A TEMPERATURE CONTROL SYSTEM

Field of Invention

The present invention relates generally to a temperature control system. Specifically, the invention relates to a system for reducing the operating temperature of fuel cell systems.

Background

A fuel cell is an electrochemical device that enables generation of electricity or power through oxidation of a fuel, which is also known as a reactant. A typical fuel cell configuration comprises a membrane-electrolyte assembly (MEA) sandwiched substantially between a pair of bipolar plates. The MEA is constructed from a proton exchange membrane (PEM), and an anode and a cathode formed on outwardly opposing surfaces of the PEM. Typically, the fuel introduced into the fuel cell gets oxidized at the anode. Oxidation of the fuel produces protons and electrons. The electrons are generally harvested for production of electricity or power by an external circuit. The protons travel to the cathode and are utilized thereat for reduction of an oxidant. Reaction products, for example water, are produced by the reduction reaction at the cathode. The reaction products, together with unreacted or excess fuel, are typically removed from the fuel cell.

An exemplary fuel cell utilizes hydrogen gas as fuel, and is generally referred to as a hydrogen fuel cell. Hydrogen gas introduced into the hydrogen fuel cell is oxidized at the anode for production of electrons and protons. As previously mentioned, the electrons are generally harvested by the external circuit for generating electricity or power. The protons travel to the cathode for reducing oxygen gas, which is supplied thereto. The reduction reaction at the cathode produces water as the reaction product. The water produced, together with unreacted or excess hydrogen gas, is removed as a mixture from the fuel cell.

Fuel cells are efficient and compact. Typically, fuel cells become active at a relatively low temperature of 100° C. or less and can thus be applied as an electric power source for

automobiles or as a home power generator. A typical fuel cell has relatively high power generation efficiency. However, waste heat is still generated from a portion of the energy. The heat must be discharged efficiently from the fuel cell to protect high molecular electrolyte films, which are located in the fuel cell. Harnessing the waste as energy for other applications is difficult as the heat generated, although normally at 100° C. or less, is relatively low for effective use.

Therefore, there is a temperature control system for use in the fuel cell.

Summary

In accordance with a first aspect of the invention, there is disclosed a temperature control system comprising at least one storage container for storing fuel providable to at least one fuel cell unit with the fuel being endo-thermically discharged from the at least one storage container, and a channel for passage of air therethrough. The channel and the at least one storage container being inter-disposed for enabling communication of thermal energy from the air passaging through the channel to the at least one storage container during discharge of fuel therefrom to thereby reduce temperature of the air. The system further comprises an actuator for displacing the air through the channel, the actuator further for displacing and the channel being disposed for directing the cooled air towards the at least one fuel cell unit for reducing temperature of at least a portion of the at least one fuel cell.

In accordance with a second aspect of the invention, there is disclosed a temperature control method comprising displacing air across at least one storage container for reducing the temperature of the air. The at least one storage container for storing fuel providable to at least one fuel cell unit, the fuel being endo-thermically dischargeable from the at least one storage container with thermal energy being communicated from the air directed across the at least one storage container during discharge of fuel therefrom to thereby cool the air. The method further comprises directing the cooled air towards the at least one fuel cell unit to thereby reduce the temperature of the at least one fuel cell unit.

Brief Description of the Drawings

FIG. 1 shows a system air-flow diagram of a temperature control system with a single inlet and a single outlet according to an embodiment of the invention; and

FIG. 2 shows a system air-flow diagram of the temperature control system of FIG. 1 with two inlets and a single outlet.

Detailed Description

A fuel cell is an electrochemical device for facilitating generation of electricity or power. Fuel cells are increasingly important as an alternative source of energy, especially in light of surging oil prices and heightened global awareness of environmental issues such as global warming. Efficiency of fuel cells is generally adversely affected by insufficient cooling or insufficient temperature control. It will be appreciated by a person skilled in the art that enhancing the efficiency of fuel cells will be important for promoting and sustaining large-scale utilization of fuel cells as a viable and attractive source of alternative energy.

For purposes of brevity and clarity, the description of the present invention is limited hereinafter to applications relating to a fuel cell system utilizing hydrogen gas as fuel. The fuel cell system enables recirculation of gaseous fuel for enhancing electricity or power generating efficiency thereof. This however does not preclude various embodiments of the present invention from other applications where fundamental principles prevalent among the various embodiments of the invention such as operational, functional or performance characteristics are required.

An exemplary embodiment of the present invention, a temperature control system 20 for use with a fuel cell system 22, is described herein with reference to FIG. 1 and FIG. 2. Preferably, the fuel cell system 22 comprises multiple fuel cell units. The temperature control system 20 comprises a storage container 26 for storing fuel providable to one or more of the fuel cell units. A channel 28 extends between the storage container 26 and

the fuel cell system 22 for communicating air therebetween. The temperature control system 20 further comprises an actuator 30 for displacing air through the channel.

Preferably, the storage container 26 utilises a fuel storage system that enables fuel to be endo-thermically discharged from the storage container 26. The channel 28 and the storage container 26 are inter-disposed for enabling communication of thermal energy from the air passaging through the channel to the at least one storage container during discharge of fuel therefrom to thereby cool the air. The cooled air is then displaceable by the actuator 30 towards the fuel cell system 22 for dissipating heat from at least one of the fuel cell units. The actuator 30 preferably comprises one or more blower fans.

