

DEVICE FOR ELECTROCHEMICALLY GENERATING HYDROGEN PEROXIDE AND PRODUCTION METHOD FOR HYDROGEN PEROXIDE

CROSS-REFERENCE TO RELATED APPLICATIONS

The present application claims priority to Chinese Patent Application No. 202310787719.3, filed to the China National Intellectual Property Administration on June 29, 2023, entitled "DEVICE FOR ELECTROCHEMICALLY GENERATING HYDROGEN PEROXIDE AND CONTROL METHOD THEREOF"; priority to Chinese Patent Application No. 202321688771.5, filed to China National Intellectual Property Administration on June 29, 2023, entitled "DEVICE FOR ELECTROCHEMICALLY PRODUCING HYDROGEN PEROXIDE"; priority to Chinese Patent Application No. 202311144859.5, filed to China National Intellectual Property Administration on September 5, 2023, entitled "DEVICE FOR ELECTROCHEMICALLY GENERATING HYDROGEN PEROXIDE AND PRODUCTION METHOD FOR HYDROGEN PEROXIDE"; and priority to Chinese Patent Application No. 202311789540.8, filed to China National Intellectual Property Administration on December 22, 2023, entitled "DEVICE FOR ELECTROCHEMICALLY GENERATING HYDROGEN PEROXIDE AND PRODUCTION METHOD FOR HYDROGEN PEROXIDE", the entire contents of which are incorporated herein by reference.

TECHNICAL FIELD

The present application relates to the field of electrochemical technology, and in particular to a device for electrochemically generating hydrogen peroxide and a method for producing hydrogen peroxide.

BACKGROUND

As a highly efficient, harmless and residue-free oxidant, hydrogen peroxide solution is widely used in the sterilization and disinfection of water bodies and the treatment of organic pollutants. The existing industrial production of hydrogen peroxide requires large-scale,

energy-intensive and cumbersome preparation processes, and transportation and storage facilities have additional equipment costs and potential safety hazards.

In the prior art, in order to avoid the cost and risk of storing and transporting hydrogen peroxide, a ready-to-use hydrogen peroxide production device has been proposed. Typically, an anode electrode and a cathode electrode are arranged in a reaction tank. When the anode electrode and the cathode electrode are energized, the electrolyte in the reaction tank is electrolyzed to generate hydrogen peroxide.

However, the above method requires manual addition of electrolyte.

SUMMARY OF THE INVENTION

Therefore, the technical problem to be solved by the present application is to overcome the problem in the prior art that hydrogen peroxide production devices require manual addition of electrolyte, thereby providing a device for electrochemically generating hydrogen peroxide and a method for producing hydrogen peroxide.

In one aspect, the present application provides a device for electrochemically generating hydrogen peroxide, comprising: a cathode electrode; an anode electrode spaced apart from the cathode electrode; and a water absorbing member arranged between the anode electrode and the cathode electrode, wherein the water absorbing member is tightly attached to the anode electrode and the cathode electrode.

Optionally, the device further comprises a refrigeration device for cooling space between the anode electrode and the cathode electrode so as to reduce the temperature between the anode electrode and the cathode electrode to condense liquid.

Optionally, the anode electrode is made from heat-conducting and electrically-conductive material.

Optionally, the anode electrode is made from an alloy of one or more of platinum, palladium, ruthenium, rhodium, iridium, osmium, and gold, or the anode electrode is made from a boron-doped diamond film, or the anode electrode is made from a glassy carbon electrode.

Optionally, a semiconductor chilling plate is disposed against a side of the anode electrode away from the cathode electrode.

Optionally, the cathode electrode is made from a porous conductive material.

Optionally, a fan is provided on a side of the cathode electrode away from the anode electrode.

Optionally, the cathode electrode and the anode electrode are horizontally arranged plate profiles.

Optionally, the water absorbing member is a plate-like structure made from a porous water-retaining material, an ion exchange membrane or a proton exchange membrane.

In another aspect, the present application provides a method for producing hydrogen peroxide, the device for electrochemically generating hydrogen peroxide according to any one of the above solutions is used, the method comprises the following steps:

absorbing and storing liquid in the water absorbing member;

detecting current, detecting the working current between the anode electrode and the cathode electrode, and determining whether a preset current has been reached;

if the working current between the anode electrode and the cathode electrode is greater than a preset current, hydrogen peroxide is produced.

Optionally, by cooling the anode electrode, liquid is absorbed and stored in the water absorbing member between the anode electrode and the cathode electrode.

Optionally, the method further comprises performing pre-cooling by cooling space between the anode electrode and the cathode electrode through a refrigeration device, so that obvious ice crystals appear on the surface of the anode electrode, and then the refrigeration device is shut down.

Optionally, if the working current between the anode electrode and the cathode electrode is less than a preset current, the pre-cooling and current detection steps are repeated.

In yet aspect, the present application provides a device for electrochemically generating hydrogen peroxide, comprising:

a cathode electrode;

an anode electrode spaced apart from the cathode electrode;

a water absorbing block arranged between the anode electrode and the cathode electrode, wherein two ends of the water absorbing block are respectively connected to the anode electrode and the cathode electrode.

