Claims

1. A method for extracting hydrogen from a compound comprising carbon, oxygen, and hydrogen, the method comprising:

(i) combining water with the compound to produce a wet form of the compound;

(ii) transferring the wet form of the compound into a reaction processing chamber;

(iii) heating the wet form of the compound within the reaction processing chamber such that elements comprised by the wet form of the compound dissociate and react, wherein one reaction product comprises hydrogen gas; and

(iv) extracting the hydrogen gas.

2. The method recited in claim 1, wherein heating the wet form of the compound within the reaction processing chamber such that elements comprised by the wet form of the compound dissociate and react through a non-oxidation reaction.

3. The method recited in claim 2, wherein the non-oxidation reaction comprises a hydrous pyrolysis reaction.

4. The method recited in claim 1, wherein heating the wet form of the compound within the reaction processing chamber occurs under atmospheric pressure conditions.

5. The method recited in claim 1, wherein the compound consists of carbon, oxygen, and hydrogen.

6. The method recited in claim 1, wherein the compound comprises cellulose.

7. The method recited in claim 1, wherein the compound comprises lignin.

8. The method recited in claim 1, wherein the compound comprises hemicellulose.

9. The method recited in claim 1, wherein the compound comprises a waste stream.

10. The method recited in claim 1, further comprising:

providing a flow of an inert gas to the reaction processing chamber.

11. The method recited in claim 10, wherein the inert gas comprises at least argon or nitrogen.

12. The method recited in claim 1, wherein the extracted hydrogen gas is processed to generate at least electrical power or heat.

13. The method recited in claim 1, wherein the extracted hydrogen gas is processed to produce liquid fuels.

14. The method recited in claim 1, wherein the extracted hydrogen gas is processed by burning the hydrogen gas.

15. The method recited in claim 1, wherein the extracted hydrogen gas is processed by feeding the hydrogen gas into a fuel cell.

16. The method recited in claim 1, wherein the water comprises liquid water.

17. The method recited in claim 1, ~~wherein processing the hydrogen gas comprises~~ further comprising passing reaction-product gases through a reduced pressure chamber to remove traces of unreacted carbon.

18. The method recited in claim 1 or 17, ~~wherein processing the hydrogen gas comprises~~ further comprising passing reaction-product gases through a water-cooled chamber to remove unreacted water.

19. The method recited in claim 1, wherein heating the wet form of the compound comprises heating the wet form of the compound to a temperature between 700 °C and 1100 °C.

20. The method recited in claim 1, wherein transferring the wet form of the compound into the reaction processing chamber occurs continuously.

21. The method recited in claim 20, wherein the continuous transfer of the wet form of the compound into the reactor utilizes a geometry that reduces the presence of air.

22. A system for extracting hydrogen from a compound comprising carbon, oxygen, and hydrogen, the system comprising:

(i) a processing chamber;

(ii) a heating source in thermal communication with an interior of the processing chamber;

(iii) a source of the compound disposed within the processing chamber;

(iv) a source of water for reacting with the compound; and

(v) an exhaust system for extracting resultant hydrogen gas from the processing chamber.

23. The system recited in claim 22, wherein the processing chamber and the heating source are configured to heat a wet form of the compound within the processing chamber such that elements comprised by the wet form of the compound dissociate and react through a non-oxidation reaction.

24. The system recited in claim 23, wherein the non-oxidation reaction comprises a hydrous pyrolysis reaction.

25. The system recited in claim 23, wherein the source of water is configured to combine water with the compound to produce a wet form of the compound outside the processing chamber.

26. The system recited in claim 25, further comprising:

a conveyor for conveying the wet form of the compound into the processing chamber.

27. The system recited in claim 22, wherein the processing chamber is configured to operate under atmospheric pressure conditions.