Preferably, the channel 28 has an inlet 32 for the intake of air and an outlet 34 wherefrom air is dischargeable. The actuator 30 is preferably a fan system disposed adjacent one of the inlet 32 and the outlet 34. The fuel is preferably hydrogen with the storage container 26 being a metal canister functioning as a metal hydride storage system. Therefore, the storage container 26 preferably contains hydrogen adsorbing alloy which is reversibly convertible into metal hydride for storage and release of hydrogen as the fuel. When hydrogen is introduced into the storage container, for example a metal canister, for interacting with the hydrogen adsorbing alloy, the hydrogen disassociates for diffusion into the hydrogen adsorbing alloy. This results in the nucleation and growth of the hydride phase from the hydrogen adsorbing alloy. Consequently, metal hydride is obtained from the hydrogen adsorbing alloy when hydrogen is introduced thereto. This process is reversible for changing the metal hydride into the hydrogen adsorbing alloy to thereby endo-thermically "generate" hydrogen from the metal hydride.

The metal hydride storage system enables storage and discharge of hydrogen for provision as fuel to the fuel cell system 22. The fuel cell units preferably have an open-cathode configuration

The channel 28 is preferably formed by an enclosure 36 shaped and dimensioned for receiving an containing at least a portion of the fuel cell system 22 and the storage

container 26 therewithin. Alternatively, the channel 28 is defined by a tube structure (not shown). When air is drawn across the surface of the storage container 26 during discharge of hydrogen therefrom, the surface of the storage container functions as a heat exchanger for receiving heat from the air to thereby reduce the temperature thereof. The air is then directed by the channel 28 to the fuel cell system 22 for cooling the fuel cell units. The cooling of the fuel cell units occurs in tandem with the fuel being supplied thereto to thereby reduce the temperature of the fuel cell units during operation thereof. This, in turn, improves the operating performance of the fuel cell system 22.

In the foregoing manner, an exemplary temperature control system is described according to an exemplary embodiment of the present invention. Although only one exemplary embodiment of the present invention is disclosed, it will be apparent to a person skilled in the art in view of this disclosure that numerous changes and/or modifications can be made without departing from the scope and spirit of the present invention.

Claims

1. A temperature control system comprising:

at least one storage container for storing fuel providable to at least one fuel cell unit, the fuel being endo-thermically discharged from the at least one storage container;

a channel for passage of air therethrough, the channel and the at least one storage container being inter-disposed for enabling communication of thermal energy from the air passaging through the channel to the at least one storage container during discharge of fuel therefrom to thereby reduce temperature of the air; and

an actuator for displacing the air through the channel, the actuator further for displacing and the channel being disposed for directing the cooled air towards the at least one fuel cell unit for reducing temperature of at least a portion of the at least one fuel cell.

2. The system as in claim 1, the at least one storage container comprising at least one metal hydride storage system.

3. The system as in claim 1, the fuel comprising hydrogen.

4. The system as in claim 1, the at least one fuel cell unit having an open-cathode configuration.

5. The system as in claim 1, the actuator being at least one discharge fan.

6. The system as in claim 1, the passage comprising:

an inlet for intake of the air from the atmosphere; and

an outlet wherefrom the cooled air is dischargeable.

7. The system as in claim 6, the actuator being adjacent one of the inlet and the outlet.

8. The system as in claim 1, the actuator comprising at least one blower fan.

9. The system as in claim 1, the at least one storage container comprising at least one of storage canisters and storage cylinders.

10. The system as in claim 1, at least a portion of the channel extending across the surface of the at least one storage containers.

11. The system as in claim 10, the channel being a tube structure.

12. The system as in claim 1, the at least one storage container being substantially received within the channel.

13. A temperature control method comprising:

displacing air across at least one storage container for reducing the temperature of the air, the at least one storage container for storing fuel providable to at least one fuel cell unit, the fuel being endo-thermically dischargeable from the at least one storage container, thermal energy being communicated from the air directed across the at least one storage container during discharge of fuel therefrom to thereby cool the air; and

directing the cooled air towards the at least one fuel cell unit to thereby reduce the temperature of the at least one fuel cell unit.

14. The method as in claim 13, further comprising:

providing a channel for passage of air therethrough, the channel and the at least one storage container being inter-disposed for enabling communication of thermal energy from the air passaging through the channel passage of air therethrough, the channel and the at least one storage container being inter-

disposed for enabling communication of thermal energy from the air passaging through the channel to the at least one storage container during discharge of fuel therefrom to thereby reduce temperature of the air.

15. The method as in claim 14, further comprising:

providing an actuator for displacing the air through the channel, the actuator further for displacing and the channel being disposed for directing the cooled air towards the at least one fuel cell unit for reducing temperature of at least a portion of the at least one fuel cell.

16. The method as in claim 13, the at least one storage container comprising at least one metal hydride storage system.

17. The method as in claim 13, the fuel comprising hydrogen.

18. The method as in claim 13, the at least one fuel cell unit having an open-cathode configuration.

19. The method as in claim 13, the actuator comprising at least one discharge fan.

20. The method as in claim 13, the passage comprising:

an inlet for intake of the air from the atmosphere; and

an outlet wherefrom the cooled air is dischargeable.

21. The method as in claim 20, the actuator being adjacent one of the inlet and the outlet.

22. The method as in claim 13, the actuator comprising at least one blower fan.

23. The method as in claim 13, the at least one storage container comprising at least one of storage canisters and storage cylinders.

24. The method as in claim 13, at least a portion of the channel extending across the surface of the at least one storage containers.

25. The method as in claim 24, the channel being a tube structure.

26. The method as in claim 13, the at least one storage container being substantially received within the channel.