Optionally, the anode electrode is made from an alloy of one or more of platinum, palladium, ruthenium, rhodium, iridium, osmium, and gold, or the anode electrode is made from a boron-doped diamond film, or the anode electrode is made from a glassy carbon electrode.

Optionally, the cathode electrode is made from a porous conductive material.

Optionally, the cathode electrode is arranged horizontally.

Optionally, the cathode electrode is a foam nickel plate, a porous graphite plate, a sintered titanium plate, activated carbon felt or carbon paper.

Optionally, the water absorbing block is made from a porous water-retaining material.

Optionally, the water absorbing block is a rod-shaped body.

Optionally, a plurality of the water absorbing blocks are arranged at intervals between the anode electrode and the cathode electrode.

Optionally, the device further comprises a fan, wherein the fan blows air toward the water absorbing block, and/or the fan blows air toward a side of the cathode electrode away from the anode electrode.

Optionally, the anode electrode and the cathode electrode are plate profiles arranged in parallel and at intervals.

The technical solution of the present application has the following advantages:

1. The device for electrochemically generating hydrogen peroxide provided in the present application, by a water absorbing member absorbing and storing liquid, enables the circuit between the cathode electrode and the anode electrode to be conductive, electrolyzes water to generate hydrogen peroxide, and releases it into the air to achieve a sterilization and disinfection effect. The tightly attached structure of the water absorbing member, the anode electrode, and the cathode electrode reduces the internal resistance between the anode electrode and the cathode electrode, and only a small amount of liquid is required to generate a large electrolysis current, thereby making the hydrogen peroxide production efficiency more efficient. The device for electrochemically generating hydrogen peroxide provided in the present application can directly absorb water from the air to generate hydrogen peroxide, which is more efficient than electrolyzing humid air in the gas phase, and solves the problem of a device for generating hydrogen peroxide in the prior art requiring manual addition of

electrolyte.

2. The device for electrochemically generating hydrogen peroxide provided in the present application, by using a refrigeration device to cool the space between the anode electrode and the cathode electrode, enables the temperature between the anode electrode and the cathode electrode to decrease, thereby condensing the liquid and providing raw materials for electrolytic generation of hydrogen peroxide.

3. The device for electrochemically generating hydrogen peroxide provided in the present application uses an anode electrode made from heat-conducting and electrically-conductive material, which can conduct temperature.

4. The device for electrochemically generating hydrogen peroxide provided in the present application has a semiconductor chilling plate, in which the temperature of the cold end decreases after the semiconductor chilling plate is energized. The cold end of the semiconductor chilling plate is disposed against a side of the anode electrode away from the cathode electrode. Through the heat conduction between the semiconductor chilling plate and the anode electrode, the temperature of the anode electrode is reduced. By utilizing the heat transfer characteristics of the anode electrode, the lower temperatures can be transferred toward the cathode electrode, thereby reducing the temperature of the cathode electrode and the water absorbing member, condensing the liquid, and providing raw materials for electrolytic generation of hydrogen peroxide.

5. According to the device for electrochemically generating hydrogen peroxide provided in the present application, the cathode electrode is made from a porous conductive material, which can meet the conductivity requirements of the cathode electrode while allowing the liquid condensed on the cathode electrode to penetrate downward into the water absorbing material, providing raw materials for electrolytic generation of hydrogen peroxide. Moreover, the generated hydrogen peroxide can also diffuse into the air through the porous cathode electrode.

6. The device for electrochemically generating hydrogen peroxide provided in the present application uses a fan to blow air toward the side of the cathode electrode away from the anode electrode, thereby bringing the hydrogen peroxide generated by electrolysis into the air.

7. According to the electrochemical hydrogen peroxide generating device provided in the present application, the cathode electrode and the anode electrode are horizontally arranged plate profiles, which is conducive to the storage of liquid in the water absorbing member and can avoid liquid leakage.

8. The device for electrochemically generating hydrogen peroxide provided in the present application uses a porous water-retaining material, an ion exchange membrane or a proton exchange membrane to make the water absorbing member, which is conducive to the adsorption and storage of the liquid. The water absorbing member is configured as a plate-like structure that can fit tightly with the anode electrode and the cathode electrode, which is conducive to reducing the internal resistance between the anode electrode and the cathode electrode. It can also allow the lower temperatures generated by the cold end of the semiconductor chilling plate to be conducted through temperature, thereby reducing the temperature of the anode electrode, the water absorbing member and the cathode electrode.

9. According to the device for electrochemically generating hydrogen peroxide provided in the present application, the water absorbing block reduces its resistance after absorbing moisture from the air, which enables the circuit between the cathode electrode and the anode electrode to be conducive, electrolyzes water to generate hydrogen peroxide, and releases it into the air to achieve a sterilization and disinfection effect. The electrochemical hydrogen peroxide production device provided in the present application can produce hydrogen peroxide directly from the air, and is more efficient than electrolyzing humid air in the gas phase, thereby solving the problem in the prior art that hydrogen peroxide production devices require manual addition of electrolyte.

