characteristics. There is also a need for catalysts that perform satisfactorily even in low pressure hydroconversion processes.

SUMMARY OF THE INVENTION

[011a] In one aspect, there is provided an unsupported catalyst precursor composition comprising: at least one of a metal compound selected from Group VIII, Group IIB, Group IIA, Group IVA and combinations thereof; at least one of a Group VIB metal compound; and at least an organic oxygen-containing ligand L, wherein the organic oxygen-containing ligand L has an LD50 rate of > 500 mg/Kg as single oral dose to rats; wherein the composition is of the formula

$$A_v[(M^P)(OH)_x(L)^n{}_y]_z\,(M^{VIB}O_4),$$

wherein

A comprises at least one of an alkali metal cation, an ammonium, an organic ammonium and a phosphonium cation,

M^P is at least one of a Group VIII metal, Group IIB metal, Group IIA metal, Group IVA metal and combinations thereof,

M having an oxidation state of +2 or +4,

L is at least one organic oxygen-containing ligand,

M^{VIB} is at least a Group VIB metal having an oxidation state of +6;

M^P:M^{VIB} has an atomic ratio between 100:1 and 1:100;

$v-2 + P*z-x*z + n*y*z = 0$; and

$0<y\leq -P/n$; $0<x\leq P$; $0<v\leq 2$; $0<z$.

[011b] In one aspect, there is provided an unsupported catalyst prepared by sulfiding the unsupported catalyst precursor as described herein.

[011c] In one aspect, there is provided a process for forming the unsupported catalyst precursor composition as described herein, the process comprises the step of co-precipitating at reaction conditions forming a precipitate or cogel comprising: at least a

metal compound selected from Group VIII, Group IIB, Group IIA, Group IVA and combinations thereof, at least a Group VIB metal compound, at least one organic oxygen-containing ligand.

[011d] In one aspect, there is provided a process for hydroprocessing a hydrocarbon feedstock which comprises contacting the feedstock with an unsupported catalyst under hydroprocessing conditions, wherein the unsupported catalyst is derived from the unsupported catalyst precursor composition as described herein.

[012] In one aspect, the invention relates to a charged-neutral catalyst precursor composition of the formula $A_v[(M^P)\ (OH)_x\ (L)^n{}_y]_z\ (M^{VIB}O_4)$, wherein upon sulfidation, the catalyst exhibits hydrodenitrogenation, hydrodearomatization, and hydrodesulphurization activity, wherein A comprises one or more monovalent cationic species, M^P is selected from Group VIII, Group IIB, Group IIA, Group IVA and combinations thereof, L is one or more oxygen-containing organic ligands, M^{VIB} is at least a Group VIB metal, the atomic ratio of M^P:M^{VIB} is between 100:1 and 1:100, $v - 2 + P * z - x * z + n * y * z = 0$; and $0 \leq y \leq -P/n$; $0 \leq x \leq P$; $0 \leq v \leq 2$; $0 \leq z$. In one embodiment, M^P is at least a Group VIII metal. The catalyst precursor is charge-neutral in that it has no net negative or positive charge. The catalyst precursor can contain various amounts of associated water.

[013] In one embodiment, A is a monovalent cation such as an alkali metal cation, an ammonium cation, an organic ammonium cation, a phosphonium cation, or an organic phosphonium cation. L is a monocarboxylate such as formate, acetate, or propanoate or a dicarboxylate such as oxalate, malonate, succinate, glutarate, adipate, malate, or maleate. In a further embodiment, the ratio of M^P:M^{VIB} is between 10:1 and 0.1:1. In yet another embodiment, the ratio of M^P:M^{VIB} is between 5:1 and 0.5:1.

[014] In one aspect, the invention relates to a process for making a hydroprocessing catalyst composition, the process comprising sulfiding a catalyst of the formula $A_v[(M^P)\ (OH)_x\ (L)^n{}_y]_z\ (M^{VIB}O_4)$. In one embodiment, the sulfur containing compound is selected from elemental sulfur, hydrogen sulfide, dimethyldisulfide (DMDS), polysulfides, and combinations thereof.

