PORTABLE FUEL CELL SYSTEMS AND METHODS THEREFOR

PRIORITY OF INVENTION

This non-provisional application claims the benefit of priority under 35 U.S.C. § 119(e) to U.S. Provisional Patent Application Serial No. 60/757,750, filed January 9, 2006, which is herein incorporated by reference in its entirety.

TECHNICAL FIELD

This patent document pertains generally to fuel cells, and more particularly, but not by way of limitation, to a portable or micro-fuel cell system and methods therefor.

BACKGROUND

A fuel cell is an electrochemical energy conversion device that utilizes the reaction of fuel and oxygen to produce electricity. Fuel cells operate continuously as long as fuel is present. When hydrogen is used as the fuel, the only by-product is water vapor. The conversion reaction of the fuel cell occurs electrochemically and the energy is released as a combination of electrical energy and heat. The electrical energy can do useful work directly, while the heat can be dispersed.

Portable electrical devices, such as cellular phones and laptop computers (among others), demand a significant amount of electricity to operate. The primary and optionally secondary batteries that currently provide power to these devices are reaching performance limitations. As such, it is likely that battery sources may not be able to provide the necessary power to future portable devices, which will likely require even greater electrical power needs. Fuel cells are a viable alternative power source to traditional batteries, but are currently limited by their relatively large size, low energy density levels and insufficient power output. These drawbacks of current fuel cells are the result of, among other things, the awkward integration of current fuel cell components and positioning requirements in electrical devices.

It is with this recognition of the foregoing state of the technology that the present subject matter providing a portable fuel cell system that is able to maintain a high energy density and provide sufficient power output within an all-inclusive system has been conceived and is now set forth in the text and drawings associated with this patent document.

SUMMARY

Embodiments of the present subject relate to a fuel cell system. In one example, the fuel cell system includes at least one fuel cell or fuel cell layer including an anode, a cathode, and an electrolyte interposed therebetween; a fuel or a fuel storage material; a fuel reservoir including at least one surface positioned adjacent a first portion of the at least one fuel cell or fuel cell layer in which the fuel reservoir is configured to store the fuel or the fuel storage material; a current collecting circuit contacting a second portion of the at least one fuel cell or fuel cell layer in which the current collecting circuit is configured to receive and distribute current generated by the fuel cell or fuel cell layer; and a fuel plenum interposed between the at least one reservoir surface and the first portion of the at least one fuel cell or fuel cell layer.

In another example, the fuel cell system includes a fuel reservoir; a system cover; an enclosed region; and at least one fuel cell. The fuel reservoir is configured to store fuel or a fuel storage material. The system cover is configured to be attachable with the fuel reservoir, thereby forming an enclosed region therein. The at least one fuel cell includes one or more flexible walls comprising an anode or a cathode of the fuel cell. The flexible walls are structurally arranged to form a reactant plenum and are supported, when pressurized, by a portion of one or both of the fuel reservoir or the system cover.

Embodiments of the present subject matter also relate to methods of fabricating a fuel cell system. One method includes forming a fuel cell or a fuel cell layer; coupling a fuel reservoir with a first portion of the fuel cell or fuel cell layer such that a fuel plenum is formed therebetween; disposing a current collecting

circuit adjacent to a second portion of the fuel cell or fuel cell layer; disposing a system cover having at least one air access port over one or more of the current collecting circuit, the fuel cell or fuel cell layer, or a portion of the fuel reservoir, including positioning the at least one air access port near the second portion of the fuel cell or the fuel cell layer; and coupling the system cover with the fuel reservoir.

Another method includes forming a fuel reservoir configured to store fuel therein; forming a system cover; coupling the system cover with a portion of the fuel reservoir including forming an enclosed region; and disposing at least one fuel cell in the enclosed region including arranging one or more flexible fuel cell walls to form at least one reactant plenum. In various examples, forming the fuel reservoir and system cover includes forming a support for the one or more flexible fuel cell walls.

These and other aspects, advantages, and features of the present systems and methods will become apparent from a consideration of the following description and associated drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

In the drawings, which are not necessarily drawn to scale, like numerals describe similar components throughout the several views. Like numerals having different letter suffixes represent different instances of similar components. The drawings illustrate generally, by way of example, but not by way of limitation, various embodiments discussed in the present patent document.

