

ALUMINUM CATHODE SECONDARY BATTERY

BACKGROUND OF THE INVENTION

(a) Field of the Invention

5 The present invention relates to a secondary battery able to repeatedly carry out a charging and discharging reaction, and more particularly to an aluminum cathode secondary battery comprising raw materials that are relatively easily acquired, the material cost is relatively inexpensive, and is relatively safer and more reliable during
10 use.

(b) Description of the Prior Art

 A secondary battery denotes a battery that is rechargeable and reusable, and converts chemical energy into electrical energy; moreover, a charging method is used to reconvert electrical energy into
15 chemical energy, thereby enabling reuse of the battery. However, after reuse a number of times, changes generally occur according to the materials used and design.

 The material characteristics of secondary batteries of the prior art enable distinguishing batteries into: lead acid batteries, nickel-cadmium
20 batteries, nickel-metal hydride batteries, and lithium batteries, wherein

lithium batteries are further distinguished into lithium nickel batteries, lithium cobalt batteries, lithium manganese batteries, lithium titanium batteries, and lithium iron batteries,

However, there are varying degrees of hidden concern with the various types of secondary batteries currently circulating in the market.

For example, although the safety of lead acid batteries is relatively high, however, their shortcomings include low energy density, and large and cumbersome size. Although lithium batteries are user friendly, their cost is extremely high, and lithium mineral resources are facing a depletion problem, thus making lithium batteries more and more expensive. Moreover, there are deep misgivings about its safety when in use (poor safety). At high temperatures, there are problems that the lithium battery might explode or electric capacity falls, thus, extreme danger exists as far as users are concerned.

In addition, there are relatively unfamiliar secondary batteries, such as: air batteries, in which there is a common problem for carbonization of the electrolyte to easily occur, resulting in a drop in performance of the entire battery; solar batteries, in which the problem of low energy density exists, energy source is unstable, cannot be used at night, and is susceptible to location and climate influences, thus unable to supply

stable electric power; and fuel type batteries, in which there is a common problem of long starting time, and the electrolyte is toxic, which easily leaks causing corrosion.

SUMMARY OF THE INVENTION

5 In light of the above, the primary objective of the present invention is to provide a secondary battery comprising raw materials that are relatively easily acquired, the material cost is relatively inexpensive, and is relatively safer and more reliable during use; moreover, the secondary battery complies with current policies for energy conservation and
10 carbon reduction, decrease in pollution, and environmentally friendly green energy.

In order to achieve the aforementioned objects, the present invention provides an aluminum cathode secondary battery, wherein at least one cathode material and at least one anode material are arranged at
15 predetermined spacings and encased inside a container filled with an electrolyte. The aluminum cathode secondary battery is characterized in that: The electrolyte is an ionic liquid containing aluminum salts, each of the cathode materials contains metallic aluminum, and each of the anode materials contains one of or a multiple composition selected from
20 a carbon material and quinone compounds. Each of the cathode

materials and each of the anode materials are first connected to an external positive and a negative charge, respectively, enabling aluminum ions released from each of the cathode materials to migrate into the anode materials through the electrolyte, whereby a charging reaction occurs. After completing charging, aluminum ions are released from the anode materials and return to the cathode materials through the electrolyte, whereby a discharging reaction occurs. Accordingly, migration of the aluminum ions between the cathode and anode materials is used to achieve a repeated charging/discharging effect.

Based on the above-mentioned technical characteristics, in the aluminum cathode secondary battery of the present invention, one cathode material, one anode material, and a separator material are encased inside a container. The cathode material, the anode material, and the separator material are wound round to form a battery with a cylindrical structural configuration.

Based on the above-mentioned technical characteristics, the container is an air-tight sealed container fitted with at least one safety pressure release valve on the top portion thereof. A plurality of the cathode materials, the anode materials, and the separator materials are encased inside the container, with the cathode and anode materials

assuming a staggered stacked configuration; moreover, each of the separator materials is interlined between the contiguous cathode and anode materials. The top portion of the container is provided with a positive terminal electrically connected to each of the cathode materials
5 and a negative terminal electrically connected to each of the anode materials.

Based on the above-mentioned technical characteristics, the top portion of the container is provided with an electrolyte filling hole, and the at least one safety pressure release valve is mounted on the top
10 portion of the container by plugging and sealing the electrolyte filling hole.

Based on the above-mentioned technical characteristics, each of the cathode materials is an aluminum plate provided with a predetermined thickness.

