What Is Claimed Is:

1. 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.

~~2. The electrochemical power system of Claim 1,~~ wherein at least one of the following conditions occurs:

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

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

e~~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.

~~3~~2. The electrochemical power system of Claim ~~2~~1, wherein at least one of a) different reactants or b) the same reactants under different states or conditions are provided in different cell compartments that are connected by separate conduits for electrons and ions to complete an electrical circuit between the compartments.

~~4~~3. The electrochemical power system of Claim ~~3~~2, wherein at least one of an internal mass flow and an external electron flow provides at least one of the following conditions to occur:

a) formation of the reaction mixture that reacts to produce hydrinos; and

b) formation of the conditions that permit the hydrino reaction to occur at substantial

rates.

54. The electrochemical power system of Claim 1, wherein the reactants to form hydrinos are at least one of thermally or electrolytically regenerative.

65. The electrochemical power system of Claim 54, wherein at least one of electrical and thermal energy output is over that required to regenerate the reactants from the products.

76. 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.

87. The electrochemical power system of Claim 76, wherein the source of the O species comprises at least one compound or admixture of compounds comprising O, O_2, air, oxides, NiO, CoO, alkali metal oxides, Li_2O, Na_2O, K_2O, alkaline earth metal oxides, MgO, CaO, SrO, and BaO, oxides from the group of Cu, Ni, Pb, Sb, Bi, Co, Cd, Ge, Au, Ir, Fe, Hg, Mo,

Os, Pd, Re, Rh, Ru, Se, Ag, Tc, Te, Tl, Sn, and W, peroxides, alkali metal peroxides, superoxide, alkali or alkaline earth metal superoxides, hydroxides, alkali, alkaline earth, transition metal, inner transition metal, and Group III, IV, or V, hydroxides, oxyhydroxides, AlO(OH), ScO(OH), YO(OH), VO(OH), CrO(OH), MnO(OH) (α -MnO(OH) groutite and γ -MnO(OH) manganite), FeO(OH), CoO(OH), NiO(OH), RhO(OH), GaO(OH), InO(OH), $Ni_{1/2}Co_{1/2}O(OH)$, and $Ni_{1/3}Co_{1/3}Mn_{1/3}O(OH)$.

~~98~~. The electrochemical power system of Claim ~~87~~, wherein the source of the H species comprises at least one compound or admixture of compounds comprising H, a metal hydride,

$LaNi_5H_6$, hydroxide, oxyhydroxide, H_2, a source of H_2, H_2 and a hydrogen permeable membrane, $Ni(H_2)$, $V(H_2)$, $Ti(H_2)$, $Nb(H_2)$, $Pd(H_2)$, $PdAg(H_2)$, and $Fe(H_2)$.

~~109~~. The electrochemical power system of Claim 1 comprising
a hydrogen anode;
a molten salt electrolyte comprising a hydroxide, and
at least one of an O_2 and a H_2O cathode.

110. The electrochemical power system of Claim ~~109~~, wherein the hydrogen anode comprises a hydrogen permeable electrode.

~~1211~~. The electrochemical power system of Claim ~~11~~ 10 comprising
a hydrogen source;
a hydrogen anode capable of forming at least one of OH, OH^-, and H_2O catalyst, and providing H;
a source of at least one of O_2 and H_2O;
a cathode capable of reducing at least one of H_2O or O_2;
an alkaline electrolyte;
an optional system capable of collection and recirculation of at least one of H_2O vapor, N_2, and O_2, and
a system to collect and recirculate H_2.

132. The electrochemical power system of Claim 1, comprising
an anode comprising at least one of:
a) a metal chosen from V, Zr, Ti, Mn, Zn, Cr, Sn, In, Cu, Ni, Pb, Sb, Bi, Co, Cd, Ge, Au, Ir, Fe, Hg, Mo, Os, Pd, Re, Rh, Ru, Se, Ag, Tc, Te, Tl, and W;
b) a metal hydride chosen from R-Ni, $LaNi_5H_6$, $La_2Co_1Ni_9H_6$, $ZrCr_2H_{3.8}$, $LaNi_{3.55}Mn_{0.4}Al_{0.3}Co_{0.75}$, $ZrMn_{0.5}Cr_{0.2}V_{0.1}Ni_{1.2}$,;
c) other alloys capable of storing hydrogen chosen from AB_5 (LaCePrNdNiCoMnAl) or AB_2 (VTiZrNiCrCoMnAlSn) type, where the "AB_x" designation refers to the ratio of the A type elements (LaCePrNd or TiZr) to that of the B type elements (VNiCrCoMnAlSn), AB_5-type, $MmNi_{3.2}Co_{1.0}Mn_{0.6}Al_{0.11}Mo_{0.09}$ (Mm = misch metal: 25 wt% La, 50 wt% Ce, 7 wt% Pr, 18 wt% Nd), AB_2-type: $Ti_{0.51}Zr_{0.49}V_{0.70}Ni_{1.18}Cr_{0.12}$ alloys, magnesium-based alloys, $Mg_{1.9}Al_{0.1}Ni_{0.8}Co_{0.1}Mn_{0.1}$ alloy, $Mg_{0.72}Sc_{0.28}(Pd_{0.012} + Rh_{0.012})$, and $Mg_{80}Ti_{20}$, $Mg_{80}V_{20}$, $La_{0.8}Nd_{0.2}Ni_{2.4}Co_{2.5}Si_{0.1}$, $LaNi_{5-x}M_x$ (M= Mn, Al), (M= Al, Si, Cu), (M= Sn), (M= Al, Mn, Cu) and $LaNi_4Co$, $MmNi_{3.55}Mn_{0.44}Al_{0.3}Co_{0.75}$, $LaNi_{3.55}Mn_{0.44}Al_{0.3}Co_{0.75}$, $MgCu_2$, $MgZn_2$, $MgNi_2$, AB compounds, TiFe, TiCo, and TiNi, AB_n compounds (n = 5, 2, or 1), AB_{3-4} compounds, AB_x (A = La, Ce, Mn, Mg; B = Ni, Mn, Co, Al), $ZrFe_2$, $Zr_{0.5}Cs_{0.5}Fe_2$,

$Zr_{0.8}Sc_{0.2}Fe_2$, 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.

~~1413~~. The electrochemical power system of Claim ~~1312~~, further comprising an electrolysis system that intermittently charges and discharges the cell such that there is a gain in the net energy balance.

~~1514~~. 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 $NaCl\text{-}MgCl_2$, $NaCl\text{-}CaCl_2$, or $MX\text{-}M'X_2'$ (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.

15. The electrochemical power system of Claim 14, wherein at least one of a) different reactants or b) the same reactants under different states or conditions are provided in different cell compartments that are connected by separate conduits for electrons and ions to complete an electrical circuit between the compartments.