28. The system recited in claim 22, wherein the compound consists of carbon, oxygen, and hydrogen.

29. The system recited in claim 22, wherein the compound comprises cellulose.

30. The system recited in claim 22, wherein the compound comprises lignin.

31. The system recited in claim 22, wherein the compound comprises hemicellulose.

32. The system recited in claim 22, wherein the compound comprises a waste stream.

33. The system recited in claim 22, further comprising:
gas delivery system configured to provide a flow of inert gas to the processing chamber.

34. The system recited in claim 33, wherein the inert gas comprises at least argon or nitrogen.

35. The system recited in claim 22, wherein the extracted hydrogen gas is processed to generate at least electrical power or heat.

36. The system recited in claim 22, wherein the extracted hydrogen gas is processed to produce liquid fuels.

37. The system recited in claim 22, wherein the extracted hydrogen gas is processed by burning the hydrogen gas.

38. The system recited in claim 22, wherein the extracted hydrogen gas is processed by feeding the hydrogen gas into a fuel cell.

39. The system recited in claim 22, wherein the water comprises liquid water.

40. The system recited in claim 22, wherein the exhaust system for extracting resultant hydrogen gas from the processing chamber is configured to pass reaction-product gases through a reduced pressure chamber to remove traces of unreacted carbon.

41. The system recited in claim 22, wherein the exhaust system for extracting resultant hydrogen gas from the processing chamber is configured to pass reaction-product gases through a water-cooled chamber to remove unreacted water.

42. The system recited in claim 22, wherein at least the processing chamber or the heating source is configured to heat a wet form of the compound to a temperature between 700 °C and 1100 °C.

43. The system recited in claim 22, further comprising:
a conveyor configured for transferring a wet form of the compound into the processing chamber.

44. The system recited in claim 43, wherein the conveyor is configured to continuously transfer of the wet form of the compound into the processing chamber utilizing a geometry that reduces the presence of air.

45. A method for extracting hydrogen for further processing comprising:
(i) heating a wet compound, the compound comprising carbon, oxygen, and hydrogen, such that elements comprised from the wet compound dissociate and react to form at least hydrogen gas; and
(ii) processing the hydrogen gas.

46. The method recited in claim 45, wherein heating the wet compound such that elements comprised from the wet compound dissociate and react to form at least hydrogen gas through a non-oxidation reaction.

47. The method recited in claim 46, wherein the non-oxidation reaction comprises a hydrous pyrolysis reaction.

48. The method recited in claim 45, wherein the hydrogen gas is processed to generate at least electrical power or heat.

49. The method recited in claim 45, wherein the hydrogen gas is processed to produce liquid fuels.

50. The method recited in claim 45, wherein the compound consists of carbon, oxygen, and hydrogen.

51. The method recited in claim 45, wherein the compound comprises cellulose.

52. The method recited in claim 45, wherein the compound comprises lignin.

53. The method recited in claim 45, wherein the compound comprises hemicellulose.

54. The method recited in claim 45, wherein processing the hydrogen gas comprises burning the hydrogen gas.

55. The method recited in claim 45, wherein processing the hydrogen gas comprises feeding the hydrogen gas into a fuel cell.

56. The method recited in claim 45, further comprising:
forming the wet compound through mixing water with the compound comprising carbon, oxygen, and hydrogen, before heating the wet compound.

57. A system for extracting hydrogen for further processing comprising:
(i) a processing chamber in thermal communication a heat source configured to heat a wet compound, the compound comprising carbon, oxygen, and hydrogen, such that elements comprised from the wet compound dissociate and react to form at least hydrogen gas; and
(ii) an exhaust system configured to process the hydrogen gas.

58. The system recited in claim 57, wherein the processing chamber in thermal communication the heat source is configured to heat the wet compound such that elements comprised from the wet compound dissociate and react to form at least hydrogen gas through a non-oxidation reaction.

59. The system recited in claim 58, wherein the non-oxidation reaction comprises a hydrous pyrolysis reaction.

60. The system recited in claim 57, wherein the exhaust system configured to process the hydrogen gas is configured to process the hydrogen gas to generate at least electrical power or heat.

