and at least one compound selected from the group consisting of compounds comprising at least two hydroxyl groups and 2-20 carbon atoms, and the (poly)ethers of these compounds.

18. The catalyst of claim 17, wherein the compound comprising two hydroxyl groups and 2-20 carbon atoms further comprises at least one secondary amine group.

19. The catalyst of claim 18 wherein the at least 2 hydroxyl groups are separated from the secondary amine group by 1 or more carbon atoms, preferably by 2 to 4 carbon atoms.

20. The catalyst of claim 17 wherein the organic additive is chosen from the group consisting of polyhydroxyalkanes and polyhydroxyalkenes comprising two or more hydroxyl groups and between 1 and 4 carbon atoms per hydroxyl group and polycondensates thereof, and secondary amines comprising alkanol or alkenol groups and polycondensates thereof.

21. The catalyst of claim 17 wherein the additive is at least one compound selected from ethylene glycol, diethylene glycol, polyethylene glycol, di-ethanolamine or a dialkanoldiamine.

22. The catalyst of any one of claims 17 to 21 wherein the mole ratio between the amount of additive and the amount of cobalt and molybdenum is in the range of from 0.01:1 to 2.5:1.

23. The catalyst of any one of claims 17 to 22 wherein the amount of additive is at least 5 wt% relative to the total weight of the catalyst.

24. The catalyst of any one of claims 17 to 23 wherein the silica support has a pore volume between about 1.0 cc/g and about 1.5 cc/g.

25. The catalyst of any one of claims 17 to 24 wherein the median pore sizes of the silica support before impregnation are in the range of from about 150Å to about 1000Å.

26. The catalyst of any one of claims 17 to 25 wherein the silica support contains at least about 90 wt.% silica.

27. The catalyst of any one of claims 17 to 26 wherein the amounts of cobalt salt and molybdenum salts are sufficient to provide a catalyst containing from about 2 wt.% to about 8 wt.% cobalt oxide and about 8 wt.% to about 30 wt.% molybdenum oxide, based on silica support.

28. The catalyst of any one of claims 17 to 27 that has been sulphided by in-situ or ex-situ sulphidation.

29. A method for the hydrodesulfurization of naphtha having an olefin content of at least about 5 wt%, based on the weight of naphtha, the method comprising contacting, under hydrodesulfurization conditions, the naphtha with a catalyst prepared by the method of any one of claims 1 to 15 or with a catalyst according to claims 16 or 28.

30. A method for the hydrodesulfurization of naphtha having an olefin content of at least about 5 wt%, based on the weight of naphtha, the method comprising

(a) sulfiding a catalyst according to any one of claims 17 to 27 to form a sulfided catalyst;

(b) contacting the sulfided catalyst with the naphtha under hydrodesulfurization conditions.

31. The method of any one of claims 29 or 30, wherein the naphtha is at least one of FCC naphtha, steam cracked naphtha or coker naphtha.

32. The method of any one of claims 29 to 31, wherein the naphtha has an olefin content of from about 5 wt% to about 60 wt%, a nitrogen content

of from about 5 ppmw to about 500 ppmw and a sulfur content of from about 300 ppmw to about 7000 ppmw, relative to the weight of naphtha.

CLAIMS

1. A method for making a catalyst for the hydrodesulfurisation (HDS) of naphtha, the method comprising:

(i) impregnating a silica support that has a silica content of at least about 85 wt. %, based on silica, and has a pore volume between about 0.6 cc/g and about 2.0cc/g, and median pore sizes in the range of about 200 Å to 500 Å with (a) an aqueous solution of a cobalt salt, (b) an aqueous solution of a molybdenum salt, at least one organic acid, and at least one organic additive, said organic additive comprising at least one compound selected from the group consisting of compounds comprising at least two hydroxyl groups and 2-20 carbon atoms, and the (poly)ethers of these compounds, to form a catalyst precursor;

(ii) drying the catalyst precursor at a temperature of less than about 350°C. to form a dried catalyst precursor; and

(iii) optionally sulfiding the dried catalyst precursor, provided that the dried catalyst precursor or catalyst is not calcined prior to sulfiding or use for HDS; wherein the amounts of cobalt salt and molybdenum salts are sufficient to provide a catalyst containing from about 2 wt. % to about 8 wt. % cobalt oxide and about 8 wt. % to about 30 wt. % molybdenum oxide, based on the silica support.

2. The method of claim 1 wherein the compound comprising two hydroxyl groups and 2-20 carbon atoms further comprises at least one secondary amine group.

3. The method of claim 2 wherein the at least 2 hydroxyl groups are separated from the secondary amine group by 1 or more carbon atoms.

4. The method of claim 1 wherein the organic additive is chosen from the group consisting of polyhydroxyalkanes and polyhydroxyalkenes comprising two or more hydroxyl groups and between 1 and 4 carbon atoms per hydroxyl group and

polycondensates thereof, and secondary amines comprising alkanol or alkenol groups and polycondensates thereof.

