ELECTROCHEMICAL HYDROGEN-CATALYST POWER SYSTEM

CROSS-REFERENCES TO RELATED APPLICATIONS

This application claims the benefit of priority of U.S. Provisional Application Nos. 61/315,186, filed March 18, 2010; 61/317,176 filed March 24, 2010; 61/329,959 filed April 30, 2010; 61/332,526 filed May 7, 2010; 61/347,130 filed May 21, 2010; 61/356,348 filed June 18, 2010; 61/358,667 filed June 25, 2010; 61/363,090 filed July 9, 2010; 61/365,051 filed July 16, 2010; 61/369,289 filed July 30, 2010; 61/371,592 filed August 6, 2010; 61/373,495 filed August 13, 2010; 61/377,613 filed August 27, 2010; 61/383,929 filed September 17, 2010; 61/389,006 filed October 1, 2010; 61/393,719 filed October 15, 2010; 61/408,384 filed October 29, 2010; 61/413,243 filed November 12, 2010; 61/419,590 filed December 3, 2010; 61/425,105 filed December 20, 2010; 61/430,814 filed January 7, 2011; 61/437,377 filed January 28, 2011; 61/442,015 filed February 11, 2011 and 61/449,474 filed March 4, 2011, all of which are herein incorporated by reference in their entirety.

SUMMARY OF DISCLOSED EMBODIMENTS:

One aspect of the present invention relates to an electrochemical power system that generates an electromotive force (EMF) and thermal energy comprising

a cathode;

an anode, and

reactants that constitute hydrino reactants during cell operation with separate electron flow and ion mass transport, comprising at least two components chosen from:

a) a source of catalyst or a catalyst comprising at least one of the group of nH, OH, OH^-, H_2O, H_2S, or MNH_2 wherein n is an integer and M is alkali metal;

b) a source of atomic hydrogen or atomic hydrogen;

c) reactants to form at least one of the source of catalyst, the catalyst, the source of atomic hydrogen, and the atomic hydrogen; one or more reactants to initiate the catalysis of atomic hydrogen; and a support, wherein at least one of the following conditions occurs:

d) atomic hydrogen and the hydrogen catalyst is formed by a reaction of the reaction mixture;

e) one reactant that by virtue of it undergoing a reaction causes the catalysis to be active; and

f) the reaction to cause the catalysis reaction comprises a reaction chosen from:

(i) exothermic reactions;

(ii) coupled reactions;

(iii) free radical reactions;

(iv) oxidation-reduction reactions;

(v) exchange reactions, and

(vi) getter, support, or matrix-assisted catalysis reactions.

In another aspect, there is provided an electrochemical power system that generates an electromotive force (EMF) and thermal energy comprising

a cathode;

an anode, and

reactants that constitute hydrino reactants during cell operation with separate electron flow and ion mass transport, comprising at least two components chosen from:

a) a source of catalyst or catalyst comprising at least one oxygen species chosen from O_2, O_3, O_3^+, O_3^-, O, O^+, H_2O, H_3O^+, OH, OH^+, OH^-, HOOH, OOH^-, O^-, O^{2-}, O_2^-, and O_2^{2-} that undergoes an oxidative reaction with a H species to form at least one of OH and H_2O, wherein the H species comprises at least one of H_2, H, H^+, H_2O, H_3O^+, OH, OH^+, OH^-, HOOH, and OOH^-;

b) a source of atomic hydrogen or atomic hydrogen;

c) reactants to form at least one of the source of catalyst, the catalyst, the source of atomic hydrogen, and the atomic hydrogen; and one or more reactants to initiate the catalysis of atomic hydrogen; and a support, wherein at least one of the following conditions occurs:

d) atomic hydrogen and the hydrogen catalyst is formed by a reaction of the reaction mixture;

e) one reactant that by virtue of it undergoing a reaction causes the catalysis to be active; and

f) the reaction to cause the catalysis reaction comprises a reaction chosen from:

(i) exothermic reactions;

(ii) coupled reactions;

(iii) free radical reactions;

(iv) oxidation-reduction reactions;

(v) exchange reactions, and

(vi) getter, support, or matrix-assisted catalysis reactions.

