**Claims:**

1. A process for forming a precipitate-free solution, which process comprises

A) bringing together, in an aqueous medium,

i) at least one phosphorus compound,

ii) at least one Group VI metal compound,

iii) at least one Group VIII metal compound, and

iv) an additive which is

a) tetraethylene glycol,

b) polyethylene glycol having an average molecular weight in the range of about 200 to about 400,

c) a mixture of tetraethylene glycol and polyethylene glycol having an average molecular weight in the range of about 200 to about 400, or

d) a mixture of (1) tetraethylene glycol and/or polyethylene glycol having an average molecular weight in the range of about 200 to about 400 and (2) one or more of monoethylene glycol, diethylene glycol, and triethylene glycol,

where the molar ratio of additive to the total moles of Group VI metal and Group VIII metal is in the range of 0.31:1 to 0.6:1, and where the atomic ratio of phosphorus to Group VI metal is at least about 0.33:1,

to form a solution;

B) optionally heating said solution at a temperature above about 40°C to form a heated solution; and

C) optionally cooling said heated solution to form a cooled solution.

2. A process as in Claim 1 wherein said atomic ratio of phosphorus to Group VI metal is at least about 0.33:1 to about 0.8:1, and/or wherein said Group VI metal compound and the Group VIII metal compound are in an amount such that the Group VI metal and the Group VIII metal are in an atomic ratio of at least about 1.5:1.

3. A process as in Claim 1 wherein said phosphorus compound is a water soluble, acidic phosphorus compound, optionally wherein said phosphorus compound is orthophosphoric acid.



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4. A process as in Claim 1 wherein said Group VIII metal compound is a carbonate, hydroxide, or hydroxy-carbonate, and/or wherein said Group VI metal compound is an oxide or an oxo-acid.

5. A process as in Claim 1 wherein the molar ratio of additive to the total moles of Group VI metal and Group VIII metal is at least about 0.36:1.

6. A process as in Claim 1 wherein said additive is polyethylene glycol having an average molecular weight in the range of about 200 and about 400, or a mixture of triethylene glycol and tetraethylene glycol and/or polyethylene glycol having an average molecular weight in the range of about 200 to about 400.

7. A process as in Claim 1 wherein an organic acid is included, which organic acid has at least one acid group and at least one functional group selected from a hydroxyl group and an acid group, optionally wherein said organic acid is citric acid.

8. A process as in any of Claims 1, 2, 3, or 4-7 wherein said Group VI metal is molybdenum and/or tungsten, and/or wherein said Group VIII compound is a nickel or cobalt compound.

9. A precipitate-free solution formed as in Claim 1, which solution comprises a Group VI metal, a Group VIII metal, phosphorus, and an additive which is

a) tetraethylene glycol,

b) polyethylene glycol having an average molecular weight in the range of about 200 to about 400,

c) a mixture of tetraethylene glycol and polyethylene glycol having an average molecular weight in the range of about 200 to about 400, or

d) a mixture of (1) tetraethylene glycol and/or polyethylene glycol having an average molecular weight in the range of about 200 to about 400 and (2) one or more of monoethylene glycol, diethylene glycol, and triethylene glycol,

where the molar ratio of additive to the total moles of Group VI metal and Group VIII metal is above 0.30:1, and where the atomic ratio of phosphorus to Group VI metal is in the range of about 0.31:1 to about 0.6:1.

10. A solution as in Claim 9 wherein said atomic ratio of phosphorus to Group VI metal is in the range of about 0.33:1 to about 0.8:1, and/or wherein said Group VI metal compound and the Group VIII metal compound are in an amount such that the Group VI metal and the Group VIII metal are in an atomic ratio of about 1.5:1 to about 6:1.

11. A solution as in Claim 9 wherein the molar ratio of additive to the total moles of Group VI metal and Group VIII metal is at least about 0.36:1.

12. A solution as in any of Claims 9 or 10 wherein said Group VI metal is molybdenum and/or tungsten, and/or wherein said Group VIII metal is nickel or cobalt.

13. A process for forming a catalyst, which process comprises

I) bringing together a carrier and an impregnation solution, which impregnation solution comprises a solution of Claim 12, to form an impregnated carrier; and

II) drying the impregnated carrier, and

III) optionally calcining the impregnated carrier,

to form a catalyst, and optionally sulfiding the catalyst.

14. A process as in Claim 13 wherein I) comprises a single impregnation step.

15. A process as in Claim 13 wherein said carrier is silica, alumina, silica-alumina, alumina with silica-alumina dispersed therein, alumina-coated silica, or silica-coated alumina.

16. A process as in Claim 13 wherein at least one organic acid, which organic acid has at least one acid group and at least one functional group selected from a hydroxyl group and an acid group, is present in the impregnation solution, optionally wherein said organic acid is citric acid.

17. A catalyst composition formed as in any of Claims 13, 14, 15, or 16.

18. A composition as in Claim 17 wherein the Group VI metal is molybdenum, and wherein the molybdenum is present in an amount of about 5 to about 40 wt%, calculated as molybdenum trioxide.



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19. A method for hydrotreating, hydrodenitrogenation, and/or hydrodesulfurization, which method comprises contacting a hydrocarbon feed and a catalyst of Claim 17.



