hydrogen or atomic hydrogen; one or more reactants to initiate the catalysis of atomic hydrogen; and a support to enable the catalyst,

wherein the battery or fuel cell system for forming compounds having hydrogen in lower-energy states can further comprise any of a reaction vessel, a vacuum pump, and systems such as separator systems, an electrolyzer, thermal systems for reversing an exchange reaction, and chemical synthesis reactors to regenerate the fuel from the reaction products.

In one aspect, there is provided a power source comprising:

a reaction cell for the catalytic reaction of atomic hydrogen to form hydrogen species that have a total energy that is more negative and more stable than that of the uncatalyzed hydrogen species and compositions of matter comprising said hydrogen species;

a reaction vessel;

a vacuum pump;

a source of atomic hydrogen from a source in communication with the reaction vessel;

a source of a catalyst in communication with the reaction vessel,

the source of at least one of the source of atomic hydrogen and the source of hydrogen catalyst comprising a reaction mixture of at least one reactant comprising the element or elements that form at least one of the atomic hydrogen and the hydrogen catalyst and at least one other element, whereby at least one of the atomic hydrogen and hydrogen catalyst is formed from the source,

at least one other reactant to cause catalysis by performing at least one function of activating and propagating the catalysis; and

a heater for the vessel which initiates the formation of at least one of the atomic hydrogen and the catalyst in the reaction vessel, and initiates the reaction to cause catalytic reaction whereby the catalytic reaction of atomic hydrogen releases energy in an amount greater than about 300 kJ per mole of hydrogen during the catalytic reaction of the hydrogen atom.

BRIEF DESCRIPTION OF THE DRAWINGS

FIGURE 1 is a schematic drawing of an energy reactor and power plant in accordance with the present disclosure.

FIGURE 2 is a schematic drawing of an energy reactor and power plant for recycling or regenerating the fuel in accordance with the present disclosure.

FIGURE 3 is a schematic drawing of a power reactor in accordance with the present disclosure.

FIGURE 4 is a schematic drawing of a system for recycling or regenerating the fuel in accordance with the present disclosure.

FIGURE 5 is a schematic drawing of a discharge power and plasma cell and reactor in accordance with the present disclosure.

FIGURE 6 is a schematic drawing of a battery and fuel cell in accordance with the present disclosure.

DETAILED DESCRIPTION OF THE EMBODIMENTS OF THE DISCLOSURE

The present disclosure is directed to catalyst systems to release energy from atomic hydrogen to form lower energy states wherein the electron shell is at a closer position relative to the nucleus. The released power is harnessed for power generation and additionally new hydrogen species and compounds are desired products. These energy states are predicted by classical physical laws and require a catalyst to accept energy from the hydrogen in order to undergo the corresponding energy-releasing transition.

Classical physics gives closed-form solutions of the hydrogen atom, the hydride ion, the hydrogen molecular ion, and the hydrogen molecule and predicts corresponding species having fractional principal quantum numbers. Using Maxwell's equations, the structure of the electron was derived as a boundary-value problem wherein the electron comprises the source current of time-varying electromagnetic fields during transitions with the constraint that the bound $n=1$ state electron cannot radiate energy. A reaction predicted by the solution of the H atom involves a resonant, nonradiative energy transfer from otherwise stable atomic hydrogen to a catalyst capable of accepting the energy to form hydrogen in

What Is Claimed Is:

1. A power source comprising:

a reaction cell for the catalytic reaction of atomic hydrogen to form hydrogen species that have a total energy that is more negative and more stable than that of the uncatalyzed hydrogen species and compositions of matter comprising said hydrogen species;

a reaction vessel;

a vacuum pump;

a source of atomic hydrogen from a source in communication with the reaction vessel;

a source of a catalyst in communication with the reaction vessel,

the source of at least one of the source of atomic hydrogen and the source of hydrogen catalyst comprising a reaction mixture of at least one reactant comprising the element or elements that form at least one of the atomic hydrogen and the hydrogen catalyst and at least one other element, whereby at least one of the atomic hydrogen and hydrogen catalyst is formed from the source,

at least one other reactant to cause catalysis by performing at least one function of activating and propagating the catalysis; and

a heater for the vessel which initiates the formation of at least one of the atomic hydrogen and the catalyst in the reaction vessel, and initiates the reaction to cause catalytic reaction whereby the catalytic reaction of atomic hydrogen releases energy in an amount greater than about 300 kJ per mole of hydrogen during the catalytic reaction of the hydrogen atom.

2. The power source of Claim 1 wherein the reaction to cause the catalytic reaction comprise a reaction chosen from:

(i) exothermic reactions which provide the activation energy for the catalytic reaction;

(ii) coupled reactions that provide for at least one of a source of catalyst or atomic hydrogen to support the catalytic reaction;

(iii) free radical reactions that serve as an acceptor of electrons from the catalyst during the catalytic reaction;

(iv) oxidation-reduction reactions that serve as an acceptor of electrons from the catalyst during the catalytic reaction;

(v) exchange reactions facilitate the action of the catalyst to become ionized as it accepts energy from atomic hydrogen to form said hydrogen species, and

(vi) getter, support, or matrix-assisted catalytic reaction.

3. The power source of Claim 1 wherein the reaction mixture comprises an electrically conductive support to enable the catalytic reaction.

4. The power source of Claim 1 wherein the reaction mixture comprises a solid, liquid, or heterogeneous catalysis reaction mixture.