[015] In yet another aspect, the invention relates to relates to a process for hydroprocessing oil feedstock using a catalyst derived from a catalyst precursor of the formula $A_v[(M^P)\ (OH)_x\ (L)^n{}_y]_z\ (M^{VIB}O_4)$, wherein A comprises an alkali metal cation, an ammonium, an organic ammonium or a phosphonium cation, M^P is selected from Group

What is claimed is:

1. An unsupported catalyst precursor composition comprising: at least one of a metal compound selected from Group VIII, Group IIB, Group IIA, Group IVA and combinations thereof; at least one of a Group VIB metal compound; and at least an organic oxygen-containing ligand L, wherein the organic oxygen-containing ligand L has an LD50 rate of > 500 mg/Kg as single oral dose to rats;

wherein the composition is of the formula

$$A_v[(M^P)(OH)_x(L)^n{}_y]_z\ (M^{VIB}O_4),$$

wherein
A comprises at least one of an alkali metal cation, an ammonium, an organic ammonium and a phosphonium cation,

M^P is at least one of a Group VIII metal, Group IIB metal, Group IIA metal, Group IVA metal and combinations thereof,

M having an oxidation state of +2 or +4,

L is at least one organic oxygen-containing ligand,

M^{VIB} is at least a Group VIB metal having an oxidation state of +6;

M^P:M^{VIB} has an atomic ratio between 100:1 and 1:100;

$v-2 + P*z-x*z + n*y*z = 0$; and

$0<y\leq -P/n$; $0<x\leq P$; $0<v\leq 2$; $0<z$.

2. The unsupported catalyst precursor composition of claim 1, wherein M^P is at least a Group VIII metal, M having an oxidation state of +2.

3. The unsupported catalyst precursor composition of claim 1, wherein M^P is nickel.

4. The unsupported catalyst precursor composition of claim 1, wherein M^P is at least one of a Group IIB metal, a Group IVA metal, and combinations thereof, M having an oxidation state of either +2 or +4

5. The unsupported catalyst precursor composition of claim 1, wherein M^P is selected from zinc, cadmium, tin, lead and combinations thereof.

6. The unsupported catalyst precursor composition of claim 1, wherein M^{VIB} is selected from molybdenum (Mo), tungsten (W), and combinations thereof.

7. The unsupported catalyst precursor composition of claim 1, wherein M^{VIB} comprises molybdenum and tungsten, and wherein the molybdenum : tungsten ratio ranges from 1:10 to 10:1.

8. The unsupported catalyst precursor composition of claim 1, wherein the molybdenum : tungsten ratio ranges from 1:2 to 1:3.

9. The unsupported catalyst precursor composition of claim 1, wherein the unsupported catalyst precursor is mesoporous with an average pore volume between 0.1 and 0.2 cc/g.

10. The unsupported catalyst precursor composition of claim 1, wherein the unsupported catalyst precursor has an average surface area between 10 and 200 m^2/g as measured by BJH analysis under B.E.T. nitrogen adsorption conditions.

11. The unsupported catalyst precursor composition of claim 1, wherein L is at least one of carboxylates, enolates, and combinations thereof.

12. The unsupported catalyst precursor composition of claim 1, wherein L is a carboxylate.

13. The unsupported catalyst precursor composition of claim 1, wherein L is maleate.

14. The unsupported catalyst precursor composition of claim 1, wherein L is negatively charged.

15. The unsupported catalyst precursor composition of claim 1, wherein the composition is extruded forming an extrudate.

16. The unsupported catalyst precursor composition of claim 15, wherein at least a cellulose containing material is added to the catalyst precursor composition prior to extrusion forming an extrudate.

17. The unsupported catalyst precursor composition of any of claims 15-16, wherein the extrudate is sulfided resulting in a catalyst.

18. An unsupported catalyst prepared by sulfiding the unsupported catalyst precursor of claim 1.

19. A process for forming the unsupported catalyst precursor composition of claim 1, the process comprises the step of co-precipitating at reaction conditions forming a precipitate or cogel comprising: at least a metal compound selected from Group VIII, Group IIB, Group IIA, Group IVA and combinations thereof, at least a Group VIB metal compound, at least one organic oxygen-containing ligand

20. A process for hydroprocessing a hydrocarbon feedstock which comprises contacting the feedstock with an unsupported catalyst under hydroprocessing conditions, wherein the unsupported catalyst is derived from the unsupported catalyst precursor composition of claim 1.