Claims

1. A support device for carrying a selectively permeable element, the device comprising:

at least one support member including at least one support surface;

at least one selectively permeable element, partially supported on said support surface; and

at least one sealing portion for sealing said selectively permeable element to said surface, wherein said sealing portion comprises at least one glass material.

2. A support device according to claim 1 further comprising at least one foamed metal at least partially covering said sealing portion.

3. A support device according to claim 2 wherein said foamed metal covers said sealing portion and exposed portions of said selectively permeable element.

4. A support device according to any one of claims 1 to 3 wherein said glass comprises sodalime glass.

5. A support device according to any one of claims 1 to 4 wherein said selectively permeable element comprises a membrane.

6. A support device according to any one of claims 1 to 5 wherein said element is selectively permeable to at least one of oxygen and hydrogen.

7. A support device according to any one of claims 1 to 6 wherein said support member comprises at least one metal.

8. A support device according to claim 7 wherein said metal is at least partially oxidisable on its surface.

9. A support device according to claim 8 wherein said metal is stainless steel.

10. A support device according to any one of claims 1 to 9 wherein said support surface comprises a plurality of holes extending therethrough.

11. An apparatus for separating a component of a gas from other components using a selectively permeable element, the apparatus comprising a vessel having at least one input and inlet and at least one outlet and said vessel divided into at least one first volume and at least one second volume, wherein said first and second volumes are separated by a support device according to any one of claims 1 to 10.

12. An apparatus according to claim 11 further comprising at least one sealing element for sealing the join between said vessel and said support device.

13. An apparatus according to claim 12 wherein said sealing member comprises copper.

14. A method of forming a support device for a selectively permeable element comprising the steps:-

placing at least one sealing material, in the form of at least one glass material, into engagement between a support surface of a support member and a support element that is to be partially supported on said support surface;

heating said support member, selectively permeable element and sealing material so as to melt said sealing material.

15. A method according to claim 15 further comprising heating said support element so as to form an oxidised layer on a surface of said support member that engages said sealing material.

16. A method according to claim 15 or 16, wherein said glass is powdered and mixed with a liquid to form a paste before application.

17. A method according to claim 16, wherein said liquid is polyethylene glycol.

18. An apparatus for the removal of long chain hydrocarbons from a stream of gas, the apparatus comprising:

a vessel including at least one inlet and at least one outlet, allowing a stream of gas to pass therebetween;

a plurality of electrodes including at least one anode and at least one cathode, contained within said vessel, such that said stream of gas passes between at least one said anode

and at least one said cathode, wherein at least one said electrode comprises at least one catalyst.

19. An apparatus according to claim 18 wherein at least one cathode comprises at least one said catalyst.

20. An apparatus according to claim 18 wherein at least one anode and at least one cathode comprise at least one catalyst.

21. An apparatus according to any of claims 18 to 20 wherein said electrode including said catalyst further comprises at least one porous metal.

22. An apparatus according to claim 21 wherein said metal comprises nickel.

23. An apparatus according to any of claims 18 to 22 wherein said catalyst comprises a cobalt based catalyst.

24. An apparatus according to claim 23 wherein said catalyst is supported on silica.

25. An apparatus according to any of claims 18 to 24 further comprising at least one water supply for supplying a spray of water into said vessel.

26. An apparatus according to any of claims 18 to 25 further comprising at least one bed of solid material located at least partially between said electrodes.

27. An apparatus according to claim 26 wherein said bed comprises a fixed bed.

28. An apparatus according to claim 26 wherein said bed comprises a fluidised bed.

29. An apparatus according to any of claims 26 to 28 wherein said solid material comprises at least one tar adsorbent.

30. An apparatus according to any of claims 26 to 29 wherein said solid material comprises at least one catalyst.

31. An apparatus according to any of claims 26 to 30 wherein said solid material comprises at least one PolyHIPE polymer.

