CLAIMS

WHAT IS CLAIMED IS:

1. A method for generating electricity using a fuel cell, comprising:

(a) reacting, using an ammonia reformer, ammonia to generate a first continuous stream comprising nitrogen and hydrogen, wherein the ammonia reformer is in fluid communication with the fuel cell, and wherein the ammonia reformer comprises one or more combustion heaters, the fuel cell comprising:

i. an electrochemical circuit comprising an anode, a cathode, and an electrolyte between the anode and the cathode;

ii. a first channel comprising a first inlet and a first outlet, wherein the first channel is in fluid communication with the anode, wherein the first channel comprises one or more features configured to (i) increase a hydrogen consumption rate of the fuel cell, or (ii) increase an output voltage of the fuel cell at a same hydrogen consumption rate, when the first continuous stream contacts the anode compared to an equivalent fuel cell lacking the one or more features, wherein the one or more features comprise (1) one or more cuts, (2) one or more cutouts, (3) one or more grooves, or (4) any combination thereof; and

iii. a second channel comprising a second inlet and a second outlet, wherein the second channel is in fluid communication with the cathode; and

(b) directing the first continuous stream into the first channel via the first inlet so that the hydrogen contacts the anode;

(c) directing a second continuous stream comprising oxygen into the second channel via the second inlet so that the oxygen contacts the cathode;

(d) reacting the hydrogen and the oxygen, using the fuel cell, to generate electricity;

(e) reducing the hydrogen consumption rate of the fuel cell and outputting from the fuel cell a third continuous stream comprising unconverted hydrogen;

(f) directing the third continuous stream comprising unconverted hydrogen to the ammonia reformer;

(g) combusting at least part of the third continuous stream to heat the ammonia

reformer; and

(h) venting at least part of the third continuous stream at one or more combustion exhausts of the one or more combustion heaters, wherein the one or more combustion heaters are in thermal communication with the ammonia reformer for heating the ammonia reformer, and wherein the one or more combustion heaters are in fluidic communication with the fuel cell to receive the at least part of the third continuous stream.

2. The method of claim 1, wherein the one or more features increase the hydrogen consumption rate by at least 20%.
3. The method of claim 1 or 2, wherein the one or more features increase the output voltage by at least 10%.
4. The method of any one of claims 1-3, wherein the nitrogen is continuously purged out of the first channel by the one or more features so that nitrogen accumulation is reduced in the first channel, thereby increasing the hydrogen consumption rate compared to the equivalent fuel cell lacking the one or more features.
5. The method of any one of claims 1-4, wherein the hydrogen consumption rate of the fuel cell when the first continuous stream contacts the anode is at least about 20% of the hydrogen in the first continuous stream.
6. The method of any one of claims 1-5, further comprising intermittently reducing the hydrogen consumption rate to purge out at least one of hydrogen, nitrogen, or water.
7. The method of any one of claims 1-6, wherein the fuel cell is configured to provide a ratio of an electrical power output of the fuel cell to a projected surface area of the anode that is at least about 0.05 W/cm^2.
8. The method of claim 7, wherein the ratio of an electrical power output of the fuel cell to a projected surface area of the anode is at least about 0.2 W/cm^2.
9. A system comprising:

(a) an ammonia reformer configured to react ammonia to generate a first continuous stream comprising nitrogen and hydrogen, wherein the ammonia reformer comprises one or more combustion heaters;

(b) a fuel cell in fluid communication with the ammonia reformer, wherein the fuel cell comprises:

i. an electrochemical circuit comprising an anode, a cathode, and an electrolyte between the anode and the cathode;

ii. a first channel comprising a first inlet and a first outlet, wherein the first channel is in fluid communication with the anode, wherein the first channel comprises one or more features configured to (i) increase a hydrogen consumption rate, or (ii) increase an output voltage at the same hydrogen consumption rate, when the first continuous stream contacts the anode compared to an equivalent fuel cell lacking the one or more features, wherein the one or more features comprise (i) one or more cuts, (ii) one or more cutouts, (iii) one or more grooves, or (iv) any combination thereof; and

iii. a second channel comprising a second inlet and a second outlet, wherein the second channel is in fluid communication with the cathode; and

(c) a controller comprising at least one processor configured to perform executable instructions, wherein, when executed, the instructions cause the controller to cause the system to:

i. react the ammonia, using the ammonia reformer, to generate the first continuous stream comprising hydrogen and nitrogen;

ii. direct a second continuous stream comprising oxygen to the cathode of the fuel cell; and

iii. direct the first continuous stream to the anode of the fuel cell to react the hydrogen and oxygen to generate electricity;

iv. reduce the hydrogen consumption rate of the fuel cell and output, from the fuel cell, a third continuous stream comprising unconverted hydrogen;

v. direct the third continuous stream comprising unconverted hydrogen to the ammonia reformer;

vi. combust at least part of the third continuous stream to heat the ammonia reformer; and

vii. vent at least part of the third continuous stream at one or more combustion exhausts of the one or more combustion heaters, wherein the one or more combustion heaters are in thermal communication with the ammonia

reformer for heating the ammonia reformer, and wherein the one or more combustion heaters are in fluidic communication with the fuel cell to receive the at least part of the third continuous stream.

10. The system of claim 9, wherein the one or more features increase the hydrogen consumption rate by at least 20%.
11. The system of claim 9 or 10, wherein the one or more features increase the output voltage by at least 10%.
12. The system of any one of claims 9-11, wherein the hydrogen consumption rate of the fuel cell when the first continuous stream contacts the anode is at least about 20% of the hydrogen in the first continuous stream.
13. The system of any one of claims 9-12, wherein the fuel cell comprises a plurality of channels in fluid communication with the anode, wherein the plurality of channels comprise the first channel.
14. The system of claim 13, wherein the plurality of channels comprises a stack of layers that are adjacent to one another.
15. The system of claim 14, wherein at least one channel in the plurality of channels does not comprise or lacks the one or more features comprising (i) one or more cuts, (ii) one or more cutouts, (iii) one or more grooves, or (iv) any combination thereof.
16. The system of any one of claims 9-15, wherein the one or more features are further configured to facilitate purging of a select material from an anode gas diffusion layer of the first channel, wherein the select material comprises one or more of nitrogen, ammonia, water, or one or more impurities.
17. The system of any one of claims 9-15, wherein the one or more features are configured to purge nitrogen from the fuel cell while the fuel cell is generating electricity.
18. The system of any one of claims 9-17, wherein a concentration of ammonia in the first continuous stream is at most 1000 ppm.
19. The system of any one of claims 9-18, wherein the one or more features increase a power density of the fuel cell by at least 10%.
20. The system of any one of claims 9-19, wherein the fuel cell is configured to provide a ratio of an electrical power output of the fuel cell to a projected surface area of the anode that is

at least about 0.05 W/cm^2.