FIG. 1 illustrates an exploded view of a fuel cell system, as constructed in accordance with at least one embodiment.

FIG. 2 illustrates a cross-sectional view of a fuel cell system, such as along line 2-2 of FIG. 1, as constructed in accordance with at least one embodiment.

FIGS. 3A-3D illustrate cross-sectional views of portions of a fuel cell system, including one or more fuel cells and a fuel reservoir, as constructed in accordance with various embodiments.

FIG. 4 illustrates a method of fabricating a fuel cell system, such as the fuel cell system illustrated in FIG. 1, as constructed in accordance with at least one embodiment.

FIGS. 5A-5B illustrate cross-sectional views of portions of a fuel cell system, including one or more fuel cells, a fuel reservoir, and a system cover, as constructed in accordance with various embodiments.

FIG. 6 illustrates a method of fabricating a fuel cell system, such as the fuel cell system illustrated in FIG. 5B, as constructed in accordance with at least one embodiment.

DETAILED DESCRIPTION

The following detailed description includes references to the accompanying drawings, which form a part of the detailed description. The drawings show, by way of illustration, specific embodiments in which the present systems and methods may be practiced. These embodiments, which are also referred to herein as "examples," are described in enough detail to enable those skilled in the art to practice the present systems and methods. The embodiments may be combined, other embodiments may be utilized, or structural and logical changes may be made without departing from the scope of the present systems and methods. The following detailed description is, therefore, not to be taken in a limiting sense, and the scope of the present systems and methods are defined by the appended claims and their equivalents.

In this document, the terms "a" or "an" are used to include one or more than one, and the term "or" is used to refer to a nonexclusive or unless otherwise indicated. In addition, it is to be understood that the phraseology or terminology employed herein, and not otherwise defined, is for the purpose of description only and not of limitation.

If they are going to be used to power electrical devices, such as cellular phones, satellite phones, laptop computers, computer accessories, displays, personal

audio or video players, medical devices, televisions, transmitters, receivers, lighting devices including outdoor lighting or flashlights, electronic toys, power tools or any device conventionally used with batteries, it is desirable and even necessary for fuel cell systems to occupy only a small volume of the overall electrical device volume, maintain high energy density, and provide sufficient power output. However, current fuel cell systems are either too large to be use in the electrical devices or fail to maintain the high energy density and provide the energy required to power the electrical devices for a sufficient period of time. Advantageously, the present subject matter provides a fuel cell system that is able to maintain a high energy density and provide sufficient power output, yet still occupy a relatively small volume of the overall electrical device volume. In addition, the present fuel cell systems may operate passively, requiring no pumps, valves or heaters, and may instantly startup without having to rely on any supplemental battery or other power source.

Referring now to the drawings, particularly to FIG. **1**, there is illustrated a fuel cell system **100**, including, among other things, a fuel cell layer **102** and a fuel reservoir (e.g., a fuel tank) **104**. The fuel cell layer **102** includes one or more fuel cells each comprising an anode **107**, a cathode **108**, and an electrolyte **109** (e.g., an ion-exchange membrane) interposed therebetween. The fuel cell layer **102** utilized in the system **100** may be a planar fuel cell, such as an electrochemical cell structure having an electrical current-carrying structure which, at least in part, underlies an electrochemical reaction layer. In one such example, the cell includes an ion-exchange membrane with a catalyst layer on each side thereof. In another such example, the electrochemical cell structure includes a plurality of individual unit cells formed on a sheet of the ion-exchange membrane. In the fuel cell system **100**, the cathode **108** of each cell is supplied with an air containing oxygen as an oxidizing agent, and the anode **107** of each cell is supplied with a fuel, such as hydrogen.

Many structural options are available for the fuel reservoir **104**. For instance, in one example, the fuel reservoir **104** may comprise a cellular fuel tank in

which a first and a second cellular component are interconnected and arranged to substantially fill an available electrical device space. In such an example, one or more internal ports fluidly connect the first and second cellular components, while one or more end caps are coupled to the ends of the components. In another example, the fuel reservoir **104** may comprise a structural filler and an outer enclosure wall conformably coupled to the structural filler. In yet another example, the fuel reservoir **104** may comprise an irregular shape (e.g., a non-circular, a non-rectangular, or a non-triangular shape), which substantially conforms to an available volume of an allotted space. The allotted space may be located in, among other things, a cellular phone, a satellite phone, a laptop computer, a computer accessory, a display, a personal audio or video player, a medical device, a television, a transmitter, a receiver, a lighting device including an outdoor light or a flashlight, an electronic toy, or a power tool. In a further example, and as illustrated in FIG. **1**, the fuel reservoir **104** may comprise a void **152** to house optional components, such as a supplemental energy battery **122** or an electronic conditioning circuit **120**.