61. The system recited in claim 57, wherein the exhaust system configured to process the hydrogen gas is configured to process the hydrogen gas to produce liquid fuels.

62. The system recited in claim 57, wherein the compound consists of carbon, oxygen, and hydrogen.

63. The system recited in claim 57, wherein the compound comprises cellulose.

64. The system recited in claim 57, wherein the compound comprises lignin.

65. The system recited in claim 57, wherein the compound comprises hemicellulose.

66. The system recited in claim 57, wherein the exhaust system configured to process the hydrogen gas is configured to burn the hydrogen gas.

67. The system recited in claim 57, wherein the exhaust system configured to process the hydrogen gas is configured to feed the hydrogen gas into a fuel cell.

68. The system recited in claim 57, further comprising:
a conveyor configured to transfer the wet compound to the processing chamber.

69. The system recited in claim 57, further comprising:
a chamber configured to at least mix or combine water with the compound to form the wet compound before the processing chamber in thermal communication with the heart source heats the wet compound.

70. A method for making a liquid fuel from a compound comprising carbon, oxygen, and hydrogen, the method comprising:
(i) combining water with the compound to produce a wet form of the compound;
(ii) transferring the wet form of the compound into a reaction processing chamber; and
(iii) heating the wet form of the compound within the reaction chamber such that elements comprised by the wet form of the compound dissociate and react, wherein one reaction product comprises the liquid fuel.

71. The method recited in claim 70, wherein heating the wet form of the compound within the reaction chamber such that elements comprised by the wet form of the compound dissociate and react through a non-oxidation reaction.

72. The method recited in claim 71, wherein the non-oxidation reaction comprises a hydrous pyrolysis reaction.

73. The method recited in claim 70, wherein the compound comprising carbon, oxygen, and hydrogen comprises cellulose.

74. The method recited in claim 70, wherein the compound comprising carbon, oxygen, and hydrogen comprises lignin.

75. The method recited in claim 70, wherein the compound comprising carbon, oxygen, and hydrogen comprises hemicellulose.

76. The method recited in claim 73, wherein:

(i) the liquid fuel comprises methanol; and

(ii) heating the wet form of the compound within the reaction chamber comprises inducing a reaction $C_6H_{10}O_5 + 6H_2O \rightarrow CH_4O + 5CO_2 + 9H_2$.

77. The method recited in claim 73, wherein:

(i) the liquid fuel comprises methanol; and

(ii) heating the wet form of the compound within the reaction chamber comprises inducing a reaction $C_6H_{10}O_5 + 5H_2O \rightarrow 2CH_4O + 4CO_2 + 6H_2$.

78. The method recited in claim 73, wherein:

(i) the liquid fuel comprises methanol; and

(ii) heating the wet form of the compound within the reaction chamber comprises inducing a reaction $C_6H_{10}O_5 + 4H_2O \rightarrow 3CH_4O + 3CO_2 + 3H_2$.

79. The method recited in claim 73, wherein:

(i) the liquid fuel comprises methanol; and

(ii) heating the wet form of the compound within the reaction chamber comprises inducing a reaction $C_6H_{10}O_5 + 3H_2O \rightarrow 4CH_4O + 2CO_2$.

80. The method recited in claim 73, wherein:

(i) the liquid fuel comprises ethanol; and

(ii) heating the wet form of the compound within the reaction chamber comprises inducing a reaction $C_6H_{10}O_5 + 4H_2O \rightarrow C_2H_6O + 4CO_2 + 6H_2$.

81. The method recited in claim 73, wherein:

(i) the liquid fuel comprises ethanol; and

(ii) heating the wet form of the compound within the reaction chamber comprises inducing a reaction $C_6H_{10}O_5 + H_2O \rightarrow 2C_2H_6O + 2CO_2$.