32. An apparatus according to any of claims 26 to 31 wherein said solid material comprises at least one plasma catalysis promoter.

33. An apparatus according to any of claims 18 to 32 wherein at least one electrode is annular forming an outer electrode extending around an inner electrode.

34. An apparatus according to claim 33 wherein said outer electrode comprises a cathode and said inner electrode comprises an anode.

35. An apparatus according to claim 33 or 34 wherein said inner electrode is annular.

36. An apparatus according to claim 35 wherein said inner electrode is at least partially conical.

37. An apparatus according to any of claims 18 to 36, wherein said catalyst is a metal catalyst supported on a microporous solid support obtained or obtainable from a process comprising:

(A) adding together a metal catalyst precursor and surface-modified nanoparticles of the material of the microporous solid support to form an aqueous supported-catalyst precursor solution; and

(B) subjecting the aqueous supported-catalyst precursor solution to a source of energy at a power sufficient to cause repeated formation and collapse of films in the supported-catalyst precursor solution and to facilitate the emergence of the metal catalyst precursor or a decomposition product thereof supported on the microporous solid support.

38. A method for removing long chain hydrocarbons from a stream of gas, comprising passing a stream of gas between at least one inlet and at least one outlet of a vessel;

the stream passing between a plurality of electrodes including at least one anode and at least one cathode, wherein at least one of said electrodes comprises at least one catalyst.

39. A method according to claim 37 or 38, wherein said gas is syngas.

40. An apparatus for the removal of long chain hydrocarbons from a stream of gas, the apparatus comprising:

a vessel including at least one inlet and at least one outlet, allowing a stream of gas to pass therebetween;

a plurality of electrodes including at least one anode and at least one cathode, having a space therebetween contained within said vessel, such that said stream of gas passes between said electrodes, wherein a cross-sectional area of the space between the electrodes, measured perpendicular to the path of the stream of gas, decreases at at least one point between said inlet and said outlet.

41. An apparatus according to claim 40 wherein at least one electrode is annular forming an outer electrode extending around an inner electrode.

42. An apparatus according to claim 40 wherein said outer electrode comprises a cathode and said inner electrode comprises an anode.

43. An apparatus according to claim 40 wherein said inner electrode is annular.

44. An apparatus according to claim 40 wherein said inner electrode is at least partially conical.

45. An apparatus according to any of claims 40 to 44 wherein at least one electrode comprises a catalyst.

46. An apparatus according to claim 40 wherein at least one cathode comprises at least one said catalyst.

47. An apparatus according to claim 40 wherein at least one anode and at least one cathode comprise at least one catalyst.

48. An apparatus according to any of claims 46 to 47 wherein said electrode comprising said catalyst further comprises at least one porous metal.

49. An apparatus according to claim 48 wherein said metal comprises nickel.

50. An apparatus according to any of claims 46 to 49 wherein said catalyst comprises a cobalt based catalyst.

51. An apparatus according to claim 50 wherein said catalyst is supported on silica.

52. An apparatus according to any of claims 45 to 51, wherein said catalyst is a metal catalyst supported on a microporous solid support obtained or obtainable from a process comprising:

(A) adding together a metal catalyst precursor and surface-modified nanoparticles of the material of the microporous solid support to form an aqueous supported-catalyst precursor solution; and

(B) subjecting the aqueous supported-catalyst precursor solution to a source of energy at a power sufficient to cause repeated formation and collapse of films in the supported-catalyst precursor solution and to facilitate the emergence of the metal catalyst precursor or a decomposition product thereof supported on the microporous solid support.

53. A method of removing long chain hydrocarbons from a stream of gas, comprising:

generating plasma in a plasma generation zone of a vessel between an anode and a cathode, passing a stream of gas between at least one inlet and at least one outlet and through said plasma generation zone of said vessel, said vessel containing at least one catalyst within said plasma generation zone.