5. The power source of Claim 2 wherein the reaction mixture comprising an oxidation – reduction reaction to cause the catalytic reaction comprises:

(i) at least one catalyst chosen from Li, *LiH* , K, *KH* , *NaH* , Rb, RbH, Cs, and CsH;

(ii) H_2 gas, a source of H_2 gas, or a hydride;

(iii) at least one oxidant chosen from

metal compounds comprising halides, phosphides, borides, oxides, hydroxide, silicides, nitrides, arsenides, selenides, tellurides, antimonides, carbides, sulfides, hydrides, carbonate, hydrogen carbonate, sulfates, hydrogen sulfates, phosphates, hydrogen phosphates, dihydrogen phosphates, nitrates, nitrites, permanganates, chlorates, perchlorates, chlorites, perchlorites, hypochlorites, bromates, perbromates, bromites, perbromites, iodates, periodates, iodites, periodites, chromates, dichromates, tellurates, selenates, arsenates, silicates, borates, colbalt oxides, tellurium oxides, and oxyanions of halogens, P, B, Si, N, As, S, Te, Sb, C, S, P, Mn, Cr, Co, and Te;

a transition metal, Sn, Ga, In, lead, germanium, alkali metal and alkaline earth metal compound;

GeF_2, $GeCl_2$, $GeBr_2$, GeI_2, GeO, GeP, GeS, GeI_4, and $GeCl_4$, fluorocarbon, CF_4 , $ClCF_3$, chlorocarbon, CCl_4, O_2, MNO_3, $MClO_4$, MO_2, NF_3, N_2O, NO, NO_2, a boron-nitrogen compound such as $B_3N_3H_6$, a sulfur compound such as SF_6, S, SO_2, SO_3, $S_2O_5Cl_2$, F_5SOF, $M_2S_2O_8$, S_xX_y such as S_2Cl_2, SCl_2, S_2Br_2, or S_2F_2, CS_2, SO_xX_y, $SOCl_2$, SOF_2, SO_2F_2, $SOBr_2$, $X_xX'_y$, ClF_5, $X_xX'_yO_z$, ClO_2F, ClO_2F_2, $ClOF_3$, ClO_3F, ClO_2F_3, boron-nitrogen compound, $B_3N_3H_6$, Se, Te, Bi, As, Sb, Bi, TeX_x, TeF_4, TeF_6, TeO_x, TeO_2, TeO_3, SeX_x, SeF_6, SeO_x, SeO_2 or SeO_3, a tellurium oxide, halide, tellurium compound, TeO_2, TeO_3, $Te(OH)_6$, $TeBr_2$, $TeCl_2$, $TeBr_4$, $TeCl_4$, TeF_4, TeI_4, TeF_6, CoTe, or NiTe, a selenium compound. a selenium oxide, a selenium halide, a selenium sulfide, SeO_2, SeO_3, Se_2Br_2, Se_2Cl_2, $SeBr_4$, $SeCl_4$, SeF_4, SeF_6, $SeOBr_2$, $SeOCl_2$, $SeOF_2$, SeO_2F_2, SeS_2, Se_2S_6, Se_4S_4, or Se_6S_2, P, P_2O_5, P_2S_5, P_xX_y, PF_3, PCl_3, PBr_3, PI_3, PF_5, PCl_5, PBr_4F, PCl_4F, PO_xX_y, $POBr_3$, POI_3, $POCl_3$ or POF_3, PS_xX_y, (M is an alkali metal, x, y and z are integers, X and X' are halogen) $PSBr_3$, PSF_3, $PSCl_3$, a phosphorous-nitrogen compound, P_3N_5, $(Cl_2PN)_3$, $(Cl_2PN)_4$, $(Br_2PN)_x$, an arsenic compound, an arsenic oxide, arsenic halide, arsenic sulfide, arsenic selenide, arsenic telluride, AlAs, As_2I_4, As_2Se, As_4S_4, $AsBr_3$, $AsCl_3$, AsF_3, AsI_3, As_2O_3, As_2Se_3, As_2S_3, As_2Te_3, $AsCl_5$, AsF_5, As_2O_5, As_2Se_5, As_2S_5, an antimony compound, an antimony oxide, an antimony halide, an antimony sulfide, an antimony sulfate, an antimony selenide, an antimony arsenide, SbAs, $SbBr_3$, $SbCl_3$, SbF_3, SbI_3, Sb_2O_3, SbOCl, Sb_2Se_3, $Sb_2(SO4)_3$, Sb_2S_3, Sb_2Te_3, Sb_2O_4, $SbCl_5$, SbF_5, $SbCl_2F_3$, Sb_2O_5, Sb_2S_5, a bismuth compound, a bismuth oxide, a bismuth halide, a bismuth sulfide, a bismuth selenide,