10. According to the device for electrochemically generating hydrogen peroxide provided in the present application, the anode electrode is made from an alloy of one or more of platinum, palladium, ruthenium, rhodium, iridium, osmium, and gold, or the anode electrode is made from a boron-doped diamond film, or the anode electrode is made from a glassy carbon electrode, which can meet the electrical conductivity requirements of the anode electrode and prevent water leakage from the anode electrode.

11. The device for electrochemically generating hydrogen peroxide provided in the present application electrolyzes water to generate hydrogen peroxide to form hydrogen

peroxide solution. The cathode electrode made from a porous conductive material can guide the hydrogen peroxide solution to the side of the cathode electrode away from the anode electrode, and then diffuse it into the air.

12. The device for electrochemically generating hydrogen peroxide provided in the present application has a horizontally arranged cathode electrode, which facilitates the conduction of hydrogen peroxide solution after electrolysis to the upper surface of the cathode electrode.

13. According to the device for electrochemically generating hydrogen peroxide provided in the present application, a foam nickel plate, a porous graphite plate, a sintered titanium plate, activated carbon felt or carbon paper has a porous structure. The cathode electrode is made from the above materials, which can meet the conductivity requirements of the cathode electrode while facilitating the diffusion of hydrogen peroxide generated by electrolysis into the air.

14. The device for electrochemically generating hydrogen peroxide provided in the present application uses a water absorbing block made from porous water-retaining material, which can absorb moisture in the air and facilitates the diffusion of hydrogen peroxide generated after electrolysis into the air.

15. According to the device for electrochemically generating hydrogen peroxide provided in the present application, the water absorbing block is designed as a rod-shaped body, which can form a connection between the anode electrode and the cathode electrode. The water absorbing block reduces its resistance after absorbing moisture from the air, which enables the circuit between the cathode electrode and the anode electrode to be conductive, and facilitates the diffusion of hydrogen peroxide generated after electrolysis into the air.

16. According to the device for electrochemically generating hydrogen peroxide provided in the present application, a plurality of the water absorbing blocks are arranged at intervals between the anode electrode and the cathode electrode, which can increase the contact area between the water absorbing blocks and the air and improve the efficiency of water absorption and hydrogen peroxide diffusion.

17. The device for electrochemically generating hydrogen peroxide provided in the present application has a fan blowing toward the water absorbing block and/or the cathode

electrode. The generated airflow blows through between the anode electrode and the cathode electrode, and/or blows through the side of the cathode electrode away from the anode electrode, thereby bringing the hydrogen peroxide on the water absorbing block and/or the cathode electrode into the air.

18. According to the device for electrochemically generating hydrogen peroxide provided in the present application, the anode electrode and the cathode electrode are arranged in parallel and spaced apart with plate profiles to form a gap, which clamps the water absorbing block, is conducive to the full electrolysis of water and improves efficiency.

19. The method for producing hydrogen peroxide provided in the present application, by a water absorbing member absorbing and storing liquid, enables the circuit between the cathode electrode and the anode electrode to be conductive, and detects the working current between the anode electrode and the cathode electrode. If the working current between the anode electrode and the cathode electrode is greater than a preset current, hydrogen peroxide is produced. If the working current between the anode electrode and the cathode electrode is less than a preset current, the liquid is continued to be absorbed and stored through the water absorbing member, and the above-mentioned current detection process is repeated. Due to the use of the above-mentioned device for electrochemically generating hydrogen peroxide, any of the above-mentioned advantages are achieved.

20. The method for producing hydrogen peroxide provided in the present application, condenses moisture in the air into liquid by cooling the anode electrode. The liquid is absorbed and stored in the water absorbing member between the anode electrode and the cathode electrode, thereby providing raw materials for electrolytic generation of hydrogen peroxide and solving the problem of a device for generating hydrogen peroxide in the prior art requiring manual addition of electrolyte.

21. The method for producing hydrogen peroxide provided in the present application uses a refrigeration device to cool the space between the anode electrode and the cathode electrode, thereby rapidly reducing the temperature between the anode electrode and the cathode electrode, and rapidly condensing moisture in the air between the anode electrode and the cathode electrode. When obvious ice crystals appear on the surface of the anode electrode, the refrigeration device is shut down, and the ice crystals on the surface of the anode electrode

melt into water, moistening the cathode electrode, thereby making the anode electrode and the cathode electrode conductive. The working current between the anode electrode and the cathode electrode is detected. If the working current between the anode electrode and the cathode electrode is greater than a preset current, it indicates that the amount of condensed water is sufficient to electrolyze and produce the required hydrogen peroxide concentration, and hydrogen peroxide production is performed. Due to the use of the above-mentioned device for electrochemically generating hydrogen peroxide, any of the above-mentioned advantages are achieved.

22. The control method of the device for electrochemically generating hydrogen peroxide provided in the present application is as follows: if the working current between the anode electrode and the cathode electrode is less than the preset current, it means that the amount of condensed water between the anode electrode and the cathode electrode is insufficient to produce the required hydrogen peroxide concentration, and the steps of preforming pre-cooling and current detection are repeated to quickly condense the moisture in the air so that the condensed water reaches the required amount.