5. The method of claim 1 wherein the additive is at least one compound selected from ethylene glycol, diethylene glycol, polyethylene glycol, di-ethanolamine or a dialkanoldiamine.

6. The method of claim 1 wherein the mole ratio between the amount of additive and the amount of cobalt and molybdenum is in the range of from 0.01:1 to 2.5:1.

7. The method of claim 1 wherein the amount of additive is at least 5 wt % relative to the total weight of the catalyst.

8. The method of claim 1 wherein the silica support has a pore volume between about 1.0 cm^3/g and about 1.5 cm^3/g.

9. The method of claim 1 wherein the silica support contains at least about 90 wt. % silia.

10. The method of claim 1 wherein the catalyst precursor is sulfided in-situ or ex-situ in the presence of at least one sulfiding agent.

11. The method of claim 10 wherein the suifiding agent is hydrogen sulfide at concentrations of from about 0.1 vol. % to about 10 vol. %, based on total volume of gases present.

12. The method of claim 10 wherein the dried catalyst precursor or sulfided catalyst is not heated to temperatures greater than about 350°C prior to sulfiding or use for HDS.

13. A method for the hydrodesulfurization of naphtha having an olefin content of at least about 5 wt %, based on the weight of naphtha, the method comprising contacting, under hydrodesulfurization conditions, the naphtha with a catalyst prepared by the method of claim 1.

14. A method for making a catalyst for the hydrodesulfurisation (HDS) of naphtha, the method comprising:

(i) impregnating a silica support that has a silica content of at least about 85 wt. %, based on silica, and has a pore volume between about 0.6 cc/g and about 2.0 cc/g, and median pore sizes in the range of about 200 Å to 500 Å with (a) an aqueous solution of a cobalt salt and (b) an aqueous solution of a molybdenum salt to form a first catalyst precursor;

(ii) drying the first catalyst precursor at a temperature of less than about 350°C to form a first dried catalyst precursor;

(iii) impregnating the dried catalyst precursor with (c) at least one organic acid and at least one organic additive, the organic additive comprising at least one compound selected from the group consisting of compounds comprising at least two hydroxyl groups and 2-20 carbon atoms, and the (poly)ethers of these compounds, to form a second catalyst precursor;

(iv) optionally drying the second catalyst precursor to form a second dried catalyst precursor; and

(v) optionally sulfiding the second catalyst precursor, provided that the second dried catalyst precursor or catalyst is not calcined prior to sulfiding or use for HDS;

wherein the amounts of cobalt salt and molybdenum salts are sufficient to provide a catalyst containing from about 2 wt. % to about 8 wt. % cobalt oxide and about 8 wt. % to about 30 wt. % molybdenum oxide, based on the silica support.

15. The method of claim 14 wherein the compound comprising two hydroxyl groups and 2-20 carbon atoms further comprises at least one secondary amine group.

16. The method of claim 15 wherein the at least 2 hydroxyl groups are separated from the secondary amine group by 1 or more carbon atoms.

17. The method of claim 14 wherein the organic additive is chosen from the group consisting of polyhydroxyalkanes and polyhydroxyalkenes comprising two or more hydroxyl groups and between 1 and 4 carbon atoms per hydroxyl group and polycondensates thereof, and secondary amines comprising alkanol or alkenot groups and polycondensates thereof.

18. The method of claim 14 wherein the additive is at least one compound selected from ethylene glycol, diethylene glycol, polyethylene glycol, diethanolamine or a dialkanoldiaraine.

19. The method of claim 14 wherein the mole ratio between the amount of additive and the amount of cobalt and molybdenum is in the range of from 0.01:1 to 2.5:1.

20. The method of claim 14 wherein the amount of additive is at least 5 wt % relative to the total weight of the catalyst.

21. The method of claim 14 wherein the silica support has a pore volume between about 1.0 cm^3/g and about 1.5 cm^3g.

22. The method of claim 14 wherein the catalyst precursor is sulfided in-situ or ex-situ in the presence of at least one sulfiding agent.

23. The method of claim 22 wherein the sulfiding agent is hydrogen sulfide at concentrations of from about 0.1 vol. % to about 10 vol. %, based on total volume of gases present.

24. The method of claim 14 wherein neither the first nor second dried catalyst precursor is heated to temperatures greater than about 350°C prior to sulfiding or use for HDS.