82. The method recited in claim 73, wherein:

(i) the liquid fuel comprises propanol; and

(ii) heating the wet form of the compound within the reaction chamber comprises inducing a reaction $C_6H_{10}O_5 + 2H_2O \rightarrow C_3H_8O + 3CO_2 + 3H_2$.

83. The method recited in claim 73, wherein:

(i) the liquid fuel comprises butanol; and

(ii) heating the wet form of the compound within the reaction chamber comprises inducing a reaction $C_6H_{10}O_5 \rightarrow C_4H_{10}O + 2CO_2$.

84. The method recited in claim 73, wherein:

(i) the liquid fuel comprises gasoline; and

(ii) heating the wet form of the compound within the reaction chamber comprises inducing the reaction $C_6H_{10}O_5 + 4C + 4H_2O \rightarrow C_7H_{16} + 2CO_2$.

85. The method recited in claim 73, wherein:

(i) the liquid fuel comprises diesel; and

(ii) heating the wet form of the compound within the reaction chamber comprises inducing a reaction $C_6H_{10}O_5 + 10C + 2H_2O \rightarrow C_{16}H_{24} + 6CO_2$.

86. The method recited in claim 70, further comprising:

extracting a hydrogen gas that is another reaction product as an end product.

87. The method recited in claim 70, further comprising:

extracting a carbon dioxide gas that is another reaction product as an end product.

88. A system for making a liquid fuel from a compound comprising carbon, oxygen, and hydrogen, the system comprising:

(i) a processing chamber;

(ii) a heating source in thermal communication with an interior of the processing chamber;

(iii) a source of the compound disposed within the processing chamber;

(iv) a source of water to wet the source of the compound; and

(v) a subsystem for controlling the heating source to induce a dissociation and reaction of the wet source of the compound, wherein one reaction product comprises the liquid fuel.

89. The system recited in claim 88, further comprising:

an exhaust system for extracting at least the liquid fuel or resulting gases from the processing chamber.

90. The system recited in claim 88, wherein the subsystem for controlling the heating source to induce the dissociation and reaction of the wet source of the compound utilizing a non-oxidation reaction.

91. The system recited in claim 90, wherein the non-oxidation reaction comprises a hydrous pyrolysis reaction.

92. The system recited in claim 88, wherein the compound comprising carbon, oxygen, and hydrogen comprises cellulose.

93. The system recited in claim 88, wherein the compound comprising carbon, oxygen, and hydrogen comprises lignin.

94. The system recited in claim 88, wherein the compound comprising carbon, oxygen, and hydrogen comprises hemicellulose.

95. The system recited in claim 92, wherein:

(i) the liquid fuel comprises methanol; and

(ii)heating the wet form of the compound within the reaction chamber comprises inducing the reaction $C_6H_{10}O_5 + 6H_2O \rightarrow CH_4O + 5CO_2 + 9H_2$.

96. The system recited in claim 92, wherein:

(i) the liquid fuel comprises methanol; and

(ii) heating the wet form of the compound within the reaction chamber comprises inducing a reaction $C_6H_{10}O_5 + 5H_2O \rightarrow 2CH_4O + 4CO_2 + 6H_2$.

97. The system recited in claim 92, wherein:

(i) the liquid fuel comprises methanol; and

(ii) heating the wet form of the compound within the reaction chamber comprises inducing a reaction $C_6H_{10}O_5 + 4H_2O \rightarrow 3CH_4O + 3CO_2 + 3H_2$.

98. The system recited in claim 92, wherein:

(i) the liquid fuel comprises methanol; and

(ii) heating the wet form of the compound within the reaction chamber comprises inducing a reaction $C_6H_{10}O_5 + 3H_2O \rightarrow 4CH_4O + 2CO_2$.

99. The system recited in claim 92, wherein:

(i) the liquid fuel comprises ethanol; and

(ii) heating the wet form of the compound within the reaction chamber comprises inducing a reaction $C_6H_{10}O_5 + 4H_2O \rightarrow C_2H_6O + 4CO_2 + 6H_2$.

