CLAIMS

1. A catalyst comprising

at least one Group VIB metal component,

at least one Group VIII metal component,

a phosphorus component, and

a boron-containing carrier component,

wherein the amount of the phosphorus component is at least 1 wt %, expressed as an oxide (P_2O_5) and based on the total weight of the catalyst, and the amount of boron content is in the range of 1 to 13 wt%, expressed as an oxide (B_2O_3) and based on the total weight of the catalyst; and wherein the formation of the catalyst involves at least co-extruding a boron source with a carrier to form a boron-containing carrier extrudate, drying and calcining the extrudate, and impregnating the calcined extrudate with a solution comprised of a phosphorus source, at least one Group VIB metal source and/or at least one Group VIII metal source.

2. The catalyst according to claim 1 wherein the Group VIB metal component comprises molybdenum.

3. The catalyst according to either of claims 1 and 2 wherein the Group VIII metal component comprises nickel.

4. The catalyst according to either of claims 1 and 2 wherein the Group VIII metal component comprises nickel.

5. The catalyst according to any of claims 1-4 wherein the amount of the phosphorus component is in the range of 4 wt% to 10 wt%, expressed as an oxide (P_2O_5) and based on the total weight of the catalyst.

6. The catalyst according to claim 5, wherein the amount of the phosphorus component is in the range of 4 wt% to 7 wt%, expressed as an oxide (P_2O_5) and based on the total weight of the catalyst.

7. The catalyst according to claim 6, wherein the boron content in the range of 2 wt% to 8 wt%, expressed as an oxide (B_2O_3) and based on the total weight of the catalyst.

8. The catalyst according to claim 7, wherein the boron content in the range of 4 wt% to 6 wt%, expressed as an oxide (B_2O_3) and based on the total weight of the catalyst.

9. The catalyst according to any of the preceding claims, wherein the carrier comprises alumina.

10. The catalyst according to any of the preceding claims, wherein the boron source comprises boric acid.

11. The catalyst according to any of the preceding claims, further comprising an organic additive.

12. The catalyst according to claim 11, wherein the organic additive is selected from the group consisting of (i) 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/or (ii) an organic compound comprising at least one covalently bonded nitrogen atom and at least one carbonyl moiety.

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

co-extruding a boron source with a carrier to form a boron-containing carrier extrudate, drying and calcining the extrudate, and

impregnating the calcined extrudate with a solution comprised of a phosphorus source, at least one Group VIB metal source and/or at least one Group VIII metal source,

the amount of the boron source and the amount of the phosphorus source being sufficient so as to form a catalyst composition at least having a boron content in the range of 1 wt% to 13 wt%, expressed as an oxide (B_2O_3) and based on the total weight of the catalyst, and a phosphorus content of at least 1 wt%, expressed as an oxide (P_2O_5) and based on the total weight of the catalyst.

14. The method according to claim 13, wherein the amount of the boron source is sufficient so that the boron content of the catalyst produced is in the range of 2 wt% to 8 wt%, expressed as an oxide (B_2O_3) and based on the total weight of the catalyst.

15. The method according to claim 14, wherein the amount of the boron source is sufficient so that the boron content of the catalyst produced is in the range of 4 wt% to 6 wt%, expressed as an oxide (B_2O_3) and based on the total weight of the catalyst.

16. The method according to claim 15, wherein the amount of the phosphorus source is sufficient so that the phosphorus content of the catalyst produced is in the range of 4 wt% to 10 wt%, expressed as an oxide (P_2O_5) and based on the total weight of the catalyst.

17. The method according to claim 16, wherein the amount of the phosphorus source is sufficient so that the phosphorus content of the catalyst is in the range of 4 wt% to 7 wt%, expressed as an oxide (P_2O_5) and based on the total weight of the catalyst.

18. The method according to any of claims 13-17, further comprising calcining an impregnated calcined extrudate formed in the impregnating step.

19. The method according to any of claims 13-17, further comprising drying an impregnated calcined extrudate formed in the impregnation step so as to form a dried impregnated calcined extrudate so as to form the catalyst.

20. The method according to any of claim 13-17, further comprising drying an impregnated calcined extrudate formed in the impregnation step so as to form a dried impregnated calcined extrudate, and further calcining the dried impregnated calcined extrudate so as to form the catalyst.

21. The method according to any of claims 13-17 and 19, wherein the solution further comprises an organic additive.

22. The method according to claim 21, wherein the organic additive is selected from the group consisting of (i) 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/or (ii) an organic compound comprising at least one covalently bonded nitrogen atom and at least one carbonyl moiety.

