Description

Title: Battery with improved electrolyte and improved electrodes

Technical field

[1] This disclosure relates to the field of batteries, whether in the form of a primary cell, fuel cell, or rechargeable battery.

Prior art

[2] Document WO-2018/060656 presented a particularly promising material for forming the electrolyte of a supercapacitor, this material being a crystalline solid with a $A_2B_2O_5$ structure, where A can be an alkali metal and B can be titanium. The performance of this material led the inventors named in that document to consider an application in batteries, which is mentioned in that document (specifically on page 12, lines 15-30, with reference to FIG. 8 of the document).

[3] However, the aim of the embodiment presented was to consider the entire electrolyte, in contact with the two electrodes, as a "pseudo-battery" in the sense that the electrical discharge ("rapid, on the order of a few minutes, then relatively slow thereafter, on the order of a few hours") could not be perfectly controlled, and jackets of piezoelectric elements PZ1, PZ2, PZ3, etc., remained necessary to mechanically constrain or relax the material in order to block or release the electrical charges.

[4] Typically, the materials provided for the electrodes were carbon, or a metal such as copper, silver, gold, or platinum, simply for collecting electrons.

Summary

[5] The present disclosure improves the situation.

[6] It proposes retaining a similar material for the electrolyte but improving the materials chosen for the electrodes, in order to better manage the charging/discharging of the device and increase the energy density that can be stored, by bringing into play a controlled chemical interaction between the material of an electrode and ions capable of moving within the material of the electrolyte.

[7] In an aspect, the present disclosure refers to a battery device comprising:

- electrodes comprising an anode and a cathode, and
- an electrolyte, between the electrodes, comprising a crystalline material having the composition $M_2B_2O_5.x(HOH).y(NOH)$, where M and N are alkali metals or hydrogen or mixtures of alkali metals or hydrogen, B is titanium, O and H respectively denote the elements oxygen and hydrogen, and x and y are between 0 and 4 and indicate the presence of H^+, OH^-, N^+ ions capable of migrating in the crystalline material,

wherein at least one of the ions among H^+, OH^-, N^+ and M^+ is mobile so as to migrate in the crystalline material towards at least one of the electrodes, and said at least one of the electrodes is made of a material suitable for carrying out a chemical interaction with at least one of said H^+, OH^-, N^+ and M^+ ions.

Claims

[Claim 1] A battery device, comprising:

- electrodes comprising an anode and a cathode, and

- an electrolyte, between the electrodes, comprising a crystalline material having the composition $M_2B_2O_5.x(HOH).y(NOH)$, where M and N are alkali metals or hydrogen or mixtures of alkali metals or hydrogen, B is titanium, O and H respectively denote the elements oxygen and hydrogen, and x and y are between 0 and 4 and indicate the presence of H^+, OH^-, N^+ ions capable of migrating in the crystalline material,

wherein at least one of the ions among H^+, OH^-, N^+ and M^+ is mobile so as to migrate within the crystalline material towards at least one of the electrodes, and said at least one of the electrodes is made of a material suitable for carrying out a chemical interaction with at least one of said H^+, OH^-, N^+ and M^+ ions.

[Claim 2] The battery device according to claim 1, comprising an anode made of a material comprising a metal hydride, for a chemical reaction with migrating OH^- ions.

[Claim 3] The battery device according to claim 1, comprising an anode made of a material comprising at least one element among zinc, iron, and aluminum, for a chemical reaction with migrating OH^- ions.

[Claim 4] The battery device according to claim 1, comprising an anode made of a material comprising dihydrogen, for a chemical reaction with migrating OH^- ions.

[Claim 5] The battery device according to claim 1, wherein the cathode comprises a mixture of oxygen and water.

[Claim 6] The battery device according to claim 1, wherein the cathode is made of a material comprising nickel oxide hydroxide (NiOOH).

[Claim 7] The battery device according to claim 1, wherein the cathode comprises silver oxide (AgO).

[Claim 8] The battery device according to claim 7, wherein the cathode is made of a material comprising silver (Ag), and wherein silver oxide (AgO) is formed at an interface with the electrolyte.

[Claim 9] The battery device according to claim 5, wherein the cathode is exposed to ambient air.

[Claim 10] The battery device according to claim 1, wherein the ions migrating in the electrolyte are H^+ and OH^-, the device comprising:

- a cathode made of a material that comprises silver and intercalates OH^- ions, and

- an anode made of a material that comprises a $M_2B_3O_7$ type structure, where M is an alkali metal or mixtures of alkali metals, B is titanium, and O is oxygen, for intercalating H^+ ions.

[Claim 11] The battery device according to claim 1, wherein the ions migrating in the electrolyte are H^+ and OH^-, the device comprising:

- a cathode made of a material that comprises silver and intercalates OH^- ions, and
- an anode made of a material that comprises graphite and intercalates H^+ ions.

[Claim 12] The battery device according to claim 1, wherein x=0 and M and/or N comprise at least one element selected among sodium and lithium, the device comprising:
- an anode made of a material comprising an element among sodium and lithium, respectively, and
- a cathode allowing the incorporation of lithium and/or sodium ions.

[Claim 13] The battery device according to claim 12, wherein the cathode is made of a material selected among graphite and an $M'_2B_3O_7$ type structure where M' is an alkali metal or mixtures of alkali metals, B is titanium, and O is oxygen, for intercalating the migrating M^+ and/or N^+ ions.

[Claim 14] The battery device according to claim 1, wherein the anode material and the electrolyte material are successively deposited in the form of respective thin layers.

[Claim 15] The battery device according to claim 1, wherein at least the anode is encapsulated in a resin-type material so as to be sealed against air and moisture.

[Claim 16] The battery device according to claim 1, wherein the entire device is encapsulated in a resin-type material so as to be sealed against air and moisture.