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**Claims:**

1. A process for forming a precipitate-free solution, which process comprises

A) bringing together, in an aqueous medium,

i) at least one phosphorus compound,

ii) at least one Group 6 metal compound,

iii) at least one Group 8-10 metal compound, and

iv) an additive which is

a) tetraethylene glycol,

b) polyethylene glycol having an average molecular weight in the range of about 200 to about 400,

c) a mixture of tetraethylene glycol and polyethylene glycol having an average molecular weight in the range of about 200 to about 400, or

d) a mixture of (1) tetraethylene glycol and/or polyethylene glycol having an average molecular weight in the range of about 200 to about 400 and (2) one or more of monoethylene glycol, diethylene glycol, and triethylene glycol,

where the molar ratio of additive to the total moles of Group 6 metal and Group 8-10 metal is in the range of 0.31:1 to 0.6:1, and where the atomic ratio of phosphorus to Group 6 metal is at least about 0.33:1,

to form a solution;

B) optionally heating said solution at a temperature above about 40°C to form a heated solution; and

C) optionally cooling said heated solution to form a cooled solution.

2. A process as in Claim 1 wherein said atomic ratio of phosphorus to Group 6 metal is at least about 0.33:1 to about 0.8:1, and/or wherein said Group 6 metal compound and the Group 8-10 metal compound are in an amount such that the Group 6 metal and the Group 8-10 metal are in an atomic ratio of at least about 1.5:1.

3. A process as in Claim 1 wherein said phosphorus compound is a water soluble, acidic phosphorus compound, optionally wherein said phosphorus compound is orthophosphoric acid.



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4. A process as in Claim 1 wherein said Group 8-10 metal compound is a carbonate, hydroxide, or hydroxy-carbonate, and/or wherein said Group 6 metal compound is an oxide or an oxo-acid.

5. A process as in Claim 1 wherein the molar ratio of additive to the total moles of Group 6 metal and Group 8-10 metal is at least about 0.36:1.

6. A process as in Claim 1 wherein said additive is polyethylene glycol having an average molecular weight in the range of about 200 and about 400, or a mixture of triethylene glycol and tetraethylene glycol and/or polyethylene glycol having an average molecular weight in the range of about 200 to about 400.

7. A process as in Claim 1 wherein an organic acid is included, which organic acid has at least one acid group and at least one functional group selected from a hydroxyl group and an acid group, optionally wherein said organic acid is citric acid.

8. A process as in any of Claims 1, 2, 3, or 4-7 wherein said Group 6 metal is molybdenum and/or tungsten, and/or wherein said Group 8-10 compound is a nickel or cobalt compound.

9. A precipitate-free solution formed as in Claim 1, which solution comprises a Group 6 metal, a Group 8-10 metal, phosphorus, and an additive which is

a) tetraethylene glycol,

b) polyethylene glycol having an average molecular weight in the range of about 200 to about 400,

c) a mixture of tetraethylene glycol and polyethylene glycol having an average molecular weight in the range of about 200 to about 400, or

d) a mixture of (1) tetraethylene glycol and/or polyethylene glycol having an average molecular weight in the range of about 200 to about 400 and (2) one or more of monoethylene glycol, diethylene glycol, and triethylene glycol,

where the molar ratio of additive to the total moles of Group 6 metal and Group 8-10 metal is in the range of about 0.31:1 to about 0.6:1, and where the atomic ratio of phosphorus to Group 6 metal is at least about 0.33:1.

10. A solution as in Claim 9 wherein said atomic ratio of phosphorus to Group 6 metal is in the range of about 0.33:1 to about 0.8:1, and/or wherein said Group 6 metal compound and the Group 8-10 metal compound are in an amount such that the Group 6 metal and the Group 8-10 metal are in an atomic ratio of about 1.5:1 to about 6:1.

11. A solution as in Claim 9 wherein the molar ratio of additive to the total moles of Group 6 metal and Group 8-10 metal is at least about 0.36:1.

12. A solution as in any of Claims 9 or 10 wherein said Group 6 metal is molybdenum and/or tungsten, and/or wherein said Group 8-10 metal is nickel or cobalt.

13. A process for forming a catalyst, which process comprises

I) bringing together a carrier and an impregnation solution, which impregnation solution comprises a solution of Claim 12, to form an impregnated carrier; and

II) drying the impregnated carrier, and

III) optionally calcining the impregnated carrier,

to form a catalyst, and optionally sulfiding the catalyst.

14. A process as in Claim 13 wherein I) comprises a single impregnation step.

15. A process as in Claim 13 wherein said carrier is silica, alumina, silica-alumina, alumina with silica-alumina dispersed therein, alumina-coated silica, or silica-coated alumina.

16. A process as in Claim 13 wherein at least one organic acid, which organic acid has at least one acid group and at least one functional group selected from a hydroxyl group and an acid group, is present in the impregnation solution, optionally wherein said organic acid is citric acid.

17. A catalyst composition formed as in any of Claims 13, 14, 15, or 16.

18. A composition as in Claim 17 wherein the Group 6 metal is molybdenum, and wherein the molybdenum is present in an amount of about 5 to about 40 wt%, calculated as molybdenum trioxide.



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19. A method for hydrotreating, hydrodenitrogenation, and/or hydrodesulfurization, which method comprises contacting a hydrocarbon feed and a catalyst of Claim 17.



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