BRIEF DESCRIPTION OF THE DRAWINGS

In order to more clearly illustrate the specific implementation methods of the present application or the technical solutions in the prior art, the following is a brief introduction to the drawings required for use in the specific implementation methods or the description of the prior art. Obviously, the drawings described below are some implementation methods of the present application. For those skilled in the art, other drawings can be obtained based on these drawings without any creative work.

FIG. 1 is a schematic diagram of an example of the device for electrochemically generating hydrogen peroxide provided in an example of the present application;

FIG. 2 is a schematic diagram of another example of the device for electrochemically generating hydrogen peroxide provided in an example of the present application;

FIG. 3 is a flow chart of a method for producing hydrogen peroxide.

Explanation of the reference signs:

1. anode electrode; 2. cathode electrode; 3. water absorbing member; 4. semiconductor

chilling plate; 5. fan; 6. first power supply; 7. second power supply; and 8. water absorbing block.

DETAILED DESCRIPTION

The technical solution of the present application will be clearly and completely described below in conjunction with the accompanying drawings. Obviously, the described examples are only part of the examples of the present application, rather than all the examples. Based on the examples in the present application, all other examples obtained by those skilled in the art without making any creative work shall fall within the scope of protection of the present application.

In the description of the present application, it should be noted that the terms "center", "up", "down", "left", "right", "vertical", "horizontal", "inside", "outside", etc., indicating orientations or positional relationships, are based on the orientations or positional relationships shown in the accompanying drawings. They are only for the convenience of describing this application and simplifying the description, and do not indicate or imply that the device or element referred to must have a specific orientation, be constructed and operated in a specific orientation. Therefore, they cannot be understood as limitations on the present application. Furthermore, the terms "first," "second," and "third" are used for descriptive purposes only and should not be understood as indicating or implying relative importance.

In the description of the present application, it should be noted that, unless otherwise clearly specified and limited, the terms "installed", "connected" and "connected" should be understood in a broad sense. For example, it can be a fixed connection, a detachable connection, or an integral connection; it can be a mechanical connection or an electrical connection; it can be a direct connection or an indirect connection through an intermediate medium, or it can be the internal connection of two components. For those skilled in the art, the specific meanings of the above terms in the present application can be understood according to specific circumstances.

In addition, the technical features involved in the different embodiments of the present application described below can be combined with each other as long as they do not conflict with each other.

This example provides a device for electrochemically generating hydrogen peroxide capable of directly producing hydrogen peroxide from air, which is used to produce hydrogen peroxide for sterilization and disinfection.

As shown in FIG. 1, a specific example of a device for electrochemically generating hydrogen peroxide provided in this example comprises a cathode electrode 2, an anode electrode 1 and a water absorbing member 3; the anode electrode 1 and the cathode electrode 2 are spaced apart; the water absorbing member 3 is disposed between the anode electrode 1 and the cathode electrode 2, and the water absorbing member 3 is tightly attached to the anode electrode 1 and the cathode electrode 2.

During use, liquid is absorbed and stored through the water absorbing member 3, so that the circuit between the cathode electrode 2 and the anode electrode 1 is conducted, the water is electrolyzed to produce hydrogen peroxide, and the hydrogen peroxide is released into the air to achieve a sterilization and disinfection effect. The tightly attached structure of the water absorbing member 3, the anode electrode 1 and the cathode electrode 2 reduces the internal resistance between the anode electrode 1 and the cathode electrode 2, and only a small amount of liquid is needed to generate a large electrolysis current, thereby making the hydrogen peroxide production efficiency higher. The device for electrochemically generating hydrogen peroxide provided in this example can directly absorb water from the air to produce hydrogen peroxide, which is more efficient than electrolyzing humid air in the gas phase, and solves the problem of hydrogen peroxide production devices in the prior art requiring manual addition of electrolyte.

Specifically, the anode electrode 1 and the cathode electrode 2 are electrically connected to a first power supply 6, which uses low-voltage alternating current. The anode electrode 1 is connected to the positive electrode of the first power supply 6, and the cathode electrode 2 is connected to the negative electrode of the first power supply 6.

As shown in FIG. 1, the device for electrochemically generating hydrogen peroxide provided in this example further comprises a refrigeration device for cooling the space between the anode electrode 1 and the cathode electrode 2 so as to reduce the temperature between the anode electrode 1 and the cathode electrode 2 to condense liquid. By the refrigeration device cooling the space between the anode electrode 1 and the cathode electrode

2, the temperature between the anode electrode 1 and the cathode electrode 2 is reduced to condense liquid, thereby providing raw materials for electrolytic generation of hydrogen peroxide. In addition, as an alternative embodiment, the refrigeration device can be omitted, and the moisture in the air can be adsorbed by the water absorbing member 3. A humidifying device can also be provided to increase the humidity in the air.

