Alex Romane - Geocircuit; free, clean, sustainable, renewable, scalable energy

TITLE

Geocircuit [Patent No. 1707567.2]

TECHNOLOGICAL FIELD

Examples of the disclosure relate to an apparatus, method and system, and a particularly an apparatus, method and system for providing a microbial fuel.

BACKGROUND

A microbial fuel cell uses microorganisms, such as bacteria, to oxidize organic or inorganic matter and directly convert chemical energy into electrical energy. Electrons produced by microorganisms from organic or inorganic matter are transferred to an anode electrode (negative electrode) and flow to a cathode electrode (positive electrode) linked by a conductive material containing a resistor, or operating under a load (i.e. producing electricity that operates a device).

The amount of electricity produced by known microbial fuel cells is low, which limits the use of such known cells.

There is a requirement therefore to provide improved microbial fuel cells.

BRIEF SUMMARY

According to various, but not necessarily all, examples of the disclosure there is provided an apparatus for use as a microbial fuel cell, the apparatus comprising a plurality of pairs of electrodes, each pair of electrodes comprising an anode and a cathode, the anode and cathode of each of the plurality of pairs of electrodes being spaced apart, wherein the apparatus is configured such that a fuel source comprising microorganisms can be provided between each of the plurality of pairs of electrodes.

An electrical connection may be provided between the anode and cathode of adjacent pairs of electrodes. The electrical connection may comprise an electrically conductive material. The electrically conductive material may comprise metal. The electrically conductive material may be the anode of a one of the pairs of electrodes, which may be arranged to contact the cathode of an adjacent pair of electrodes. Adjacent pairs of electrodes may be linked through the electrical connection, and may be linked in series.

A plate may be provided between the anode and cathode of adjacent pairs of electrodes. The plate may comprise a polymer, which polymer may comprise hemp.

The anode may be arranged to form a bridge over the plate to contact the cathode.

The anode may comprise zinc. The cathode may comprise copper.

The apparatus may comprise a housing, wherein the plurality of pairs of electrodes are located in the housing. The housing may comprise a polymer, which polymer may comprise hemp.

The housing may comprise a lid configured to sealingly close the housing to isolate the internal environment of the housing.

The plates provided between the anode and cathode of adjacent pairs of electrodes may be integrally formed in the housing.

Electrically conductive wire containing a resistor or operating under a load may connect the terminal ends of the apparatus.

According to various, but not necessarily all, examples of the disclosure there is provided a system, the system comprising an apparatus as defined in any of the preceding paragraphs and a fuel source comprising microorganisms.

The fuel source may comprise organic or inorganic material which is capable of being oxidised by the microorganisms. The fuel source may comprise soil.

According to various, but not necessarily all, examples of the disclosure there is provided a method comprising providing an apparatus for use as a microbial fuel cell, the apparatus comprising a plurality of pairs of electrodes, each pair of electrodes comprising an anode and a cathode, the anode and cathode of each of the plurality of pairs of electrodes being spaced apart, wherein the apparatus is configured such that a fuel source comprising microorganisms can be provided between each of the plurality of pairs of electrodes.

The apparatus may comprise any of the features described in any of the preceding statements or following description.

The system may comprise any of the features described in any of the preceding statements or following description.

The methods may comprise any of the features described in any of the preceding statements or following description.

According to various, but not necessarily all, examples of the disclosure there may be provided examples as claimed in the appended claims.

BRIEF DESCRIPTION

For a better understanding of various examples that are useful for understanding the detailed description, reference will now be made by way of example only to the accompanying drawings in which:

Fig. 1 schematically illustrates an apparatus;
Fig. 2 schematically illustrates an apparatus in perspective view;
Fig. 3 schematically illustrates the apparatus of Fig. 2 viewed from above;
Fig. 4 schematically illustrates a part of the apparatus of Fig. 2 in perspective view, and the method steps to form that part; and
Fig. 5 schematically illustrates a system.

DETAILED DESCRIPTION

Figs. 1 to 4 illustrate an apparatus 10 and method according to examples of the present disclosure, and Fig. 5 illustrates a system according to examples of the present disclosure.

The apparatus 10 is provided for use as a microbial fuel cell. The apparatus 10 comprises a plurality of pairs of electrodes 12. In the example illustrated in Fig. 1, three pairs of electrodes 12 are provided. In the example provided in Figs. 2 and 3, eleven pairs of electrodes 12 are provided. It will be appreciated that any number of pairs of electrodes 12 could be provided.

Each pair of electrodes 12 comprises an anode 14 and a cathode 16. The anode may comprise zinc. The cathode may comprise copper. The anode and cathode may be in the form of plates.

The anode 14 and cathode 16 of each of the plurality of pairs of electrodes 12 are spaced apart. A gap 18 is therefore provided between each respective pair of electrodes 12. The apparatus 10 is configured such that a fuel source 20, as illustrated in Fig. 5, comprising microorganisms can be provided in the gap 18 between each of the plurality of pairs of electrodes 12. In practice, all the gaps 18 would be filled with the fuel source 20.

An electrical connection 22 is provided between the anode 14 and cathode16 of adjacent pairs of electrodes. The electrical connection 22 comprises an electrically conductive material. The electrically conductive material may comprise any electrically conductive metal. The electrically conductive material may be the anode 14 of a one of the pairs of electrodes 12. As best illustrated in Fig. 4, the anode 14 may be arranged to contact the cathode 16 of an adjacent pair of electrodes 12.

Adjacent pairs of electrodes 12 are linked through the electrical connection 22. In some examples, adjacent pairs of electrodes 12 are linked in series through the electrical connection 22. In other examples, adjacent pairs of electrodes 12 are linked in parallel through the electrical connection 22.