In each of these structural examples, the fuel reservoir **104** encloses a fuel, such as hydrogen, or a fuel storage material, such as a hydrogen storage material. In one example, the fuel reservoir **104** encloses a composite hydrogen storage material comprising one or more active material particles and a binder, wherein the binder immobilizes the active material particles sufficient to maintain a relative spatial relationship between the active material particles. In one such example, the hydrogen storage material includes a metal hydride. Among other techniques, the hydrogen storage material may store hydrogen using one or both of physisorption or chemisorption.

Power from the fuel cell layer **102** may be gathered by a current collecting circuit **106**, which collects the current generated by the fuel cell layer **102** and routes it out of the system **100** via a power output connector **116** or alternatively into the conditioning electronics section **120** (e.g., an electronic conditioning circuit). In the example shown, but as may vary, the power output connector **116** is attached to both the current collector circuit **106** and the optional conditioning electronics section

120. The current collecting circuit 106 may be flexible to conform to a shape or location of the fuel cell layer 102 or other fuel cell system component. In one example, the fuel cell system 100 provides a peak power output of up to about 4 Watts, while in other examples, the fuel cell system 100 may provide a peak power output of about 2-3 Watts. In various examples, the average power output of the fuel cell system is between about 0.2-1.8 Watts, such about 0.5-1.5 Watts, about 0.75-1.25 Watts, or about 1 Watt. In various examples, the fuel cell system 100 provides an energy density of about 200-600 Watt-hr/L or more, such as about 250-350 Watt-hr/L or about 300 Watt-hr/L. In various examples, the fuel cell system 100 includes a size of about 25 cubic centimeters or less. In certain examples, the size of the fuel cell system 100 is about 10 cubic centimeter or less.

In various examples, the fuel reservoir 104 includes a refueling port 112 and a pressure regulator 110. The refueling port 112 may be a pressure activated valve that allows a flow of fluid, for example, fluid fuel, into the fuel reservoir 104. In one example, the refueling port 112 includes a fuel inlet and at least one compressible member having a first sealing position and a second fueling position. In such an example, the at least one compressible member is sealingly coupled with the fuel inlet port when the at least one compressible member is in the first sealing position. In the example shown, the refueling valve 112 is coupled with a lower wall 114 of the fuel reservoir 104.

The pressure regulator 110 may be designed to reduce a fuel reservoir pressure to a more constant, lower pressure that is acceptable to the fuel cell layer 102. In one example, the pressure regulator 110 is integrated with an upper wall 115 of the fuel reservoir 104 and includes a regulator body, a resilient member, a diaphragm, a regulator valve, and a seal member. In such an example, the diaphragm and the regulator valve are movingly responsive to a pressure difference between a first chamber pressure and a second chamber pressure.

In example shown, a fuel plenum 212 (FIG. 2) is created by positioning the fuel cell layer 102 adjacent to at least one surface 150 of the fuel reservoir 104. A perimeter of the fuel reservoir surface 150 adjacent the fuel cell layer 102 may be

sealed by a seal member **126**, such as a compressive or elastic gasket or an adhesive, thereby forming the fuel plenum **212**. In operation of this example, the fuel reservoir **104** is filled with fuel by pressurizing the refueling port **112**. The pressure regulator **110** is then used to reduce or maintain the pressure in the fuel plenum **212** to a level sufficient for the operation and movement of the fuel cell layer **102**. The pressure in the fuel plenum **212**, in turn, urges or forces the fuel cell layer **102** against the current collecting circuit **106**, providing contact between such components. In this way, the fuel cell system **100** can then be activated (i.e., the electrochemical reaction between, for example, hydrogen and oxygen can be initiated) simply by exposing the system **100** to ambient air. In an alternative example, the fuel cell layer **102** may be directly bonded to the current collecting circuit **106** such that current can be collected without pressure activation.