As shown in FIG. 1, in the device for electrochemically generating hydrogen peroxide provided in this example, the anode electrode 1 is made from heat-conducting and electrically-conductive material. The anode electrode 1 made from heat-conducting and electrically-conductive materials can conduct temperature. Specifically, the anode electrode 1 can be made from an alloy of one or more of platinum, palladium, ruthenium, rhodium, iridium, osmium, and gold, or the anode electrode 1 is made from a boron-doped diamond film, or the anode electrode 1 is made from a glassy carbon electrode, which can meet the electrical and thermal conduction requirements of the anode electrode 1 and prevent condensed liquid from leaking from the anode electrode 1.

As shown in FIG. 1, in the device for electrochemically generating hydrogen peroxide provided in this example, a semiconductor chilling plate 4 is disposed against a side of the anode electrode 1 away from the cathode electrode 2. After the semiconductor chilling plate 4 is energized, the temperature of the cold end is reduced. The cold end of the semiconductor chilling plate 4 is disposed against the side of the anode electrode 1 away from the cathode electrode 2. Through the heat conduction between the semiconductor chilling plate 4 and the anode electrode 1, the temperature of the anode electrode 1 is reduced. By utilizing the heat transfer characteristics of the anode electrode 1, the lower temperatures can be transferred toward the cathode electrode 2, thereby reducing the temperature of the cathode electrode 2 and the water absorbing member 3, condensing the liquid, and providing raw materials for electrolytic generation of hydrogen peroxide. Specifically, the semiconductor chilling plate 4 is electrically connected to a second power supply 7. In addition, as an alternative embodiment, the semiconductor chilling plate 4 can also be replaced by a heat exchanger with a refrigeration medium, or other refrigeration methods that can exchange heat with the anode electrode 1.

As shown in FIG. 1, in the device for electrochemically generating hydrogen peroxide

provided in this example, the cathode electrode 2 is made from a porous conductive material. The cathode electrode 2 made from porous conductive material can meet the conductivity requirements of the cathode electrode 2, and at the same time, it can also allow the liquid condensed on the cathode electrode 2 to penetrate downward into the water absorbing material, providing raw materials for electrolytic generation of hydrogen peroxide, and the produced hydrogen peroxide can diffuse into the air through the porous cathode electrode 2. Specifically, the cathode electrode 2 is a foam nickel plate, a porous graphite plate, a sintered titanium plate, activated carbon felt or carbon paper.

As shown in FIG. 1, in the device for electrochemically generating hydrogen peroxide provided in this example, a fan 5 is provided on a side of the cathode electrode 2 away from the anode electrode 1. The fan 5 blows air toward the side of the cathode electrode 2 away from the anode electrode 1 to bring hydrogen peroxide generated by electrolysis into the air. In addition, as an alternative embodiment, the fan 5 may also be arranged at other locations where wind can blow from the side of the cathode electrode 2 away from the anode electrode 1.

As shown in FIG. 1, in the device for electrochemically generating hydrogen peroxide provided in this example, the cathode electrode 2 and the anode electrode 1 are horizontally arranged plate profiles. The cathode electrode 2 and the anode electrode 1 are formed of horizontally arranged plate profiles, which is beneficial for storing the liquid in the water absorbing member 3 and can prevent liquid leakage. In addition, as an alternative embodiment, the cathode electrode 2 may also be in a grid-like, mesh-like or other structure.

As shown in FIG. 1, in the device for electrochemically generating hydrogen peroxide provided in this example, the water absorbing member 3 is a plate-shaped structure made from a porous water-retaining material, an ion exchange membrane or a proton exchange membrane. The water absorbing member 3 is made from porous water-retaining material, ion exchange membrane or proton exchange membrane, which is conducive to the adsorption and storage of liquid. The water absorbing member 3 is set to a plate-like structure and can fit tightly with the anode electrode 1 and the cathode electrode 2, which is conducive to reducing the internal resistance between the anode electrode 1 and the cathode electrode 2. It can also allow the cold end of the semiconductor chilling plate 4 to generate lower temperatures through

temperature conduction, thereby reducing the temperature of the anode electrode 1, the water absorbing member 3 and the cathode electrode 2. Specifically, the porous water absorbing material is a material that can absorb water, such as fiber paper and cotton cloth. Compared with porous water absorbing materials, ion exchange membranes and proton exchange membranes are more expensive, but have better conductive properties. The water absorbing member 3 is insulating before absorbing water and conductive after absorbing water. An appropriate amount of electrolyte can be added to the water absorbing member 3, which is beneficial to reducing resistance and improving the conductivity of the water-absorbing member 3. Only a small amount of liquid is needed to generate a large electrolysis current, making the hydrogen peroxide production efficiency higher.

As shown in FIG. 3, the method for producing hydrogen peroxide provided in this example further includes the following steps: pre-cooling, by cooling the anode electrode 1, so that the water absorbing member 3 between the anode electrode 1 and the cathode electrode 2 absorbs and stores liquid. The anode electrode 1 is cooled by a refrigeration device, so that the moisture in the air is condensed into liquid. The liquid is absorbed and stored in the water absorbing member 3 to provide raw materials for electrolytic generation of hydrogen peroxide, thereby solving the problem of a device for generating hydrogen peroxide in the prior art requiring manual addition of electrolyte.