$BiAsO4$, $BiBr_3$, $BiCl_3$, BiF_3, BiF_5, $Bi(OH)_3$, BiI_3, Bi_2O_3, BiOBr, BiOCl, BiOI, Bi_2Se_3, Bi_2S_3, Bi_2Te_3, Bi_2O_4, $SiCl_4$, $SiBr_4$, a transition metal halide, $CrCl_3$, ZnF_2, $ZnBr_2$, ZnI_2, $MnCl_2$, $MnBr_2$, MnI_2, $CoBr_2$, CoI_2, $CoCl_2$, $NiCl_2$, $NiBr_2$, NiF_2, FeF_2, $FeCl_2$, $FeBr_2$, $FeCl_3$, TiF_3, CuBr, $CuBr_2$, VF_3, $CuCl_2$, a metal halide , SnF_2, $SnCl_2$, $SnBr_2$, SnI_2, SnF_4, $SnCl_4$, $SnBr_4$, SnI_4, InF, InCl, InBr, InI, AgCl, AgI, AlF_3, $AlBr_3$, AlI_3, YF_3, $CdCl_2$, $CdBr_2$, CdI_2, $InCl_3$, $ZrCl_4$, NbF_5, $TaCl_5$, $MoCl_3$, $MoCl_5$, $NbCl_5$, $AsCl_3$, $TiBr_4$, $SeCl_2$, $SeCl_4$, InF_3, $InCl_3$, PbF_4, TeI_4, WCl_6, $OsCl_3$, $GaCl_3$, $PtCl_3$, $ReCl_3$, $RhCl_3$, $RuCl_3$, metal oxide, a metal hydroxide, Y_2O_3, FeO, Fe_2O_3, or NbO, NiO, Ni_2O_3, SnO, SnO_2, Ag_2O, AgO, Ga_2O, As_2O_3, SeO_2, TeO_2, $In(OH)_3$, $Sn(OH)_2$, $In(OH)_3$, $Ga(OH)_3$, $Bi(OH)_3$, CO_2, As_2Se_3, SF_6, S, SbF_3, CF_4, NF_3, a metal permanganate, $KMnO_4$, $NaMnO_4$, P_2O_5, a metal nitrate, $LiNO_3$, $NaNO_3$, KNO_3, a boron halide , BBr_3, BI_3, a group 13 halide, an indium halide, $InBr_2$, $InCl_2$, InI_3, a silver halide, AgCl, AgI, a lead halide, a cadmium halide, a zirconoium halide, a transition metal oxide, a transition metal sulfide, or a transition metal halide (Sc, Ti, V, Cr, Mn, Fe, Co, Ni, Cu, or Zn with F, Cl, Br or I), a second or third transition series halide, YF_3, second or third transition series oxide, second or third transition series sulfide, Y_2S_3, a halide of Y, Zr, Nb, Mo, Tc, Ag, Cd, Hf, Ta, W, Os, such as NbX_3, NbX_5, or TaX_5, Li_2S, ZnS, FeS, NiS, MnS, Cu_2S, CuS, SnS, an alkaline earth halide, $BaBr_2$, $BaCl_2$, BaI_2, $SrBr_2$, SrI_2, $CaBr_2$, CaI_2, $MgBr_2$, or MgI_2, a rare earth halide, $EuBr_3$, LaF_3, $LaBr_3$, $CeBr_3$, GdF_3, $GdBr_3$, a rare earth halide with the metal in the II state, CeI_2, EuF_2, $EuCl_2$, $EuBr_2$, EuI_2, DyI_2, NdI_2, SmI_2, YbI_2, and TmI_2, a metal boride, a europium boride, an MB_2 boride, CrB_2, TiB_2, MgB_2, ZrB_2, GdB_2, an alkali halide, LiCl, RbCl, or CsI, a metal phosphide, as Ca_3P_2, a noble metal halide, a noble metal oxide, a noble metal sulfide, $PtCl_2$, $PtBr_2$, PtI_2, $PtCl_4$, $PdCl_2$, $PbBr_2$, PbI_2, a rare earth sulfide, CeS, a La halide, a Gd halide, a metal and an anion, Na_2TeO_4, Na_2TeO_3, $Co(CN)_2$, CoSb, CoAs, Co_2P, CoO, CoSe, CoTe, NiSb, NiAs, NiSe, Ni_2Si, MgSe, a rare earth telluride, EuTe, a rare earth selenide, EuSe, a rare earth nitride, EuN, a metal nitride, AlN, GdN, Mg_3N_2, a compound containing at least two atoms chosen from oxygen and different halogen atoms, F_2O, Cl_2O, ClO_2, Cl_2O_6, Cl_2O_7, ClF, ClF_3, $ClOF_3$, ClF_5, ClO_2F, ClO_2F_3, ClO_3F, BrF_3, BrF5, I_2O_5, IBr, ICl, ICl_3, IF, IF_3, IF_5, IF_7, a metal second or third transition series halide, OsF_6, PtF_6, or IrF_6, a compound that can form a metal upon reduction, a metal hydride, rare earth hydride, alkaline earth hydride, or alkali hydride;

(iv) at least one reductant chosen from a metal, an alkali, alkaline earth, transition, second and third series transition, and rare earth metals, *Al*, *Mg*, MgH_2, *Si*, La, B, Zr, and Ti powders, and H_2, and

(v) at least one electrically conducting support chosen from AC, 1% Pt or Pd on carbon (Pt/C, Pd/C), a carbide, TiC, and WC.

6. The power source of Claim 2 wherein the reaction mixture comprising an oxidation – reduction reaction to cause the catalytic reaction comprises:

(i) at least one catalyst or a source of catalyst comprising a metal or a hydride from the Group I elements;

(ii) at least one source of hydrogen comprising H_2 gas or a source of H_2 gas, or a hydride;

(iii) at least one oxidant comprising an atom or ion or a compound comprising at least one of the elements from Groups 13, 14, 15, 16, and 17 chosen from F, Cl, Br, I, B, C, N, O, Al, Si, P, S, Se, and Te;

(iv) at least one reductant comprising an element or hydride chosen from Mg, MgH_2, Al, Si, B, Zr, and a rare earth metal ; and

(v) at least one electrically conductive support chosen from carbon, AC, graphene, carbon impregnated with a metal, Pt/C, Pd/C, a carbide, TiC, and WC.

7. The power source of Claim 2 wherein the reaction mixture comprising an oxidation – reduction reaction to cause the catalytic reaction comprises:

(i) at least one catalyst or a source of catalyst comprising a metal or a hydride from the Group I elements;

(ii) at least one source of hydrogen comprising H_2 gas or a source of H_2 gas, or a hydride;

(iii) at least one oxidant comprising a halide, oxide, or sulfide compound of the elements chosen from Groups IA, IIA, 3d, 4d, 5d, 6d, 7d, 8d, 9d, 10d, 11d, 12d, and lanthanides;

(iv) at least one reductant comprising an element or hydride chosen from Mg, MgH_2, Al, Si, B, Zr, and a rare earth metal; and

(v) at least one electrically conductive support chosen from carbon, AC, graphene, carbon impregnated with a metal such as Pt or Pd/C, a carbide, TiC, and WC.