Optionally, the fuel cell system **100** may comprise a system cover **124** or a porous protective member **118**. The system cover **124** may be utilized to assist the attachment of such things as the fuel cell layer **102** and the fuel reservoir **104**. Among other things, the system cover **124** may be constructed of a rigid, but ductile material, including steel or aluminum. Other examples of suitable materials for the system cover **124** include rigid plastics, such as Ultem® (a registered trademark of General Electric Company) or polyethylene. In various examples, the system cover **124** includes one or more air access ports **206** (FIG. **2**) that allow at least partial access of the fuel cell cathode **108** to ambient air. As shown, the system cover **124** is configured to surround the fuel cell layer **102** and may be attached to the fuel reservoir **104** by any physical or chemical means, such as by welding, soldering, brazing, crimping, gluing, thermal adhesive, pressure sensitive adhesive, or one or more mechanical structures (e.g., fasteners or protrusions). The mechanical structure may optionally be releasable.

The porous protective member **118** may provide protection to the fuel cell cathode **108** while still allowing air to flow thereto. In one example, the porous protective member **118** protects the cathode **108** from interferents in the ambient air. In certain examples, the porous protective member **118** may be disposed adjacent to

the fuel cell layer **102** on the anode side to provide protection to the anode **107** while still allowing fuel to flow therethrough.

FIG. **2** is a cross-sectional view, such as along line **2-2** of FIG. **1**, of a fuel cell system **100** according to one example. In this example, a first fuel reservoir surface **150** contacts a first side of a seal member **126** on a perimeter thereof. A first side **250** of a fuel cell layer **102** contacts a second side of the seal member **126**, such that a fuel plenum **212** is thereby created. A second side **252** of the fuel cell layer **102** contacts a current collecting circuit **106**. A protective member **118** shields the fuel cell layer **102** and its components from interferents from the environment. A system cover **124** surrounds the fuel cell layer **102** and other components of the fuel cell system **100** (e.g., the protective porous member **118**, the current collecting circuit **106**, and the fuel plenum **212**) and attaches to the fuel reservoir **104**. The system cover **124** includes air access ports **206**, which allow for ambient air to access the fuel cell layer **102** components, such as the cathode **108** (FIG. **1**). Air flows in direction **208** through the air access ports **206** and the porous protective member **118** to provide oxygen to the cathode **108** of fuel cell layer **102**.

In this example, as fuel (e.g., hydrogen) flows **210** from the fuel reservoir **104**, through the pressure regulator **110**, and into the fuel plenum **212**, the fuel pressure **202** exerts a force on the fuel cell layer **102** in a direction toward the current collecting circuit **106**, providing a contact therebetween. As shown, the mechanical binding of the system cover **124** to the fuel reservoir **104** exerts a cover pressure **204** on the current collecting circuit **106** toward the fuel cell layer **102** (i.e., in the opposite direction of fuel pressure **202**), further providing efficient contact between the components of fuel cell system **100**.

There are many options for the fuel cell system **100**. For instance, in certain examples, the fuel plenum **212** includes a size less than about 1mm in width (wherein the width is the distance substantially perpendicular to the fuel reservoir **104** and extending from the fuel reservoir **104** to the fuel cell layer **102**), while in other examples, the fuel plenum **212** includes a width greater than 1mm. In certain examples, the current collecting circuit **106** may be disposed underneath the fuel

cell layer **102**, integrated with the fuel cell layer **102**, or within the fuel plenum **212**, rather than contacting a second side **252** of the fuel cell layer **102**. In such examples, the connection between the fuel cell layer **102** and the current collecting circuit **106** may not be activated by the outward force **202** created through the fuel pressure, but rather through a more positive means of connection (e.g., a bonding process).

FIGS. **3A-3D** illustrate cross-sectional views of portions of a fuel cell system **100**, including, among other things, one or more fuel cell layers **102**, a fuel reservoir **104**, such as a hydrogen fuel reservoir, and one or more seal members **126**. In FIG. **3A**, one fuel cell layer **102** is disposed adjacent the fuel reservoir **104**. In FIG. **3B**, two fuel cell layers **102** are oppositely disposed around the fuel reservoir **104**. In FIG. **3C**, three fuel cell layers **102** are disposed on three separate surfaces of the fuel reservoir **104**. In FIG. **3D**, two fuel cell layers **102** are disposed on two separate surfaces of an irregularly-shaped (e.g., a non-square or non-rectangular shape) fuel reservoir **104**. The fuel cell systems shown in FIGS. **1-2** can utilize the configurations shown in FIGS. **3A-3B**, among others. As discussed in association with FIG. **2**, one or more seal members **126** may be disposed between the fuel cell layer **102** and the fuel reservoir **104** thereby forming a fuel plenum **212** into which fuel may flow **210** from the reservoir **104**.

