CLAIMS

1. A method of generating energy, comprising:

reacting a liquid compound capable of producing hydrogen and having a formula R-XH with a metal substrate to produce hydrogen gas, and utilizing the hydrogen gas to generate energy;

wherein R is a moiety selected from the group consisting of an alkyl, heteroalkyl, alkenyl, substituted alkenyl, alkynyl, aryl, heteroaryl, alkoxy, cycloalkyl, heterocyclic, alkylaryl, arylalkyl, arylalkenyl, arylalkynyl, arylene, oxarylene group, and combinations thereof;

wherein X is selected from the group consisting of sulfur, oxygen and selenium; and

wherein reacting the liquid compound with the metal substrate additionally produces a spent, dehydrogenated compound bound to the metal substrate.

2. The method of claim 1, wherein the metal substrate comprises a metal selected from the group consisting of gold, silver, platinum, copper, and mercury.

3. The method of claim 1, wherein the metal substrate comprises a metal treated to remove a surface oxide coating.

4. The method of claim 1, wherein R is a C_2-C_8 alkyl, heteroalkyl, alkenyl, or heteroalkenyl group.

5. The method of claim 1, wherein utilizing the hydrogen gas comprises consuming the hydrogen gas in a combustible engine.

6. The method of claim 1, wherein utilizing the hydrogen gas comprises consuming the hydrogen gas in a fuel cell.

7. A method of storing and producing hydrogen for use in generating energy, comprising:

reacting a liquid compound capable of producing hydrogen and having a formula R_1-XH, with a metal substrate to produce hydrogen gas and a spent compound comprising:

(a) R_2-XH, wherein R_2 is dehydrogenated relative to R_1;

(b) R_3=X, wherein R_3 is dehydrogenated relative to R_1; or

(c) a combination of (a) and (b); and

collecting the hydrogen gas;

wherein each of R_1, R_2, and R_3 is a moiety independently selected from the group

consisting of an alkyl, heteroalkyl, alkenyl, substituted alkenyl, alkynyl, aryl, heteroaryl, alkoxy, cycloalkyl, heterocyclic, alkylaryl, arylalkyl, arylalkenyl, arylalkynyl, arylene, oxyarylene group, and combinations thereof;

and X is selected from the group consisting of sulfur, oxygen, and selenium.

8. The method of claim 7, wherein the metal substrate comprises gold, silver, platinum, copper, or mercury.

9. The method of claim 7, wherein the metal substrate comprises a metal treated to remove a surface oxide coating.

10. The method of clam 1 further comprising dissociating the spent, dehydrogenated compound from the metal substrate.

11. The method of claim 7, wherein the collecting comprises consuming the hydrogen gas in a combustible engine or fuel cell.

12. A device for producing hydrogen for generating energy, comprising:

a storage reservoir adapted to contain a liquid compound capable of producing hydrogen and having a formula R-XH, wherein R is a moiety selected from the group consisting of an alkyl, heteroalkyl, alkenyl, substituted alkenyl, alkynyl, aryl, heteroaryl, alkoxy, cycloalkyl, heterocyclic, alkylaryl, arylalkyl, arylalkenyl, arylalkynyl, arylene, oxyarylene group, and combinations thereof; and X is selected from the group consisting of sulfur, oxygen, and selenium; and

a metal substrate adapted to react with the liquid compound to produce an R-X compound bound to the metal substrate and hydrogen gas.

13. The device of claim 12, wherein the liquid compound comprises a C_2-C_8 organothiol compound.

14. The device of claim 12, wherein the metal substrate comprises silver, platinum, copper, or mercury.

15. The device of claim 12, wherein the metal substrate comprises gold.

16. The device of claim 16, wherein the gold comprises nanoporous gold.

17. The device of claim 12, wherein the metal substrate comprises a metal treated to

remove a surface oxide coating.

18. The device of claim 12, further comprising an energy source capable of disassociating R-X from the metal substrate to produce a spent compound.