25. The method of claim 14 wherein the silica support contains at least about 90 wt. % silica.

26. A method for making a catalyst for the hydrodesulfurisation (HDS) of naphtha, the method comprising:

(i) regenerating a spent catalyst comprising a silica support that has a silica content of at least about 85 wt. %, based on silica, and has a pore volume between about 0.6 cc/g and about 2.0 cc/g, and median pore sizes in the range of about 200 Å to 500 Å into which a cobalt salt and a molybdenum salt have been impregnated, to form a regenerated catalyst

(ii) impregnating the regenerated catalyst with at least one organic acid and at least one organic additive, said organic additive comprising at least one compound selected from the group consisting of compounds comprising at least two hydroxyl groups and 2-20 carbon atoms, and the (poly)ethers of these compounds, to form a catalyst precursor;

(iii) drying the catalyst precursor at a temperature of less than about 350°C to form a dried catalyst precursor, and

(iv) optionally sulfiding the dried catalyst precursor, provided that the dried catalyst precursor or catalyst is not calcined prior to sulfiding or use for HDS; wherein the amounts of cobalt salt and molybdenum salts are sufficient to provide a catalyst containing from about 2 wt. % to about 8 wt. % cobalt oxide and about 8 wt. % to about 30 wt. % molybdenum oxide, based on the silica support.

27. The method of claim 26 wherein the organic additive is chosen from the group consisting of polyhydroxyalkanes and polyhydroxyalkenes comprising two or more hydroxyl groups and between 1 and 4 carbon atoms per hydroxyl group and

polycondensates thereof, and secondary amines comprising alkanol or alkenol groups and polycondensates thereof.

28. The method of claim 26 wherein the additive is at least one compound selected from ethylene glycol, diethylene glycol, polyethylene glycol, diethanolamine or a dialkanoldiamine.

29. The method of claim 26 wherein the mole ratio between the amount of additive and the amount of cobalt and molybdenum is in the range of from 0.01:1 to 2.5:1.

30. The method of claim 26 wherein the amount of additive is at least 5 wt % relative to the total weight of the catalyst.

31. The method of claim 26 wherein the silica support has a pore volume between about 1.0 cm^3/g and about 1.5 cm^3/g.

32. The method of claim 26 wherein the catalyst precursor is sulfided in-situ or ex-situ in the presence of at least one sulfiding agent.

33. The method of claim 32 wherein the sulfiding agent is hydrogen sulfide at concentrations of from about 0.1 vol. % to about 10 vol. %, based on total volume of gases present.

34. The method of claim 26 wherein neither the dried catalyst precursor nor the sulfided catalyst is heated to temperatures greater than about 350°C prior to sulfiding or use for HDS.

35. The method of claim 26 wherein the silica support contains at least about 90 wt. % silica.

36. A catalyst comprising a silica support that has a silica content of at least about 85 wt. %, based on silica, and has a pore volume between about 0.6 cc/g and about 2.0 cc/g, and median pore sizes in the range of about 200 Å to 500 Å, said silica support having impregnated therein a cobalt salt, a molybdenum salt, at least one organic acid and at least one organic additive, said organic additive comprising at least one compound selected from the group consisting of compounds comprising at least two hydroxyl groups and 2-20 carbon atoms, and the (poly)ethers of these compounds; wherein the catalyst contains from about 2wt. % to about 8 wt. % cobalt oxide and about 8 wt. % to about 30 wt. % molybdenum oxide, based on the silica support.

37. The catalyst of claim 36, wherein the compound comprising two hydroxyl groups and 2-20 carbon atoms further comprises at least one secondary amine group.

38. The catalyst of claim 37 wherein the at least 2 hydroxyl groups are separated from the secondary amine group by 1 or more carbon atoms.

39. The catalyst of claim 36 wherein the organic additive is chosen from the group consisting of polyhydroxyalkanes and polyhddroxyalkenes comprising two or more hydroxyl groups and between 1 and 4 carbon atoms per hydroxyl group and polycondensates thereof, and secondary amines comprising alkanol or alkenol groups and polycondensates thereof.

40. The catalyst of claim 36 wherein the additive is at least one compound selected from ethylene glycol, diethylene glycol, polyethylene glycol, di-ethanolumine or a dialkanoldiamine.

41. The catalyst of claim 36 wherein the mole ratio between the amount of additive and the amount of cobalt and molybdenum is in the range of from 0.01:1 to 2.5:1.

42. The catalyst of claim 36 wherein the amount of additive is at least 5 wt % relative to the total weight of the catalyst.

43. The catalyst of claim 36 wherein the silica support has a pore volume between about 1.0 cc/g and about 1.5 cc/g.

44. The catalyst of claim 36 wherein the silica support contains at least about 90 wt. % silica.

45. The catalyst of claim 36 that has been sulphided by in-situ or ex-situ sulphidation.

46. A method for the hydrodesulfurization of naphtha having an olefin content of at least about 5 wt %, based on the weight of naphtha, the method comprising:

(a) sulfiding a catalyst according to claim 36 to form a sulfided catalyst;

(b) contacting the sulfided catalyst with the naphtha under hydrodesulfurization conditions.

47. The method of claim 46, wherein the naphtha is at least one of FCC naphtha, steam cracked naphtha or coker naphtha.

48. The method of claim 47, wherein the naphtha has an olefin content of from about 5 wt % to about 60 wt %, a nitrogen content of from about 5 ppmw to about 500 ppmw and a sulfur content of from about 300 ppmw to about 7000 ppmw, relative to the weight of naphtha.