15 Based on the above-mentioned technical characteristics, each of the cathode materials is an aluminum alloy plate provided with a predetermined thickness, wherein the aluminum alloy plate is structured from one metal or multiple metals selected from magnesium, silicon, scandium, titanium, manganese, zinc, and niobium.

20 Based on the above-mentioned technical characteristics, each of the

anode materials comprises a nickel collector plate provided with a predetermined thickness, wherein the nickel collector plate is coated with a carbon material on the surface thereof. The carbon material is formed from a mixture of graphite, graphene, silica, and HEMC
5 (Hydroxyethylmethyl Cellulose) thickener.

Based on the above-mentioned technical characteristics, each of the anode materials comprises a lead collector plate provided with a predetermined thickness, and quinone compounds are coated on the surface of the lead collector plate. The quinone compounds are formed
10 from a mixture of one or a multiple composition of the following substances: benzoquinone, anthraquinone, naphthaquinone, and phenanthrenequinone, after which acetylene black conductive agent and HEMC thickener is additionally added.

Based on the above-mentioned technical characteristics, each of the
15 separator materials assumes an absorbent fiberglass mat as its structural form.

Based on the above-mentioned technical characteristics, the electrolyte is an ionic liquid formed from a mixture of 1-butyl-3-methylimidazolium chloride and at least one aluminum salt, wherein the
20 aluminum salt is selected from one of the following: polyaluminium

chloride, aluminum trichloride anhydrous, or sodium metaaluminate.

Compared to secondary batteries of the prior art, the raw materials of the aluminum cathode secondary battery disclosed in the present invention are relatively easily acquired, and the material cost is relatively inexpensive. When in use, the present invention prevents the possibility of explosion at high temperature and averts worries over a drop in electric capacity, and thus relatively safer and more reliable, as well as achieving a relative longer serviceable life. In particular, the aluminum cathode secondary battery meets the current needs for environmentally friendly green energy products that conserve energy, reduce carbon emissions, and decrease global pollution. Accordingly, the present invention is provided with originality, advancement, and practicability.

To enable a further understanding of said objectives, structures, characteristics, and effects, as well as the technology and methods used in the present invention and effects achieved, a brief description of the drawings is provided below followed by a detailed description of the preferred embodiments.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a basic structural schematic view of an aluminum cathode secondary battery of the present invention.

Figure 2 shows an arrowhead denoting aluminum ion migration during a charging reaction according to the present invention.

Figure 3 shows an arrowhead denoting aluminum ion migration during a discharging reaction according to the present invention.

5 Figure 4 is an external schematic view of an embodiment of the aluminum cathode secondary battery of the present invention.

Figure 5 is an exploded structural schematic view of the aluminum cathode secondary battery of the present invention.

10 Figure 6 is an external schematic view of a nickel collector plate of the present invention.

Figure 7 is an external schematic view of a lead collector plate of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

15 The present invention primarily provides an aluminum cathode secondary battery comprising raw materials that are relatively easily acquired, material costs are relatively inexpensive, and during use is safer and more reliable. Referring to Figure 1, which shows the aluminum cathode secondary battery, wherein at least one cathode material 30 and at least one anode material 40 arranged at
20 predetermined spacings are disposed inside a container 10 filled with an

electrolyte 20. The aluminum cathode secondary battery is characterized in that:

The electrolyte 20 is an ionic liquid containing aluminum salts, each of the cathode materials 30 contains metallic aluminum, and each of the anode materials 40 contains carbon material or quinone compounds. In an application, the electrolyte 20 is an ionic liquid formed from a mixture of 1-butyl-3-methylimidazolium chloride and at least one aluminum salt.

The aluminum salts can be polyaluminium chloride, aluminum trichloride anhydrous, or sodium metaaluminate, and a single mixture, double mixture, or a multiple mixture is used according to the usage characteristics of the aluminum cathode secondary battery, such as motive power type (requires high power output) or power storage type (stable output).

The above-mentioned at least one cathode material 30 can be a plate containing metallic aluminum, which is immersed into the electrolyte 20 filling the container 10. In an application, each of the cathode materials 30 is an aluminum plate provided with a predetermined thickness or is an aluminum alloy plate provided with a predetermined thickness, wherein the aluminum alloy plate is structured from one metal or multiple metals selected from magnesium, silicon, scandium, titanium,

manganese, zinc, and niobium.