8. The power source of Claim 2 wherein the exchange reaction to cause the catalysis reaction comprises an anion exchange between at least two of the oxidant, reductant, and catalyst wherein the anion is chosen from halide, hydride, oxide, sulfide, nitride, boride, carbide, silicide, arsenide, selenide, telluride, phosphide, nitrate, hydrogen sulfide, carbonate, sulfate, hydrogen sulfate, phosphate, hydrogen phosphate, dihydrogen phosphate, perchlorate, chromate, dichromate, cobalt oxide, and oxyanions.

9. The power source of Claim 8 wherein the exchange reaction to cause the catalytic reaction is reversible thermally to regenerate the initial exchange reactants.

10. The power source of Claim 9 wherein the thermally regenerative reactants comprise

(i) at least one catalyst or a source of catalyst chosen from NaH and KH;

(ii) a source of hydrogen chosen from NaH, KH, and MgH_2;

(iii) at least one oxidant chosen from

(a) an alkaline earth halide chosen from $BaBr_2$, $BaCl_2$, BaI_2, $CaBr_2$, $MgBr_2$, and MgI_2;

(b) a rare earth halide chosen from $EuBr_2$, $EuBr_3$, EuF_3, DyI_2, LaF_3, and GdF_3;

(c) a second or third series transition metal halide chosen from YF_3;

(d) a metal boride chosen from CrB_2 and TiB_2;

(e) an alkali halide chosen from LiCl, RbCl, and CsI;

(f) a metal sulfide chosen from Li_2S, ZnS and Y_2S_3;

(h) a metal oxide chosen from Y_2O_3, and

(i) a metal phosphide chosen from Ca_3P_2;

(iv) at least one reductant chosen from Mg and MgH_2; and

(v) at least one support chosen from AC, TiC, and WC.

11. The power source of Claim 2 wherein the getter, support, or matrix-assisted catalysis reaction to cause the catalytic reaction comprises that provides at least one of a chemical environment for the catalytic reaction, acts to transfer electrons to facilitate the H catalyst function, undergoes a reversible phase or other physical change or change in its electronic state, and binds said hydrogen species product to increase at least one of the extent or rate of the catalytic reaction.

12. The power source of Claim 11 wherein the getter, support, or matrix-assisted catalysis reaction can be reversed thermally to regenerate the initial exchange reactants.

13. The power source of Claim 12 wherein the getter, support, or matrix-assisted catalysis reaction mixture comprises

(i) at least one catalyst or a source of catalyst chosen from NaH and KH;

(ii) a source of hydrogen chosen from NaH, KH and MgH_2;

(iii) at least one oxidant chosen from

(a) a metal arsenide chosen from Mg_3As_2; and

(b) a metal nitride chosen from Mg_3N_2 and AlN;

(iv) at least one reductant chosen from Mg and MgH_2; and

(v) at least one support chosen from AC, TiC, and WC.

14. The power source of Claim 1 wherein the reaction mixture to cause the catalytic reaction comprising a catalyst comprising an alkali metal is regenerated from the products by separating one or more of the components and regenerating the alkali metal by electrolysis.

15. The power source according to claim 1, wherein the power source is a hydride reactor.

16. The power source of Claim 15 wherein the reaction mixture for the synthesis of the compounds comprises at least two species chosen from the following genus of components (i) - (v): (i) a catalyst, (ii) a source of hydrogen, (iii) an oxidant, (iv) a reductant, and (v) a support.

17. The power source of Claim 16 wherein the oxidant is chosen from sulfur, phosphorous, oxygen SF_6, S, SO_2, SO_3, $S_2O_5Cl_2$, F_5SOF, $M_2S_2O_8$, S_xX_y S_2Cl_2, SCl_2, S_2Br_2, S_2F_2, CS_2, Sb_2S_5, SO_xX_y, $SOCl_2$, SOF_2, SO_2F_2, $SOBr_2$, P, P_2O_5, P_2S_5, P_xX_y, PF_3, PCl_3, PBr_3, PI_3, PF_5, PCl_5, PBr_4F, PCl_4F, PO_xX_y, $POBr_3$, POI_3, $POCl_3$, POF_3, PS_xX_y, $PSBr_3$, PSF_3, $PSCl_3$, a phosphorous-nitrogen compound, P_3N_5, $(Cl_2PN)_3$, or $(Cl2PN)_4$, $(Br_2PN)_x$ (M is an alkali metal, x and y are integers, X is halogen), O_2, N_2O, and TeO_2, a halide, CF_4, NF_3, CrF_2, a source of phosphorous, a source of sulfur, MgS, MHS (M is an alkali metal).

18. The power source of Claim 17 wherein the reaction mixture further comprises a getter for the catalyzed hydrogen chosen from elemental S, P, O, Se, and Te and compounds comprising S, P, O, Se, and Te.

19. The power source of Claim 1, wherein the catalyst is capable of accepting energy from atomic hydrogen in integer units of one of about 27.2 eV ± 0.5 eV and $\frac{27.2}{2}\ eV$ ± 0.5 eV.

20. The power source of Claim 1, wherein the catalyst comprises an atom or ion M wherein the ionization of t electrons from the atom or ion M each to a continuum energy level is such that the sum of ionization energies of the t electrons is approximately one of $m \bullet 27.2eV$ and $m \bullet \frac{27.2}{2} eV$ where m is an integer.

21. The power source of Claim 1 wherein the catalyst comprised a diatomic molecule MH wherein the breakage of the M-H bond plus the ionization of t electrons from the atom M each to a continuum energy level is such that the sum of the bond energy and ionization energies of the t electrons is approximately one of $m\ X\ 27.2\ eV$ and $m \bullet \frac{27.2}{2} eV$ where m is an integer.