19. The device of claim 18, wherein the spent compound is a dimeric compound having the formula R-X-X-R.

20. The device of claim 18, wherein the energy source comprises a heat source.

21. The device of claim 18, wherein the energy source comprises a UV light source.

22. The device of claim 18, further comprising a reservoir for storing the spent compound.

23. The device of claim 22, wherein the reservoir for storing the spent compound is adapted for removal of the spent compound from the device.

24. The device of claim 18, further comprising a regeneration chamber adapted to react the spent compound with hydrogen received from a source external to the device to produce a compound having a formula R-XH, thereby regenerating the compound capable of producing hydrogen from the spent compound.

25. The device of claim 12, wherein the hydrogen gas is used to generate energy.

26. An automobile comprising a hydrogen consuming device and the device of claim 12.

27. The automobile of claim 26, wherein the hydrogen consuming device comprises a hydrogen combustion engine.

28. The automobile of claim 26, wherein the hydrogen consuming device comprises a fuel cell.

29. A device for producing hydrogen for generating energy, comprising:

a storage reservoir adapted to contain a liquid compound capable of producing hydrogen and having a formula R_1-XH; and

a metal substrate adapted to react with the liquid compound to produce hydrogen gas and a spent, dehydrogenated compound bound to the metal substrate that is subsequently dissociated from the metal substrate to produce a dissociated spent compound comprising:

(a) R_2-XH, wherein R_2 is dehydrogenated relative to R_1;

(b) R_3=X, wherein R_3 is dehydrogenated relative to R_1; or

(c) A combination of (a) and (b);

wherein each of R_1, R_2, and R_3 is a moiety independently selected from the group consisting of an alkyl, heteroalkyl, alkenyl, substituted alkenyl, alkynyl, aryl, heteroaryl, alkoxy, cycloalkyl, heterocyclic, alkylaryl, arylalkyl, arylalkenyl, arylalkynyl, arylene, oxyarylene group, and combinations thereof; and

X is selected from the group consisting of sulfur, oxygen, and selenium.

30. The device of claim 29, wherein the metal substrate comprises silver, platinum, copper, or mercury.

31. The device of claim 29, wherein the metal substrate comprises gold.

32. The device of claim 31, wherein the gold comprises nanoporous gold.

33. The device of claim 29, wherein the metal substrate comprises a metal treated to remove a surface oxide coating.

34. The device of claim 29, further comprising a reservoir for storing the spent compound.

35. The device of claim 34, wherein the reservoir for storing the spent compound is adapted for removal of the spent compound from the device.

36. The device of claim 29, further comprising a regeneration chamber adapted to react the spent compound with hydrogen received from a source external to the device to produce a compound having a formula R_1-XH, thereby regenerating the compound capable of producing hydrogen from the spent compound.

37. The device of claim 29, wherein the hydrogen gas is used to generate energy.

38. An automobile comprising a hydrogen consuming device and the device of claim 29.

39. The automobile of claim 38, wherein the hydrogen consuming device comprises a hydrogen combustion engine.

40. The automobile of claim 38, wherein the hydrogen consuming device comprises a fuel cell.

41. A method of regenerating a compound capable of producing hydrogen from a spent compound, comprising:

receiving the spent compound from the device of claim 29; and

reacting the spent compound with hydrogen to produce a compound having a formula R-XH, thereby regenerating the compound capable of producing hydrogen from the spent compound.

42. A method of regenerating a compound capable of producing hydrogen from a spent compound, comprising:

receiving the spent compound from the device of claim 52; and

reacting the spent compound with hydrogen to produce a compound having a formula R_1-XH, thereby regenerating the compound capable of producing hydrogen from the spent compound.

