**[0004]** Another example is US 6,383,975 which discloses a catalyst that uses a support consisting on an alumina matrix, having dispersed on its surface or in its mass, or in both, a metal oxide from group IVB of the periodic table. The support is prepared by co-precipitation technique, co-gelification or impregnation of the alumina with a Ti compound, soluble in an organic solvent, followed by drying at 100 to 200°C and calcination at 400 to 600°C, on oxidizing atmosphere. However, this reference also fails to disclose the combination of the present invention as it does not disclose the synergistic effect of titanium and organic additives

**[0005]** Another example is US 9,463,452 which discloses a catalyst that uses a titania coated alumina particles shaped into extrudates. The hydrotreating catalyst then supports a periodic table group 6 metal compound, a periodic table group 8-10 metal compound, a phosphorus compound, and a saccharide. The invention of the '452 patent is limited to a very specific manufacturing process and only to the use of saccharides as potential additives.

**[0006]** It was found that by using $TiO_2$-containing carriers in combination with the use of certain organics in the preparation method, highly active hydrotreating catalysts can be made. The activity of these catalysts is higher than (i) what can be achieved on a conventional $Al_2O_3$ support with the same organic or (ii) when the $TiO_2$-containing catalysts are being prepared without organics. Moreover, it appears the activity of the active phase in the catalyst prepared with $TiO_2$-containing supports in combination with organics is higher than can be expected based on the effect of the individual contributions of these parameters. This higher active phase activity can be applied to generate hydrotreating catalysts with a superior volumetric activity or catalysts with high activity at considerably lower concentrations of the active Group VIB and Group VIII metal components.

**[0007]** Thus, in one example of the disclosure there is provided a catalyst comprising at least one Group VIB metal component, at least one Group VIII metal component, an organic additive resulting in a C-content of the final catalysts of about 1 to about 30 wt% C, and preferably about 1 to about 20 wt% C, and more preferably about 5 to about 15 wt% C and a titanium-containing carrier component, wherein the amount of the titanium component is in the range of about 3 to about 60 wt%, expressed as an oxide ($TiO_2$) and based on the total weight of the catalyst. The 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 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, and

a titanium-containing carrier component,

**[0008]** wherein the titanium content is in the range of 1 to 60 wt.%, expressed as an oxide, $TiO_2$, and based on the total weight of the catalyst and wherein the silica content is less than 1.0 wt.% expressed as an oxide, $SiO_2$, and based on the total weight of the catalyst.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 1 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.

**[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 1 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.

**[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 1 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.

**[0008d]** In another aspect, there is provided a method which comprises contacting a hydrocarbon feed with a catalyst as defined above or produced according to a method 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