FIG. **4** illustrates one method **400** of fabricating a fuel cell system, such as the portable fuel cell system **100** shown in FIG. **1**. At **402**, at least one fuel cell is formed. In various examples, multiple fuel cells are formed to create a fuel cell layer. Each fuel cell includes an anode, a cathode, and an electrolyte interposed therebetween. At **404**, a fuel reservoir is coupled with a first portion of the at least one fuel cell, thereby forming a fuel plenum therebetween. In one example, the fuel reservoir is coupled with the first portion of the at least one fuel cell using a non-conductive adhesive. In another example, a seal member is disposed between the fuel reservoir and the first portion of the at least one fuel cell.

At **406**, a current collecting circuit is disposed adjacent to a second portion of the at least one fuel cell. In one example, the current collecting circuit is

electrically coupled with a portable electronic device. In another example, the current collecting circuit is electrically coupled with an electronic conditioning circuit.

Further, at **408**, a system cover having at least one air access port is disposed over one or more of the current collecting circuit, the at least one fuel cell, or a portion of the fuel reservoir, in which the at least one air access port is positioned near the second portion of the at least one fuel cell. In one example, a protective porous member is disposed between the at least one air access port and the second portion of the at least one fuel cell. At **410**, the system cover is coupled with the fuel reservoir. In one example, the system cover is coupled to the fuel reservoir by welding, soldering, brazing, crimping, gluing, thermal adhesive, pressure sensitive adhesive, or one or more mechanical structures (e.g., fasteners or protrusions). The mechanical structure may optionally be releasable.

Referring now to FIGS. **5A-5B**, there is illustrated, in cross-section, a fuel cell system **100** including, among other things, a fuel cell layer **102** including one or more flexible walls **502**, a fuel reservoir **104** configured to store fuel or a fuel storage material, a system cover **124**, and an enclosed region **504**. The fuel cell layer **102** includes one or more fuel cells each comprising an anode **107**, a cathode **108**, an electrolyte (not expressly shown) interposed between anode **107** and cathode **108**, and a current collecting circuit **106**.

The system cover **124** is attachable with a portion of fuel reservoir **104** via, among other things, a weld, a solder, a braze, a crimp, the use of an adhesive, or one or more mechanical structures, thereby forming the enclosed region **504**, as shown. The one or more fuel cell layers **102** may be disposed in the enclosed region **504** such that their respective flexible walls **502** are structurally arranged to form at least one reactant plenum **506**. The one or more flexible walls **502** are supported by a portion of one or both of the fuel reservoir **104** or the system cover **124**. In the example shown, the cathode **108** may be accessible from an outside of the flexible wall **502** and exposed to ambient air via air access ports in the system cover **124**, while the anode **107** may be accessible from an inside of the flexible wall **502** and

exposed to a reactant, such as hydrogen fuel. The current collecting circuit **106** (integral with the fuel cell layer **102**) is configured to receive current generated by the fuel cell layer **102** and distribute such current to, for example, a portable electronic device.

In various examples, a plenum inlet **550** fluidly connects the reactant plenum **506** and the fuel reservoir **104** or ambient air. As reactant enters via the plenum inlet **550**, a reactant pressure pressurizes the fuel plenum **506**, thus urging the one or more flexible walls **502** of the fuel cell layer **102** toward the supporting portions of one or both of the fuel reservoir **104** or the system cover **124**.

FIG. **6** is a flow diagram illustrating one method **600** of fabricating a fuel cell system, such as the fuel cell system illustrated in FIG. **5B**. At **602**, a fuel reservoir configured to store fuel therein is formed. At **604**, a system cover is formed. At **606**, the system cover is coupled with a portion of the fuel reservoir such that an enclosed region is formed therein. In one example, the system cover is coupled with the fuel reservoir via welding, soldering, brazing, crimping, gluing, thermal adhesive, pressure sensitive adhesive, or one or more mechanical structures (e.g., fasteners or protrusions). The mechanical structure may optionally be releasable.

