precipitating a titanium source with a Al_2O_3 precursor to form a porous support material primarily comprising Al_2O_3 or by impregnating a titanium source onto a porous support material primarily comprising Al_2O_3.

[0007a] In an aspect, there is provided a catalyst comprising

at least one Group VIB metal component selected from molybdenum and tungsten,

at least one Group VIII metal component selected from nickel and cobalt,

at least one organic additive component,

a phosphorus component in an amount of at least 1 wt.%, as oxide P_2O_5, based on the total weight of the catalyst; and

a titanium-containing carrier component,

wherein the titanium content is in the range of 5 to 60 wt.%, expressed as an oxide, TiO_2, and based on the total weight of the catalyst and wherein the catalyst comprises silica at a silica content of 0 to less than 1.0 wt.% expressed as an oxide, SiO_2, and based on the total weight of the catalyst.

[0008] In another example of the disclosure, provided is a method of producing a catalyst. The method comprises the preparation of a Ti-containing porous support material primarily comprising Al_2O_3. This can be achieved by co-extruding or precipitating a titanium source with a Al_2O_3 precursor, shaping to form carrier extrudates, followed by drying and calcination. Alternatively, porous Al_2O_3 extrudates may be impregnated with a Ti-source followed by drying and calcination. The Ti-containing porous support is impregnated with a solution comprised of at least one Group VIB metal source and/or at least one Group VIII metal source. An organic additive is added in the production process either by co-impregnation with the metal sources or via a post-impregnation. In the process, the amount of the titanium source is sufficient so as to form a catalyst composition at least having a titanium content in the range of about 3 wt% to about 60 wt%, expressed as an oxide (TiO_2) and based on the total weight of the catalyst after calcination.

[0008a] In another aspect, there is provided a method of producing a catalyst, the method comprising

co-extruding a titanium source with a porous material comprising Al_2O_3 to form a titanium-containing carrier extrudate,

drying and calcining the extrudate, and

impregnating the calcined extrudate with an organic additive, at least molybdenum and/or tungsten metal source and at least one nickel and/or cobalt metal source,

the amount of the titanium source being sufficient so as to form a catalyst composition at least having a titanium content in the range of 5 to 60 wt.%, expressed as an oxide, TiO_2, based on the total weight of the catalyst and has less than 1.0 wt.% silica expressed as an oxide, SiO_2, and based on the total weight of the catalyst; and wherein the catalyst further comprises a phosphorus component in an amount of at least 1 wt.%, as oxide P_2O_5, based on the total weight of the catalyst.

[0008b] In another aspect, there is provided a method of producing a catalyst, the method comprising

precipitating a titanium source with an aluminum source,

extruding the precipitate to form a titanium-containing carrier extrudate,

drying and calcining the extrudate, and

impregnating the calcined extrudate with an organic additive, at least one molybdenum and/or tungsten metal source and at least one nickel and/or cobalt metal source,

the amount of the titanium source being sufficient so as to form a catalyst composition at least having a titanium content in the range of 5 to 60 wt.%, expressed as an oxide, TiO_2, based on the total weight of the catalyst and has less than 1.0 wt.% silica expressed as an oxide, SiO_2, and based on the total weight of the catalyst, and wherein the catalyst further comprises a phosphorus component in an amount of at least 1 wt.%, as oxide P_2O_5, based on the total weight of the catalyst.

[0008c] In another aspect, there is provided a method of producing a catalyst, the method comprising

impregnating a porous material comprising Al_2O_3 with a titanium source to form a titanium-containing carrier,

drying and calcining the carrier, and

impregnating the calcined carrier with an organic additive, at least one molybdenum and/or tungsten metal source and at least one nickel and/or cobalt metal source,

the amount of the titanium source being sufficient so as to form a catalyst composition at least having a titanium content in the range of 5 to 60 wt.%, expressed as an oxide, TiO_2, based on the total weight of the catalyst and has less than 1.0 wt.% silica expressed as an oxide, SiO_2, based on the total weight of the catalyst; and wherein the catalyst further comprises a phosphorus component in an amount of at least 1 wt.%, as oxide P_2O_5, based on the total weight of the catalyst.