22. The power source of Claim 1 wherein the catalyst comprises atoms, ions, and/or molecules chosen from molecules of AlH, BiH, ClH, CoH, GeH, InH, NaH, RuH, SbH, SeH, SiH, SnH, C_2, N_2, O_2, CO_2, NO_2, and NO_3 and atoms or ions of Li, Be, K, Ca, Ti, V, Cr,

Mn, Fe, Co, Ni, Cu, Zn, As, Se, Kr, Rb, Sr, Nb, Mo, Pd, Sn, Te, Cs, Ce, Pr, Sm, Gd, Dy, Pb, Pt, Kr, $2K^+$, He^+, Ti^{2+}, Na^+, Rb^+, Sr^+, Fe^{3+}, Mo^{2+}, Mo^{4+}, In^{3+}, He^+, Ar^+, Xe^+, Ar^{2+} and H^+, and Ne^+ and H^+.

23. The power source of Claim 1, operated continuously as power production and regeneration are maintained in synchrony using electrolysis or thermal regeneration reactions.

24. The power source of Claim 1, further comprising a power converter.

25. The power source according to Claim 24, wherein the converter comprises a steam generator in communication with the reaction vessel, a steam turbine in communication with the steam generator, and an electrical generator in communication with the steam turbine.

What Is Claimed Is:

1. A power source comprising:

a reaction cell for the catalysis of atomic hydrogen to form hydrogen species that have a total energy that is more negative and more stable than that of the uncatalyzed hydrogen species and compositions of matter comprising said hydrogen species;

a reaction vessel;

a vacuum pump;

a source of atomic hydrogen from a source in communication with the reaction vessel;

a source of a hydrogen catalyst in communication with the reaction vessel,

the source of at least one of the source of atomic hydrogen and the source of hydrogen catalyst comprising a reaction mixture of at least one reactant comprising the element or elements that form at least one of the atomic hydrogen and the hydrogen catalyst and at least one other element, whereby at least one of the atomic hydrogen and hydrogen catalyst is formed from the source,

at least one other reactant to cause catalysis by performing at least one function of activating and propagating the catalysis; and

a heater for the vessel which initiates the formation of at least one of the atomic hydrogen and the hydrogen catalyst in the reaction vessel, and initiates the reaction to cause catalysis whereby the catalysis of atomic hydrogen releases energy in an amount greater than about 300 kJ per mole of hydrogen during the catalysis of the hydrogen atom.

2. The power source of Claim 1 wherein the reaction to cause the catalysis reaction comprise a reaction chosen from:

(i) exothermic reactions which provide the activation energy for the catalysis reaction;

(ii) coupled reactions that provide for at least one of a source of catalyst or atomic hydrogen to support the catalysis reaction;

(iii) free radical reactions that serve as an acceptor of electrons from the catalyst during the catalysis reaction;

(iv) oxidation-reduction reactions that serve as an acceptor of electrons from the catalyst during the catalysis reaction;

(v) exchange reactions facilitate the action of the catalyst to become ionized as it accepts energy from atomic hydrogen to form said hydrogen species, and

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

3. The power source of Claim 1 wherein the reaction mixture comprises an electrically conductive support to enable the catalysis reaction.

4. The power source of Claim 1 wherein the reaction mixture comprises a solid, liquid, or heterogeneous catalysis reaction mixture.

5. The power source of Claim 2 wherein the reaction mixture comprising an oxidation – reduction reaction to cause the catalysis reaction comprises:

(i) at least one catalyst chosen from Li, *LiH* , K, *KH* , *NaH* , Rb, RbH, Cs, and CsH;

(ii) H_2 gas, a source of H_2 gas, or a hydride;

(iii) at least one oxidant chosen from

metal compounds comprising halides, phosphides, borides, oxides, hydroxide, silicides, nitrides, arsenides, selenides, tellurides, antimonides, carbides, sulfides, hydrides, carbonate, hydrogen carbonate, sulfates, hydrogen sulfates, phosphates, hydrogen phosphates, dihydrogen phosphates, nitrates, nitrites, permanganates, chlorates, perchlorates, chlorites, perchlorites, hypochlorites, bromates, perbromates, bromites, perbromites, iodates, periodates, iodites, periodites, chromates, dichromates, tellurates, selenates, arsenates, silicates, borates, colbalt oxides, tellurium oxides, and oxyanions of halogens, P, B, Si, N, As, S, Te, Sb, C, S, P, Mn, Cr, Co, and Te;

a transition metal, Sn, Ga, In, lead, germanium, alkali metal and alkaline earth metal compound;