At **608**, at least one fuel cell including an anode, a cathode, and an electrolyte interposed therebetween is disposed in the enclosed region. In various examples, multiple fuel cells are formed to create a fuel cell layer. In one example, one or more flexible fuel cell walls comprise one or both of the fuel cell anode or the fuel cell cathode. Accordingly, in another example, disposing the at least one fuel cell into the enclosed region includes arranging the one or more flexible fuel cell walls to form at least one reactant plenum. In various examples, forming the fuel reservoir and the system cover includes forming a support for the one or more flexible fuel cell walls such that when a reactant enters a plenum inlet and pressurizes the reactant plenum, the fuel cell walls expand and conform to a shape of the one or more supports.

At **610**, a current collecting circuit is integrated with the at least one fuel cell. In various examples, the current collecting circuit is configured to collect current from the at least one fuel cell and distribute such current to one or more electrical devices, such as portable electrical devices.

Fuel cell systems and methods for their manufacture are provided herein. Among other things, the present systems and methods provide for a fuel cell system providing sufficient power output and a high energy density, all within a relatively small amount of space. The fuel cell system can operate as a stand alone power source or be integrated into an electrical device. Further, the fuel cell system need not rely on pumps, valves or heaters for its operation, saving precious energy and electrical device volume.

It is to be understood that the above description is intended to be illustrative, and not restrictive. For example, the above-described embodiments (and/or aspects thereof) may be used in combination with each other. Many other embodiments will be apparent to those of skill in the art upon reviewing the above description. The scope of the invention should, therefore, be determined with reference to the appended claims, along with the full scope of equivalents to which such claims are entitled. In the appended claims, the terms "including" and "in which" are used as the plain-English equivalents of the respective terms "comprising" and "wherein." Also, in the following claims, the terms "including" and "comprising" are open-ended, that is, a system, device, article, or process that includes elements in addition to those listed after such a term in a claim are still deemed to fall within the scope of that claim. Moreover, in the following claims, the terms "first," "second," and "third," etc. are used merely as labels, and are not intended to impose numerical requirements on their objects.

The Abstract of the Disclosure is provided to comply with 37 C.F.R. §1.72(b), requiring an abstract that will allow the reader to quickly ascertain the nature of the technical disclosure. It is submitted with the understanding that it will not be used to interpret or limit the scope or meaning of the claims. In addition, in the foregoing Detailed Description, various features may be grouped together to

streamline the disclosure. This method of disclosure is not to be interpreted as reflecting an intention that the claimed embodiments require more features than are expressly recited in each claim. Rather, as the following claims reflect, inventive subject matter may lie in less than all features of a single disclosed embodiment. Thus the following claims are hereby incorporated into the Detailed Description, with each claim standing on its own as a separate embodiment.

WHAT IS CLAIMED IS:

1. A fuel cell system comprising:

a fuel reservoir configured to store a fuel therein;

an at least partially flexible fuel cell layer, in fluidic contact with the fuel reservoir; and

a fuel plenum, formed between the fuel reservoir and the fuel cell layer;

wherein the fuel reservoir substantially conforms to a volume of an allotted space within an electronic device.

2. The fuel cell system of claim 1, further comprising a system cover, configured to at least partially surround the fuel cell layer.

3. The fuel cell system of claim 2, wherein the system cover comprises the housing of the electronic device.

4. The fuel cell system of any of claims 1-3, wherein the fuel reservoir comprises a fuel storage material and an outer enclosure wall conformably coupled to the storage material.

5. The fuel cell system of any of claims 1-4, further comprising a current collecting circuit in contact with the fuel cell layer, the current collecting circuit configured to receive and distribute current generated by the fuel cell layer.

6. The fuel cell system of claim 5, wherein the current collecting circuit is integral with the fuel cell layer.

7. The fuel cell system of claim 5, wherein the current collecting circuit is configured to distribute the fuel cell-generated current to the electronic device and wherein the electronic device is a portable electronic device.

8. The fuel cell system of claim 7, wherein the portable electronic device includes a cellular phone, a satellite phone, a laptop computer, a computer accessory, a display, a personal audio or video player, a medical device, a television, a transmitter, a receiver, a lighting device, an electronic toy, or a power tool.