It should be noted that, during pre-cooling, the working current of the refrigeration device is adjusted to the maximum value, so that the refrigeration device operates at maximum power and cools down quickly, so that the temperature between the anode electrode 1 and the cathode electrode 2 drops rapidly, and the moisture in the air condenses quickly or even freezes; when the working current between the anode electrode 1 and the cathode electrode 2 is greater than a preset current, the working current of the refrigeration device is adjusted to the set value, maintaining a stable and continuous power supply to achieve a balance between the consumption and replenishment of condensed water, and ensure the continuous production of the required hydrogen peroxide concentration.

As shown in FIG. 2, another specific embodiment of a device for electrochemically generating hydrogen peroxide provided in this example comprises a cathode electrode 2, an anode electrode 1 and a water absorbing block 8; the anode electrode 1 and the cathode

electrode 2 are spaced apart; the water absorbing block 8 is disposed between the anode electrode 1 and the cathode electrode 2, and the two ends of the water absorbing block 8 are respectively connected to the anode electrode 1 and the cathode electrode 2.

During use, the water absorbing block 8 absorbs moisture in the air, and its resistance decreases, so that the circuit between the cathode electrode 2 and the anode electrode 1 is conducted, and the water in the water absorbing block 8 is electrolyzed to produce hydrogen peroxide, which is released into the air to achieve a sterilization and disinfection effect. The device for electrochemically generating hydrogen peroxide provided in the present application can produce hydrogen peroxide directly from the air, and has higher efficiency than electrolyzing humid air in the gas phase, thereby solving the problem of a device for generating hydrogen peroxide in the prior art requiring manual addition of electrolyte.

Specifically, the anode electrode 1 is electrically connected to the positive electrode of the first power supply 6, and the cathode electrode 2 is electrically connected to the negative electrode of the first power supply 6, and the first power supply 6 uses low-voltage alternating current.

As shown in FIG. 2, in the device for electrochemically generating hydrogen peroxide provided in this example, the anode electrode 1 is made from an alloy of one or more of platinum, palladium, ruthenium, rhodium, iridium, osmium, and gold, or the anode electrode 1 is made from a boron-doped diamond film, or the anode electrode 1 is made from a glassy carbon electrode. The anode electrode 1 is made from the above-mentioned material, which can meet the electrical and thermal conduction requirements of the anode electrode 1 and prevent condensed water from leaking from the anode electrode 1.

As shown in FIG. 2, in the device for electrochemically producing hydrogen peroxide provided in this example, the cathode electrode 2 is made from a porous conductive material. Water electrolysis produces hydrogen peroxide to form hydrogen peroxide solution. The cathode electrode 2 made from porous conductive material can guide the hydrogen peroxide to the side of the cathode electrode 2 away from the anode electrode 1, and then diffuse into the air.

As shown in FIG. 2, in the device for electrochemically producing hydrogen peroxide provided in this example, the cathode electrode 2 is arranged horizontally. The cathode

electrode 2 is arranged horizontally, which is conducive to the hydrogen peroxide solution after electrolysis being conducted to the upper surface of the cathode electrode 2.

As shown in FIG. 2, in the device for electrochemically producing hydrogen peroxide provided in this example, the cathode electrode 2 is a foam nickel plate, a porous graphite plate, a sintered titanium plate, activated carbon felt or carbon paper. The foam nickel plate, porous graphite plate, sintered titanium plate, activated carbon felt or carbon paper have a porous structure. Using the above materials to make the cathode electrode 2 can meet the conductivity requirements of the cathode electrode 2 while facilitating the diffusion of hydrogen peroxide generated by electrolysis into the air.

As shown in FIG. 2, in the device for electrochemically producing hydrogen peroxide provided in this example, the water absorbing block 8 is made from a porous water-retaining material. The water absorbing block 8 made from porous water-retaining material can absorb moisture in the air and facilitates the diffusion of hydrogen peroxide generated after electrolysis into the air. Specifically, the water absorbing block 8 can be made of ceramic fiber (ceramic yarn, glass fiber, etc.), organic fiber (polyester fiber, synthetic fiber, nylon fiber, etc.), metal fiber (stainless steel fiber, copper fiber, titanium fiber, etc.), etc. In addition, as an alternative embodiment, the water absorbing block 8 can also be made of ceramic particles or metal particles sintered into a porous body, or a foamed body such as urethane resin or styrene resin.

As shown in FIG. 2, in the device for electrochemically producing hydrogen peroxide provided in this example, the water absorbing block 8 is a rod-shaped body. The water absorbing block 8 is designed as a rod-shaped body, which can form a connection between the anode electrode 1 and the cathode electrode 2. When the water absorbing block 8 absorbs moisture in the air, the resistance is reduced, so that the circuit between the anode electrode 1 and the cathode electrode 2 is conducive, and it is beneficial for the hydrogen peroxide generated after electrolysis to diffuse into the air. In addition, as an alternative embodiment, the water absorbing block 8 may also be in a sheet shape or other shapes that are conducive to water absorption and diffusion of hydrogen peroxide.