GeF_2, $GeCl_2$, $GeBr_2$, GeI_2, GeO, GeP, GeS, GeI_4, and $GeCl_4$, fluorocarbon, CF_4 , $ClCF_3$, chlorocarbon, CCl_4, O_2, MNO_3, $MClO_4$, MO_2, NF_3, N_2O, NO, NO_2, a boron-nitrogen compound such as $B_3N_3H_6$, a sulfur compound such as SF_6, S, SO_2, SO_3, $S_2O_5Cl_2$, F_5SOF, $M_2S_2O_8$, S_xX_y such as S_2Cl_2, SCl_2, S_2Br_2, or S_2F_2, CS_2, SO_xX_y, $SOCl_2$, SOF_2, SO_2F_2, $SOBr_2$, $X_xX'_y$, ClF_5, $X_xX'_yO_z$, ClO_2F, ClO_2F_2, $ClOF_3$, ClO_3F, ClO_2F_3, boron-nitrogen compound, $B_3N_3H_6$, Se, Te, Bi, As, Sb, Bi, TeX_x, TeF_4, TeF_6, TeO_x, TeO_2, TeO_3, SeX_x, SeF_6, SeO_x, SeO_2 or SeO_3, a tellurium oxide, halide, tellurium compound, TeO_2, TeO_3, $Te(OH)_6$, $TeBr_2$, $TeCl_2$, $TeBr_4$, $TeCl_4$, TeF_4, TeI_4, TeF_6, CoTe, or NiTe, a selenium compound. a selenium oxide, a selenium halide, a selenium sulfide, SeO_2, SeO_3, Se_2Br_2, Se_2Cl_2, $SeBr_4$, $SeCl_4$, SeF_4, SeF_6, $SeOBr_2$, $SeOCl_2$, $SeOF_2$, SeO_2F_2, SeS_2, Se_2S_6, Se_4S_4, or Se_6S_2, P, P_2O_5, P_2S_5, P_xX_y, PF_3, PCl_3, PBr_3, PI_3, PF_5, PCl_5, PBr_4F, PCl_4F, PO_xX_y, $POBr_3$, POI_3, $POCl_3$ or POF_3, PS_xX_y, (M is an alkali metal, x, y and z are integers, X and X' are halogen) $PSBr_3$, PSF_3, $PSCl_3$, a phosphorous-nitrogen compound, P_3N_5, $(Cl_2PN)_3$, $(Cl_2PN)_4$, $(Br_2PN)_x$, an arsenic compound, an arsenic oxide, arsenic halide, arsenic sulfide, arsenic selenide, arsenic telluride, AlAs, As_2I_4, As_2Se, As_4S_4, $AsBr_3$, $AsCl_3$, AsF_3, AsI_3, As_2O_3, As_2Se_3, As_2S_3, As_2Te_3, $AsCl_5$, AsF_5, As_2O_5, As_2Se_5, As_2S_5, an antimony compound, an antimony oxide, an antimony halide, an antimony sulfide, an antimony sulfate, an antimony selenide, an antimony arsenide, SbAs, $SbBr_3$, $SbCl_3$, SbF_3, SbI_3, Sb_2O_3, SbOCl, Sb_2Se_3, $Sb_2(SO4)_3$, Sb_2S_3, Sb_2Te_3, Sb_2O_4, $SbCl_5$, SbF_5, $SbCl_2F_3$, Sb_2O_5, Sb_2S_5, a bismuth compound, a bismuth oxide, a bismuth halide, a bismuth sulfide, a bismuth selenide, BiAsO4, $BiBr_3$, $BiCl_3$, BiF_3, BiF_5,

$Bi(OH)_3$, BiI_3, Bi_2O_3, BiOBr, BiOCl, BiOI, Bi_2Se_3, Bi_2S_3, Bi_2Te_3, Bi_2O_4, $SiCl_4$, $SiBr_4$, a transition metal halide, $CrCl_3$, ZnF_2, $ZnBr_2$, ZnI_2, $MnCl_2$, $MnBr_2$, MnI_2, $CoBr_2$, CoI_2, $CoCl_2$, $NiCl_2$, $NiBr_2$, NiF_2, FeF_2, $FeCl_2$, $FeBr_2$, $FeCl_3$, TiF_3, CuBr, $CuBr_2$, VF_3, $CuCl_2$, a metal halide , SnF_2, $SnCl_2$, $SnBr_2$, SnI_2, SnF_4, $SnCl_4$, $SnBr_4$, SnI_4, InF, InCl, InBr, InI, AgCl, AgI, AlF_3, $AlBr_3$, AlI_3, YF_3, $CdCl_2$, $CdBr_2$, CdI_2, $InCl_3$, $ZrCl_4$, NbF_5, $TaCl_5$, $MoCl_3$, $MoCl_5$, $NbCl_5$, $AsCl_3$, $TiBr_4$, $SeCl_2$, $SeCl_4$, InF_3, $InCl_3$, PbF_4, TeI_4, WCl_6, $OsCl_3$, $GaCl_3$, $PtCl_3$, $ReCl_3$, $RhCl_3$, $RuCl_3$, metal oxide, a metal hydroxide, Y_2O_3, FeO, Fe_2O_3, or NbO, NiO, Ni_2O_3, SnO, SnO_2, Ag_2O, AgO, Ga_2O, As_2O_3, SeO_2, TeO_2, $In(OH)_3$, $Sn(OH)_2$, $In(OH)_3$, $Ga(OH)_3$, $Bi(OH)_3$, CO_2, As_2Se_3, SF_6, S, SbF_3, CF_4, NF_3, a metal permanganate, $KMnO_4$, $NaMnO_4$, P_2O_5, a metal nitrate, $LiNO_3$, $NaNO_3$, KNO_3, a boron halide , BBr_3, BI_3, a group 13 halide, an indium halide, $InBr_2$, $InCl_2$, InI_3, a silver halide, AgCl, AgI, a lead halide, a cadmium halide, a zirconoium halide, a transition metal oxide, a transition metal sulfide, or a transition metal halide (Sc, Ti, V, Cr, Mn, Fe, Co, Ni, Cu, or Zn with F, Cl, Br or I), a second or third transition series halide, YF_3, second or third transition series oxide, second or third transition series sulfide, Y_2S_3, a halide of Y, Zr, Nb, Mo, Tc, Ag, Cd, Hf, Ta, W, Os, such as NbX_3, NbX_5, or TaX_5, Li_2S, ZnS, FeS, NiS, MnS, Cu_2S, CuS, SnS, an alkaline earth halide, $BaBr_2$, $BaCl_2$, BaI_2, $SrBr_2$, SrI_2, $CaBr_2$, CaI_2, $MgBr_2$, or MgI_2, a rare earth halide, $EuBr_3$, LaF_3, $LaBr_3$, $CeBr_3$, GdF_3, $GdBr_3$, a rare earth halide with the metal in the II state, CeI_2, EuF_2, $EuCl_2$, $EuBr_2$, EuI_2, DyI_2, NdI_2, SmI_2, YbI_2, and TmI_2, a metal boride, a europium boride, an MB_2 boride, CrB_2, TiB_2, MgB_2, ZrB_2, GdB_2, an alkali halide, LiCl, RbCl, or CsI, a metal phosphide, as Ca_3P_2, a noble metal halide, a noble metal oxide, a noble metal sulfide, $PtCl_2$, $PtBr_2$, PtI_2, $PtCl_4$, $PdCl_2$, $PbBr_2$, PbI_2, a rare earth sulfide, CeS, a La halide, a Gd halide, a metal and an anion, Na_2TeO_4, Na_2TeO_3, $Co(CN)_2$, CoSb, CoAs, Co_2P, CoO, CoSe, CoTe, NiSb, NiAs, NiSe, Ni_2Si, MgSe, a rare earth telluride, EuTe, a rare earth selenide, EuSe, a rare earth nitride, EuN, a metal nitride, AlN, GdN, Mg_3N_2, a compound containing at least two atoms chosen from oxygen and different halogen atoms, F_2O, Cl_2O, ClO_2, Cl_2O_6, Cl_2O_7, ClF, ClF_3, $ClOF_3$, ClF_5, ClO_2F, ClO_2F_3, ClO_3F, BrF_3, BrF5, I_2O_5, IBr, ICl, ICl_3, IF, IF_3, IF_5, IF_7, a metal second or third transition series halide, OsF_6, PtF_6, or IrF_6, a compound that can form a metal upon reduction, a metal hydride, rare earth hydride, alkaline earth hydride, or alkali hydride;