[0008d] In another aspect, there is provided a method which comprises contacting a hydrocarbon feed with a catalyst as defined above under hydrotreating conditions so as to hydrotreat the hydrocarbon feed.

[0009] In another example of the disclosure, there is provided a catalyst composition formed by the just above-described process. Another example of the disclosure is a hydrotreating process carried out employing the catalyst composition.

[0010] These and still other examples, advantages and features of the present disclosure shall become further apparent from the following detailed description, including the appended claims.

FURTHER DETAILED DESCRIPTION OF THE INVENTION

[0011] Unless otherwise indicated, weight percent (__wt.%) as used herein is the weight percent of the specified form of the substance, based upon the total weight of the product for which the specified substance or form of substance is a constituent or component. The weight percent of TiO_2 and Group VIB and Group VIII metals-oxides are based on the total weight of the final catalyst after calcination, i.e. excluding the presence of organics and/or water. The weight percent of organics in the final catalyst is based on the total weight of the final catalyst without calcination. It should further be understood that, when describing steps or

CLAIMS:

1. A catalyst comprising

at least one Group VIB metal component selected from molybdenum and tungsten,

at least one Group VIII metal component selected from nickel and cobalt,

at least one organic additive component,

a phosphorus component in an amount of at least 1 wt.%, as oxide P_2O_5, based on the total weight of the catalyst; and

a titanium-containing carrier component,

wherein the titanium content is in the range of 5 to 60 wt.%, expressed as an oxide, TiO_2, and based on the total weight of the catalyst and wherein the catalyst comprises silica at a silica content of 0 to less than 1.0 wt.% expressed as an oxide, SiO_2, and based on the total weight of the catalyst.

2. The catalyst of Claim 1 wherein the Group VIB metal component is in an amount of 15 to 30 wt.% expressed as an oxide based on the total weight of the catalyst.

3. The catalyst of Claim 1 wherein the Group VIII metal component in an amount of 2 to 8 wt.% expressed as an oxide based on the total weight of the catalyst.

4. The catalyst of Claim 1 wherein the silica content is less than 0.5 wt.% expressed as an oxide, SiO_2, and based on the total weight of the catalyst.

5. The catalyst of Claim 1 wherein the organic component is an organic compound selected from the group consisting of organic compounds comprising at least two oxygen atoms and 2 - 10 carbon atoms and ethers derived therefrom.

6. The catalyst of Claim 5 wherein the organic component is an organic compound selected from the group consisting of at least two oxygen-containing moieties, such as a carboxyl moiety and ethers derived therefrom.

7. The catalyst of Claim 6 wherein the organic component is an organic compound selected from the group consisting of ethylene glycol, propylene glycol, triethylene glycol, propanediol, glycerin, trimethylol ethane, trimethylol propane, diethylene glycol.

8. The catalyst of Claim 5 wherein the organic component is an organic compounds comprising at least two hydroxyl groups and a H:O ratio of 2:1, e.g., monosaccharides such as glucose, ribose, and ethers derived therefrom.

9. The catalyst of Claim 1 wherein the organic component is a sulfur-containing component.

10. The catalyst of Claim 9 wherein the organic component is mercapto carboxylic acid.

11. The catalyst of Claim 10 wherein the mercapto carboxylic acid is thioglycolic acid, thiolactic acid, thiopropionic acid, mercapto succinic acid or cysteine.

12. The catalyst of Claim 1 comprising the phosphorus component in the amount of 1 to 8 wt.% expressed as oxide based on the total weight of the catalyst.