The above-mentioned at least one anode material 40 is at least a plate containing carbon material or quinone compounds, and is immersed into the electrolyte 20 filling the container 10. In an application, the carbon material can be formed from a mixture of one or a multiple composition of the following substances: graphite, graphene, silica, and HEMC (Hydroxyethylmethyl Cellulose) thickener. The quinone compounds can be formed from a mixture of one or a multiple composition of the following substances: benzoquinone, anthraquinone, naphthaquinone, and phenanthrenequinone, after which acetylene black conductive agent and HEMC thickener is additionally added.

Referring to Figure 2, which shows each of the cathode materials 30 and each of the anode materials 40 first connected to an external positive and a negative charge, respectively, enabling aluminum ions released from each of the cathode materials 30 to migrate into the anode materials 40 through the electrolyte 20, whereby a charging reaction occurs. After completing charging, aluminum ions are released from the anode materials 40 and return to the cathode materials 30 through the electrolyte 20, whereby a discharging reaction occurs, as shown in Figure 3. Accordingly, migration of the aluminum ions between

the cathode and anode materials 30, 40 is used to achieve a repeated charging/discharging effect.

In an application of the aluminum cathode secondary battery of the present invention, the cathode materials 30, the anode materials 40, and separator materials 50 can be wound round to form a battery with a cylindrical structural configuration, or as shown in Figure 5, can be stacked to form a battery with a laminated structural configuration.

The at least one separator material 50 is primarily interlined between the contiguous cathode and anode materials 30, 40, and is used to enable the electrolyte 20 in a semisolid state to be situated between the contiguous cathode and anode materials 30, 40. At least one of the separator materials 50 must be acid-resistant, which is primarily used to prevent short circuiting at the cathode/anode, as well as providing a powerful absorptive capacity.

In the above-mentioned embodiments, each of the separator materials 50 assumes an absorbent fiberglass mat as its preferred structural form, to enable effective absorption of a large quantity of the electrolyte 20, thereby enabling the electrolyte 20 in a semisolid form to be situated between the contiguous cathode and anode materials 30, 40, and further enable aluminum ions to pass therethrough.

Referring to Figures 4 and 5, which show the cathode and anode materials 30, 40 and the separator materials 50 of the present invention stacked to form a battery with a laminated embodiment configuration, wherein the container 10 can be an air-tight sealed container fitted with
5 at least one safety pressure release valve 60 on the top portion thereof. The cathode and anode materials 30, 40 and the separator materials 50 are encased inside the container 10, with the cathode and anode materials 30, 40 assuming a staggered stacked configuration, and each of the separator materials 50 is interlined between the contiguous
10 cathode and anode materials 30, 40. The top portion of the container 10 is provided with a positive terminal 11 electrically connected to each of the cathode materials 30 and a negative terminal 12 electrically connected to each of the anode materials 40.

In the above-disclosed embodiment, the top portion of the container
15 10 can be further provided with an electrolyte filling hole 13, and the at least one safety pressure release valve 60 is mounted on the top portion of the container 10 by plugging and sealing the electrolyte filling hole 13. When the entire aluminum cathode secondary battery is in a high workload state, or is in a fast charging state, or when the ambient
20 temperature suddenly changes, then the internal pressure of the

container 10 will rise.

For example, when the internal pressure of the container 10 reaches 2.5~3 psi, the safety pressure release valve 60 automatically opens to release the internal pressure of the container 10; when the internal
5 pressure of the container 10 drops to 2~ 1.5 psi, the safety pressure release valve 60 then automatically closes, thereby ensuring that the entire aluminum cathode secondary battery is safe and secure.

In an embodiment configuration of the present invention wherein each of the anode materials 40 contains at least carbon material, each of the
10 anode materials 40 comprises a nickel collector plate 41 provided with a predetermined thickness (as shown in Figure 6). The nickel collector plate 41 is coated with a carbon material on the surface thereof, with the nickel collector plate 41 being formed by stamping a sheet of nickel, and has a thickness between 0.1 mm and 1 mm or thicker. In addition, the
15 nickel collector plate 41 is preferably provided with a plurality of through holes 411.

In an embodiment configuration of the present invention wherein each of the anode materials 40 contains at least quinone compounds, each of the anode materials 40 comprises a lead collector plate 42 provided
20 with a predetermined thickness (as shown in Figure 7). The lead

collector plate 42 is coated with the quinone compounds on the surface thereof, with the lead collector plate 42 being formed by stamping a sheet of lead, and has a thickness between 0.6 mm and 1.5 mm or thicker. Similar to the nickel collector plate 41, the lead collector plate 42
5 is preferably provided with a plurality of through holes 421.