(iv) at least one reductant chosen from a metal, an alkali, alkaline earth, transition, second and third series transition, and rare earth metals, Al, Mg, MgH_2, Si, La, B, Zr, and Ti powders, and H_2, and

(v) at least one electrically conducting support chosen from AC, 1% Pt or Pd on carbon (Pt/C, Pd/C), a carbide, TiC, and WC.

6. The power source of Claim 2 wherein the reaction mixture comprising an oxidation – reduction reaction to cause the catalysis reaction comprises:

(i) at least one catalyst or a source of catalyst comprising a metal or a hydride from the Group I elements;

(ii) at least one source of hydrogen comprising H_2 gas or a source of H_2 gas, or a hydride;

(iii) at least one oxidant comprising an atom or ion or a compound comprising at least one of the elements from Groups 13, 14, 15, 16, and 17 chosen from F, Cl, Br, I, B, C, N, O, Al, Si, P, S, Se, and Te;

(iv) at least one reductant comprising an element or hydride chosen from Mg, MgH_2, Al, Si, B, Zr, and a rare earth metal ; and

(v) at least one electrically conductive support chosen from carbon, AC, graphene, carbon impregnated with a metal, Pt/C, Pd/C, a carbide, TiC, and WC.

7. The power source of Claim 2 wherein the reaction mixture comprising an oxidation – reduction reaction to cause the catalysis reaction comprises:

(i) at least one catalyst or a source of catalyst comprising a metal or a hydride from the Group I elements;

(ii) at least one source of hydrogen comprising H_2 gas or a source of H_2 gas, or a hydride;

(iii) at least one oxidant comprising a halide, oxide, or sulfide compound of the elements chosen from Groups IA, IIA, 3d, 4d, 5d, 6d, 7d, 8d, 9d, 10d, 11d, 12d, and lanthanides;

(iv) at least one reductant comprising an element or hydride chosen from Mg, MgH_2, Al, Si, B, Zr, and a rare earth metal; and

(v) at least one electrically conductive support chosen from carbon, AC, graphene, carbon impregnated with a metal such as Pt or Pd/C, a carbide, TiC, and WC.

8. The power source of Claim 2 wherein the exchange reaction to cause the catalysis reaction comprises an anion exchange between at least two of the oxidant, reductant, and catalyst wherein the anion is chosen from halide, hydride, oxide, sulfide, nitride, boride, carbide, silicide, arsenide, selenide, telluride, phosphide, nitrate, hydrogen sulfide, carbonate, sulfate, hydrogen sulfate, phosphate, hydrogen phosphate, dihydrogen phosphate, perchlorate, chromate, dichromate, cobalt oxide, and oxyanions.

9. The power source of Claim 8 wherein the exchange reaction to cause the catalysis is reversible thermally to regenerate the initial exchange reactants.

10. The power source of Claim 9 wherein the thermally regenerative reactants comprise

(i) at least one catalyst or a source of catalyst chosen from NaH and KH;

(ii) a source of hydrogen chosen from NaH, KH, and MgH_2;

(iii) at least one oxidant chosen from

(a) an alkaline earth halide chosen from $BaBr_2$, $BaCl_2$, BaI_2, $CaBr_2$, $MgBr_2$, and MgI_2;

(b) a rare earth halide chosen from $EuBr_2$, $EuBr_3$, EuF_3, DyI_2, LaF_3, and GdF_3;

(c) a second or third series transition metal halide chosen from YF_3;

(d) a metal boride chosen from CrB_2 and TiB_2;

(e) an alkali halide chosen from LiCl, RbCl, and CsI;

(f) a metal sulfide chosen from Li_2S, ZnS and Y_2S_3;

(h) a metal oxide chosen from Y_2O_3, and

(i) a metal phosphide chosen from Ca_3P_2;

(iv) at least one reductant chosen from Mg and MgH_2; and

(v) at least one support chosen from AC, TiC, and WC.

11. The power source of Claim 2 wherein the getter, support, or matrix-assisted catalysis reaction to cause the catalysis reaction comprises that provides at least one of a chemical environment for the catalysis reaction, acts to transfer electrons to facilitate the H catalyst function, undergoes a reversible phase or other physical change or change in its electronic state, and binds said hydrogen species product to increase at least one of the extent or rate of the catalysis reaction.

12. The power source of Claim 11 wherein the getter, support, or matrix-assisted catalysis reaction can be reversed thermally to regenerate the initial exchange reactants.