In another aspect, there is provided an electrochemical power system comprising at least one of

a) a cell comprising:

(i) an anode comprising a hydrogen permeable metal and hydrogen gas chosen from $Ni(H_2)$, $V(H_2)$, $Ti(H_2)$, $Fe(H_2)$, $Nb(H_2)$ or a metal hydride chosen from $LaNi_5H_6$, $TiMn_2H_x$, and $La_2Ni_9CoH_6$ (x is an integer);

(ii) a molten electrolyte chosen from MOH or $M(OH)_2$, or MOH or $M(OH)_2$ with M'X or $M'X_2$ wherein M and M' are independently chosen from Li, Na, K, Rb, Cs, Mg, Ca, Sr, and Ba, and X is chosen from hydroxides, halides, sulfates, and carbonates, and

(iii) a cathode comprising the metal that is the same as that of the anode and further comprising air or O_2;

b) a cell comprising:

(i) an anode comprising at least one metal chosen from R-Ni, Cu, Ni, Pb, Sb, Bi, Co, Cd, Ge, Au, Ir, Fe, Hg, Mo, Os, Pd, Re, Rh, Ru, Se, Ag, Tc, Te, Tl, Sn, W, Al, V, Zr, Ti, Mn, Zn, Cr, In, and Pb;

(ii) an electrolyte comprising an aqueous alkali hydroxide having the concentration range of about 10 M to saturated;

(iii) an olefin separator, and

(iv) a carbon cathode and further comprising air or O_2;

c) a cell comprising:

(i) an anode comprising molten NaOH and Ni as a hydrogen permeable membrane and hydrogen gas;

(ii) an electrolyte comprising beta alumina solid electrolyte (BASE), and

(iii) a cathode comprising molten as NaCl-$MgCl_2$, NaCl-$CaCl_2$, or MX-M'X_2' (M is alkali, M' is alkaline earth, and X and X' are halide);

d) a cell comprising:

(i) an anode comprising molten Na;

(ii) an electrolyte comprising beta alumina solid electrolyte (BASE), and

(iii) a cathode comprising molten NaOH;

e) a cell comprising:

(i) an anode comprising $LaNi_5H_6$;

(ii) an electrolyte comprising an aqueous alkali hydroxide having the concentration range of about 10 M to saturated;

(iii) an olefin separator, and

(iv) a carbon cathode and further comprising air or O_2;

f) a cell comprising:

(i) an anode comprising Li;

(ii) an olefin separator;

(ii) an electrolyte comprising LP30 and $LiPF_6$, and

(iv) a cathode comprising CoO(OH);

g) a cell comprising:

(i) an anode comprising Li_3Mg;

(ii) LiCl-KCl or MX-M'X' (M and M' are alkali, X and X' are halide) molten salt electrolyte, and

(iii) a cathode comprising a metal hydride chosen from CeH_2, LaH_2, ZrH_2, and TiH_2, and further comprising carbon black, and

h) a cell comprising:

(i) an anode comprising Li;

(ii) LiCl-KCl or MX-M'X' (M and M' are alkali, X and X' are halide) molten salt electrolyte, and

(iii) a cathode comprising a metal hydride chosen from CeH_2, LaH_2, ZrH_2, and TiH_2, and further comprising carbon black, and

wherein at least one of the following conditions occurs:

m) atomic hydrogen and the hydrogen catalyst is formed by a reaction of the reaction mixture;

n) one reactant that by virtue of it undergoing a reaction causes the catalysis to be active; and

o) the reaction to cause the catalysis reaction comprises a reaction chosen from:

(i) exothermic reactions;

(ii) coupled reactions;

(iii) free radical reactions;

(iv) oxidation-reduction reactions;

(v) exchange reactions, and

(vi) getter, support, or matrix-assisted catalysis reactions.