100. The system recited in claim 92, wherein:

(i) the liquid fuel comprises ethanol; and

(ii) heating the wet form of the compound within the reaction chamber comprises inducing a reaction $C_6H_{10}O_5 + H_2O \rightarrow 2C_2H_6O + 2CO_2$.

101. The system recited in claim 92, wherein:

(i) the liquid fuel comprises propanol; and

(ii) heating the wet form of the compound within the reaction chamber comprises inducing a reaction $C_6H_{10}O_5 + 2H_2O \rightarrow C_3H_8O + 3CO_2 + 3H_2$.

102. The system recited in claim 92, wherein:

(i) the liquid fuel comprises butanol; and

(ii) heating the wet form of the compound within the reaction chamber comprises inducing a reaction $C_6H_{10}O_5 \rightarrow C_4H_{10}O + 2CO_2$.

103. The system recited in claim 92, wherein:

(i) the liquid fuel comprises gasoline; and

(ii) heating the wet form of the compound within the reaction chamber comprises inducing a reaction $C_6H_{10}O_5 + 4C + 4H_2O \rightarrow C_7H_{16} + 2CO_2$.

104. The system recited in claim 92, wherein:

(i) the liquid fuel comprises diesel; and

(ii) heating the wet form of the compound within the reaction chamber comprises inducing a reaction $C_6H_{10}O_5 + 10C + 2H_2O \rightarrow C_{16}H_{24} + 6CO_2$.

105. The system recited in claim 88, wherein one resulting gas comprises a hydrogen gas as an end product.

106. The system recited in claim 88, wherein one resulting gas comprises a carbon dioxide gas as an end product.

~~107. A method for extracting hydrogen from a compound comprising carbon, oxygen, and hydrogen, the method comprising:~~

~~(i) introducing a source of the compound into a chamber;~~

~~(ii) adding water for reacting with the compound;~~

~~(iii) heating the compound inside the chamber to dissociate the compound into a hydrogen gas, a carbon dioxide gas, and a solid residue of carbon; and~~

~~(iv) separating the hydrogen gas from the carbon dioxide gas.~~

~~108. The method recited in claim 107, wherein heating the compound inside the chamber to dissociate the compound into a hydrogen gas, a carbon dioxide gas, and a solid residue of carbon utilizes a non-oxidation reaction.~~

~~109. The method recited in claim 108, wherein the non-oxidation reaction comprises a hydrous pyrolysis reaction.~~

~~110. The method recited in claim 107, further comprising providing a flow of an inert gas to the chamber.~~

~~111. The method recited in claim 110, wherein the inert gas comprises at least argon or nitrogen.~~

~~112. The method recited in claim 107, wherein the compound comprises cellulose.~~

~~113. The method recited in claim 107, further comprising:~~

~~processing the hydrogen gas to generate electrical power.~~

~~114. The method recited in claim 112, wherein the cellulose comprises cellulose waste.~~

~~115. The method recited in claim 112, further comprising:~~

~~partially burning cellulose in the processing chamber that contains air until oxygen in the air inside the processing chamber is depleted.~~

~~116. The method recited in claim 112, wherein a temperature of the chamber for the dissociation of cellulose is approximately 325°C or above.~~

~~117. The method recited in claim 112, wherein a source of cellulose comprises corn.~~

~~118. The method recited in claim 112, wherein a source of cellulose comprises paper.~~

~~119. The method recited in claim 107, wherein:~~

~~(i) burning the hydrogen in the presence of oxygen to form water vapor and release energy; and~~

~~(ii) burning the carbon in the presence of oxygen to form carbon dioxide and release energy.~~

~~120. The method recited in claim 119, further comprising:~~

~~converting the water vapor into electrical power.~~

~~121. The method recited in claim 107, further comprising:~~

~~feeding the hydrogen gas into a fuel cell, wherein the fuel cell converts the hydrogen gas and an oxygen gas into water to produce heat.~~