13. The power source of Claim 12 wherein the getter, support, or matrix-assisted catalysis reaction mixture comprises

(i) at least one catalyst or a source of catalyst chosen from NaH and KH;

(ii) a source of hydrogen chosen from NaH, KH and MgH_2;

(iii) at least one oxidant chosen from

(a) a metal arsenide chosen from Mg_3As_2; and

(b) a metal nitride chosen from Mg_3N_2 and AlN;

(iv) at least one reductant chosen from Mg and MgH_2; and

(v) at least one support chosen from AC, TiC, and WC.

14. The power source of Claim 1 wherein the reaction mixture to cause the catalysis reaction comprising a catalyst comprising an alkali metal is regenerated from the products by separating one or more of the components and regenerating the alkali metal by electrolysis.

15. A hydride reactor comprising:

a reaction cell for the catalysis of atomic hydrogen to form hydrogen species that have a total energy that is more negative and stable than that of the uncatalyzed hydrogen species and compositions of matter comprising said hydrogen species;

a reaction vessel;

a vacuum pump;

a source of atomic hydrogen from a source in communication with the reaction vessel;

a source of a hydrogen catalyst in communication with the reaction vessel,

the source of at least one of the source of atomic hydrogen and source of hydrogen catalyst comprising a reaction mixture of at least one reactant comprising the element or elements that form at least one of the atomic hydrogen and hydrogen catalyst and at least one other element, whereby at least one of the atomic hydrogen and hydrogen catalyst is formed from the source,

at least one other reactant to cause catalysis by performing at least one function of activating and propagating the catalysis; and

a heater for the vessel which initiates the formation of at least one of the atomic hydrogen and the hydrogen catalyst in the reaction vessel, and initiates the reaction to cause catalysis whereby the catalysis of atomic hydrogen releases energy in an amount greater than about 300 kJ per mole of hydrogen during the catalysis of the hydrogen atom.

16. The hydride reactor of Claim 15 wherein the reaction mixture for the synthesis of the compounds comprises at least two species chosen from the following genus of components (i) - (v): (i) a catalyst, (ii) a source of hydrogen, (iii) an oxidant, (iv) a reductant, and (v) a support.

17. The hydride reactor of Claim 16 wherein the oxidant is chosen from sulfur, phosphorous, oxygen SF_6, S, SO_2, SO_3, $S_2O_5Cl_2$, F_5SOF, $M_2S_2O_8$, S_xX_y S_2Cl_2, SCl_2, S_2Br_2, S_2F_2, CS_2, Sb_2S_5, SO_xX_y, $SOCl_2$, SOF_2, SO_2F_2, $SOBr_2$, P, P_2O_5, P_2S_5, P_xX_y, PF_3, PCl_3, PBr_3, PI_3, PF_5, PCl_5, PBr_4F, PCl_4F, PO_xX_y, $POBr_3$, POI_3, $POCl_3$, POF_3, PS_xX_y, $PSBr_3$, PSF_3, $PSCl_3$, a phosphorous-nitrogen compound, P_3N_5, $(Cl_2PN)_3$, or $(Cl2PN)_4$, $(Br_2PN)_x$ (M is an alkali metal, x and y are integers, X is halogen), O_2, N_2O, and TeO_2, a halide, CF_4, NF_3, CrF_2, a source of phosphorous, a source of sulfur, MgS, MHS (M is an alkali metal).

18. The hydride reactor of Claim 17 wherein the reaction mixture further comprises a getter for the catalyzed hydrogen chosen from elemental S, P, O, Se, and Te and compounds comprising S, P, O, Se, and Te.

19. The power source of Claim 1, wherein the catalyst is capable of accepting energy from atomic hydrogen in integer units of one of about 27.2 eV ± 0.5 eV and $\frac{27.2}{2}\ eV$ ± 0.5 eV.

20. The power source of Claim 1, wherein the catalyst comprises an atom or ion M wherein the ionization of t electrons from the atom or ion M each to a continuum energy level is such that the sum of ionization energies of the t electrons is approximately one of $m \cdot 27.2eV$ and $m \cdot \frac{27.2}{2}eV$ where m is an integer.

21. The power source of Claim 1 wherein the catalyst comprised a diatomic molecule MH wherein the breakage of the M-H bond plus the ionization of t electrons from the atom M each to a continuum energy level is such that the sum of the bond energy and ionization energies of the t electrons is approximately one of $m\,X\ 27.2\ eV$ and $m \cdot \frac{27.2}{2}eV$ where m is an integer.

22. The power source of Claim 1 wherein the catalyst comprises atoms, ions, and/or molecules chosen from molecules of AlH, BiH, ClH, CoH, GeH, InH, NaH, RuH, SbH, SeH, SiH, SnH, C_2, N_2, O_2, CO_2, NO_2, and NO_3 and atoms or ions of Li, Be, K, Ca, Ti, V, Cr, Mn, Fe, Co, Ni, Cu, Zn, As, Se, Kr, Rb, Sr, Nb, Mo, Pd, Sn, Te, Cs, Ce, Pr, Sm, Gd, Dy, Pb, Pt, Kr, $2K^+$, He^+, Ti^{2+}, Na^+, Rb^+, Sr^+, Fe^{3+}, Mo^{2+}, Mo^{4+}, In^{3+}, He^+, Ar^+, Xe^+, Ar^{2+} and H^+, and Ne^+ and H^+.

23. The power source of Claim 1, operated continuously as power production and regeneration are maintained in synchrony using electrolysis or thermal regeneration reactions.

24. The power source of Claim 1, further comprising a power converter.

25. The power source according to Claim 24, wherein the converter comprises a steam generator in communication with the reaction vessel, a steam turbine in communication with the steam generator, and an electrical generator in communication with the steam turbine.