54. A method according to claim 53 wherein said vessel also contains at least one plasma promoter.

55. A method according to claim 54 wherein said plasma promoter comprises at least one of barium titanate and glass balls.

56. A method according to any of claims 53 to 55, wherein said catalyst comprises at least one of nickel, cobalt and iron.

57. A method according to any of claims 53 to 56, wherein said catalyst is a metal catalyst supported on a microporous solid support obtained or obtainable from a process comprising:

(A) adding together a metal catalyst precursor and surface-modified nanoparticles of the material of the microporous solid support to form an aqueous supported-catalyst precursor solution; and

(B) subjecting the aqueous supported-catalyst precursor solution to a source of energy at a power sufficient to cause repeated formation and collapse of films in the supported-catalyst precursor solution and to facilitate the emergence of the metal

catalyst precursor or a decomposition product thereof supported on the microporous solid support.

58. A support device for carrying a selectively permeable element substantially as hereinbefore described with reference to the accompanying drawings.

59. An apparatus for separating a component of a gas from other components using a selectively permeable element substantially as hereinbefore described with reference to the accompanying drawings.

60. A method of forming a support device for a selectively permeable element substantially as hereinbefore described with reference to the accompanying drawings.

61. An apparatus for the removal of long chain hydrocarbons from a stream of gas substantially as hereinbefore described with reference to the accompanying drawings.

62. A method for removing long chain hydrocarbons from a stream of gas substantially as hereinbefore described with reference to the accompanying drawings.

Claims

1. An apparatus for the removal of long chain hydrocarbons from a stream of gas, the apparatus comprising:

a vessel including at least one inlet and at least one outlet, allowing a stream of gas to pass therebetween;

a plurality of electrodes including at least one anode and at least one cathode, contained within said vessel, such that said stream of gas passes between at least one said anode and at least one said cathode, wherein at least one said electrode comprises at least one catalyst.

2. An apparatus according to claim 1 wherein at least one cathode comprises at least one said catalyst.

3. An apparatus according to claim 1 wherein at least one anode and at least one cathode comprise at least one catalyst.

4. An apparatus according to any of claims 1 to 3 wherein said electrode including said catalyst further comprises at least one porous metal.

5. An apparatus according to claim 4 wherein said metal comprises nickel.

6. An apparatus according to any of claims 1 to 5 wherein said catalyst comprises a cobalt based catalyst.

7. An apparatus according to claim 6 wherein said catalyst is supported on silica.

8. An apparatus according to any of claims 1 to 7 further comprising at least one water supply for supplying a spray of water into said vessel.

9. An apparatus according to any of claims 1 to 8 further comprising at least one bed of solid material located at least partially between said electrodes.

10. An apparatus according to claim 9 wherein said bed comprises a fixed bed.

11. An apparatus according to claim 9 wherein said bed comprises a fluidised bed.

12. An apparatus according to any of claims 9 to 11 wherein said solid material comprises at least one tar adsorbent.

13. An apparatus according to any of claims 9 to 12 wherein said solid material comprises at least one catalyst.

14. An apparatus according to any of claims 9 to 13 wherein said solid material comprises at least one PolyHIPE polymer.

15. An apparatus according to any of claims 9 to 14 wherein said solid material comprises at least one plasma catalysis promoter.

16. An apparatus according to any of claims 1 to 15 wherein at least one electrode is annular forming an outer electrode extending around an inner electrode.

17. An apparatus according to claim 16 wherein said outer electrode comprises a cathode and said inner electrode comprises an anode.

18. An apparatus according to claim 16 or 17 wherein said inner electrode is annular.

19. An apparatus according to claim 18 wherein said inner electrode is at least partially conical.

20. An apparatus according to any of claims 1 to 19, wherein said catalyst is a metal catalyst supported on a microporous solid support obtained or obtainable from a process comprising:

(A) adding together a metal catalyst precursor and surface-modified nanoparticles of the material of the microporous solid support to form an aqueous supported-catalyst precursor solution; and

(B) subjecting the aqueous supported-catalyst precursor solution to a source of energy at a power sufficient to cause repeated formation and collapse of films in the supported-catalyst precursor solution and to facilitate the emergence of the metal catalyst precursor or a decomposition product thereof supported on the microporous solid support.

