

Claims

The invention claimed is:

1. A planar electrochemical reformer (ECR) that is fed a mixture of an oxidizable reactant (fuel), reducible reactant (water) and ionically conductive electrolyte (i.e. sodium hydroxide, potassium hydroxide, carbonate, buffer or acid) into a cell with a hydrogen evolution cathode and hydrocarbon fuel anode. This planar reactor can be controlled by the addition of thermal or electrical input and/or output at each electrode.
2. An ECR as in Claim 1 that uses carbon dioxide as its input fuel.
3. An ECR as in Claim 1 that uses carbon dioxide as its input fuel.
4. An ECR as in Claim 1 that uses carbon monoxide as its input fuel.
5. An ECR as in Claim 1 that uses methanol as its input fuel.
6. An ECR as in Claim 1 that uses ethanol as its input fuel.
7. An ECR as in Claim 1 that uses natural gas as its input fuel.
8. An ECR as in Claim 1 that uses biogas as its input fuel.
9. An ECR as in Claim 1 that uses carbon as its input fuel.
10. An ECR as in Claim 1 that uses slurry made from pretreated coal as its input fuel.
11. An ECR as in Claim 1 that uses Fischer-Tropsch Gases, Liquids or Waxes as its input fuel.

12. An ECR as in Claim 1 that uses biochar as its input fuel.
13. An ECR as in Claim 1 that uses char from hydrothermal carbonization of municipal solid waste as its input fuel.
14. An ECR as in Claim 1 that uses char from hydrothermal carbonization of medical waste as its input fuel.
15. An ECR as in Claim 1 that uses char from hydrothermal carbonization of biomass as its input fuel.
16. An ECR as in Claim 1 that uses producer gas from gasification of biogas or coal as its input fuel.
17. An ECR as in Claim 1 that uses producer gas from plasma destruction of biomass, biogas, municipal solid waste, biosolids or coal as its input fuel.
18. An ECR as in Claim 1, with fed by any of the fuels in sub-claims 2-17, with an external hydrogen stripper as where the carbonized electrolyte is fed into the top of a column with steam injected in the bottom in a modified Benfield Process.
19. A planar electrochemical CCR Decarbonizer that uses the input fuels in Claim 1 as the source of additional carbon fed into the initial electrolyte. This planar reactor can be controlled by the addition of thermal or electrical input and/or output at each electrode.
20. A CCR Decarbonizer as in Claim 19 that uses carbon dioxide from an external capture subsystem as the source of additional carbon fed into the electrolyte.
21. A CCR Decarbonizer as in Claim 19 that uses the input fuels in Claim 1 as the source of additional carbon fed into the initial electrolyte.
22. A planar Fuel Cell that can be controlled by the addition of thermal or electrical input and/or output at each electrode.

23. A fuel cell as in Claim 22 that uses air at as the cathode feed.

24. A fuel cell as in Claim 22 that uses oxygen as the cathode feed

25. A fuel cell as in Claim 22 that uses hydrogen as its anode feed.

26. A fuel cell as in Claim 22 that uses reformat as its anode feed.

27. A fuel cell as in Claim 22 that uses methanol as its anode feed.

28. A fuel cell as in Claim 22 that uses ethanol as its anode feed.

29. A fuel cell as in Claim 22 that uses ammonia as its anode feed.

30. A fuel cell as in Claim 22

31. An integrated Fuel Processing System comprised of an ECR as in Claim 1 and a CCR Decarbonizer as in Claim 19 closely coupled for optimal thermal management and minimal external electrical and/or thermal input. that uses formate as its anode feed.

32. An integrated Fuel Processing System as in Claim 31 where the co-product hydrocarbons are collected for downstream external use.

33. An integrated Fuel Processing System as in Claim 31 where the co-product hydrocarbons are recycled for internal reuse.

34. An integrated Electrical Generating System comprised of an ECR as in Claim 1 and a Decarbonizer as in Claim 19 closely coupled with a Fuel Cell as in Claim 22 for optimal thermal management and minimal external electrical and/or thermal input.

35. An integrated electrical generating system as in Claim 34 that produces only the amount of hydrogen and oxygen necessary to satisfy the electrical demand and therefore seals the fuel cell away from all external contamination

36. an integrated electrical generating system as in Claims 34 that produces hydrogen and oxygen in amounts surplus to the electrical demand and exports these gases for other uses.

37. A electrolytic cell made in similar configuration to the fuel cell as in Claim 22 designed for water electrolysis.

38. A electrolytic cell made in similar configuration to the fuel cell as in Claim 22 designed for chlorine production.

39. A electrolytic cell made in similar configuration to the fuel cell as in Claim 22 designed for aluminum or other metal production.