As shown in FIG. 2, in the device for electrochemically producing hydrogen peroxide provided in this example, a plurality of water absorbing blocks 8 are arranged at intervals

between the anode electrode 1 and the cathode electrode 2. A plurality of the water absorbing blocks 8 are arranged at intervals between the anode electrode 1 and the cathode electrode 2, which can increase the contact area between the water absorbing blocks 8 and the air, thereby improving the efficiency of water absorption and hydrogen peroxide diffusion.

As shown in FIG. 2, the electrochemical hydrogen peroxide production device provided in this example further comprises a fan 5, which blows air toward the water absorbing block 8 and/or blows air toward the side of the cathode electrode 2 away from the anode electrode 1. The fan 5 blows air toward the water absorbing block 8 and/or the cathode electrode 2, and the generated airflow blows through between the anode electrode 1 and the cathode electrode 2, and/or blows through the side of the cathode electrode 2 away from the anode electrode 1, bringing the hydrogen peroxide on the water absorbing block 8 and/or the cathode electrode 2 into the air.

As shown in FIG. 2, in the device for electrochemically producing hydrogen peroxide provided in this example, the anode electrode 1 and the cathode electrode 2 are plate profiles arranged in parallel and at intervals. The anode electrode and the cathode electrode are arranged in parallel and spaced apart with plate profiles to form a gap, which clamps the water absorbing block, is conducive to the full electrolysis of water and improves efficiency. In addition, as an alternative embodiment, the cathode electrode 2 and the anode electrode 1 may also be in other structures such as a grid or a mesh.

As shown in FIG. 2, the device for electrochemically producing hydrogen peroxide provided in this example, when in use, the water absorbing block 8 absorbs moisture in the air and its resistance decreases, so that the circuit between the cathode electrode 2 and the anode electrode 1 is conducted, and the water in the water absorbing block 8 is electrolyzed to produce hydrogen peroxide, which is blown into the air by the fan 5 to achieve a sterilization and disinfection effect; the device for electrochemically generating hydrogen peroxide provided in the present application can produce hydrogen peroxide directly from the air, which is more efficient than electrolyzing humid air in the gas phase, and solves the problem of a device for generating hydrogen peroxide in the prior art requiring manual addition of electrolyte.

Method of Application

As shown in FIG. 1, the device for electrochemically generating hydrogen peroxide provided in this example, when in use, is cooled by the semiconductor chilling plate 4, and the temperature of the anode electrode 1, the water absorbing member 3, and the cathode electrode 2 is lowered through temperature transfer, and the moisture in the air condenses into liquid. The water absorbing member 3 adsorbs and stores the liquid, and the circuit between the cathode electrode 2 and the anode electrode 1 is conducted, and the moisture is electrolyzed to generate hydrogen peroxide, which is released into the air to achieve a sterilization and disinfection effect.

In addition, as shown in FIG. 3, this example further provides a method for producing hydrogen peroxide, using the device for electrochemically generating hydrogen peroxide described in the above example, comprising the following steps: absorbing and storing liquid in the water absorbing member 3; detecting the current, specifically the working current between the anode electrode 1 and the cathode electrode 2, and determining whether a preset current has been reached; and if the working current between the anode electrode 1 and the cathode electrode 2 is greater than a preset current, hydrogen peroxide is produced.

During use, liquid is absorbed and stored through the water absorbing member 3, so that the circuit between the cathode electrode 2 and the anode electrode 1 is conducted, and the working current between the anode electrode 1 and the cathode electrode 2 is detected. If the working current between the anode electrode 1 and the cathode electrode 2 is greater than the preset current, hydrogen peroxide is produced. If the working current between the anode electrode 1 and the cathode electrode 2 is less than the preset current, liquid is continued to be absorbed and stored through the water absorbing member 3, and the above current detection process is repeated. The hydrogen peroxide production method provided in this example prepares hydrogen peroxide by absorbing moisture in the air through the water absorbing member 3, which solves the problem of a device for generating hydrogen peroxide in the prior art requiring manual addition of electrolyte.

It should be noted that when the working current between the anode electrode 1 and the cathode electrode 2 is greater than the preset current, the working voltages of the refrigeration device, the anode electrode 1 and the cathode electrode 2 in the device for electrochemically generating hydrogen peroxide described in the above example are reduced so that the working

current between the anode electrode 1 and the cathode electrode 2 is equal to the preset value, thereby continuously and efficiently generating hydrogen peroxide and avoiding situations such as increased energy consumption, material sintering or corrosion caused by excessive current.

Obviously, the above examples are merely examples for clear description and are not intended to limit the implementation methods. For those skilled in the art, other different forms of changes or modifications can be made based on the above description. It is not necessary and impossible to list all implementation methods exhaustively here. However, obvious changes or modifications derived therefrom are still within the scope of protection of the present application.