21. A method for removing long chain hydrocarbons from a stream of gas, comprising passing a stream of gas between at least one inlet and at least one outlet of a vessel;

the stream passing between a plurality of electrodes including at least one anode and at least one cathode, wherein at least one of said electrodes comprises at least one catalyst.

22. A method according to claim 21, wherein said gas is syngas.

23. An apparatus for the removal of long chain hydrocarbons from a stream of gas, the apparatus comprising:

a vessel including at least one inlet and at least one outlet, allowing a stream of gas to pass therebetween;

a plurality of electrodes including at least one anode and at least one cathode, having a space therebetween contained within said vessel, such that said stream of gas passes between said electrodes, wherein a cross-sectional area of the space between the electrodes, measured perpendicular to the path of the stream of gas, decreases at at least one point between said inlet and said outlet.

24. An apparatus according to claim 23 wherein at least one electrode is annular forming an outer electrode extending around an inner electrode.

25. An apparatus according to claim 23 wherein said outer electrode comprises a cathode and said inner electrode comprises an anode.

26. An apparatus according to claim 23 wherein said inner electrode is annular.

27. An apparatus according to claim 23 wherein said inner electrode is at least partially conical.

28. An apparatus according to any of claims 23 to 27 wherein at least one electrode comprises a catalyst.

29. An apparatus according to claim 23 wherein at least one cathode comprises at least one said catalyst.

30. An apparatus according to claim 23 wherein at least one anode and at least one cathode comprise at least one catalyst.

31. An apparatus according to any of claims 29 to 30 wherein said electrode comprising said catalyst further comprises at least one porous metal.

32. An apparatus according to claim 31 wherein said metal comprises nickel.

33. An apparatus according to any of claims 29 to 32 wherein said catalyst comprises a cobalt based catalyst.

34. An apparatus according to claim 33 wherein said catalyst is supported on silica.

35. An apparatus according to any of claims 28 to 34, wherein said catalyst is a metal catalyst supported on a microporous solid support obtained or obtainable from a process comprising:

(A) adding together a metal catalyst precursor and surface-modified nanoparticles of the material of the microporous solid support to form an aqueous supported-catalyst precursor solution; and

(B) subjecting the aqueous supported-catalyst precursor solution to a source of energy at a power sufficient to cause repeated formation and collapse of films in the supported-catalyst precursor solution and to facilitate the emergence of the metal catalyst precursor or a decomposition product thereof supported on the microporous solid support.

36. A method of removing long chain hydrocarbons from a stream of gas, comprising:

generating plasma in a plasma generation zone of a vessel between an anode and a cathode, passing a stream of gas between at least one inlet and at least one outlet and through said plasma generation zone of said vessel, said vessel containing at least one catalyst within said plasma generation zone.

37. A method according to claim 36 wherein said vessel also contains at least one plasma promoter.

38. A method according to claim 37 wherein said plasma promoter comprises at least one of barium titanate and glass balls.

39. A method according to any of claims 36 to 38, wherein said catalyst comprises at least one of nickel, cobalt and iron.

40. A method according to any of claims 36 to 39, wherein said catalyst is a metal catalyst supported on a microporous solid support obtained or obtainable from a process comprising:

(A) adding together a metal catalyst precursor and surface-modified nanoparticles of the material of the microporous solid support to form an aqueous supported-catalyst precursor solution; and

(B) subjecting the aqueous supported-catalyst precursor solution to a source of energy at a power sufficient to cause repeated formation and collapse of films in the supported-catalyst precursor solution and to facilitate the emergence of the metal catalyst precursor or a decomposition product thereof supported on the microporous solid support.