A plate 24 is provided between the anode 14 and cathode 16 of adjacent pairs of electrodes 12. The plate 24 may comprise a polymer, which polymer may comprise hemp, for instance, hemp based plastics.

The anode 14 may be arranged to form a bridge 26 over the plate 24 to contact the cathode 16. The anode 14 and bridge 26 may be formed from a single piece of material. The bridge 26 may have a reduced width relative to the remainder of the anode 14. The bridge 26 may be pressed between the plate 24 and the cathode 16.

The apparatus 10 may comprise a housing 28, wherein the plurality of pairs of electrodes 12 are located in the housing 28. The housing 28 may comprise a polymer, which polymer may comprise hemp.

The housing 28 may comprise a lid (not illustrated in drawings) configured to sealingly close the housing 28 to isolate the internal environment of the housing 28. The lid may be connected to the housing 28 by any suitable means, for instance, a clip formation 30.

The plates 24 provided between the anode 14 and cathode 16 of adjacent pairs of electrodes 12 may be integrally formed in the housing 28. This ensures a robust construction. An assembly comprising the housing 28 and plates 24 may be formed by 3D printing.

Electrically conductive wire 32 containing a resistor or operating under a load connects the terminal ends 34 of the apparatus 10.

Fig. 5 illustrates a system 100 comprising an apparatus 10 described above, and a fuel source 20 comprising microorganisms. In one example, the fuel source 20 comprising microorganisms is provided in the gap 18 between each of the plurality of pairs of electrodes 12 to a level indicated by the reference 36. In use, the system can generate electricity from sustainable fuel source 20. Furthermore, the voltage output of the system 100 is a function of the number of electrode pairs 12 provided in series in the apparatus 10. Accordingly, the voltage output is the sum of the voltages provided by each respective pair of electrodes 12 in the series. In some examples, the system 100 generates between 5.5 and 22 volts per cubic inch of fuel source.

The fuel source 20 may comprise organic or inorganic material which is capable of being oxidised by the microorganisms. In one example, the fuel source 20 comprises soil. In other examples, the fuel source may comprise any of pure citric acid, fruit juice, for instance, lemon juice, vinegar, salad cream, shampoo, body wash gel, washing up liquid, water, milk, disinfectant, household cleaner, biodegradable lubricants, compost, fertilizer, milk shake, vehicle screen wash or salt, or combinations thereof. The system 100 therefore can be used to provide electricity from various fuel sources which fuel sources are abundant.

The microorganisms may be bacteria, and may be electrochemically active bacteria. In some examples, chemical mediators, such as neutral red or anthraquinone-2,6-disulfonate may be added to the system to allow electricity production by bacteria unable to otherwise use the electrodes. In other examples, the system may not include a mediator, for instance, if the bacteria are electrochemically active. Examples of electrochemically active bacteria include Shewanella putrefaciens and Aeromonas hydrophila. Electron transfer from electrochemically active bacteria to the electrodes 14, 16 may be through conductive pilli, also known as nanowires.

The figures not only illustrate an apparatus 10 and system 100, but also a method of forming the apparatus 10. The method comprises providing an apparatus 10 for use as a microbial fuel cell, the apparatus 10 comprising a plurality of pairs of electrodes 12, each pair of electrodes 12 comprising an anode 14 and a cathode 16, the anode 14 and cathode 16 of each of the plurality of pairs of electrodes 12 being spaced apart, wherein the apparatus 10 is configured such that a fuel source 20 comprising microorganisms can be provided between each of the plurality of pairs of electrodes 12.

There is thus described an apparatus, system and method with a number of advantages as described above. Additionally, components of the apparatus 10 are manufactured from renewable lightweight materials. The manufacture of the apparatus 10 does not require oil, as hemp based polymers are used. The apparatus 10 is therefore lightweight and portable. The apparatus 10 is also inexpensive to manufacture.

Although embodiments of the present invention have been described in the preceding paragraphs with reference to various examples, it should be appreciated that modifications to the examples given can be made without departing from the scope of the invention as claimed. For instance, multiple apparatus 10 can be linked together to provide a larger system 100 with a greater voltage output.

Features described in the preceding description may be used in combinations other than the combinations explicitly described.

Although functions have been described with reference to certain features, those functions may be performable by other features whether described or not.

Although features have been described with reference to certain embodiments, those features may also be present in other embodiments whether described or not.

The term “comprise” is used in this document with an inclusive not an exclusive meaning. That is any reference to X comprising Y indicates that X may comprise only one Y or may comprise more than one Y. If it is intended to use “comprise” with an exclusive meaning then it will be made clear in the context by referring to “comprising only one…” or by using “consisting”.

In this brief description, reference has been made to various examples. The description of features or functions in relation to an example indicates that those features or functions are present in that example. The use of the term “example” or “for example” or “may” in the text denotes, whether explicitly stated or not, that such features or functions are present in at least the described example, whether described as an example or not, and that they can be, but are not necessarily, present in some of or all other examples. Thus “example”, “for example” or “may” refers to a particular instance in a class of examples. A property of the instance can be a property of only that instance or a property of the class or a property of a sub-class of the class that comprise some but not all of the instances in the class. It is therefore implicitly disclosed that a features described with reference to one example but not with reference to another example, can where possible be used in that other example but does not necessarily have to be used in that other example.

Whilst endeavoring in the foregoing specification to draw attention to those features of the invention believed to be of particular importance it should be understood that the Applicant claims protection in respect of any patentable feature or combination of features hereinbefore referred to and/or shown in the drawings whether or not particular emphasis has been placed thereon.