13. The catalyst of Claim 1 wherein the organic additive component is in amount of 1 to 30 wt.% C.

14. The catalyst of Claim 13 wherein the organic additive component is in amount of 1 to 20 wt.% C.

15. The catalyst of Claim 14 wherein the organic additive component is in amount of 5 to 15 wt.% C.

16. A method of producing a catalyst, the method comprising

co-extruding a titanium source with a porous material comprising Al_2O_3 to form a titanium-containing carrier extrudate,

drying and calcining the extrudate, and

impregnating the calcined extrudate with an organic additive, at least molybdenum and/or tungsten metal source and at least one nickel and/or cobalt metal source,

the amount of the titanium source being sufficient so as to form a catalyst composition at least having a titanium content in the range of 5 to 60 wt.%, expressed as an oxide, TiO_2, based on the total weight of the catalyst and has less than 1.0 wt.% silica expressed as an oxide, SiO_2, and based on the total weight of the catalyst; and wherein the catalyst further comprises a phosphorus component in an amount of at least 1 wt.%, as oxide P_2O_5, based on the total weight of the catalyst.

17. A method of producing a catalyst, the method comprising

precipitating a titanium source with an aluminum source,

extruding the precipitate to form a titanium-containing carrier extrudate,

drying and calcining the extrudate, and

impregnating the calcined extrudate with an organic additive, at least one molybdenum and/or tungsten metal source and at least one nickel and/or cobalt metal source,

the amount of the titanium source being sufficient so as to form a catalyst composition at least having a titanium content in the range of 5 to 60 wt.%, expressed as an oxide, TiO_2, based on the total weight of the catalyst and has less than 1.0 wt.% silica expressed as an oxide, SiO_2, and based on the total weight of the catalyst; and wherein the catalyst further comprises a phosphorus component in an amount of at least 1 wt.%, as oxide P_2O_5, based on the total weight of the catalyst.

18. The method of Claim 17 wherein the precipitation comprises the steps of (a) simultaneous dosing of sodium aluminate and aluminum sulfate to water at a fixed pH (b) re-slurrying the formed alumina filter cake in water (c) adding to this slurry $TiOSO_4$ or titanium sulfate at a fixed pH > 7 controlled by an alkaline solution.

19. The method of Claim 17 wherein the aluminum source and the titanium source are mixed in one stream and sodium aluminate are dosed either simultaneously or subsequently to water at a pH > 7.

20. A method of producing a catalyst, the method comprising

impregnating a porous material comprising Al_2O_3 with a titanium source to form a titanium-containing carrier,

drying and calcining the carrier, and

impregnating the calcined carrier with an organic additive, at least one molybdenum and/or tungsten metal source and at least one nickel and/or cobalt metal source,

the amount of the titanium source being sufficient so as to form a catalyst composition at least having a titanium content in the range of 5 to 60 wt.%, expressed as an oxide, TiO_2, based on the total weight of the catalyst and has less than 1.0 wt.% silica expressed as an oxide, SiO_2, based on the total weight of the catalyst; and wherein the catalyst further comprises a phosphorus component in an amount of at least 1 wt.%, as oxide P_2O_5, based on the total weight of the catalyst.

21. The method of Claims 16, 17 or 20 wherein the organic additive is an organic compound selected from the group consisting of organic compounds comprising at least two oxygen atoms and 2 - 10 carbon atoms, and the ethers, esters, acetals, acid chlorides, acid amides, oligomers or polymers thereof and the impregnation is performed in a single step with a solution comprising the organic additive, at least one molybdenum and/or tungsten metal source and at least one nickel and/or cobalt metal source.

22. The method of Claims 16, 17 or 20 wherein the organic additive is an organic compound selected from the group consisting of organic compounds comprising at least two oxygen atoms and 2 - 10 carbon atoms, and the ethers, esters, acetals, acid chlorides, acid amides, oligomers or polymers thereof and the impregnation is performed in more than one

step, wherein the carrier is impregnated with a solution comprising at least one molybdenum and/or tungsten metal source and at least one nickel and/or cobalt metal source, followed by a step of impregnating the carrier with a solution comprising the organic additive.

23. The method of Claims 16, 17 or 20 further comprising the titanium source being selected from the group consisting of titanyl sulfate, titanium sulfate, titanium alkoxide, or Titanium(IV)bis(ammonium lactato)dihydroxide.

24. A method which comprises contacting a hydrocarbon feed with a catalyst according to any one of claims 1 to 15 under hydrotreating conditions so as to hydrotreat the hydrocarbon feed.