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

CLAIMS

1. A catalyst comprising

at least one Group VIB metal component,

at least one Group VIII metal component,

a phosphorus component, and

a boron-containing carrier component,

wherein the amount of the phosphorus component is at least 1 wt %, expressed as an oxide (P_2O_5) and based on the total weight of the catalyst, and the amount of boron content is in the range of 1 to 13 wt%, expressed as an oxide (B_2O_3) and based on the total weight of the catalyst; and wherein the formation of the catalyst involves at least co-extruding a boron source with a carrier to form a boron-containing carrier extrudate, drying and calcining the extrudate, and impregnating the calcined extrudate with a solution comprised of a phosphorus source, at least one Group VIB metal source and/or at least one Group VIII metal source.

2. The catalyst according to claim 1 wherein the Group VIB metal component comprises molybdenum.

3. The catalyst according to either of claims 1 and 2 wherein the Group VIII metal component comprises nickel.

4. The catalyst according to any of claims 1-3 wherein the amount of the phosphorus component is in the range of 4 wt% to 10 wt%, expressed as an oxide (P_2O_5) and based on the total weight of the catalyst.

5. The catalyst according to claim 4, wherein the amount of the phosphorus component is in the range of 4 wt% to 7 wt%, expressed as an oxide (P_2O_5) and based on the total weight of the catalyst.

6. The catalyst according to claim 5, wherein the boron content in the range of 2 wt% to 8 wt%, expressed as an oxide (B_20_3) and based on the total weight of the catalyst.

7. The catalyst according to claim 6, wherein the boron content in the range of 4 wt% to 6 wt%, expressed as an oxide (B_2O_3) and based on the total weight of the catalyst.

8. The catalyst according to any of the preceding claims, wherein the carrier comprises alumina.

9. The catalyst according to any of the preceding claims, wherein the boron source comprises boric acid.

10. The catalyst according to any of the preceding claims, further comprising an organic additive.

11. The catalyst according to claim 10, wherein the organic additive is selected from the group consisting of (i) 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/or (ii) an organic compound comprising at least one covalently bonded nitrogen atom and at least one carbonyl moiety.

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

co-extruding a boron source with a carrier to form a boron-containing carrier extrudate, drying and calcining the extrudate, and

impregnating the calcined extrudate with a solution comprised of a phosphorus source, at least one Group VIB metal source and/or at least one Group VIII metal source,

the amount of the boron source and the amount of the phosphorus source being sufficient so as to form a catalyst composition at least having a boron content in the range of 1 wt% to 13 wt%, expressed as an oxide (B_2O_3) and based on the total weight of the catalyst, and a phosphorus content of at least 1 wt%, expressed as an oxide (P_2O_5) and based on the total weight of the catalyst.

13. The method according to claim 12, wherein the amount of the boron source is sufficient so that the boron content of the catalyst produced is in the range of 2 wt% to 8 wt%, expressed as an oxide (B_2O_3) and based on the total weight of the catalyst.

14. The method according to claim 13, wherein the amount of the boron source is sufficient so that the boron content of the catalyst produced is in the range of 4 wt% to 6 wt%, expressed as an oxide (B_2O_3) and based on the total weight of the catalyst.

15. The method according to claim 14, wherein the amount of the phosphorus source is sufficient so that the phosphorus content of the catalyst produced is in the range of 4 wt% to 10 wt%, expressed as an oxide (P_2O_5) and based on the total weight of the catalyst.

16. The method according to claim 15, wherein the amount of the phosphorus source is sufficient so that the phosphorus content of the catalyst is in the range of 4 wt% to 7 wt%, expressed as an oxide (P_2O_5) and based on the total weight of the catalyst.

17. The method according to any of claims 12-16, further comprising calcining an impregnated calcined extrudate formed in the impregnating step.

18. The method according to any of claims 12-16, further comprising drying an impregnated calcined extrudate formed in the impregnation step so as to form a dried impregnated calcined extrudate so as to form the catalyst.

19. The method according to any of claim 12-16, further comprising drying an impregnated calcined extrudate formed in the impregnation step so as to form a dried impregnated calcined extrudate, and further calcining the dried impregnated calcined extrudate so as to form the catalyst.

20. The method according to any of claims 12-16 and 18, wherein the solution further comprises an organic additive.

21. The method according to claim 20, wherein the organic additive is selected from the group consisting of (i) 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/or (ii) an organic compound comprising at least one covalently bonded nitrogen atom and at least one carbonyl moiety.

22. A method which comprises contacting a hydrocarbon feed with a catalyst according to any of the preceding claims 1-11, under hydrotreating conditions so as to hydrotreat the hydrocarbon feed.