43. An assembly for producing and utilizing hydrogen, comprising: a first unit for producing hydrogen, the first unit comprising:

(a) a storage reservoir adapted to contain a liquid compound capable of producing hydrogen and having a formula R-XH;

wherein R is a moiety selected from the group consisting of an alkyl, heteroalkyl, alkenyl, substituted alkenyl, alkynyl, aryl, heteroaryl, alkoxy, cycloalkyl, heterocyclic, alkylaryl, arylalkyl, arylalkenyl, arylalkynyl, arylene, oxyarylene group, and combinations thereof; and

X is selected from the group consisting of sulfur, oxygen, and selenium; and

(b) a metal substrate adapted to react with the liquid compound to produce an R-X compound bound to the metal substrate and hydrogen gas; and

a second unit for utilizing hydrogen to generate energy, wherein the second unit is adapted to accept hydrogen from the first unit.

44. The assembly of claim 43, wherein the reactive metal substrate comprises

silver, platinum, copper, mercury, or a metal treated to remove a surface oxide coating.

45. The assembly of claim 43, wherein the metal substrate comprises gold.

46. The assembly of claim 45, wherein the gold comprises nanoporous gold.

47. The assembly of claim 43, further comprising an energy source capable of disassociating R-X from the metal substrate to produce a spent compound.

48. The assembly of claim 47, wherein the spent compound comprises a dimeric compound having a formula R-X-X-R.

49. The assembly of claim 47, wherein the energy source comprises a heat source.

50. The assembly of claim 47, wherein the energy source comprises a UV light source.

51. The assembly of claim 47, further comprising a reservoir for storing the spent compound adapted for removal of the spent compound from the device.

52. The assembly of claim 47, further comprising a regeneration chamber adapted to react the spent compound with hydrogen received from a source external to the device to produce a compound having a formula R-XH, thereby regenerating the compound capable of producing hydrogen from the spent compound.

53. The assembly of claim 43, wherein the second unit comprises a combustible engine.

54. The assembly of claim 43, wherein the second unit comprises a fuel cell.

55. The assembly of claim 43, wherein the assembly is contained within an automobile.

56. An assembly for producing and utilizing hydrogen, comprising:

a first unit for producing hydrogen, the first unit comprising:

(1) a storage reservoir adapted to contain a liquid compound capable of producing hydrogen and having a formula R_1-XH, and

(2) a metal substrate adapted to react with the liquid compound to produce hydrogen gas and a spent, dehydrogenated compound bound to the metal substrate that is subsequently dissociated from the metal substrate to produce a dissociated spent compound comprising: (a) R_2-XH, wherein R_2 is dehydrogenated relative to R_1; (b) R_3=X, wherein R_3 is dehydrogenated relative to R_1; or (c) a combination of (a) and (b);

wherein each of R_1, R_2, and R_3 is a moiety independently selected from the group consisting of an alkyl, heteroalkyl, alkenyl, substituted alkenyl, alkynyl, aryl, heteroaryl, alkoxy, cycloalkyl, heterocyclic, alkylaryl, arylalkyl, arylalkenyl, arylalkenyl, arylalkynyl, arylene, oxyarylene group, and combinations thereof, and

X is selected from the group consisting of sulfur, oxygen and selenium; and

a second unit for utilizing hydrogen to generate energy, wherein the second unit is adapted to accept hydrogen from the first unit.

57. The assembly of claim 56, wherein the reactive metal substrate comprises silver, platinum, copper, mercury, or a metal treated to remove a surface oxide coating.

58. The assembly of claim 56, wherein the metal substrate comprises gold.

59. The assembly of claim 58, wherein the gold comprises nanoporous gold.

60. The assembly of claim 56, further comprising a reservoir for storing the spent compound adapted for removal of the spent compound from the device.

61. The assembly of claim 60, further comprising a regeneration chamber adapted to react the spent compound with hydrogen received from a source external to the device to produce a compound having a formula RAH, thereby regenerating the compound capable of producing hydrogen from the spent compound.

62. The assembly of claim 56, wherein the second unit comprises a combustible engine.

63. The assembly of claim 56, wherein the second unit comprises a fuel cell.

64. The assembly of claim 56, wherein the assembly is contained within an automobile.