The present disclosure is directed to a battery or fuel cell system that generates an electromotive force (EMF) from the catalytic reaction of hydrogen to lower energy (hydrino) states providing direct conversion of the energy released from the hydrino reaction into electricity, the system comprising:

reactants that constitute hydrino reactants during cell operation with separate electron flow and ion mass transport,

a cathode compartment comprising a cathode,

an anode compartment comprising an anode, and

a source of hydrogen.

Other embodiments of the present disclosure are directed to a battery or fuel cell system that generates an electromotive force (EMF) from the catalytic reaction of hydrogen to lower energy (hydrino) states providing direct conversion of the energy released from the hydrino reaction into electricity, the system comprising at least two components chosen from: a catalyst or a source of catalyst; atomic hydrogen or a source of atomic hydrogen; reactants to form the catalyst or source of catalyst and atomic hydrogen or source of atomic hydrogen; one or more reactants to initiate the catalysis of atomic hydrogen; and a support to enable the catalysis,

wherein the battery or fuel cell system for forming hydrinos can further comprise a cathode compartment comprising a cathode, an anode compartment comprising an anode, optionally a salt bridge, reactants that constitute hydrino reactants during cell operation with separate electron flow and ion mass transport, and a source of hydrogen.

In an embodiment of the present disclosure, the reaction mixtures and reactions to initiate the hydrino reaction such as the exchange reactions of the present disclosure are the

$Zr_{0.8}Sc_{0.2}Fe_2$, YNi_5, $LaNi_5$, $LaNi_{4.5}Co_{0.5}$, (Ce, La, Nd, Pr)Ni_5, Mischmetal-nickel alloy, $Ti_{0.98}Zr_{0.02}V_{0.43}Fe_{0.09}Cr_{0.05}Mn_{1.5}$, $La_2Co_1Ni_9$, and $TiMn_2$;

a separator;

an aqueous alkaline electrolyte;

at least one of a O_2 and a H_2O reduction cathode, and

at least one of air and O_2.

13. The electrochemical power system of Claim 12, further comprising an electrolysis system that intermittently charges and discharges the cell such that there is a gain in the net energy balance.

14. An~~The~~ electrochemical power system comprising at least one of

a) a cell comprising:

(i) an anode comprising a hydrogen permeable metal and hydrogen gas chosen from $Ni(H_2)$, $V(H_2)$, $Ti(H_2)$, $Fe(H_2)$, $Nb(H_2)$ or a metal hydride chosen from $LaNi_5H_6$, $TiMn_2H_x$, and $La_2Ni_9CoH_6$ (x is an integer);

(ii) a molten electrolyte chosen from MOH or $M(OH)_2$, or MOH or $M(OH)_2$ with M'X or $M'X_2$ wherein M and M' are independently chosen from Li, Na, K, Rb, Cs, Mg, Ca, Sr, and Ba, and X is chosen from hydroxides, halides, sulfates, and carbonates, and

~~a)~~ (iii) a cathode comprising the metal that is the same as that of the anode and further comprising air or O_2;

b) a cell comprising:

(i) an anode comprising at least one metal chosen from R-Ni, Cu, Ni, Pb, Sb, Bi, Co, Cd, Ge, Au, Ir, Fe, Hg, Mo, Os, Pd, Re, Rh, Ru, Se, Ag, Tc, Te, Tl, Sn, W, Al, V, Zr, Ti, Mn, Zn, Cr, In, and Pb;

(ii) an electrolyte comprising an aqueous alkali hydroxide having the concentration range of about 10 M to saturated;

(iii) an olefin separator, and

(iv) a carbon cathode and further comprising air or O_2;

c) a cell comprising:

(i) an anode comprising molten NaOH and Ni as a hydrogen permeable membrane and hydrogen gas;

(ii) an electrolyte comprising beta alumina solid electrolyte (BASE), and

(iii) a cathode comprising molten as NaCl-$MgCl_2$, NaCl-$CaCl_2$, or MX-$M'X_2$' (M is alkali, M' is alkaline earth, and X and X' are halide);

d) a cell comprising:

(i) an anode comprising molten Na;