~~122. The method recited in claim 107, further comprising:~~

~~using the hydrogen gas to improve automotive engine efficiency.~~

~~123. A method for conversion of cellulose into hydrogen, the method comprising:~~

~~(i) introducing a source of cellulose into a chamber;~~

(ii) adding water into the chamber for reacting with the cellulose;

(iii) heating the chamber to generate water vapor;

(iv) causing a reaction between the water vapor and the cellulose to form a hydrogen gas and a carbon dioxide gas; and

(v) separating the hydrogen gas from the carbon dioxide gas.

124. The method recited in claim 123, wherein the reaction comprises a non-oxidation reaction.

125. The method recited in claim 124, wherein the non-oxidation reaction comprises a hydrous pyrolysis reaction.

126. The method recited in claim 123, further comprising:

burning the hydrogen gas in the presence of an oxygen gas to form water vapor and release energy.

127. The method recited in claim 126, further comprising:

converting the water vapor into electrical power.

128. The method recited in claim 123, further comprising:

feeding the hydrogen gas into a fuel cell, the fuel cell converting the hydrogen gas and an oxygen gas into water vapor and producing electricity and heat.

129. The method recited in claim 123, further comprising:

partially burning cellulose in the chamber that contains air until oxygen in the air inside the processing chamber is depleted.

130. The method recited in claim 123, further comprising:

providing a flow of an inert gas to the chamber.

131. The method recited in claim 130, wherein the inert gas comprises at least argon or nitrogen.

~~132. A method for conversion of cellulose into hydrogen of claim 123, wherein the water vapor is formed at approximately 400°C or above.~~

~~133. The method recited in claim 123, wherein a source of the cellulose comprises corn.~~

~~134. The method recited in claim 123, wherein a source of the cellulose comprises paper.~~

~~135. The method recited in claim 123, wherein a source of the cellulose comprises cellulose waste.~~

~~136. A system for producing hydrogen from a compound comprising carbon, oxygen, and hydrogen, the system comprising:~~

~~(i) a processing chamber;~~

~~(ii) a heating source in thermal communication with an interior of the processing chamber;~~

~~(iii) a source of the compound disposed within the processing chamber;~~

~~(iv) a source of water for reacting with the compound; and~~

~~(v) an exhaust system for extracting resultant hydrogen gas and carbon dioxide gas from the processing chamber.~~

~~137. The system recited in claim 136, wherein the heating source is further configured to react the source of water with the compound utilizing a non-oxidation reaction.~~

~~138. The system recited in claim 137, wherein the non-oxidation reaction comprises a hydrous pyrolysis reaction.~~

~~139. The system recited in claim 136, further comprising:~~

~~a combustion chamber configured to burn the hydrogen gas in the presence of oxygen to release heat energy and to form water vapor.~~

~~140. The system recited in claim 136, further comprising:~~

~~a fuel cell for converting hydrogen gas into electrical power.~~

~~141. The system recited in claim 136, wherein a source of the compound comprises at least corn or paper.~~

~~142. The system recited in claim 136, further comprising:~~

~~a gas delivery system configured to provide a flow of inert gas to the processing chamber.~~

~~143. The system recited in claim 142, wherein the inert gas comprises at least argon or nitrogen.~~

~~144. The system recited in claim 136, wherein the compound is partially burned in the processing chamber that contains air until oxygen in the air inside the processing chamber is depleted.~~

~~145. The system recited in claim 136, wherein a source of water is disposed within the processing chamber for reaction of the compound and water to form hydrogen and carbon dioxide.~~

~~146. The system recited in claim 136, wherein the source of the compound comprises cellulose waste.~~

~~147. The system recited in claim 136, further comprising:~~

~~a subsystem configured to process the hydrogen gas to produce electrical power~~