Compared to secondary batteries of the prior art, the raw materials of the aluminum cathode secondary battery disclosed in the present invention are relatively easily acquired, and the material cost is relatively inexpensive. When in use, the present invention prevents the possibility
10 of explosion at high temperature or averts worries over a drop in electric capacity, and thus relatively safer and more reliable, as well as being able to achieve a relative longer serviceable life.

The technical contents of the present invention and technical features thereof are as disclosed above. It is of course to be understood that the
15 embodiments described herein are merely illustrative of the principles of the invention and that a wide variety of modifications thereto may be effected by persons skilled in the art without departing from the spirit and scope of the invention as set forth in the following claims.

What is claimed is:

1. An aluminum cathode secondary battery, wherein at least one cathode material and at least one anode material are arranged at predetermined spacings and disposed inside a container filled with an electrolyte; and is characterized in that:

the electrolyte is an ionic liquid containing aluminum salts, each of the cathode materials contains metallic aluminum, and each of the anode materials contains one of or a multiple composition selected from a carbon material and quinone compounds;

each of the cathode materials and each of the anode materials are first connected to an external positive and a negative charge, respectively, enabling aluminum ions released from each of the cathode materials to migrate into the anode materials through the electrolyte, whereby a charging reaction occurs; after completing charging, aluminum ions are released from the anode materials and return to the cathode materials through the electrolyte, whereby a discharging reaction occurs; moreover, migration of the aluminum ions between the cathode and anode materials is used to achieve a repeated charging/discharging effect.

2. The aluminum cathode secondary battery according to claim 1,

wherein in the aluminum cathode secondary battery of the present invention, one cathode material, one anode material, and a separator material are encased inside a container; the cathode material, the anode material, and the separator material are wound round to form a battery with a cylindrical structural configuration.

3. The aluminum cathode secondary battery according to claim 1, wherein the container is an air-tight sealed container fitted with at least one safety pressure release valve on the top portion thereof; a plurality of the cathode materials, the anode materials, and the separator materials are encased inside the container, with the cathode and anode materials assuming a staggered stacked configuration; moreover, each of the separator materials is interlined between the contiguous cathode and anode materials; the top portion of the container is provided with a positive terminal electrically connected to each of the cathode materials and a negative terminal electrically connected to each of the anode materials.

4. The aluminum cathode secondary battery according to claim 3, wherein the top portion of the container is provided with an electrolyte filling hole, and the at least one safety pressure release valve is mounted on the top portion of the container by plugging and sealing

the electrolyte filling hole.

5. The aluminum cathode secondary battery according to claims 1 to 3, wherein each of the cathode materials is an aluminum plate provided with a predetermined thickness.

5 6. The aluminum cathode secondary battery according to claims 1 to 3, wherein each of the cathode materials is an aluminum alloy plate provided with a predetermined thickness, wherein the aluminum alloy plate is structured from one metal or multiple metals selected from magnesium, silicon, scandium, titanium, manganese, zinc, and
10 niobium.

7. The aluminum cathode secondary battery according to claims 1 to 3, wherein each of the anode materials comprises a nickel collector plate provided with a predetermined thickness, and the nickel collector plate is coated with a carbon material on the surface thereof,
15 wherein the carbon material is formed from a mixture of graphite, graphene, silica, and HEMC (Hydroxyethylmethyl Cellulose) thickener.

8. The aluminum cathode secondary battery according to claims 1 to 3, wherein each of the anode materials comprises a lead collector plate provided with a predetermined thickness, and quinone compounds
20 are coated on the surface of the lead collector plate, wherein the

quinone compounds are formed from a mixture of one or a multiple composition of the following substances: benzoquinone, anthraquinone, naphthaquinone, and phenanthrenequinone, after which acetylene black conductive agent and HEMC thickener is
5 additionally added.

9. The aluminum cathode secondary battery according to claims 2 or 3, wherein each of the separator materials assumes an absorbent fiberglass mat as its structural form.

10. The aluminum cathode secondary battery according to claims 1 to 3,
10 wherein the electrolyte is an ionic liquid formed from a mixture of 1-butyl-3-methylimidazolium chloride and at least one aluminum salt, wherein the aluminum salt is selected from one of the following: polyaluminium chloride, aluminum trichloride anhydrous, or sodium metaaluminate.

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