CLAIMS

1. A device for electrochemically generating hydrogen peroxide, comprising:
a cathode electrode (2);
an anode electrode (1) spaced apart from the cathode electrode (2); and
a water absorbing member (3) arranged between the anode electrode (1) and the cathode electrode (2), wherein the water absorbing member (3) is tightly attached to the anode electrode (1) and the cathode electrode (2).
2. The device for electrochemically generating hydrogen peroxide according to claim 1, wherein the device further comprises a refrigeration device for cooling space between the anode electrode (1) and the cathode electrode (2) so as to reduce the temperature between the anode electrode (1) and the cathode electrode (2) to condense liquid.
3. The device for electrochemically generating hydrogen peroxide according to claim 1, wherein the anode electrode (1) is made from heat-conducting and electrically-conductive material;
optionally, the anode electrode (1) is made from an alloy of one or more of platinum, palladium, ruthenium, rhodium, iridium, osmium, and gold, or the anode electrode (1) is made from a boron-doped diamond film, or the anode electrode (1) is made from a glassy carbon electrode.
4. The device for electrochemically generating hydrogen peroxide according to claim 3, wherein a semiconductor chilling plate (4) is disposed against a side of the anode electrode (1) away from the cathode electrode (2).
5. The device for electrochemically generating hydrogen peroxide according to claim 1, wherein the cathode electrode (2) is made from a porous conductive material.
6. The device for electrochemically generating hydrogen peroxide according to claim 5, wherein a fan (5) is provided on a side of the cathode electrode (2) away from the anode

electrode (1).

7. The device for electrochemically generating hydrogen peroxide according to any one of claims 1 to 6, wherein the cathode electrode (2) and the anode electrode (1) are horizontally arranged plate profiles.

8. The device for electrochemically generating hydrogen peroxide according to claim 7, wherein the water absorbing member (3) is a plate-like structure made from a porous water-retaining material, an ion exchange membrane or a proton exchange membrane.

9. A method for producing hydrogen peroxide, wherein the device for electrochemically generating hydrogen peroxide according to any one of claims 1 to 8 is used, comprising the following steps:

absorbing and storing liquid in the water absorbing member (3);

detecting current, detecting the working current between the anode electrode (1) and the cathode electrode (2), and determining whether a preset current has been reached;

if the working current between the anode electrode (1) and the cathode electrode (2) is greater than a preset current, hydrogen peroxide is produced.

10. The method for producing hydrogen peroxide according to claim 9, wherein by cooling the anode electrode (1), liquid is absorbed and stored in the water absorbing member (3) between the anode electrode (1) and the cathode electrode (2).

11. The method for producing hydrogen peroxide according to claim 9, wherein the method further comprises the following steps:

performing pre-cooling by cooling space between the anode electrode (1) and the cathode electrode (2) through a refrigeration device, so that obvious ice crystals appear on the surface of the anode electrode (1), and then the refrigeration device is shut down.

12. The method for producing hydrogen peroxide according to claim 11, wherein if the

working current between the anode electrode (1) and the cathode electrode (2) is less than a preset current, the pre-cooling and current detection steps are repeated.

13. A device for electrochemically generating hydrogen peroxide, comprising:

a cathode electrode (2);

an anode electrode (1) spaced apart from the cathode electrode (2);

a water absorbing block (8) arranged between the anode electrode (1) and the cathode electrode (2), wherein two ends of the water absorbing block (8) are respectively connected to the anode electrode (1) and the cathode electrode (2).

14. The device for electrochemically generating hydrogen peroxide according to claim 13, wherein the anode electrode (1) is made from an alloy of one or more of platinum, palladium, ruthenium, rhodium, iridium, osmium, and gold, or the anode electrode (1) is made from a boron-doped diamond film, or the anode electrode (1) is made from a glassy carbon electrode.

15. The device for electrochemically generating hydrogen peroxide according to claim 13, wherein the cathode electrode (2) is made from a porous conductive material.

16. The device for electrochemically generating hydrogen peroxide according to claim 15, wherein the cathode electrode (2) is arranged horizontally.

17. The device for electrochemically generating hydrogen peroxide according to claim 13, wherein the cathode electrode (2) is a foam nickel plate, a porous graphite plate, a sintered titanium plate, activated carbon felt or carbon paper.

18. The device for electrochemically generating hydrogen peroxide according to claim 13, wherein the water absorbing block (8) is made from a porous water-retaining material.

19. The device for electrochemically generating hydrogen peroxide according to claim

18, wherein the water absorbing block (8) is a rod-shaped body.

20. The device for electrochemically generating hydrogen peroxide according to claim 19, wherein a plurality of the water absorbing blocks (8) are arranged at intervals between the anode electrode (1) and the cathode electrode (2).

21. The device for electrochemically generating hydrogen peroxide according to claim 13, wherein the device further comprises a fan (5), wherein the fan (5) blows air toward the water absorbing block (8), and/or the fan (5) blows air toward a side of the cathode electrode (2) away from the anode electrode (1).

22. The device for electrochemically generating hydrogen peroxide according to any one of claims 13 to 21, wherein the anode electrode (1) and the cathode electrode (2) are plate profiles arranged in parallel and at intervals.