titanium-containing carrier is formed by co-extruding or precipitating a titanium source with a Al_2O_3 precursor to form a porous support material comprising Al_2O_3 or by impregnating a titanium source onto a porous support material 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 sulfur containing organic additive component selected from thiolactic acid, mercapto succinic acid and cysteine, and

a titanium-containing carrier component,

wherein the amount of titanium content is in the range of 1 to 60 wt%, expressed as an oxide, TiO_2, 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 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. One or more sulfur containing 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 a sulfur containing organic additive selected from thiolactic acid, mercapto succinic acid and cysteine, 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 1 wt% to 60 wt%, expressed as an oxide, TiO_2, 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 a sulfur containing organic additive selected from thiolactic acid, mercapto succinic acid and cysteine, at least one molybdenum and/or tungsten 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 1 wt% to 60 wt%, expressed as an oxide, TiO_2, 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 a sulfur containing organic additive selected from thiolactic acid, mercapto succinic acid and cysteine, at least one molybdenum and/or tungsten metal source and/or 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 1 wt% to 60 wt%, expressed as an oxide, TiO_2, 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.

[0008e] In another aspect, there is provided a use of a catalyst in refining processes for hydrodenitrogenating hydrocarbon feedstocks, wherein the catalyst comprises 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 sulfur containing organic additive component,

and a titanium-containing carrier component,

wherein the amount of titanium content is in the range of 1 to 60 wt%, expressed as an oxide, TiO_2, based on the total weight of the catalyst.

[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 sulfur containing organic additive component selected from thiolactic acid, mercapto succinic acid and cysteine, and

a titanium-containing carrier component,

wherein the amount of titanium content is in the range of 1 to 60 wt%, expressed as an oxide, TiO_2, 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 is in an amount of 2 to 8 wt% expressed as an oxide based on the total weight of the catalyst.

4. The catalyst according to claim 1 wherein the Group VIB metal is molybdenum and the Group VIII metal is nickel and/or cobalt.

5. The catalyst of Claim 1 further comprising a phosphorous component in the amount of 1 to 8% expressed as oxide based on the total weight of the catalyst.

6. The catalyst of Claim 1 wherein the at least one sulfur containing organic additive component is in amount of 1 to 30 wt% C.

7. The catalyst of Claim 6 wherein the at least one sulfur containing organic additive component is in amount of 1 to 20 wt% C.

8. The catalyst of Claim 7 wherein the at least one sulfur containing organic additive component is in amount of 5 to 15 wt% C.

9. 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 a sulfur containing organic additive selected from thiolactic acid, mercapto succinic acid and cysteine, 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 1 wt% to 60 wt%, expressed as an oxide, TiO_2, based on the total weight of the catalyst.

10. 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 a sulfur containing organic additive selected from thiolactic acid, mercapto succinic acid and cysteine, at least one molybdenum and/or tungsten 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 1 wt% to 60 wt%, expressed as an oxide, TiO_2, based on the total weight of the catalyst.

11. The method of Claim 10 wherein the precipitation comprises the steps of (a) simultaneous dosing of sodium aluminate and aluminum sulfate to water at a fixed pH (b) the formed alumina filter cake is re-slurried in water (c) to this slurry $TiOSO_4$ or titanium sulfate is added at a fixed pH > 7 controlled by an alkaline solution.

12. The method of Claim 10 wherein the aluminum source and the titanium source are mixed in one stream and sodium aluminate is dosed either simultaneously or subsequently to water at a pH > 7.

13. 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 a sulfur containing organic additive selected from thiolactic acid, mercapto succinic acid and cysteine, 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 1 wt% to 60 wt%, expressed as an oxide, TiO_2, based on the total weight of the catalyst.

14. The method of Claims 9, 10 or 13 further comprising the impregnation with the sulfur containing organic additive, at least one Group VIB metal source and/or at least one Group VIII metal source being performed in a single step with a solution comprising the sulfur containing organic additive, at least one Group VIB metal source and/or at least one Group VIII metal source.

15. The method of Claims 9, 10 or 13 further comprising the impregnation with the sulfur containing organic additive, at least one Group VIB metal source and/or at least one Group VIII metal source being performed in more than one step, wherein the carrier is impregnated with a solution comprising at least one Group VIB metal source and/or at least one Group VIII metal source, followed by a step of impregnating the carrier with a solution comprising the sulfur containing organic additive.

16. The method of Claims 9, 10 or 13 wherein the titanium source is selected from the group consisting of titanyl sulfate, titanium sulfate, titanium alkoxide or Titanium(IV)bis(ammonium lactato)dihydroxide.

17. A method which comprises contacting a hydrocarbon feed with a catalyst according to any one of claims 1 to 8 under hydrotreating conditions so as to hydrotreat the hydrocarbon feed.

18. A use of a catalyst in refining processes for hydrodenitrogenating hydrocarbon feedstocks, wherein the catalyst comprises 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 sulfur containing organic additive component,

and a titanium-containing carrier component,

wherein the amount of titanium content is in the range of 1 to 60 wt%, expressed as an oxide, TiO_2, based on the total weight of the catalyst.