9. The fuel cell system of any of claims 1-8, wherein the fuel reservoir includes a pressure regulator.

10. The fuel cell system of any of claims 1-9, further comprising a protective porous member disposed adjacent the fuel cell layer.

11. The fuel cell system of any of claims 1-10, wherein the fuel reservoir comprises a refueling port.

12. The fuel cell system of any of claims 1-11, wherein the fuel plenum is at least partially defined by the fuel cell layer, the fuel reservoir, or a combination thereof.

13. A method of fabricating a fuel cell system, the method comprising:

forming a fuel reservoir configured to store fuel therein;

forming a fuel cell layer, at least part of which is flexible;

contacting the fuel reservoir and the fuel cell layer, sufficient to form a fuel plenum positioned therebetween;

configuring the fuel reservoir to substantially conform to a volume of an allotted space within an electronic device.

14. The method of claim 13, further comprising forming a system cover having one or more air access ports.

15. The method of claim 14, further comprising coupling the system cover with one or more portions of the fuel reservoir.

16. The method of any of claims 13-15, further comprising contacting a current collecting circuit with the fuel cell layer.

17. The method of any of claims 13-16, further comprising disposing a protective porous member adjacent the fuel cell layer.

18. A fuel cell system comprising:

a planar fuel cell layer, the fuel cell layer including at least one fuel cell, the fuel cell including an anode, a cathode, and an electrolyte interposed between the anode and the cathode;

a fuel or fuel storage material;

a fuel reservoir including at least one surface positioned adjacent a first portion of the planar fuel cell layer, the fuel reservoir configured to store the fuel or the fuel storage material; and

a fuel plenum interposed between the at least one fuel reservoir surface and the first portion of the planar fuel cell layer.

19. The fuel cell system of claim 18, wherein the fuel plenum is at least partially surrounded by a seal member, the seal member providing a seal between the at least one fuel reservoir surface and the first portion of the planar fuel cell layer.

20. The fuel cell system of any of claims 18-19, further comprising a protective porous member positioned adjacent the planar fuel cell layer.

21. The fuel cell system of any of claims 18-20, further comprising a system cover including at least one air access port, wherein the system cover comprises the housing of an electronic device.

22. The fuel cell system of claim 21, wherein the system cover houses one or more of the protective porous member, a current collecting circuit, the planar fuel cell layer, the fuel plenum, or a portion of the fuel reservoir.

23. The fuel cell system of any of claims 18-21, further comprising a current collecting circuit.

24. The fuel cell system of claim 23, further comprising an electronic conditioning circuit, wherein the current collecting circuit is configured to distribute the power generated by the at least one fuel cell to the electronic conditioning circuit.

25. The fuel cell system of any of claims 18-24, further comprising a supplemental battery.

26. The fuel cell system of any of claims 18-25, wherein the fuel comprises hydrogen.

27. The fuel cell system of any of claims 18-26, wherein the fuel storage material comprises a hydrogen storage material.

28. The fuel cell system of claim 18-27, wherein the fuel storage material stores fuel by physisorption, chemisorption, or combinations thereof.

29. The fuel cell system of any of claims 18-28, wherein the fuel storage material comprises a metal hydride.

30. The fuel cell system of any of claims 18-29, wherein the allotted space is located in a portion of a cell phone, a personal digital assistant, a laptop computer, a digital camera, a game device, a portable television, or a flashlight.

31. The fuel cell system of any of claims 18-30, wherein the fuel reservoir comprises a structural filler and an outer enclosure wall conformably coupled to the structural filler.

32. The fuel cell system of any one of claims 18-31, wherein the fuel reservoir comprises a fuel storage material and an outer enclosure wall conformably coupled to the storage material.

33. The fuel cell system of any of claims 18-32, wherein the fuel reservoir includes one or both of a pressure regulator or a refueling port.

34. A fuel cell system providing portable power, the system comprising:

a flexible fuel cell layer;

a hydrogen reservoir in contact with the flexible fuel cell layer, the hydrogen reservoir configured to store hydrogen fuel;

a fuel plenum interposed between the hydrogen reservoir and the flexible fuel cell layer; and

a refueling port, in contact with the hydrogen reservoir.

35. The fuel cell system of claim 34, further comprising a system cover including at least one air access port, the cover configured to at least partially surround at least one of the fuel cell layer, hydrogen reservoir and fuel plenum and wherein the system cover comprises a housing of an electronic device.